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1 January 2015

Online at <https://mpra.ub.uni-muenchen.de/92110/>
MPRA Paper No. 92110, posted 12 Feb 2019 09:20 UTC

Revisiting the Relationship between Unemployment Rate and Economic Growth in Algeria, 1970-2014: Co-Integration Approach using ARDL model

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Abstract

The study provides an estimation of Okun's law in Algeria during the period (1970 - 2014) using for this purpose time series of techniques. Our empirical analysis consists of Dickey-Fuller test (ADF) (Dickey and Fuller 1979 and 1981), and the Phillips-Perron (1988) test and ARDL Bounds Testing Approach to Co-integration test between unemployment rate and economic growth. The estimated results of the present study conformed existence of stable, long run negative effect juste in one model (the difference version of Okun's law), whereas, in short run no relationship is observed. A one percent increase in economic growth is associated with reduction in the unemployment level by 0.265 percent in the long run. The ECM indicates high speed of adjustment of short run fluctuation as 63 percent short disequilibrium adjusts in a year. Algeria must try to increase and diversify the sources of economic growth.

The results of this study have important implications for determining macroeconomic policy. It is absolutely essential that the Algerian economy cease to be excessively dependent on the hydrocarbon sector, which is intensive capital but requires little labour. The Algerian economy should diversify away from its dependence on the energy sector.

Keywords: Okun's Law, economic growth, unemployment rate, HP filter, ARDL Bounds Testing Approach to Co-integration.

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1. Introduction

Unemployment is the main problem in developing economies. The high unemployment rate means that resources are not being used efficiently. Therefore, it should be that full employment remains a key objective of macroeconomic goal of any government because it increases and improves the economic performance. Unemployment is one of the most pressing problems facing Algerian policy makers.

Despite several years of sustained growth, the unemployment rate in Algeria remains high compared to other emerging economies. The high levels of unemployment rate have the ability to cause a serious threat to the stability prevailing in the country. Overall, unemployment has a significant impact on homelessness, poverty and affects the cohesion of the family and the cause of despair and other social evils such as violence and crime.

Growth performance in the last ten years was accompanied by a significant reduction in the overall unemployment rate. However, Algerian economy continues to face important challenges, especially the need to diversify the economy, reduce youth and female unemployment. The youth unemployment is more difficult to address them, given demographic trends and expected future increases in the labour force among young people, youth unemployment is likely to remain high in the medium term.

Okun's law constitutes one of the most important relationships in macroeconomic framework. This law is provided because of the negative relationship between the movements of unemployment and real gross domestic product (GDP).

This paper provides a new and useful framework for developing various models to investigate the output-unemployment relationship.

The purpose of this research is to examine whether a relationship type is the validity of Okun's law in the Algerian economy, which it links between real gross domestic product and unemployment. We are keen to find the level of GDP growth rate that is needed to achieve full employment. Hence, from this analysis, the causal relationship between output and unemployment is going to be determined.

This research analyzes and describes trends in unemployment rates and labour market developments in Algeria. In addition, it reveals the relationship between economic growth and unemployment within the framework of Okun's Law.

The aim of this paper is to examine if the Okun's law of 1970-2014 is applicable to the Algerian economy in order draw appropriate economic policies and achieve the objectives underlined.

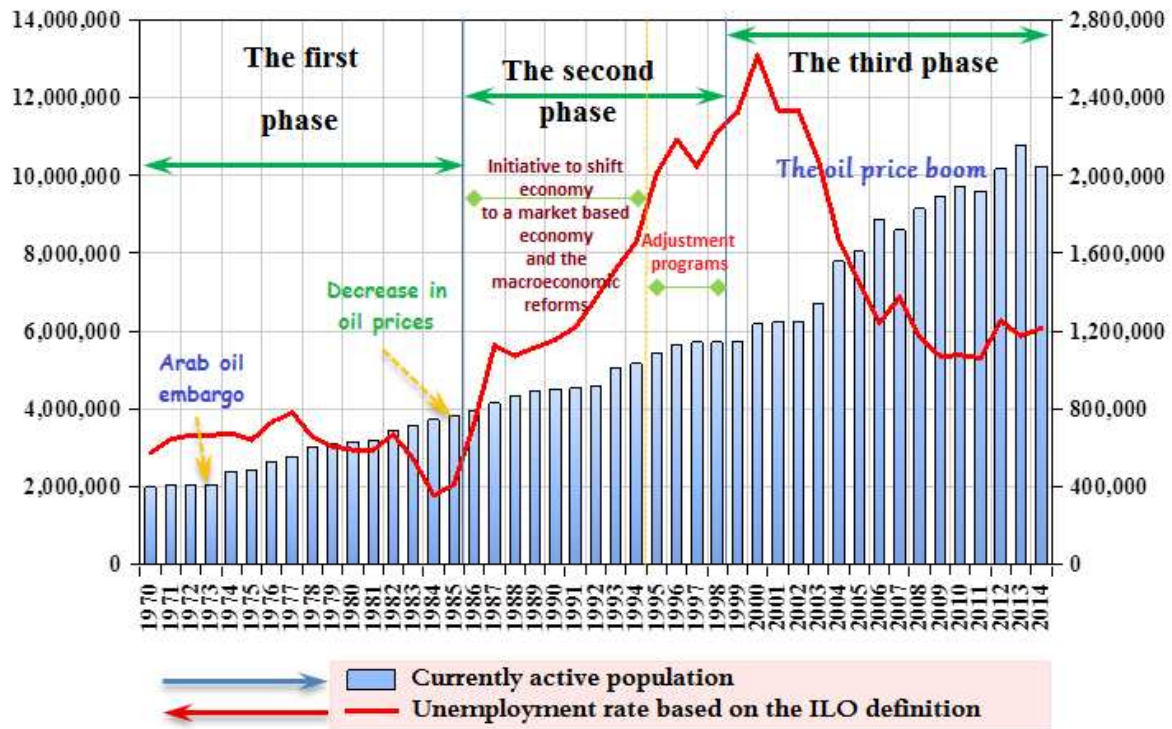
The study is organized in V Sections as follows. The first section presents key descriptive statistics on Algeria's labour market. Section II, briefly reviews some of the related works in the body of literature. Section III introduces data and the method. Section IV reports our empirical results and finally, section V concludes with some policy recommendations.

2. Background of the Algerian economy

2.1 Trends of unemployment

This study presents an overview of the Algerian economy since 1970. It aims at highlighting the major events of economics that changed from the period 1970 to 2014.

Figure 1. The general trends of unemployment over the last four decades



From Figure 1. We can identify general trends of unemployment over the last four decades, from 1970 to 2014. In reality, the chart could be divided into three phases. The first part can be assigned for period 1970-1986. Then, the following one from 1986 to 2000 and the third part from 1999 to 2014.

During the first phase, we should observe that the onset of the debt crisis in Algeria in 1982 has one of the principal causes of high unemployment in Algeria; this is also associated with changes in oil prices (the onset of decline oil price). Thus, the accumulation of external debts linked to the decline in oil prices (1986 economic crisis) influenced the fall of the country's macroeconomic performance.

The second phase (1986-2000) which has increased unemployment. The high unemployment rate attributed to the economic recession that followed the collapse of oil prices in the world in 1986. As a result the speed of employment has reduced with the breakdown of the world oil prices. Even with policies designed to create employment through specific programs temporary, the impact was significantly and permanently.

Afterwards, in the third phase starting from 1999, Algeria was working on strengthening its external financial position thanks to strong hydrocarbon revenues. These improvements in external financial position will enable to improving labour market indicators especially unemployment rates.

From Figure.1 we see that Algerian total unemployment rates have decreased markedly since 2000, but both remain high. Total unemployment was cut in half, from 29.9 percent in 2000 to 10.6 percent in 2014, and youth unemployment dropped from 48 percent in 2001 to 31 percent in 2005. Nevertheless, youth unemployment in Algeria is still higher than the averages for other MENA countries and for transition countries.

Also, demographic factors are essential in understanding the dynamics of the labour market in Algeria. The table .1 below shows demographic indicators in Algeria.

Table 1. Demographic indicators in Algeria

	Fertility rates (births per married woman)						Annual population growth (%)						
	1985	1995	2000	2005	2010	2014	1985	1995	2000	2005	2008	2011	2014
Algeria	5.8	3.4	2.7	2.4	2.4		3.1	1.9	1.4	1.5	1.5	1.87	1.82

Source : World Development Indicators (2009), National Office of Statistics, www.ons.dz.

During the beginning of 1985, Algeria has suffered a rapid demographic transition to lower fertility rates. This transition was caused by a significant improvement in women's health and education. Additionally, the rising youth unemployment has delayed family formation and contributed to a further decline in fertility rates.

Population growth declined from 3.1 per cent in Algeria in 1985 to 1.9 percent in 1995 and 1.5 percent by the end of 2008. The impact of this demographic transition began to affect the labor market. The growth of the working-age population began to slow during the last decade and will continue to decline.

During the period 2000-2004, the working age population has increased by 2.9 per cent in Algeria. There is also a noticeable decline of 4.2 per cent over the period 1980-1985. This slower growth of the population of working age has reduced the pressure on the labour market and contributed to the reduction of unemployment.

The demographic transition and its effects on the labour supply, participation rates in the labour market remain exceptionally low in Algeria: In 2008, these were only 41.4 per cent in Algeria. The world average amounts to 64 per cent, and it is 65 per cent in Latin America, 69 per cent in Southeast Asia.

The reasons behind the low participation rates in Algeria since 2000 have produced fewer new entrants to the labour market and indirectly led to significantly lower the unemployment rate. The additional demand for employments as expressed by the population, as the population continues to increase about 2.5 per cent in Algeria. On average, each year saw about 240,000 new entrants in labour market in Algeria, during the period 2000. - 2008. Due to the demographic transition and the slower growth of the labour force, these figures are lower than the 1990 levels.

Despite of the significant improvements in female education in Algeria, women's participation in the labour market remains low. In Algeria, women's participation has declined to less than 14 per cent 2009 compared to 17 per cent ten years ago.

Algeria's unemployment rate for 2014 was 10.6 per cent, which is the same as the previous year (ONS), but there is still a sharp disparity between the genders, with the jobless rate at 19.1 per cent for men and 38.1 per cent for women.

2.2 Economic growth in Algeria

Algerian economic performance in the long term is linked by the boom cycles during the seventies and eighties, but quickly the boom session faded and turned into deflation, especially with the decline of oil prices after 1986. But after 1995, the growth rates in real GDP have slightly improved.

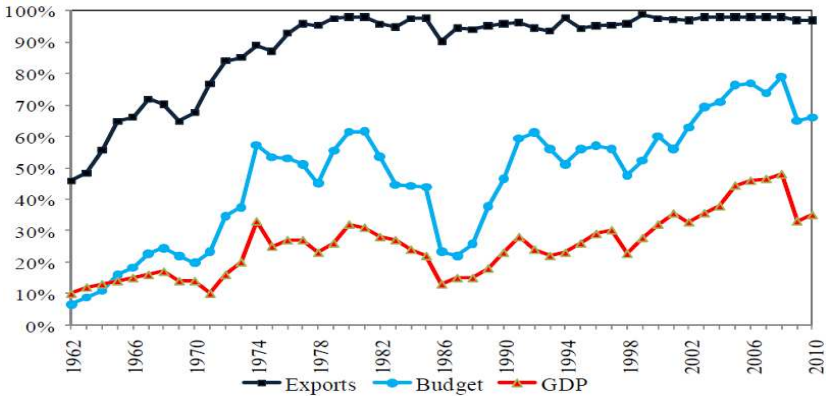
In the early 1999, oil prices have risen sharply in international markets. after this , Algeria has experienced sustained growth. Algeria takes advantage of this sustainable growth to reviving economic activity through expansionary fiscal policy.

in Algeria, this comfortable financial situation led authorities to pursue an expansionist budgetary policy began in 2001 through the implementation of a series of substantial public investment programs : The Support Program for Economic Recovery (PSRE) 2001-2004 and launch the Complementary Plan for Support to Growth (Economic growth support programme 2005-2009) , and the National Program for Agricultural Development (PNDA), and the five-year program 2010-2014.

The hydrocarbon sector remains has a major contribution in the GDP of Algeria. In 2009, the real GDP growth of 2.4% remained at the same level as compared to 2008. On the other hand, real GDP growth in 2014 reached 4.1% as per IMF projections, and it is expected to continue its sustained growth and reach 2.6% during 2015.

According to statistics reported by WB, the oil and gas sector continues to dominate the overall structural character of Algeria economy. In 2010, the sector accounted for 39 percent of GDP, 97 percent of exports and 69 percent of government revenues. as shown in Figure 2.

Figure 2. Algeria’s oil exports as % GDP, total exports and government domestic revenue, 1962-2010



Source : Using IMF and Algerian government data

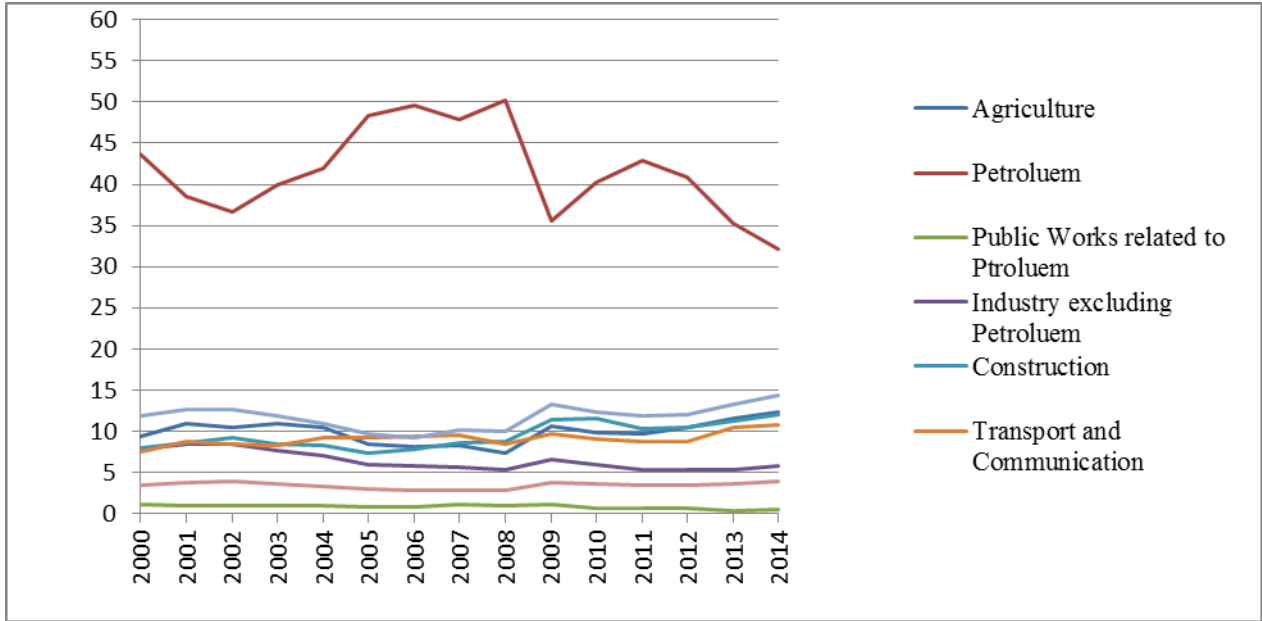
Growth in Algeria is largely dependent on the hydrocarbon sector, which contributes around 30% - 45% more than in the composition of GDP, followed by trade and services sector and construction. This dependence vis-à-vis a sector whose bid is determined mainly by foreign demand makes the Algerian economy very sensitive to fluctuations in world oil prices.

Algeria has enjoyed several years of strong economic performance driven by public spending. While the non-hydrocarbon sector enjoyed growth of around 9% in 2009, due to the strength of the service and construction sectors, but this percentage fell to 5.5% in 2013. More than 80% of the non-hydrocarbon value today in the private sector. Non-hydrocarbon sector is mainly dominated by services.

In 2009, the real GDP growth of 2.4% remained at the same level as compared to 2008. On the other hand, real GDP growth in 2014 reached 4.0% as per IMF projections, and it is expected to continue its sustained growth and reach 3.9% during 2015.

And despite the sharp increase from the rates of growth, however, this growth, remains unbalanced between sectors. The figure below shows that a large proportion in the composition of gross value added it returns to the hydrocarbon sector. While, the contribution of other sectors have seen some fluctuations

Figure 3. Shows the contribution of each sector to the annual nominal growth rate of Algeria gross value added (GVA)



Source : Office National des Statistiques

3. Theoretical background

3.1 Okun's law

Okun's law is a macroeconomic relationship that describes the relationship between output and unemployment. In his article "Potential GNP : Its measurement and significance in American Statistical Association" (1962), Arthur Okun (1928-1980) presented two empirical relationships connecting the rate of unemployment to real output, which have become associated with his name.

Okun estimated the following relationship using United States data from 1947 to 1960. This led to Okun's famous discovery that a 3% reduction in GNP was associated with an increase in unemployment of about 1% in the United States.

Okun originally described two empirical relationships between real output and the unemployment rate. These relationships are known as the difference version and the gap version of Okun's Law (Knotek 2007).

3.2 The difference version of Okun's Law

According to the first difference model, the relationship between the real output and the observed unemployment rate is given by the expression: Okun's law can be the following:

$$UN_t - UN_{t-1} = \alpha + \beta \left(\frac{RGDP_t - RGDP_{t-1}}{RGDP_{t-1}} \right) + \varepsilon_t \quad (1)$$

$$UN_t - UN_{t-1} = VarUN_{dif} \quad \text{and} \quad \left(\frac{RGDP_t - RGDP_{t-1}}{RGDP_{t-1}} \right) = VarRGDP_{Dif}$$

Where UN_t represents the unemployment rate in t, $RGDP_t$ symbolizes the level of real GDP and ε_t is the error term which satisfies the usual properties. The parameter β is called the Okun's coefficient and is expected to have a negative sign.

3.3 The gap version of Okun's Law

The gap version combines the change of unemployment with the output gap between actual and potential output. The potential output is associated with full employment, the second as given as:

$$UN - UN_{Na} = \alpha + \beta \left(\frac{RGDP - RGDP_{Po}}{RGDP_{Po}} \right) + \varepsilon \quad (2)$$
$$UN - UN_{Na} = VarUN_{gap} \text{ and } \left(\frac{RGDP - RGDP_{Po}}{RGDP_{Po}} \right) = VarRGDP_{gap}$$

Where:

RGDP : is the Real Gross Domestic Product.

RGDP_{Po} : Potential Gross Domestic Product.

UN : is the unemployment rate.

UN_{na} : is natural rate of unemployment.

This paper focuses on the well known "gap version" which highlights that the change in unemployment rates is driven by the change in the growth rate for real *GDP* . This is based on the assumption that an increase in output will need more factor input leading to a lower unemployment rate.

3.4 Literature review

A number of studies investigate empirically the relationship between output and unemployment, the list includes many economists, such as: Alia and Smith (1975), Gordan (1984), Knoester (1986), Kaufman (1988), Prachowny (1993), Weber (1995), Mossa (1997), Attfield and Silverston 1998, Lee (2000), (Silvapulle (2004).

These studies mostly reveal the validity of the relation between output and unemployment rate. The Study (M. El Shourbagy 2009) aims to measure the impact of economic growth on employment in the short-and long-term in the Egyptian economy during the period 1982-2005 using the Autoregressive Distributed Lag (*ARDL*) approach to cointegration. The results of this study can be summarized by the following: - there is a less significant positive effect of economic growth on employment in the short and long term. - Export promotion, import substitution and foreign direct investment enhance employment opportunities in the long run.

Fuad M. Kreishan (2010) examined whether there existed the relationship between unemployment and economic growth in Jordan through the implementation of Okun's law. Using annual data covering the period 1970 2008, time series techniques are used to test the relation between unemployment and economic growth and to obtain estimates for Okun's coefficient. Namely, the study used Augmented Dickey-Fuller (*ADF*) for unit root, cointegration test and a simple regression between unemployment rate and economic growth. The empirical results shown that Okun's law cannot be confirmed for Jordan. Thus, it can be suggested that the lack of economic growth does not explain the unemployment problem in Jordan. The study recommended that economic policies related to demand management would not have an important effect in reducing unemployment rate. Accordingly implementation of economic policies oriented to structural change and reform in the labor market would be more appropriate by policy makers.

Ho-Chuan Huang and Shu-Chin Lin (2008), motivated by a simple theoretical model, proposed the Bayesian approach for estimating Okun's coefficients using U.S. quarterly data from 1948: Q1 to 2006: Q1. The results showed that there was overwhelming evidence in favour of smooth –time – varying Okun's law which was positively related to productivity

trend. Also their results indicated that the commonly – used Okun’s law coefficient could lead to inappropriate results.

I. Moosa (2008) in his research, examined the existence of an Okun – type relationship between real gross domestic product and unemployment rate in four Arab economic countries Algeria, Egypt, Morocco and Tunisia. The results indicated that unemployment and RGDP were not linked in all four countries. Okun suggested three reasons for explaining the invalidity of this law in the four countries examined in this research:

- First, unemployment in developing countries was not cyclical but structural and frictional.
- Second, the labour markets in these countries are rigid, especially because they are dominated by their governments which are the main source of the demand for labour.
- Third, the structure of these economies which is dominated by the government or any other dominant sector and which does not use a lot of labour. Furthermore, the growth in these sectors cannot reduce unemployment.

Using a simple model of Hamad A. Al-Ghannam (2003) exhibited the relationship between the economic growth and employment in Saudi private firms. Using the cointegration, error correction model, and Granger causality techniques were used to determine the long run equilibrium relationship and the direction of the causality in both short and long runs. The study covers the period from 1973 to 2002. The cointegration test indicates a long-run equilibrium relationship between economic growth and employment. Error correction model and Granger causality test provide that there exists unidirectional causality from economic growth to employment not vice versa in the short run and long run as well. This result suggests that the Saudi private firms should focus on the quality of hired labor to increase their productivity via technological improvements in order for employment to play bigger rule on economic growth.

Khalil Ahmad, Sumaira Khalil and Allah Ditta Saeed (2011), estimated variability of Okun’s law for Pakistan economy to test the relevance of Okun’s law using the “Gap” and the “difference” versions. This study used data from 1974 to 2009 for Pakistan economy to test the relevance of Okun’s law using the two versions.

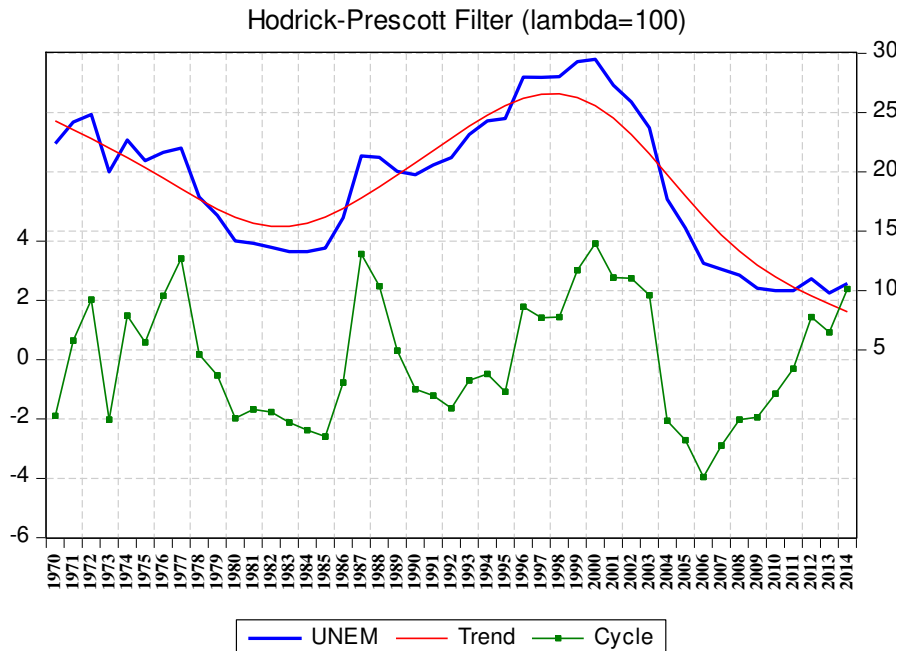
The study could not find any evidence for the existence of Okun’s relationship in Pakistan neither through the “Difference version” nor through “the Gap version”. Further, the inflation rate which interacts with unemployment is highly volatile and unstable in case of Pakistan. The study recommends further research on this topic by incorporating the behaviour of inflation and allowing for trade-off between inflation and unemployment. This suggests use of simultaneous equation model so that the possible bias resulting from exclusion of some relevant variables.

Geidenhuys and Marinkov (2007) tried to give answer to the question if unemployment response to changes in output in South Africa. For this reason, they estimated the relationship between economic activity and unemployment rate. The results indicated the presence of an Okun’s law relationship in South Africa over the period 1970 -2005 with more evidence in favour of asymmetries during recessions.

4. Structural, frictional, and cyclical unemployment in Algeria

The natural unemployment rates associate in Algeria either through estimation depending on the new Phillips curve or through the Hodrick–Prescott filter closely linked with the nature and the structure of the economy.

Figure 4. Unemployment rate, annual time trends , and cyclical unemployment using the HP filter



We note that the unemployment rate fluctuates closely about the general trend (About the natural unemployment rate). The cyclical unemployment rate has less than the natural rate of unemployment. The long-term trend of unemployment may connect to its highest level in 1990 and then taken back down of the year 2001, however, it remains at relatively high levels.

All this clearly explains the limited effectiveness of the expansionary fiscal policy through the growth of government spending in the reduction of the levels of structural unemployment. And the impact remains only in the short term and affect only cyclical unemployment, which constitute a small fraction compared to the total unemployment rate.

5. Empirical Analysis

5.1 data sources and variable definition

The paper examines the issue of the existence for the long run and short run the relationship between unemployment and economic growth in Algeria using annual data for the period 1980-2014.

Different data sets we used in this study, which is, the overall unemployment rate (UN), gross domestic product (GDP constant prices 2000 US \$), inflation rate (π), potential output ($RGDP_{p_0}$), cyclical unemployment rate ($CyUN$), output gap (Gap).

Data variables of: the overall levels of unemployment, $RGDP$ and the inflation rate, are obtained from the World Development Indicators (WDI) of the World Bank database. But the remaining data like: $(RGDP_{p_0}) - (CyUN) - (Gap)$, should be calculated in different methods.

5.2 Methods of Estimating Natural Rate of Unemployment, Potential Output and the Output Gap in Algeria

- **Estimation technique**

The technique which is more capable of interpreting the economic changes such as inflation and unemployment gap. This is achieved by implementing some univariate and multivariate methods for estimating the potential output including the popular production function approach using annual data. Univariate detrending methods include the Hodrick-Prescott (HP) filter, The Running Median Smoothing filter (RMS), and the Kalman filter.

- **HP Filter Approach**

The HP filter is a very common technique used to derive the trend in an actual data series. It is famous for its simplicity and for being a univariate technique which allows for working on a relatively short time series.

Mathematically, the *HP* filter is a linear filter that computes the smoothed series Y^* of Y by minimizing the variance of Y around Y^* , subject to a penalty that constrains the second difference of Y^* . That is, the HP filter chooses Y^* to minimize the quantity:

$$\sum_1^T (Y_t - Y_t^*)^2 + \lambda \sum_2^{T-1} ((Y_{t+1}^* - Y_t^*) - (Y_t^* - Y_{t-1}^*))^2 \quad (3)$$

The penalty parameter λ controls the smoothness of the series Y^* . The larger λ , the smoother Y^* . T refers to the series length.

we are trying to create a new series with Hodrick-Prescott filter technique using Eviews 9 . The following figure 5. Shows Potential Output and RGDP:

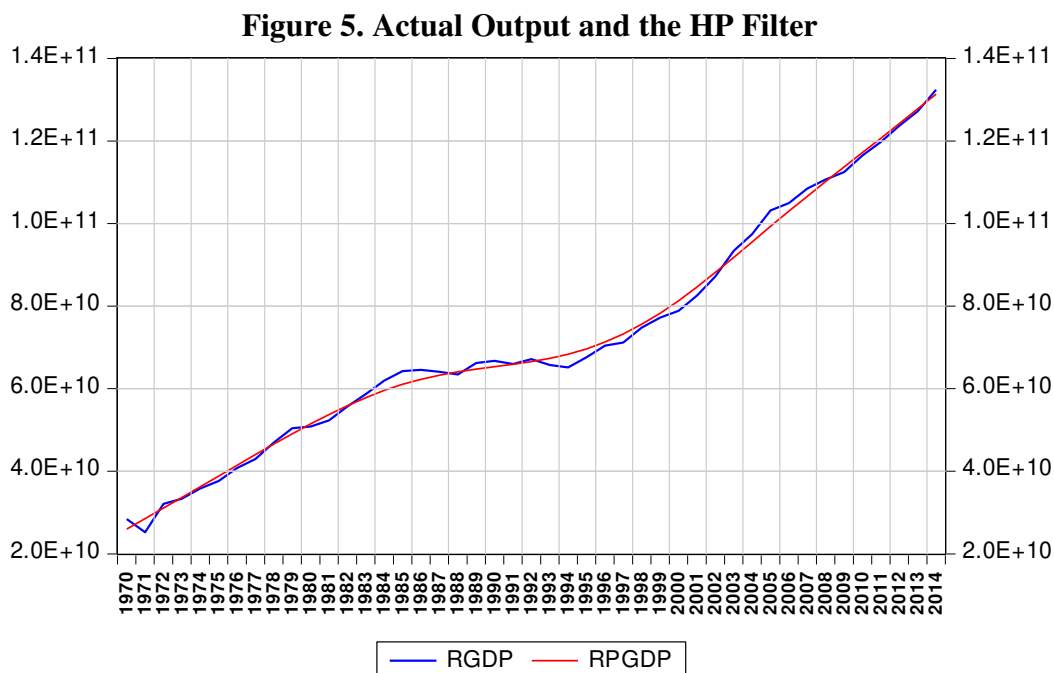


Figure 3. shows actual output against its potential measured with the HP filter which clearly gives the green line . According to the HP filter, the period starting in 1983 and ending in 1992, also the period starting in 2003 and ending in 2008 witnessed negative output gaps.

While the remaining period, that witnessed growth rates in real output – showed better performance, where the actual was very much close to, or even higher than, the potential.

- **Measuring the Natural Rate of Unemployment**

We can calculate this rate from the modern version of the Phillips curve (the augmented Phillips Curve model) . This curve can be expressed in the following format:

$$\pi_t - \pi_t^e = \beta_2 (UN_t - U^n) + u_t$$

Where π_t : actual inflation rate at time

π_t^e : expected inflation rate at time t , the expectation being formed in year $(t - 1)$.

UN_t : actual unemployment rate prevailing at time t .

U^n : natural rate of unemployment at time t .

u_t : stochastic error term.

Since π_t^e is not directly observable, as a starting point one can make the simplifying assumption that $\pi_t^e = \pi_{t-1}$ that is the inflation expected this year is the inflation rate that prevailed in the last year; of course, more complicated assumptions about expectations formation can be made. on distributed lag models. Substituting this assumption into and writing the regression model in the standard form, we obtain the following estimating equation:

$$\pi_t - \pi_{t-1} = \beta_1 + \beta_2 UN_t + u_t$$

After estimating the relationship using ordinary least squares method we get following results:

$$\pi_t - \pi_{t-1} = 2.305 - 0.126 UN_t + u_t$$

We can compute the underlying natural rate of unemployment as:

$$C^n = \frac{\hat{\beta}_1}{-\hat{\beta}_2} = \frac{2.305}{0.126} = 18.29\%$$

That is the natural rate of unemployment of about 18.29%. Economists say the natural rate of between 5 to 6%, in the developed countries. This shows that the actual rate much greater than the rate in these countries.

5. 3 Empirical results

- **Unit root test results**

In empirical economics studies, the macroeconomic variables contain of non-stationary series. Dealing of non-stationary variables in the empirical analysis is very important so that the results of spurious regression can be prevented. According to the concept of co-integration, two or more non-stationary time series share a common trend, then they are said to be cointegrated.

We use our *ADF* test or *PP* test to examine stationary of the series of these macroeconomic variables. Table shows the *ADF* test and *PP* test results for both at the level and the first difference on intercept and intercept and trend, the unit root test for $VarRGDP_{Dif}$, $VarUN_{dif}$, $VarRGDP_{gap}$, $VarUN_{gap}$:

Table 2. Tests for Unit Roots Based on ADF test

	Level		First difference		Degree of Integration
	Intercept	Intercept & Trend	Intercept	Intercept & Trend	
$VarRGDP_{Dif}$	* -9.162 (0)	* -10.254 (0)	* -6.820 (1)	* -6.821 (1)	$I(0)$
$VarUN_{dif}$	* -4.768 (0)	* -4.697 (0)	* -10.637 (0)	* -10.519 (0)	$I(0)$
$VarRGDP_{gap}$	* -7.707 (0)	* -7.704 (0)	* -18.981 (0)	* -18.783 (0)	$I(0)$
$VarUN_{gap}$	-1.216 (1)	-1.366 (1)	* -4.768 (0)	* -4.697 (0)	$I(1)$

* Indicates statistical significant at the 1 percent level

** Indicates statistical significant at the 5 percent level

*** Indicates statistical significant at the 10 percent level

() Optimal lag is selected by Schwarz criterion automatically in ADF test.

Table 3. Tests for Unit Roots Based on Phillips-Perron

	Level		First difference		Degree of Integration
	Intercept	Intercept & Trend	Intercept	Intercept & Trend	
$VarRGDP_{Dif}$	* - 8.398 (4)	* - 8.904 (4)	* - 32.614 (5)	* - 33.303 (7)	$I(0)$
$VarUN_{dif}$	* - 4.900 (3)	* - 4.842 (3)	* - 14.548 (9)	* - 14.214 (9)	$I(0)$
$VarRGDP_{gap}$	* - 7.511 (3)	* - 7.493 (3)	* - 22.892 (10)	* - 24.896 (11)	$I(0)$
$VarUN_{gap}$	- 1.118 (4)	- 1.384 (4)	* - 4.900 (3)	* - 4.842 (3)	$I(1)$

PP t-statistics are obtained from the MacKinnon (1996) table.

* Indicates statistical significant at the 1 percent level.

** Indicates statistical significant at the 5 percent level.

*** Indicates statistical significant at the 10 percent level.

() Bandwidth parameters of the PP tests are selected automatically by the Newey and West (1994) method using the Bartlett kernel MacKinnon : 1996.

The reported result in table 2. and table 3. reveals that the hypothesis of a unit root can not be rejected in one variable in levels ($VarUN_{gap}$), but we can reject the hypothesis of level stationary for the rest of the variables. It is seen that we have a mixture of stationary ($I(0)$) and $I(1)$ variables.

• The model

This study utilises the autoregressive distributed lag (ARDL) model proposed by Pesaran, et al. (2001) to examine the co- integration relationship between unemployment and economic growth. This procedure has several advantages over several methods available for conducting the co-integration test such as Engle-Granger two-step (1987) test, the maximum likelihood based Johansen (1991- 1995) and Johansen-Juselius (1990) tests.

The econometric advantages of the ARDL method include:

- The simultaneous estimation of long- and short-run parameters of the model, removing problems associated with omitted variables and autocorrelation.
- The main advantage of this testing lies in the fact that it can be applied irrespective of the regressors are $I(0)$ or $I(1)$, and this avoids the pre-testing problems associated with standard co-integration analysis which requires the classification of the variables into $I(1)$ and $I(0)$;
- The inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger method are avoided;

- Pesaran and Shin (1999) argued that the ARDL technique can be reliably used in small samples to estimate and test hypotheses on the long run coefficient in both cases where the underlying regressors are I(1) or I(0). While the Johansen co-integration techniques require larger samples for the results to be valid (Ghatak and Siddiki, 2001; Pahlavani, 2005).

For the reasons above, here we use the ARDL technique to examine the validity of Okun's law in Algeria with two versions.

First step in the ARDL approach is to estimate the following unrestricted ECM:

$$\Delta VarUN_{dif} = \alpha + \beta_1 VarUN_{dif,t-1} + \beta_2 VarRGDP_{dif,t-1} + \sum_{i=1}^p \gamma_1 \Delta VarRGDP_{dif,t-i} + \sum_{i=1}^q \gamma_2 \Delta VarUN_{dif,t-i} + \varepsilon_t \quad (4)$$

$$\Delta VarUN_{gap} = \alpha + \beta_1 VarUN_{gap,t-1} + \beta_2 VarRGDP_{gap,t-1} + \sum_{i=1}^p \gamma_1 \Delta VarRGDP_{gap,t-i} + \sum_{i=1}^q \gamma_2 \Delta VarUN_{gap,t-i} + \varepsilon_t \quad (5)$$

The first step in the ARDL bounds testing approach is to estimate the model by ordinary least squares (OLS). We conduct a Wald test (F-Statistic) by imposing restrictions on the estimated long-run coefficients. The null and alternative hypotheses are:

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

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

The computed F-statistic value is compared with the critical values tabulated in table of Pesaran et al (2001).

If the computed F-statistic falls outside the band (the values for I(0) and I(1) in the Table F), a conclusive decision can be made.

- If the computed F-statistic exceeds the upper bound of the critical value band (denote I(1) in the Table F), the null hypothesis can be rejected and then support cointegration, and;
- If the computed F-statistic falls well below the lower bound of the critical value band (denote I(0) in the Table F), and hence the null hypothesis cannot be rejected, no co-integration.

Once co-integration is established, in the second step, the orders of the lags in the ARDL model are selected by inference to either the (AIC) or (SBC). Following Pesaran and Pesaran (1997, PP. 353), the optimal lag order is chosen based on the highest value of AIC or SBC. The conditional ARDL long-run model for $VarUN_{dif}$ or $VarUN_{gap}$ can be estimated as:

$$VarUN_{dif} = \alpha + \sum_{i=1}^p \beta_1 VarUN_{dif,t-i} + \sum_{i=0}^q \beta_2 VarRGDP_{dif,t-i} + \varepsilon_t \quad (6)$$

$$VarUN_{gap} = \alpha + \sum_{i=1}^p \beta_1 VarUN_{gap,t-i} + \sum_{i=0}^q \beta_2 VarRGDP_{gap,t-i} + \varepsilon_t \quad (7)$$

In the final step, we obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

$$\Delta VarUN_{dif} = \alpha + \sum_{i=1}^p \gamma_1 \Delta VarRGDP_{dif,t-i} + \sum_{i=1}^q \gamma_2 \Delta VarUN_{dif,t-i} + \phi ECM_{t-1} + \varepsilon_t \quad (8)$$

$$\Delta VarUN_{gap} = \alpha + \sum_{i=1}^p \gamma_1 \Delta VarRGDP_{gap,t-i} + \sum_{i=1}^q \gamma_2 \Delta VarUN_{gap,t-i} + \phi ECM_{t-1} + \varepsilon_t \quad (9)$$

Where, γ_1 and γ_2 are the short-run dynamic coefficients of the model convergence to equilibrium and φ is the speed of adjustment parameter and ECM is the error correction term that is derived from the estimated equilibrium relationship of Equation (4) and (5).

- **The results based on the bounds testing procedure (ARDL)**

Table 4. Present the result of ARDL bounds test

Case III ARDL(2.0)	F-statistic		Result
[1] The difference version	* 8.465		Co-integration exists
Critical Value	Lower bound	Upper bound	
1% level of significance	4.81	6.02	
5% level of significance	3.15	4.11	
10% level of significance	2.44	3.28	
Case II ARDL(3.1)	F-statistic		
[2] The gap version	1.706		No co-integration
Critical Value	Lower bound	Upper bound	
1% level of significance	4.81	6.02	
5% level of significance	3.15	4.11	
10% level of significance	2.44	3.28	

Note: Border critical value achieved from Pesaran and Pesaran (1997) p.478 Appendices. Table CI(iii) . Case II: intercept and no trend, Case III: intercept and trend.

*, ** and *** significant at 1%, 5% and 10% significance level.

The computed F-statistic (The difference version) is obviously greater than the upper bound critical value of 6.02 at the one percent significant level. Thus, the null hypothesis of no cointegration is rejected, indicating there is a stable long-run cointegration relationship among the unemployment rate and economic growth in Algeria.

but For the second version (The gap version), we find that the computed F-statistic is 1.706 for ARDL (ARDL(3.1)), the 0.1 level critical values are 4.81 (lower bound) and 6.02 (upper bound). The result indicates the absence of co-integration (below the lower bound).

The absence of relationship stable (balanced) in long term (the gap version), does not necessarily mean the absence of any correlation between growth and overall unemployment rates. That also does not mean the relationship does not exist but they are very weak and he need to more accurate data, to validate this relationship.

Once the existence of cointegration relationship among the variables is confirmed, equation was estimated for the long-run coefficients of the selected ARDL (2.0) model based on the AIC and its results are presented in Table 5. The table result reveals that the estimated coefficient of economic growth is positive and significant at 10 per cent level. It shows that in the long run, one per cent increase in the economic growth receipts leads to approximately 0.265 per cent decrease in the unemployment. This empirical evidence confirms that the economic growth has a positive impact on economic growth in Algeria in the long-run.

Table 5. Estimated long-run and short-run coefficients using the ARDL (2.0) Approach

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long Run Coefficients				
$VarRGDP_{Dif}$	-0.265886 ***	0.152988	-1.737948	0.0901
Short Run Coefficients				
$\Delta(VarUN_{dif}(-1))$	-0.250087	0.154308	-1.620696	0.1131
$\Delta(VarRGDP_{Dif})$	-0.168863	0.100882	-1.673870	0.1022
ECM	-0.635095 *	0.186966	-3.396851	0.0016
Diagnostic Test				
1 Serial Correlation	F-stat	0.729	Prob. F	0.48
2 Heteroskedasticity	Obs*R-equa	1.200	prob	0.27
3 Normality	Jarque- Bera	1.066	Prob	0.586

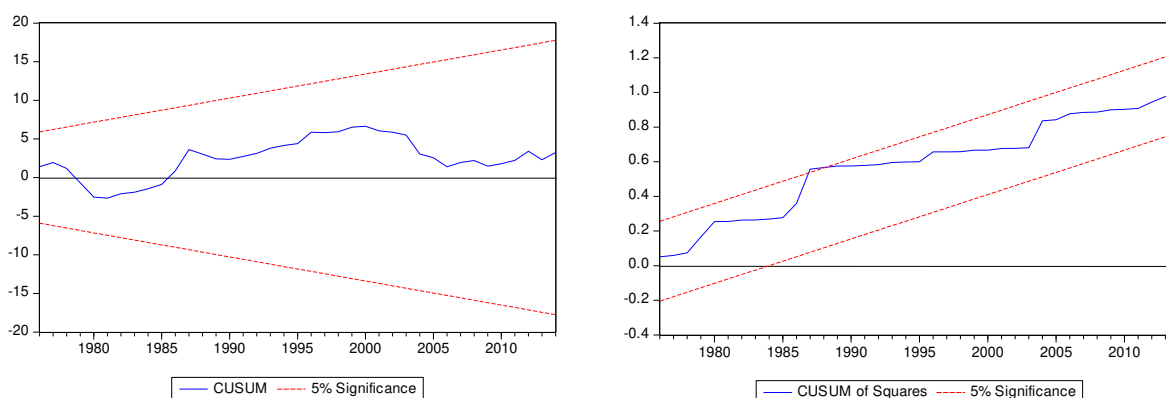
*, **, *** indicate significance at 1 , 5 and 10 per cent level, respectively.

Table 5. presents the long run coefficients of the ARDL model. The estimated long run coefficients of economic growth is negatively associated with unemployment rate in Algeria. However the relationship is very weak, as if one percent increase in economic growth is associated with reduction in the unemployment level just by 0.265 percent in the long run. But in short run the coefficient of parameters is insignificant.

Result reveals that the estimated error correction coefficient is negative and significant at one per cent level ensuring that the adjustment process from the short-run deviation is very fast.

The estimated model stability is checked through various diagnostic tests (ARCH test, LM test and Jarque-Bera test). The result shows that residuals are normally distributed and there is no sign of heteroskedasticity and serial correlation in estimated model.

Figure 6. Plot of CUSUM and CUSUMSQ



The plots of the CUSUM and CUSUMSQ statistics are well within the critical bounds, implying that, all coefficients in the ECM model are stable over the sample period 1970–2014.

6. Conclusion remarks and Policy Implications

Algeria failed to break its heavy dependence on the hydrocarbon sector. By the end of 2013, this sector accounted for 49 per cent of total gross domestic product, and more than 97 per cent of exports and 73 per cent of budget revenues. Yet, the largely capital intensive hydrocarbon sector is responsible for less than 5 per cent of the job creation in the economy.

In this paper, we tested the relevance of Okun's Law using the "Gap version" and examined the relationship between unemployment and potential GDP in Algeria over the period 1970-2014. Our estimation results shows that there is just one cointegrating relationship between this two variables. It shows that in the long run, one per cent increase in the economic growth receipts leads just to approximately 0.265 per cent decrease in the unemployment.

We conclude, that the structure of labour market in Algeria, is rigid and inelastic unemployment rate response to the shifts in the output could possibly result in little evidence in favour of the Okun's Law proposition. For this the lessons from transition countries show that the problem of unemployment is more structural than cyclical, and that unemployment cannot be cured by merely having an expansionary fiscal policy. This means that the economic policies related to demand management would not have an important effect in reducing unemployment in Algeria however, economic policies more oriented to structural changes and reform in labour market would be more appropriate in the case of Algeria.

The ancient Greek philosopher Herodotus stated: "Egypt is the gift of the Nile" Especially Egypt is largely a desert. And from the continued survival of Egypt is linked mainly down the flow of water from the headwaters of the Nile. The same phrase can be fired on Algeria, "Algeria gift of oil and gas" .Any continuation and survival as a state, "in light of the current situation" is linked mainly oil wealth. This is one of the biggest challenges facing the Algerian economy today. How we will secure for the population, jobs and income levels sufficient, job security, good Working Conditions after running out of our wealth ³.

I think the project "Algeria after the oil" is the project the more difficult and complex. We should direct the total capacity available for this strategic project to ensure the well-being of future generations.

Finally, it must be emphasized that the fragile economic structure of Algeria, and the nature of great challenges. Algeria needs a carefully designed economic strategy that will address existing imbalances and build a strong and diversified economy, one less sensitive to volatile hydrocarbon prices.

³ Mohamed Ibrahim El-Sakka (2009). The use of oil revenues: the case of the State of Kuwait, Development Series, Issue 33, Arab Planning Institute. 2009.

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