



## THE VALIDITY OF OKUN'S LAW IN NIGERIA: A DIFFERENCE MODEL APPROACH

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### ABSTRACT

*This paper, empirically, tests the validity of Okun's law in Nigerian economy from 1980-2012. The two versions of the difference model approach of the Okun's law are used even though one of them is frequently used in the literature. We utilize Var-cointegration method and examine the direction of causality using the Var Granger causality/Block Exogeneity Wald test. We find that the trace test statistic demonstrates only one cointegrating vector at 5% level. Both the Var Granger causality/Block Exogeneity Wald test and error correction model provide exactly the same conclusion of a uni-directional causality from unemployment rate to real output growth. However, Okun's coefficient estimates carry positive signs in both models and are infact contrary to unemployment-output relationship even though unemployment rate determines the real output growth in Nigeria but not vice versa from the causality analysis. Therefore a good policy space is needed to create an enabling environment for drastic reduction of unemployment which is a pointer to increasing aggregate demand and output growth in Nigeria in the long run.*

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### 1. INTRODUCTION

Unemployment is one of the major economic challenges every nation tries to avoid or reduce to the barest minimum. As a matter of fact, rate of unemployment is one of the indicators for measuring the performance of any economy in the world. Thus, efforts are being made by countries to manage the problem of unemployment and its spillover effects. It was in an attempt to tackle such menace that led Arthur M. Okun in the early 1960s to statistically establish the relationship

between change in the unemployment rate and economic growth. The empirical finding of Okun's work indicates 3:1 trade-off between real gross national product (GNP) and the unemployment rate.

Specifically, Okun's law postulates a bi-directional relationship between output and the unemployment rate. Intuitively, more labour is required to produce more output and as employment of labour increases during recovery stage of business cycle, personal income increases which in turn increases the aggregate demand and hence national output. However, during the recessionary stage of business cycle, workers lose their jobs (i.e., unemployment rate increases as output decreases).

A journey through the literature reveals that combination of Okun's law and Phillips curve provides the theoretical foundation for deriving the aggregate supply curve. Okun's law also serves as a rule of thumb for structural and stabilization policies. Similarly, the coefficient of Okun's law is very useful in forecasting the magnitude of macroeconomic variables (Rubcova, 2010).

The aim of this paper is to contribute to the existing literature using one of the Sub-Saharan African countries (Nigeria) because of its obvious high unemployment rate.

The rest of the paper is organized as follows: Section two reviews the related empirical literature while section three discusses the theoretical framework and methodological issues. Section four presents and discusses the empirical results of the study. Section five, which is the last section, concludes the paper.

## 2. A REVIEW OF SOME EMPIRICAL LITERATURE

The relationship between economic growth (real output) and rate of unemployment has generated large volume of empirical studies since the pioneer work of Okun (1962). The available literature on Okun's law is extensive and for space constraint, some of these studies are selected for review as follows:

Meidani and Zabihi (2011) examine the dynamic effect of unemployment rate on per capita real GDP in Iran over the period 1971 and 2006. Using an Auto-Regressive Distributed Lag (ARDL), the study finds that the unemployment rate has a significant and negative effect on per capita real GDP in the long-run and short-run periods.

Lal *et al.* (2010) test the validity of Okun's law in some selected Asian countries using time series annual data during the period 1980-2006. The study employs Engle-Granger (1987) cointegration technique to establish the long-run relationship between the variables of interest and error correction mechanism for short-run dynamics. After the empirical analysis, the results of the study indicate non-applicability of Okun's law in some Asian countries.

Rubcova (2010) estimates Okun's coefficient for Baltic States using cointegration and error correction model framework. The study also utilizes Hodrick-Prescott filter which allows the trend to change smoothly and gradually in the course of real business cycles analysis. The results of the study do not provide evidence in support of strong relationship between unemployment and output. The study, therefore, suggests data reliability issues and labour market features as reasons for such results.

Villaverde and Maza (2009) verify the validity of Okun's law for the Spanish regions over the period 1980 - 2004. The study provides evidence in support of a negative relationship between unemployment and output for most of the regions and for the whole country. The study, however, further reveals different estimates of Okun's coefficients across the regions which could be attributed to regional disparities in productivity.

Loria and De Jesús (2007) test the robustness of Okun's law in Mexico utilizing quarterly data between the 1<sup>st</sup> quarter of 1985 and 4<sup>th</sup> quarter of 2006. Using three structural time series models (Kalman Filter), the study estimates Okun's coefficient to fluctuate in the range 2.3 - 2.5. The study also finds robust evidence of bilateral causality between output and unemployment.

Rezitis and Apergis (2003) analyse the validity of Okun's law for certain regional areas in Greece over the period 1960-1997. Using the Hodrick-Prescott and band-pass filtering techniques, the results indicate no much interregional differences for most regional areas. The results further indicate that Okun's relationship undergoes a structural change in 1981. After this break, unemployment becomes less reactive to output changes in all regional areas of study. Zagler (2003) analyzes a vector error correction model of economic growth and unemployment in four major European countries, France, Germany, Italy and United Kingdom. The study finds the existence of positive long-run relationship between economic growth and unemployment; a finding which goes contrary to Okun's law. However, the short-run dynamics of the two variables of interest indicates agreement with Okun's law. The study further reveals that Okun's coefficient is in agreement with previous estimates for the countries in the sample with the exception of United Kingdom.

On Nigeria, Arewa and Nwakanma (2012) conduct an empirical evaluation of the relationship between output and unemployment using the first difference and output-gap models of Okun's law. The study finds no evidence to support the validity of Okun's law in Nigeria.

### 3. THEORETICAL FRAMEWORK AND THE MODEL

#### 3.1. Theoretical Framework

Theoretical viewpoint supports the existence of positive relationship between real GDP growth and employment level. William Phillips proposed higher price level following increasing employment level. Increasing employment level tends to increase the GDP growth rate, thus, employment and GDP growth rates are positively related with each other and as such, unemployment and GDP growth rates will be negatively related to each other. Arthur Okun defined this negative relationship between GDP growth and unemployment rate and this is the only empirical hypothesis explaining the relationship between unemployment rate and GDP growth. The different versions of the hypothesis are discussed below:

#### 3.2. Model Specification

*Difference Model*

$$RGDPG_t - RGDPG_{t-1} = \alpha_0 + \alpha_1(UNR_t - UNR_{t-1}) + \varepsilon_t \quad (1)$$

“Gap” Model

$$RGDPG_t - RGDPG_t^* = \alpha_0 + \alpha_1(UNR_t - UNR_t^*) + \varepsilon_t \quad (2)$$

Where:

$RGDPG_t$  = Real Gross Domestic Product Growth (measured in natural logarithm)

$RGDPG_t^*$  = Potential output (measured in natural logarithm)

$RGDPG_{t-1}$  = One period lagged Real Gross Domestic Product Growth (measured in natural logarithm)

$UNR_t$  = Unemployment rate (measured in percentage)

$UNR_t^*$  = Natural/Normal rate of unemployment (measured in percentage)

$UNR_{t-1}$  = One period lagged unemployment rate (measured in percentage)

$\varepsilon_t$  = White noise error term

*A priori/Theoretical* Expectation:  $\alpha_0 > 0$ ,  $\alpha_1 < 0$ .

*The Dynamic Version*

$$\Delta u_t = \alpha_0 + \alpha_1 \Delta y_t + \alpha_2 \Delta y_{t-1} + \alpha_3 \Delta y_{t-2} + \alpha_4 \Delta u_{t-1} + \alpha_5 \Delta u_{t-2} + \varepsilon_t \quad (3)$$

Where  $\Delta u_t$  = current unemployment rate,  $\Delta u_{t-1}$  = One period lagged unemployment rate,

$\Delta u_{t-2}$  = Two period lagged unemployment rate,  $\Delta y_{t-1}$  = One period lagged GDP growth rate,

$\Delta y_{t-2}$  = Two period lagged GDP growth rate

Equation (3) is transformable to

$$(u_t - u_{t-1}) = \alpha_0 + \alpha_1(y_t - y_{t-1}) + \alpha_2(y_{t-1} - y_{t-2}) + \alpha_3(y_{t-2} - y_{t-3}) + \alpha_4(u_{t-1} - u_{t-2}) + \alpha_5(u_{t-2} - u_{t-3}) + \varepsilon_t \quad (4)$$

*The Production Function*

$$y = \alpha_0(k + c) + \alpha_1(\phi_{0n} + \phi_1 h) + \pi + \varepsilon_t \quad (5)$$

Where  $y$  = output,  $k$  = capital input,  $c$  = utilization rate,  $n$  = numbers of workers,

$h$  = numbers of hours worked,  $\alpha_0$  and  $\alpha_1$  are output elasticities,  $\phi_0$  and  $\phi_1$  are

contributions of the workers and weekly hours to the total labour input and  $\pi$  is the disembodied technology factor. As a matter of fact, this paper uses the difference model version of Okun's law. The data used in this study are basically time series of Real Gross Domestic Product growth rate (RGDPG) and unemployment rate (UNR) covering the period 1980 – 2012. The data were basically sourced from Central Bank of Nigeria (CBN) Statistical Bulletin and National Bureau of Statistics from which the RGDP growth rate was computed. RGDP growth rate for 2012 was taken for the 2nd quarter.

### 3.3. Econometric Issues

#### 3.3.1. Unit Root Test

Generally, macroeconomic time series data are stochastically trended, which is a problem that can be solved by differencing. A number of tests can be used to verify the presence of unit roots in time series. This present study adopts the Augmented Dickey-Fuller (ADF) test for the presence of unit roots in output and unemployment rate variables. Theoretically, the following ADF specifications are possible:

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^m \beta_i \Delta y_{t-i} + u_t \quad (6)$$

$$\Delta y_t = \alpha_0 + \delta y_{t-1} + \sum_{i=1}^m \beta_i \Delta y_{t-i} + u_t \quad (7)$$

$$\Delta y_t = \alpha_0 + \delta y_{t-1} + \alpha_1 t + \sum_{i=1}^m \beta_i \Delta y_{t-i} + u_t \quad (8)$$

Each of the models is applied depending on the properties of a series. Thus, if a series has no intercept and trend, model (6) is appropriate, while model (7) is more appropriate if a series has intercept without trend. Model (8) is applicable if a series has both intercept and time trend.

#### 3.3.2. Cointegration Test

In the context of time series literature, cointegration test is conducted with a view to detecting common stochastic trends in a set of variables. In other words, cointegration is important to avoid spurious regression estimates. In the light of this, this study adopts the cointegration approach developed by [Johansen \(1988\)](#) and expanded by [Johansen and Juselius \(1990\)](#).

#### 3.3.3. Error Correction Models

After testing for unit roots and cointegration, the short-run dynamics is established by specifying the following error correction models:

$$\Delta y_t = \gamma_0 + \sum_{i=1}^p \gamma_{1,i} \Delta y_{t-i} + \sum_{i=0}^p \gamma_{2,i} \Delta x_{t-i} + \mathcal{RECT}_{t-1} + \varepsilon_t \quad (9)$$

$$\Delta x_t = \phi_0 + \sum_{i=1}^q \phi_{1,i} \Delta y_{t-i} + \sum_{i=0}^q \phi_{2,i} \Delta x_{t-i} + \delta ECT_{t-1}' + u_t \quad (10)$$

Where  $y$  = Real Gross Domestic Product Growth (measured in natural logarithm)

$x$  = Unemployment rate (measured in percentage)

$\mathcal{G}$  and  $\delta$  = Measures (in %) of speed of adjustment back to long-run equilibrium after short-run deviation.

#### 4. RESULTS AND DISCUSSION

**Table-1.** Statistical Analysis of RGDPG and  $\Delta$  UNR

	Mean	Median	Max	Min	std dev	Skewness	Kurtosis	J-B prob
RGDPG	21.51	0.63	550.53	-7.05	91.11	5.45	30.85	0.00
DUNR	0.63	0.07	9.80	-1.67	2.25	2.32	9.796	0.00

**Source:** All computations are carried out using Econometric views

Table I above shows the statistical analysis of the data. Virtually all the statistics computed for real GDP growth rate (RGDPG) exceed those computed for the change in unemployment rate ( $\Delta$  UNR). Most importantly, the RGDPG fluctuates more than the  $\Delta$  UNR over the same period as demonstrated by the standard deviation. While both distributions are positively skewed, the degree of peakedness is higher for the RGDPG as shown by the coefficients of kurtosis. The residuals are however not normally distributed based on the statistic provided.

**Table-2.** Augmented Dickey Fuller (ADF) Test for Stationarity

Variable	ADF statistic	Prob	Order of Integration	Decision
RGDPG	-6.13	0.00	I(0)	Stationary
DUNR	-5.56	0.00	I(0)	Stationary

First an informal test of stationarity was carried out using the multiple graphical method. There seems to be a clearly identified slow decay for the RGDP variable than the  $\Delta$  UNR. Due to the doubt cast on this method, we carried out a formal test for stationarity using the ADF. As shown in table 2, the variables RGDPG and DUNR are stationary in levels based on the probability values approximately given by 0.00. The existence of this stationarity may facilitate the long run equilibrium relationship.

**Table-3.** Lag Length Selection

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-159.06	NA	157.80	10.74	10.83*	10.77
1	-154.40	8.83	151.22	10.69	10.97	10.78
2	-148.59	9.68*	134.69	10.57*	11.04	10.72*

In an attempt to carry out the vector autoregression estimation, the choice of lag length is paramount. We therefore utilized various lag length selection criteria: Sequential modified LR test statistic with each test at 5%, the Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ). However each of these has different penalty factors. Some studies have chosen each of these criteria on different occasions. For instance, some have used the LR and FPE criteria. The AIC is known for long lag length while the SC for short. We adopted the HQ criterion on the ground that its optimal lag length is in-between the AIC and SC based on frequent practical experience. Therefore the optimal lag length for HQ = 2 which also equal that of the SC. It should be noted that a higher lag length results in a loss of observation in the series.

**Table-4.** Var Residual Serial Correlation LM Test

Lags	1	2	3	4	5	6	7	8	9	10	11	12
LM stat	4.58	3.21	5.36	0.75	1.25	0.84	4.24	0.66	8.19	2.73	0.97	4.06
Prob	0.33	0.52	0.25	0.95	0.87	0.93	0.37	0.96	0.09	0.60	0.91	0.398

The LM test of residual serial correlation shows no autocorrelation among the successive residuals at any of the selected lags as shown by all probability values being greater than 5% level.

**Table-5.** Vector Autoregression Estimates (VAR), lag length = 2

	RGDPG	DUNR
RGDPG(-1)	0.29	-0.00
RGDPG(-2)	-0.02	-0.00
DUNR(-1)	0.42	0.08
DUNR(-2)	0.85	-0.10
C	3.54	0.72
	$R^2 = 0.49$	$R^2 = 0.02$

The VAR estimate shows only the second lag of RGDPG influences the current RGDPG negatively. However, the coefficient of the second lag of  $\Delta$  UNR is highest among the explanatory variables in the RGDPG equation. Hence changes in unemployment rate in the last two periods impacted more on the economic growth rate more than the immediate past changes in unemployment rate. For the  $\Delta$  UNR equation, impacts of 1 unit change in RGDPG both at first and second lags on the unemployment rate changes were negligible over the periods. By implication, one and two periods ago of increase output created a very small decrease in changes in unemployment rate.

**Table-6.** Unrestricted Cointegration Rank Test (Trace and Maximum Eigen value)

Hypothesized no of cointegration	Eigen value	Trace stat/5% critical value	Maximum-Eigen value/5% critical value
None	0.45	29.21/ 25.87	17.45/19.39
At most 1	0.33	11.76/12.52	11.76/12.52
	Adjustment Coefficient Std error in parenthesis		
D(RGDPG)	-0.85(0.24)		
D(DUNR)	-0.23(0.13)		

The unrestricted cointegration rank test of table 6 shows that there is only one cointegrating vector at 5% for the trace test statistic, two cointegrating vectors for the maximum-Eigen value test but only at 10%. Given this, there is then a long run relationship between the real GDP growth rate and unemployment rate implying that changes in unemployment rate are some of the determining factors for growth. Unemployment affects growth through several mechanisms in the macroeconomic systems. One of such is the aggregate demand which may be linked with changes in unemployment rate. A wide spread change in unemployment would have some appreciable impact on growth in aggregate demand; the same may go from growth to unemployment. The adjustment coefficients for both RGDPG and  $\Delta$  UNR at first and second differences are non-positive.

Changes in unemployment rate as factor for growth are supported by the Var Granger Causality/Block Exogeneity Wald Tests showing that changes in unemployment Granger causes RGDP growth but not the reverse. Hence a uni-directional causality runs from change in unemployment to RGDP growth across the periods. Table 7 shows the results of causality test.

**Table-7.** Var Granger Causality/Block Exogeneity Wald Tests

Dep var: RGDPG/DUNR	Chi-Sq	Df	Prob
DUNR/ RGDPG	8.15/0.08	2	0.02/0.96
ALL	8.15/0.08	2	0.02/0.96

### Results of Vector Error Correction Mechanism (VECM)

Here, we specify the error correction model estimates as follows for both the RGDPG and UNR

$$\Delta(RGDPG) = -0.01\Delta(RGDPG)_{-1} - 0.01\Delta(RGDPG)_{-2} - 1.01\Delta(\Delta UNR)_{-1} - 0.20\Delta(\Delta UNR)_{-2} - 0.85ECM_{-1} + 0.72$$

$$\Delta(UNR) = -0.85\Delta(\Delta UNR)_{-1} - 0.72\Delta(\Delta UNR)_{-2} - 0.03\Delta(\Delta RGDPG)_{-1} + 0.00\Delta(RGDPG)_{-2} - 0.12ECM_{-1} + 0.29$$

The short run equations are derived accordingly from the ECM for both the RGDPG and UNR. We carry out a comparative analysis between the two short run equations even though the UNR equation is most frequently adopted.



The RGDPG equation shows a uni-directional causality between unemployment rate and the real GDP growth as demonstrated by the significant coefficient of the second lag of changes in unemployment rate. Whereas the UNR equation shows that no causality runs from real GDP growth at any lag to unemployment rate due basically to the insignificant nature of the real GDP growth coefficient. It is therefore obvious that causality only runs from unemployment rate to real GDP growth during the period. This result is exactly in conformity with the Var Granger causality /Block Exogeneity Wald test earlier carried out. The error correction coefficient indicates how quickly equilibrium is restored. Expectedly, it is negative and statistically significant for the RGDPG model and shows that about 85% deviation from equilibrium position is corrected for per period. Both output growth and unemployment have a short run negative relationship as indicated by the coefficient -1.01 which is the short run variation in RGDPG due to variation in UNR. The UNR model shows that the short run coefficient is -0.03 and the error correction term is -0.12 implying that the UNR adjusts slower than RGDPG.

**Table-8.** Ordinary least Squares (OLS)

Dep. Var: RGDPG			Dep Var: $\Delta$ UNR		
Var	Coefficient	Prob	Var	Coeff	Prob
C	4.66	0.00	C	0.09	0.87
DUNR(-1)	0.54	0.22	RGDPG	0.096	0.22
R <sup>2</sup> : 0.05, Prob(F) = 0.21			R <sup>2</sup> : 0.07, Prob (F) = 0.13		

Interpreting the RGDPG equation, the coefficient of changes  $\Delta$  UNR lagged by one period is positive (0.54). This implies that a 1% point increase in unemployment rate results in about 0.54 unit point increase in growth which actually invalidates Okun's law in Nigeria. Furthermore, the Okun's coefficient remains statistically insignificant. The coefficient of determination is extremely low and this points to the fact that changes unemployment rate variable cannot significantly contribute to the growth. Now with  $\Delta$  UNR as the dependent variable, the interpretation still holds as above. It follows then that growth pattern too is not significantly explaining the unemployment pattern in Nigeria. Clearly the estimations in both cases are at variance with the Okun's law of a negative relationship between growth and unemployment even though the causality test showed a unidirectional relationship. Thus Okun's law does not hold for Nigeria. This finding is in conformity with that of similar studies by Lal *et al.* (2010) and Arewa and Nwakanma (2012) on some selected Asian countries and Nigeria respectively. The finding, however, goes contrary to that of Meidani and Zabihi (2011) in their study on Iran.

## 5. CONCLUSION, POLICY IMPLICATIONS AND SUGGESTIONS

The focus in this paper is to test the validity of Okun's law in respect to Nigeria using the difference model approach. Both the long-run and short-run relationships are examined with the use of empirical data covering the period 33 years. Our analysis indicates a long-run relationship between real gross domestic product growth rate and unemployment rate. The Okun's coefficients

are computed for the two equations under the difference model approach for comparison purpose. We found that the coefficient of unemployment rate as an independent variable was positive and also positive for real GDP growth as an independent variable. These findings are infact contrary to Okun's law of unemployment–output relationship. If positive growth could lead to unemployment rate, then it follows that resources are substantially being channelled towards unproductive activities and to a large extent is an apparent mismatch in the system. It would therefore be a good policy space to direct resources continuously from unproductive sectors to productive ones including creating an enabling environment for drastic reduction of unemployment rate, which is a pointer to increasing aggregate demand and output growth in the long run.

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