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# **A Validation of the Phillips Curve Hypothesis in Nigeria:**

## **A Quarterly Data-Based Approach**

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### **Abstract**

*The simultaneous attainment of inflation and unemployment reduction has been pursued vigorously by various government with little or no plausible outcome, leading to the debate of a possible trade-off between inflation and unemployment in an economy. This paper thus attempt to validate the Phillips curve hypothesis in Nigeria. Employing the Generalized Method of Moments (GMM) and Canonical Cointegrating Regression (CCR) methods on quarterly data of inflation and unemployment between 2010 and 2018, the study validated the presence of a Phillips curve in the Nigerian economy. In order to cushion the devastating effects of these macroeconomic misnomer, the study among others, recommends the adoption of policy-mix that hugely leans towards ensuring employment based on the economic stage of Nigeria.*

**Keywords:** Phillips curve, GMM, CCR, inflation, unemployment

**JEL Classification:** C01, E24

### **1. Introduction**

Macroeconomic policies of governments are geared at attained economic stability in various sectors. Among targets of such policies are increase economic development accompanied with a

reduction in inflation and unemployment. However, the Phillip curve hypothesis argued against the simultaneous attainment of reduction in inflation and unemployment. The hypothesis argued that there is a stable and inverse relationship between inflation and unemployment, concluding that the economy has to choose which it wants to attain at a particular period while cushioning the effect of the other. For instance, the Central Bank of Nigeria (CBN) and policy-makers in Nigeria have occasionally weighed up the prominence to allot the reduction of inflation and unemployment. In the consideration of employing monetary policies, authorities critically consider either the achievement of an unemployment target with higher inflationary trends or vice versa.

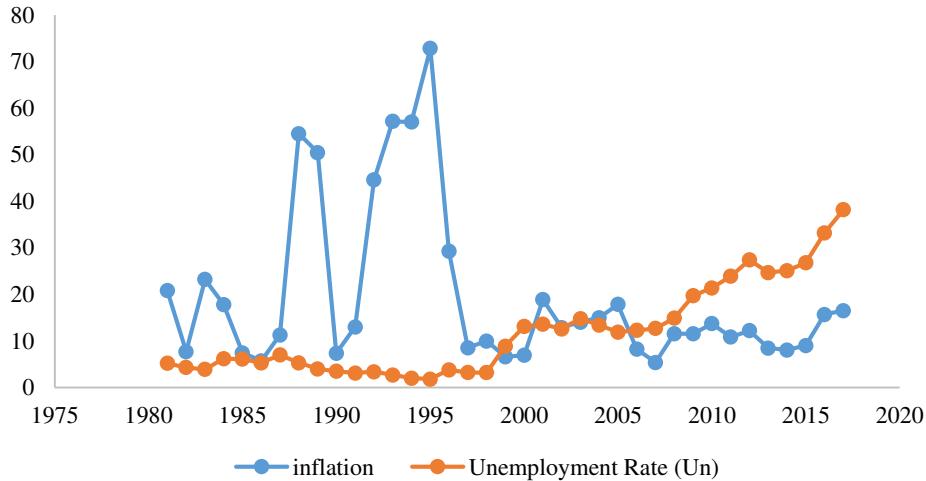
In an economy such as Nigeria, the consideration of a trade-off between unemployment and inflation cannot be undermined given the government and market failure in curbing the effects of inflation and unemployment.

The Nigerian economy has suffered immensely from the shackles of inflation and its attending effects. With current events rocking the Nigerian economy, a clear sight solution to the problem of inflation seems unimaginable. As at 2010, financial records show that the inflation rate was over 12 percent. Defiling all government intervention policies, it stood at an average 11.3 percent in 2018. As at April, 2019, the inflation rate rose to 11.4 percent (CBN, 2018).

The economy has also grappled with the challenges of unemployment. Data from the Bureau of Statistics (NBS) show that the unemployment rate in 2018 was 30 percent. Youth unemployment as per 4<sup>th</sup> quarter of 2018 stood at 56.5 percent. In a country with over 190 million people, one can only but imagine the implication of this on economy (NBS, 2018).

The figure below shows the trend in inflation and unemployment between 1981 and 2017:

Fig. 1: Trend in Unemployment and Inflations (1981-2017)



A close observation of the figure above shows occasional trade-offs between inflation and unemployment. For example, between 1981 and 1983, inflation decreased from 15 percent to 2.5 percent. This trend was accompanied with an increase in unemployment from 5 percent to 11 percent. A similar trend can be observed in the 1999-2012 era.

This bring to the fore the importance of establishing the presence or otherwise of a trade-off between inflation and unemployment in Nigeria. This is especially true in the presence of contradicting studies carried out over time in Nigeria. For instance, while some studies (see Nurudeen, 2019; Uche, 2019; Eje, 2018; Aliyu & Jelilov, 2018; Isa & Joel, 2018; Chuku, Atan & Obioesio, 2017; Jelilov, Obasa & Isik, 2016; and other) validated the Phillips Curve Hypothesis in Nigeria, the reverse was the case in other studies (see Gyang, Anzaku & Iyakwari, 2018; Salisu, Sulaiman, Yakubu & Usman, 2018; Iyeli & Ekpung, 2017; Orji, Orji & Okafor, 2015; and others).

This study is thus geared at establishing the presence or otherwise of the Phillips curve in Nigeria using quarterly data. The paper is segmented into five section. Following the introductory section, Section 2 gives a review empirical literature. Section 3 covers theoretical foundation as well as empirical methods employed to validate the Phillips curve hypothesis in Nigeria. Section 4 deals with analysis of empirical results while Section 5 concludes the study with viable policy-mix to ensure stimulated economic performance in Nigeria.

## **2. Review of related literature**

Owing to country-specific characteristics, the review of literature will mostly cover those carried out in Nigeria as a spring board to validate economic comparison and decision-making. The studies on the validation of the Phillips curve hypothesis have resulted in varying results based on the adopted techniques and time frame of the studies. For instance, Uche (2019) embarked on an investigation of the nature of relationship which exist between inflation and unemployment in Nigeria using data ranging from 1981 to 2017. Empirical findings from the Fully Modified Least Square Regression (FMOLS) showed that the Phillips curve is applicable in the Nigerian case, since a 1 percent reduction in unemployment will be achieved only if the economy will sacrifice a 49 percent increase in inflation, and vice versa.

Nurudeen (2019) examined the inflation and unemployment trade-off (Phillips curve) and its stability from 1980 to 2016 in Nigeria. Using various techniques such as the Autoregressive Distributed Lag (ARDL) bounds testing approach, Canonical Cointegrating Regression (CCR), Dynamic Ordinary Least Squares (DOLS), Fully Modified Ordinary Least Squares (FMOLS) and the Static Ordinary Least Squares (OLS), the study showed that there exist a long-run relationship between inflation and unemployment and that the Phillips curve hypothesis is fully validated.

Edeme (2018) employed data of 1972 to 2015 in an attempt to ascertain if the Phillips curve hypothesis exists in both the short- and long-run in Nigeria. Using Ordinary Least Square (OLS) method, the study shows that there exist a negative but insignificant relationship between the variables in both the short-run and the long-run in Nigeria.

Eje (2018) tested for the validation of the presence of the Phillips Curve in Nigeria using annual data for the 1986-2014 period. Employing the Ordinary Least Squares (OLS) technique, the study showed that the Phillips curve existing in Nigeria since there is a significant negative relationship between inflation and unemployment.

Aliyu and Jelilov (2018) examined the relationship between unemployment and inflation using quarterly data in the 1986-2016 period. Employing the Autoregressive Distribution Lag Model (ARDL), the study showed that there is a negative relationship between the variables both in the long- and short-run. The study concluded that government show choose a policy measure which will balance the trade-off between inflation and unemployment to the best possible level.

Gyang, Anzaku and Iyakwari (2018) investigated the unemployment-inflation-economic growth nexus using the OLS technique as well as the Johansen co-integration and the Granger causality

tests to establish long-run relationship and direction of causality. Empirical results refuted the presence of a Phillips curve in the data of 1986 to 2015.

Salisu, Sulaiman, Yakubu and Usman (2018) x-rayed the relationship between unemployment and inflation between the 1961-2015 era in Nigeria. Adopting the ARDL-bound testing approach to capture both the short- and long-run relationship between inflation and unemployment, the study reported a positive relationship between inflation and unemployment, thereby refuting the Phillips curve proposition of an inflation-unemployment trade-off in Nigeria.

Isa, C.G. and E. Joel (2018) investigated the presence of the Phillips curve in Nigeria as well as the period of existence in the presence of such existence. Employing a Vector Autoregression model and Impulse Response Function on data of inflation and unemployment for the period of 1980 to 2016, the results obtained showed an inverse relationship between the variables in the period under investigation, thus validating the presence of the Phillips curve in Nigeria.

Mutiu (2017) carried out an estimation of a New Keynesian Phillips curve model for the Nigerian Economy. The study adopted the Generalized Method of Moments (GMM) technique to analyse the ranging the first quarter of 1990 to the fourth quarter of 2012. The study shows that there is a negative relationship between inflation and unemployment, thus validating the Phillips curve hypothesis.

Iyeli and Ekpung (2017) investigated the asymmetry between unemployment and price expectation (Phillips curve) in the Nigerian economy. Employing cointegration technique on economic data between 1970 and 2011, the study found a positive relationship between unemployment and inflation, thus rejecting the presence of a Phillips curve in the Nigerian economy.

Chuku, Atan and Obioesio (2017) investigated for the presence, stability and persistence of the Phillips curve for Nigeria. The study found the existence of the Phillips curve using quarterly data from 1960 to 2009. Of particular interest in the study is the possibility of the central bank of employing a policy rate to stimulate demand to a limit without necessarily increasing the inflation rate.

Jelilov, Obasa, and Isik (2016) employed OLS technique in investigating the relationship between inflation and unemployment between 2001 and 2013. Empirical results showed that there is a positive relationship between inflation and unemployment in the short-run, but become negative in the long-run. This implies that the Phillips curve proposition exists in the long-run in Nigeria.

Okafor, Chijindu and Ugochukwu. (2016) investigated the relationship between inflation and unemployment between 1989 and 2014 using both the error correction model and Johansen cointegration method. Empirical results obtained from the techniques showed that there is a negative relationship between the variables thus validating the Phillips curve hypothesis.

Orji, Orji and Okafor (2015) examined the relationship between inflation and unemployment in a bid to validate the Phillips curve proposition in Nigeria. Utilizing data of 1970 to 2011 with a distributed lag model, empirical results showed there exists a positive relationship between the variables thus refuting the Phillips curve hypothesis in Nigeria. The study concluded by proffering policy recommendations to curbs the negative effects of unemployment and inflation.

Ogujiuba and Abraham (2013) investigated the existence of the Philips curve proposition during the 1970-2010 era in Nigeria. Utilizing the generalized error correction model, the study showed that in there is a negative relationship between the variables in the short-run. However, in the long-run, the trade-off balances out and the relationship becomes positive. By implication the study asserted the presence of the Phillips curve only in the short-run in Nigeria.

Umoru and Ayinwe (2013) the vector error correction (VEC) model to establish the relationship between inflation and unemployment between 1986 and 2012 in Nigeria. Their study showed the refuted the Phillips curve hypothesis in the short-run.

Employing the ARDL bounds testing, error correction approach as well as DOLS techniques on data of 1970 to 2010, Ojapinwa and Esan (2013) examined the presence and stability of the Phillips curve in Nigeria. As in Ogujiuba and Abraham (2013), the study found that the Phillips curve hypothesis only holds sway in the short-run, since the relationship between inflation and unemployment becomes positive in the long-run.

On their part, Umaru and Zubairu (2012) examined the relationship between inflation and unemployment in Nigeria between 1977 and 2009. The Autoregressive Conditional Heteroskedasticity (ARCH), Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and cointegration models shows that there exists a negative relationship between inflation and unemployment thus validating the Phillips curve hypothesis.

Fagge (2011) employed the Johansen technique in investigating the relationship between unemployment and inflation between 1965 and 2009 in Nigeria. The study found a negative relationship in support of the Phillips curve hypothesis.

From the brief overview of empirical studies carried out in Nigeria, it is obvious that the debate on the presence or otherwise of the Phillips curve is inconclusive. Various studies offer differing opinion on the phenomenon with attending implications on policy recommendation. Majority of the studies employed annual data. While a few employed quarterly data. One disadvantage of employing annual data in analysis is the inability to capture micro-effects which are ever present in macroeconomic data. It becomes imperative to utilize micro-unit data (such as weekly, monthly and quarterly), where available in order to adequately capture these effects. This paper will fully utilized quarterly data for its analysis.

### **3. Methodology**

#### **3.1. Theoretical Framework**

The concept of a *Phillips Curve* emerged from the findings of Phillips A.W. in his work entitled *The Relationship between Unemployment and the Rate of Change of Money Wages in the United Kingdom 1861–1957*. It is built on the axiom that higher inflation will be accompanied with lower unemployment and vice versa. It also holds that this relationship may not be attained in the long-run, it will exist in the short-run.

*The possibility of achieving the above is drawn from the fact that an increase in aggregate demand will results in higher gross domestic product (GDP). By implication, firms will employ more labour leading to a fall in unemployment. However, as this trend continues and the economy approached full capacity in terms of performance, labour may demand higher remuneration (wage) and firms may increase prices due to increased demand, thus leading to inflationary tendencies. In this regard, the economy will be experienced lower unemployment rate simultaneously with increased inflation.*

In order for the Phillips curve hypothesis to hold, there must exist a long-run monetary neutrality in the economy. This implies that a permanent increase in the volume of money does not alter the level of output.

The traditional Phillips curve has 4 blocs:

- *The Aggregate Supply*

This is given as:

$$\pi_t = \pi_{t-1} + \gamma Q_t + \varepsilon_t \quad (1)$$

- *Aggregate Demand*

This is given as:

$$Q_t = -\delta(i_t - \pi_{t+1}) + \epsilon_t \quad (2)$$

- *Monetary (interest rate) policy*

$$i_t = \varphi_\pi \pi_t + \varphi_Q Q_t + \mu_t \quad (3)$$

- *Money Demand*

$$m_t - p_t = -\omega_i i_t + \omega_Q Q_t + \tau_t \quad (4)$$

Where,

$Q$  = real output

$m$  = money aggregate (nominal)

$p$  = price level

$i$  = interest rate

$\pi$  = inflation rate

The error terms are shocks in each of the blocs.

From the above blocs, the traditional Phillips curve can be written as:

$$\Delta P_t = \alpha_0 + \alpha_1 U_t + \varepsilon_1 \quad (5)$$

Where;

$\Delta P$  = inflation

$U$  = unemployment

With a view to incorporating expectations into the Phillips curve, the expectations augmented Phillips curve states that:

$$\pi_t - \pi_t^e = -\sigma[U_t - U_n] \quad (6)$$

Where;

$\pi$  = actual inflation rate

$\pi^e$  = expected inflation rate

$U$  = unemployment rate

$U_n$  = natural rate of unemployment or unemployment rate at full employment.

$\sigma > 0$ .

### 3.2. Model Specification

Drawing from the above framework, the study will analyse the traditional and the expectations augmented Phillips curve. These are specified below:

*Traditional Phillips curve:*

$$\Delta P = \alpha_0 + \alpha_1 U_t + \alpha_2 \Delta P(-1) + \alpha_3 EXR + \varepsilon_1 \quad (7)$$

*Expectations augmented Phillips curve:*

$$\Delta \dot{P}_t = \beta_0 + \beta_1 [U_t - U_n] + \beta_2 \Delta \dot{P}(-1) + \beta_3 EXR + \varepsilon_1 \quad (8)$$

Where;

$\Delta P$  = inflation

$U$  = unemployment rate

$\Delta \dot{P}$  =  $[\pi - \pi^e]$  = change in inflation

$\pi$  = actual inflation rate

$\pi^e$  = lagged inflation rate

$U_n$  = natural rate of unemployment or unemployment rate at full employment.

EXR = exchange rate

### **3.3. Method of Analysis**

This study employed the two-step system Generalized Method of Moments (GMM) in analysing the relationship between inflation and unemployment. The choice of this technique hinges on the fact it accounts for endogeneity in the variables in the model as well results in robust estimators (Blundell and Bond, 1998; Arellano and Bover, 1995).

In both models lagged inflation and interest rate were added as were adopted as instrumental variables in the GMM specification, since there must be at least as many variables (instrumental) as there are parameters in the model in order for the GMM estimator to be identified and robust. The unemployment rate at full employment is set at 5 percent. To confirm such robustness and consistency, the study adopted the Canonical Cointegrating Regression (CCR) since this model deals with serial correlation problems and endogeneity bias (Park, 1992; Alhassan & Fiador, 2014; Singh, 2015). The study adopted the KPSS (Kwiatkowski–Phillips–Schmidt–Shin) test (Kwiatkowski, et al, 1992) in testing for stationarity in the dataset. The dataset covers quarterly data of the variables between 2010 and 2018.

## **4. Empirical analysis**

### **4.1. Stationarity Analysis**

In order to ascertain the stationarity of the data the KPSS test was adopted. The result is presented below:

**Table 1: KPSS Stationarity Test**

Constant and Time Trend				
Variable	KPSS Values	Max. Lag	Critical Values	
INFL	0.0131	2	1%	0.4721
EXR	0.0317	2	5%	0.2495
UNEMP	0.1026	2	10%	0.1837

Source: STATA 9 Output

## 4.2. Empirical Results

### 4.2.1. Traditional Phillips Curve Analysis

The table below shows the GMM estimates for the traditional Phillips curve model:

**Table 2: GMM Results**

Dependent Variable: LINF.		
Variable	Coefficient	P-value
Constant	14.5216*	0.0000
LEXR	-0.0592***	0.0221
LINF(-1)	0.7302**	0.0019
LUNEMP	-0.9057**	0.0011
<b>Diagnostic Test</b>		
Hansen-J test		0.0107
<b>Robust Test</b>		
Sum of squared residual	7.1240	
Standard Error of the regression	11.0517	

Source: STATA 9 Output

(\*\*\*), (\*\*) and (\*) indicate significance at 10%, 5% and 1% respectively

The Hansen-J test as a diagnostic test with a p-value of 0.0107 confirmed the exogeneity of the employed instruments. Thus, the estimates from the specified model are valid for estimation and decision-making.

A critical examination of Table 2 show that the explanatory variables in the model are statistically significant at various levels of significance. Both the sum of squared residuals (SSR) with a coefficient of 7.1240 and standard error of the regression (SER) with a coefficient of 11.0517 depicts satisfactory overall fit. Consequently, the hypothesis of a log-linear relationship between INFL and the explanatory variables cannot be rejected.

The results also presents a clear picture of the Phillips curve in Nigeria. A 1 percent increase in unemployment will be associated with a 0.9057 decrease in inflation. The coefficient of the lagged inflation variable shows that the Phillips curve in Nigeria tends toward a vertical one. There is a negative relationship between exchange rate and inflation, with 1 percent increase in exchange rate resulting in a 0.0592 decrease in inflation.

The above results was confirmed by the Canonical Cointegrating Regression (CRR). The results of the CRR are presented below:

**Table 3: Canonical Cointegrating Regression Results**

Dependent Variable: LINF.		
Variable	Coefficient	P-value
Constant	9.4914*	0.0000
LEXR	-0.1701***	0.0401
LINF(-1)	0.6593**	0.0009
LUNEMP	-0.5137**	0.0016
R <sup>2</sup>	0.7245	
Adj. R <sup>2</sup>	0.5508	

Source: STATA 9 Output

(\*\*\*), (\*\*) and (\*) indicate significance at 10%, 5% and 1% respectively

Table 3 indicated that unemployment negative affect inflation. Specifically, a 1 percent change (increase) in unemployment will result a 0.5137 change (decrease) in inflation, thus validating the Phillips curve hypothesis. The explanatory variables account for over 72 percent variation in inflation. The results also confirms robustness and consistency in the estimates.

#### *4.2.2. Expectations augmented Phillips curve Analysis*

The table below shows the GMM estimates for the expectations augmented Phillips curve model:

**Table 4: GMM Results**

Dependent Variable: LINFCHANGE.		
Variable	Coefficient	P-value
Constant	27.9652*	0.0000
LEXR	-0.7301*	0.0000
LINFCHANGE(-1)	0.6221*	0.0000
LUNEMPCHANGE	-0.0279*	0.0000

**Diagnostic Test**

Hansen-J test	0.0007
<b>Robust Test</b>	
Sum of squared residual	15.1602
Standard Error of the regression	8.0831

Source: STATA 9 Output

(\*\*\*), (\*\*) and (\*) indicate significance at 10%, 5% and 1% respectively

A close look at Table 4 above shows that the Hansen-J test diagnostic test confirms that the instruments adopted in the model were truly exogenous of the dependent variable. A p-value of 0.0007 confirms the exogeneity of the employed instruments. Thus, the estimates from the specified model can be relied upon for policy-making.

The results presented in Table 4 show that all three variables consisting of the one-period lagged dependent variable [INFCHANGE(-1)] are significant. The overall fit is satisfactory with the sum of squared residuals (SSR) having a value of 15.16 and the standard error of the regression (SER) has a value of 8.083. Consequently, the hypothesis of a log-linear relationship between INFCHANGE and the explanatory variables cannot be rejected at the 1 percent significance level. All the explanatory variables were statistically significant at the 1 percent level of significance.

The results also shows that a 1 percent increase in exchange rate will result in a 0.73 percent decrease in the change in inflation variable. This implies that exchange rate has a long-run negative impact on change in inflation. In the same vein, a 1 percent increase in change in unemployment will be accompanied by a 0.0279 decrease in change in inflation. This validates the expected augmented Phillips curve hypothesis during the period under review.

As expected there is positive relationship change in inflation and its lagged value. However, the coefficient of 0.6221 indicates that the Phillips curve is a vertical one in Nigeria.

In order to ascertain the robustness of the results obtained the Canonical Cointegrating Regression was carried out. Empirical results are presented below:

**Table 5: Canonical Cointegrating Regression Results**

Dependent Variable: LINFCHANGE		
Variable	Coefficient	P-value
Constant	38.0663*	0.0000
LEXR	-0.5442**	0.0005
LINFCHANGE(-1)	0.7961**	0.0001
LUNEMPCHANGE	-0.3920***	0.0011
R <sup>2</sup>	0.6102	
Adj. R <sup>2</sup>	0.4897	

Source: STATA 9 Output

(\*\*\*), (\*\*) and (\*) indicate significance at 10%, 5% and 1% respectively

The results presented above re-affirms that there is a long run relationship between inflation and unemployment in Nigeria, which confirms the presence of the Phillips curve proposition. In addition, similarities in the GMM and CCR results indicate consistency and robustness in estimates.

Overall the findings of this study validates the Phillips curve hypothesis in Nigeria. The findings corroborates with those of Nurudeen, 2019; Aliyu, and Jelilov, 2018; and Uche, 2019; among others.

## 5. Conclusion and recommendations

In an attempt to establish the presence or otherwise of a trade-off between inflation and unemployment, this study evaluated the traditional Phillips curve as well as a variant, expectations augmented Phillips curve in the Nigerian economy with the aid of quarterly data between 2010 and 2018. Results from the GMM and CRR techniques showed vividly that there is a significant trade-off between inflation and unemployment, thus validating the Phillips curve hypothesis.

The results implies that no single economy can fully eradicate both inflation and unemployment and perform optimally. There is thus need for the Nigerian economy to adopt a policy-mix which will maximize employment of labour, while creating cushions for inflationary trends. With a growing population of over 190 million, the emphasis should be placed on the employment sphere by creating hubs for populace. The central bank through its operations should closely monitor

inflationary indicators in order to ascertain how and to what extent policies should be undertaken in both the real and monetary sector of the economy.

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