Revisiting the Validity of Phillips Curve in Nigeria: An ARDL Approach

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DOI: 10.24818/mer/2023.02-02

ABSTRACT
It is evident that in Nigeria inflation and unemployment are growing simultaneously and pose a serious question in terms of the validity of the Phillips curve in Nigeria. This study investigates the relationships that exist with respect to inflation and unemployment in Nigeria using data from the CBN statistical bulletin (2020) from 1981 to 2020. The ARDL model (autoregressive distributed lag) was employed in the study. The study revealed an inverse and significant link between inflation and unemployment only in the short run, while a positive, as well as significant relationship, was found that connects inflation and output in Nigeria also in the short run. We, therefore, recommend the need for government to always consider unemployment in formulating policies aimed at achieving price stability. We also recommend that the government adopts labour-intensive techniques of production to reduce costs and, by extension, reduce the prices of goods and services.

KEYWORDS: *ARDL, Inflation, Output, Unemployment*

JEL CLASSIFICATION: *C32, E24, O47, P24*

1. INTRODUCTION

One of the most commonly used measures of economic strength is the accomplishment of full employment and price stability. Inflation, unemployment, and output are essential parts of an economy, hence the need for them to be closely monitored. The application of Philip's inference of exchange connecting inflation and unemployment is required by a constant increase in inflation and unemployment rates in Nigeria. The relationship between inflation and unemployment has been interpreted by many economists in terms of short-term and long-term basis. The former has an inverse relationship in that when there is an increase in inflation, unemployment will reduce, and vice versa. On the contrary, some economists opined that inflation and unemployment are unconnected in the long run. This connection between these two variables is referred to as the Phillips curve. Classical economists opined that alteration in the money supply is a cause of inflation. An increase in the supply of money raises the price of goods and services. This situation is referred to as inflation.

Unemployment exists when people who are ready and willing to work could not find work. Unemployment could be at a natural rate when it is at its lowest rate and characterized by non-accelerating inflation. According to classical economists, the equilibrium level of unemployment, also known as the long-term Phillips curve, is on the whole perpendicular as inflation is not ordinarily supposed to have any connection with unemployment in the long

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run. Hence, unemployment is said to be predetermined without consideration for the prominence of inflation. By and large, the rate of unemployment below the natural rate, indicated that inflation has exceeded the expected limit, and in this case, the unemployment is higher than what is the permissible limit (4% - 5%).

Unemployment and inflation are core taking into cognisant the social and economic life of people in the country, as opined by Odusola and Obadan, (2018). The existing literature considers inflation with unemployment to constitute a ferocious loop, which describes the prevalent backdrop of poverty in most developing nations of the world. The only sure way of breaking this ferocious loop is with an increase in output. Output growth provides a considerable basis for a satisfactory provision of goods and services, thus enhancing people's welfare and social progress Odusola and Obadan (2018).

Unemployment is a serious impediment to social development. Apart from signifying an immense ravaging of the nation's human resources, it results in a thrashing of welfare with respect to reduction of output, which could lead to a reduction in revenue, and the welfare of the population (Kenny, 2019). The call for curtailing the depressing effects of unemployment has necessitated the handling of unemployment problems as an element in the growth objectives of many developing nations of the world. On the other hand, inflation is not a recent development. It has been a major setback in Nigeria over the past decades and a household word in many market-oriented economies. In an attempt to invade the cost of inflation and unemployment insecurity that follow, where there is cost volatility or a soaring rate of unemployment, authorities try hard to accomplish the maintenance of price stability and full employment.

2. IMPORTANT

Nigeria faces a devastating economic situation, with persistent extreme rises in prices and an increase in unemployment. Due to the tremendous rise in prices of goods, and increase in the cost of production, producers charge low wages and increase working hours, coupled with high taxes charged by the government and the subsequent transfer of such burden to the consumer by producers resulting in economic instability in terms of inflation and unemployment and their economic consequences. In addition, with the terrorist attack, kidnappings, and armed robberies in the country, most foreign investors are indisposed to invest in Nigeria, and some are shifting their capital to other developing countries, accordingly, the labour force has become unemployed in recent years. With the current positive correlation linking inflation and unemployment in Nigeria over the years, one begins to question the existence of the Phillips curve as postulated by Williams Phillips; hence the need to revisit the validity of the Phillips curve in Nigeria. The purpose of this paper is to revisit the validity of the Phillips curve in Nigeria with the specific objective of examining the impact of unemployment and output on inflation.

The remaining part of the paper is organized as follows: Section two consists of the disclaimer and legal requirement, section three has to do with a review of related literature, section four provides methodology, section five data presentation and analysis, and section six is the conclusion and recommendation.

3. LITERATURE REVIEW

The Phillips curve as an economic theory was developed by A. W. Phillips. The theory postulates the existence of the inverse relationship between inflation and unemployment, on the one hand, and a positive relationship between inflation and growth, on the other hand. This means that as inflation increases, workers may supply labour in the short term due to high wages, leading to a fall in the unemployment rate. Subsequently, economic growth will increase due to an increase in employment (decrease in unemployment). Conversely, in the late 1960s, Milton Friedman and Edmund Phelps criticized the main Phillips cure based on the fact that it assumed the anticipated rate of inflation as given and omission of expectation on inflation. They differentiated between money wages and real wages and that if workers see through illusion and bargain in real terms, the anticipated rate of inflation will increase, and as money wages that workers will demand will also increase to maintain the value of their real wages. They opined that the economy reverts to the expected unemployment rate as well as adjusts to any inflation rate in the long run. Therefore, the underpinning theory for this study is the Friedman-Phelps natural rate model.

In Nigeria, Kanayo and Terfa (2013) tested the Phillips curve hypothesis for Nigeria and its likely growth implications. They employed a generalized error correction model and found that the Phillips curve only exists insignificantly in the short run and that inflation may likely improve growth, while unemployment may harm growth in Nigeria. Similarly, Orji, Anthony-Orji and Okafor (2015) examined inflation with unemployment connection by subjecting it to the Phillips curve proposition. Adopting the ARDL model, with data from 1970 – 2011, the results revealed; unemployment significantly determines inflation as a positive connection linking inflation with unemployment. The study recommends diversification of the economy and the adoption of appropriate policies for curtailing the menace of inflation with unemployment, in addition to the consequent reduction in stagflation in Nigeria. In the same vein, Iyeli and Edame (2017) investigate the relationship between price expectations and unemployment in Nigeria using a cointegration method and found a positive and coexistence of inflation and unemployment in Nigeria. This implies that the Phillips curve does not exist in Nigeria.

In a related study, Innocent, Irmiya and Juryilla (2019) explored the Phillips curve hypothesis in Nigeria from 1980 – 2018 by employing the Autoregressive Distributed Lag bounds test; the results indicate the absence of a significant trade-off between the variables. Strong monetary policies that could reduce inflation and unemployment were recommended. In the same vein, Tule and Adeleke (2019) explore the stability of the Phillips curve in the context of the Nigerian economy within the framework of the Lucas critique using an OLS technique. They found that the Phillips curve does not strictly hold or apply in the context of the Nigerian economy and recommend collaboration between the monetary and fiscal authorities to ensure price stability.

Yıldız (2021) investigates the correlation between inflation and unemployment in Turkey from 2006 to 2020. Employing Fourier cointegration and Single Fourier-Frequency Toda & Yamamoto causality for analysis, the result revealed the absence of a correlation connecting inflation with unemployment. The paper concluded that the Phillips curve was not valid in Turkey during the period under investigation. Similarly, Tabar and Çetin (2016) examine Phillips curve validity in Turkey from 2003 to 2016. Researchers source data from the World Bank, OECD, and the official website of TUIK. The stationarity test revealed a unit root with a structural break; besides, no cointegration connection linking these variables. Hence, the invalidity of Phillips curves in Turkey.

In a related study, Daniel, Israel, Chidubem and Quansah (2021), examined the validity of the Philips curve hypothesis in addition to the possible cause of inflation and unemployment in Nigeria. Employed Vector Autoregressive and Error Correction techniques, the results show no significant connection linking inflation with unemployment. The results also indicate inefficiencies from the government and insufficient investment as a reason for unemployment and depreciation of the exchange rate with money supply as a reason for inflation. The study recommends efficient fiscal and monetary policy to raise employment and output. Similarly, Rahman and Mustafa (2017), revisited the exchange linking inflation with unemployment rates in the USA using annual data from 1930 to 2016. Employing ARDL Bounds Testing, the results show co-integration between the variables and ECM sustain the presence of traditional Philips curve in the long run with indifferent in the short run.

Ojonta, Ogbonna and Ukwueze (2022), investigated the cogent of the Augmented Philips Curve Hypothesis and the logical prospect of inflation with the unemployment rate in Sub-Saharan African nations from 2009 to 2016. Employing Dynamic System Generalized Moments for analysis, results revealed cogent of augmented Philips curve with the positive logical prospect of inflation with unemployment. Appropriate strategy to enhance enabling environment for business was recommended. In another study, Emmanuel (2019), examined inflation with unemployment dynamics in Nigeria from 1981 to 2017, employing Fully Modified Least Square Regression, results show an inverse connection linking unemployment with inflation rates hence the existence of the Phillips curve. The study recommends an appropriate threshold to ensure stability in Nigeria's macroeconomy.

Efayena and Olele (2020) investigated the Phillips curve validity in Nigeria from 2010 to 2018. Adopting the Generalized Method of Moments and Canonical Co integrating Regression methods, the finding validated the existence of a Phillips curve. An adaptation of mixed policy was recommended to ensure an employment base. In Jordan, Al-zeaud and Al-hosban (2015), attempted to find out the existence of the Phillips curve trade-off from 1976 to 2013. Using co-integration, VECM, and linear with non-linear OLS regression techniques, the results revealed the existence of the Phillips curve. It was recommended that policymakers should target low unemployment or low inflation when applying fiscal and monetary policy.
Nar (2021), examines the validity of the Phillips curve in Turkey, from 1980 to 2019, using the Granger causality relationship, the result indicates unidirectional causality from inflation to unemployment. With the existence of cointegration and causality, the relationship between the variables is an indication of the existence of the Phillips curve. Measures targeted at promoting exports and recuperating venture means were recommended. In another study, Nautwima and Asa (2021), empirically explored the existence of the Phillips curve in Namibia. Employing the Ordinary Least Square Model for analysis, the results show two ways connection linking inflation with unemployment, which indicates the existence of the Phillips Curve. The causality test shows that inflation and unemployment are not related. Mixed policy adaptation was recommended to reduce unemployment.

Khan and Pohwani (2020) explored the impact of inflation and unemployment in Pakistan for a period of 20 years. The Granger and Johansen Cointegration test was used for the analysis, and the result revealed the existence of the Phillips curve. In another study, Muchdie (2016) empirically examines the existence of the Phillips curve in the world's economy. Using cross-section data on the inflation rate and unemployment rate from Asia (49), Europe (39), Africa (52) and America (29) totaling 182 countries, employing regression analysis, the results indicate the existence of the curve in the short-run in the economy under study, but the relationship is not statistically significant. Similarly, Azam, Khan and Khan (2022) examine the existence of the Phillips curve in the Middle East and North African (MENA) countries by

applying an ARDL/PMG panel analysis. They found that there was no significant trade-off between inflation and unemployment in the short run, while the trade-off does not exist in the long run. The study concluded that the trade-off between inflation and unemployment postulated by Phillips does not hold in the MENA countries. Furthermore, Reinbold and Wen (2020) find out whether the Phillips curve is still alive in the US using a VAR framework. The study reveals that there was no systemic relationship between inflation and unemployment in the short run, but the Phillips curve exists at the intermediate run with the business cycle. Also, a positive relationship was found between inflation and unemployment in the long run, which suggests the nonexistence of the Phillips curve in the long run in the US.

4. METHODOLOGY

The study employed the Autoregressive Distributed Lag model developed by Pesaran and Shin (1999). Towards establishing the existence of a long-run correlation between unemployment with inflation rates in Nigeria, ARDL bound test, as well as the ARDL Error Correction model were used.

4.1 Model specification

The ARDL model is specified below, with inflation rate (INF) serving as a reliant variable, whereas unemployment (UNEP) and output (GDP) are the independent variables.

$$\Delta INF_t = \gamma_0 + \gamma_1 UNEP_{t-1} + \gamma_2 LOGGDP_{t-1} + \sum_{i=1}^{p} \gamma_3 \Delta INF_{t-i} + \sum_{i=0}^{q1} \gamma_4 \Delta UNEP_{t-i} + \sum_{i=0}^{q2} \gamma_5 \Delta LOGGDP_{t-i} + \varepsilon 1 \quad (1)$$

A priori expectation

It is expected that $\gamma_1 and\ \gamma_4 < 0\ while\ \gamma_2\ and\ \gamma_5 > 0$

However, the ARDL ECM model is specified to explore the long-run link between the inflation rate (INF) and unemployment (UNEP) in Nigeria. The ECM term (λ) shows swiftness of alteration of the model back to equilibrium in the long run.

$$\Delta INF_t = \gamma_6 + \sum_{i=1}^{p} \gamma_7 \Delta INF_{t-i} + \sum_{i=0}^{q1} \gamma_8 \Delta UNEP_{t-i} + \sum_{i=0}^{q2} \gamma_9 \Delta LOGGDP_{t-i} + \lambda ECM(-1) + \varepsilon 2 \quad (2)$$

A priori expectation

By expectation, $\lambda < 0$ (negative), statistically and significantly different from zero

5. RESULTS AND DISCUSSIONS

This part has to do with the outcome and disagreement of the analysis.

Table 1. Results of Unit Root Test

	Phillips Perron (PP)					**Augmented Dicker Fuller (ADF)**				
Variable	Level T-stat	prob.	1st diff. stat	prob	order of intergration	Level T-stat	prob.	1st diff. stat	prob.	order of intergration
LINF	-3.3768	0.0178			1(0)	-3.4950	0.0133			1(0)
LUNEP	-0.8500	0.7936	-8.0883	0.0000	1(1)	-0.9858	0.7492	-8.1944	0.0000	1(1)
LNGDP	-1.0460	0.7273	-3.3851	0.0196	1(1)	-1.3946	0.5753	-9.4595	0.0147	1(1)

Source: Authors' compilation

5.1 Discussion of Stationarity Result

Table 1 shows stationarity results for inflation, and unemployment in addition to gross domestic product, and it reveals a mixed order of integration 1(0) and 1(1) which substantiate the preference for ARDL form and estimation procedure of Ordinary Least Square.

Table 2. Lag selection

Lag Selection						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-357.0475	NA	34073.36	18.94987	19.07915	18.99586
1	-205.3329	271.4892*	18.67695*	11.43857*	11.95571*	11.62256*
2	-196.3728	14.61916	18.91212	11.44067	12.34565	11.76266
3	-191.9616	6.500652	24.69499	11.68219	12.97502	12.14217

Source: Authors' compilation

Note: * indicates the preferred lag length used for the estimate of models of this study.

5.2 Lag Length Selection Results

Table 2 shows the lag selection result for inflation, unemployment, as well as the gross domestic product of Nigeria. Lag 1 is most preferred for the ARDL form, as indicated with a star (*) on LR, FPE, AIC, SC, and HQ.

Table 3. ARDL Bounds Test

Test Statistic	Value	K
F-statistic	7.940929	2

Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.63	3.35
5%	3.1	3.87
2.5%	3.55	4.38
1%	4.13	5

Source: Authors' compilation

5.3 Long-Run Bound Test Results

Table 3 shows long-run bound test results for the connection linking inflation and unemployment. F-Statistic values (7.94) is more than 5% upper-bounds, therefore, the unfounded proposition of no long-run connection was not accepted. From the results, it was concluded that a long-run connections exist linking inflation as well as unemployment. This necessitates the estimation of the short-run coefficients in addition to the ARDL-ECM representation.

Table 4. Short- and long-run ARDL results

Short run coefficients		Long Run Coefficients		
Variable	Coefficient	Variables	Coefficient	
C	2.3199***	LUNEP	-0.1716	
	(0.47870)		(0.2447)	
	{4.8467)		{-0.7015}	
D(LUNEP)	-0.3973*	LNGDP)	0.0100	
	(0.2108)		(0.0769)	
	{-1.8852)		{0.1303}	
D(LNGDP)	2.8054***	0.579971	4.837122	
	(0.5800)			
	{4.8371)			
CointEq(-1)	-0.7642***	F-Stat.	R^2=0.5000	D-W=1.67
	(0.1356)	8.7482		
	{-5.6376)	Prob. 0.0001	R^2-Adj=0.4428	

Source: Authors' compilation
Note: *** and *represent 1% and 10% significance levels respectively,
( ) represent the standard errors, { } represent the T-statistics

5.4 Discussion of Short- and long-run ARDL results

Table 4 shows short and long-run ARDL results for the connection between inflation and unemployment in Nigeria. The short-run coefficient of unemployment (– 0.40) and its equivalent likelihood value (0.0677) show that unemployment affects the inflation rate negatively and is statistically significant at 10%. This implies that a 1% increase in the unemployment rate can likely lead to a 0.40% decrease in inflation in Nigeria. This is consistent with the Phillips postulate of the existence of exchange linking inflation and unemployment. These findings were corroborated with Nar (2021), Emmanuel (2019), and Gul, Mughal, Kakar, Hussain, and Khaliq, (2012), and contradict studies by Ojonta, Ogbonna, Ukwueze (2022), Innocent, Irmiya and Juryilla (2019), Tabar and Çetin (2016) who found the existence of a positive connection between inflation and unemployment.

The short-run coefficient of GDP (2.81) and its equivalent likelihood value of 0.0000 entail that GDP has a positive and a significant effect on the inflation rate in Nigeria. Specifically, a 1% increase in GDP may likely translate into a 2.81% increase in inflation. This is not consistent with the theoretical expectation of this study, as an increase in output may boost the supply of goods and services, thereby reducing prices. This positive relationship found between inflation and output may be a result of the high cost of production in the country resulting from the importation of input required to produce the needed output. In addition, it could also be a result of a high level of insecurity that causes supply chain disruption. This study corroborated the study of Ademola and Badirum (2016) and contradicts the study of Irewole (2019), Singh (2018), and Ajie, Ani and Ameh, (2017), which showed a negative relationship between inflation and output.

The 'F' Statistic value (8.75) and its equivalent likelihood value (0.0000), which measure the joint significance of unemployment and GDP in determining inflation in Nigeria, were statistically significant at a 1% level. This implies that the unemployment rate and GDP are jointly and significantly affecting the inflation rate in Nigeria. The 'R' square value of 0.5000, which shows the explanatory power of unemployment and GDP on inflation, was found to be 50%.

This implies that 50% of the entire deviation in inflation was explained by unemployment and GDP in Nigeria for the period under study. The coefficient of error term of -0.7641 captures the speed of adjustment of the inflation and unemployment nexus model, showing that the model will converge in the long run at a speed of 76.41% annually. This means that whenever there is a state of disequilibrium in the model, it will adjust back to equilibrium in the long run at an annual speed of 76.41%.

In the long run, negative and insignificant connections exist between unemployment and inflation with a coefficient of -0.1716 and a probability value of 0.4877. The gross domestic product and inflation have a positive but insignificant connection, as indicated by a coefficient of 0.0100 and a probability value of 0.8971, while the constant is positive and significant with a coefficient of 2.3197 and a probability value of 0.0000. This result implies a long-run and insignificant connection linking inflation with unemployment in Nigeria.

Table 5. Diagnostic test results

Techniques	F. Stat (prob. Value)	Null hypothesis	decision
Heteroskedasticity: Breusch-Pagan-Godfrey	1.55(0.21)	homoskedasticity	Accepted
ARCH	0.28(0.60)	homoskedasticity	Accepted
Serial Correlation LM Test	2.31(0.11)	no serial correlation	Accepted

Source: Authors' compilation

5.5 Discussion of Diagnostic Test Results

Table 5 shows the results of the diagnostic test. The results of the ARCH heteroskedasticity test of 0.2792(0.60) and that of the Breusch-Pagan-Godfrey heteroskedasticity test of 1.5463 (0.21) both indicate homoskedasticity. Therefore, the hypothesis of homoskedasticity is hereby accepted given the probability of more than 0.05. The Breusch-Godfrey Serial Correlation LM Test results of 2.3140 (0.11) indicate the nonexistence of consecutive relationships in the representation, as indicated by a likelihood value of more than 0.05. Therefore, the hypothesis of no serial correlation is accepted.

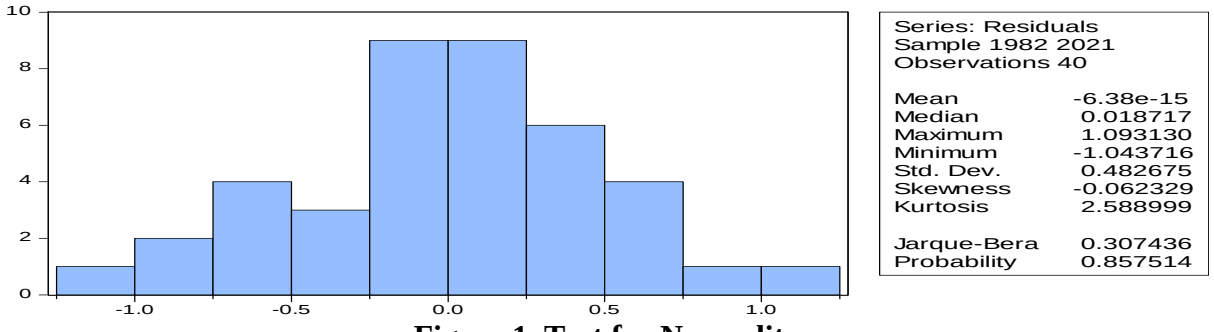

Figure 1. Test for Normality

Source: Authors' compilation

Figure 1 shows the normality test results. It indicates that the data is normally distributed with the Jarque-Bera value (0.3074) with its equivalent likelihood value (0.8575) which is more than 0.05 significant levels.

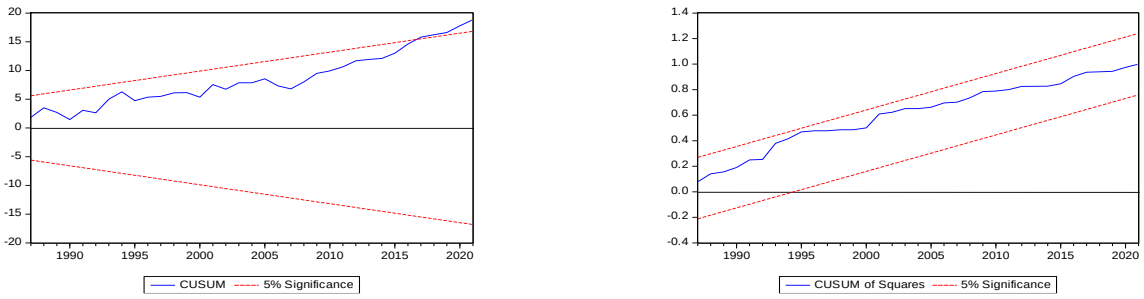

Figure 2. CUSUM with CUSUM of squares.

Source: Authors' compilation.

5.6 Discussion of Diagnostic Test Results

CUSUM with CUSUM of squares results revealed a stable representation, as a blue line cataract inside a 5% boundary.

6. CONCLUSIONS

The paper investigates the relationship linking inflation with unemployment following the Phillips postulate. Data were sourced from the CBN statistical bulletin (2020) and NBS (2020), between 1981 and 2020 on inflation, the unemployment rate with Gross Domestic Product. We employed an ARDL model in analyzing the data. This study contributes by improving the body of existing literature on the relationship between unemployment and inflation in Nigeria, as it will serve as a reference point for other researchers in the area. It will also serve as a policy document for policymakers in making informed decisions regarding the unemployment and inflation nexus. The study reveals the choices that abound for policymakers on whether to reduce unemployment amidst high inflation or to reduce inflation with high unemployment.

Based on the findings of the study, we conclude that exchange exists linking inflation with unemployment, which supports the existence of the Phillips curve. We also conclude that an increase in output may likely raise the level of inflation in Nigeria, which could be attributed to the over-dependence of the country on imported goods and services. Therefore, we recommend the need for government to always consider unemployment in formulating policies aimed at achieving price stability. We also recommend that the government adopts the labour-intensive technique of production to reduce costs and, by extension, reduce the prices of goods and services.

Limitations of the study

This study is limited to the Nigerian economy due to data availability, particularly the high-frequency series, and financial constraints. The study covers the period between 1981 and 2020 and is an annual series; we suggest that future studies should use high-frequency data, such as monthly or quarterly data, for a more robust analysis. We employed a linear ARDL model in this study; hence, we suggest further studies to use a nonlinear ARDL model.

ACKNOWLEDGEMENTS

We would like to appreciate the Journal of Management and Economic Review for its publication and free support for our paper if finally accepted. We also would like to appreciate the Central Bank of Nigeria for the data used in this study.

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