

# Impact of Selected Macroeconomic Variables on Economic Growth in Nigeria

Olajide S. Oladipo\*, Nuhu Ado, Fausat M. Alesinloye, Wasiu A. Yusuf

Department of Economics, Nile University of Nigeria, Abuja, Nigeria

Email: \*jide.oladipo@nileuniversity.edu.ng

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## Abstract

This study investigates the impact of selected macroeconomic variables on economic growth in Nigeria using quarterly data spanning from 2000Q1 to 2022Q3. The methodology, anchored in the co-integrated Autoregressive Distributed Lag (ARDL) model, emphasizes data collection, validity, and reliability considerations. Secondary data, drawn from the Central Bank of Nigeria and National Bureau of Statistics, constitute a sample of 87 data points, meeting the Central Limit Theorem's sample size requirements. The variables under scrutiny nominal GDP growth (as a proxy for economic growth), exchange rate (EXR), inflation rate (INF), and interest rate (INT) demonstrate distinct relationships established through rigorous statistical analysis. Validity and reliability assessments employing a 95% confidence level ascertain the credibility of the study's results. Stationarity tests utilizing Augmented Dickey-Fuller (ADF) and Philips-Perron Unit Root Tests reveal a mix of integration orders among the variables, guiding the choice of ARDL modeling to capture long-run relationships. Descriptive statistics illustrate variable behaviors, exhibiting fluctuations and key trends over time. Correlation analysis corroborates certain expected relationships while uncovering unexpected associations among the variables. The ARDL bounds test for co-integration confirms a long-run equilibrium relationship among the variables, enabling the estimation of long-run coefficients. Findings reveal that while inflation and interest rates seemingly bolster economic growth in theory, their impact remains statistically insignificant in both the short and long runs. Conversely, exchange rate fluctuations exhibit a significant negative impact on economic growth in both periods. Short-run analyses reveal exchange rate depreciation's detrimental effects on economic growth, aligning with theoretical expectations. However, unexpected positive correlations emerge between inflation and economic growth, challenging conventional assumptions. Robustness checks confirm model stability, normality, lack of heteroscedasticity, and absence of serial correlation, bolstering the reliability of the estimated relationships. Overall, this study underscores the complex interplay of

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macroeconomic factors on economic growth in Nigeria, revealing nuanced dynamics beyond anticipated theoretical linkages.

### Keywords

Economic Growth, Exchange Rate, Inflation Rate, Interest Rate, ARDL Model, Cointegration Analysis

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## 1. Introduction

Nigeria stands as a prominent African economy characterized by a complex interplay of diverse macroeconomic dynamics, which significantly influence its economic growth trajectory. The quest for sustained and inclusive economic growth in Nigeria has been a focal point, prompting a deeper exploration into the relationships between specific macroeconomic variables and overall economic performance. Over the past few decades, Nigeria has experienced notable economic shifts, propelled by factors ranging from internal policies and structural reforms to external global influences. As the largest economy in Africa, Nigeria's growth narrative has been shaped by its vast endowment of natural resources, demographic dividend, policy interventions, and the volatility of global commodity prices, notably oil. Understanding the implications of key macroeconomic indicators on economic growth is fundamental to deciphering the intricate web that defines Nigeria's economic fortunes. Critical variables such as gross domestic product (GDP), inflation rates, exchange rates, fiscal policies, foreign direct investment (FDI), trade openness, and government expenditure form the bedrock of economic policymaking, each contributing uniquely to the country's economic landscape. The study titled "Impact of Selected Macroeconomic Variables on Economic Growth in Nigeria" aims to unravel the causal relationships and quantify the impacts of specific macroeconomic variables on the nation's economic growth trajectory. This investigation stems from the recognition of the crucial role that these variables play in steering the course of economic development and the need for a more nuanced understanding of their effects.

Nigeria operated a fixed exchange regime in the 1960s and later changed to a pegged system in the 1970s all through the mid-1980s. However, after deregulation and the implementation of the structural adjustment program (SAP) in 1986, the exchange rate system transformed into a variety of floating regimes (SAP). This regime is characterized by its weak commitment to upholding any exchange rate parity. The failure of the Autonomous Foreign Exchange Market (AFEM) established in 1995 and the Inter-bank Foreign Exchange Market (IFEM) established in 1999 to offer stability in the exchange market led to the re-introduction of the Retail Dutch Auction System (RDAS) in July 2002. The DAS was designed to accomplish the trifecta of maintaining the foreign reserves that were dwindling, lowering the premium on the exchange rate on the black market, and creating a fair exchange rate for the naira. The RDAS was not without limitations; however,

capital flight, speculative and the authorised dealers' rent seeking behaviour forced the CBN to adopt the Whole Sale Dutch Auction System (WDAS) to consolidate the gains of the RDAS, liberalise and develop the Nigerian foreign exchange market, converge the exchange rates at the official and other segments of the market and facilitate foreign exchange auction to Deposit Money Banks and Bureaux De Change (BDC) operators. In addition to lowering authorized dealers' speculative tendencies, the RDAS and the WDAS helped to maintain external reserves, broaden the premium, and stabilize the value of the naira. The foreign exchange market has remained mostly stable since 2003.

The US dollar has been gaining ground against a basket of global currencies (including the naira) as it climbed 20 per cent and 5 per cent in 2021 at the BDC market and official I&E window, respectively. The Nigeria naira depreciated against the US dollar by 17.25 per cent year-on-year in 2021q4 to ₦565.77/US\$ from ₦468.18/US\$ in 2020q4 at the Bureau de Change (BDC) market, which is the parallel market in Nigeria. At the official Investors and Exporters window, that the naira depreciated by 5.66 per cent year-on-year in 2021q4 to ₦412.43/US\$ from ₦389.09/US\$ in 2020q4. The naira has been on a free-fall despite the series of policies taken by the CBN to rescue it. It further depreciated by 22.51 per cent to ₦711.14/US\$ in 2022q3 compared with ₦551.05/US\$ in 2021q3. The deteriorating value of the naira led to increasing inflationary pressure on account that Nigeria is major importing country.

Another macroeconomic objective that countries strive to achieve is price stability. Theoretically, inflation rate promotes economic growth to certain level beyond which it hurts growth. Hence, monetary authorities pay keen interest on managing inflation rate by deploying the necessary policy tools in order to keep inflation on check. Failure to do that is tantamount to steering the ship of state economy to a halt (Umaru & Zubairu, 2012). The resurgent wave of inflation in the global economy is a major concern for economic managers because of its effect on the general livelihood and has necessitated renewed search for solution. In Nigeria, inflation has been fueled by both increased import prices and idiosyncratic factors. Chief among the latter are structural defects in the economy that create price bubbles and deviations from the traditional cost-mark up path of prices, such as infrastructure deficits, exchange rate volatility, rising cost of energy and others. All these factors plus the persistent increase in money supply has made Nigeria to grappled with a challenge of double-digit inflation since 2016. This is worrisome as studies have established inflation threshold in Nigeria to be between 6 to 13 per cent (Ajide & Lawanson, 2012; Bawa & Abdullahi, 2012; Doguwa, 2012; Salami & Kelikume, 2010; Fabayo & Ajilore, 2006). The rate of inflation has been on an upward trend since in recent past. It moved from 4.12 per cent in 2007Q1 to 20.77 per cent in 2022Q3. This calls for investigation of the level of impact that this rising inflation could have on the growth rate of the Nigerian economy. Appendix 2 also displays the trend of maximum lending rate in Nigeria which is used as a proxy for interest rate in this study. The interest rate has been trending

upwards from 18.00 per cent in 2008Q1 to 28.33 per cent in 2022Q1. This indicates an increase in the cost of borrowing which may stifle economic growth. It is, therefore, safe to say that exchange rate is one of the macroeconomic variables that is connected to the other variables discussed. As an import dependent nation, the pass-through of exchange rate to inflation is believed to be high. Furthermore, the global economy battled the scourge of COVID-19 pandemic which led to recessions in many economies. Just when recovery was gaining momentum, the Russia-Ukraine crisis posed another setback to global economic growth. This is due to the interconnectedness of economies of the world via international trade. The Nigerian economy is not an exception to these challenges.

In Nigeria, a great number of studies have established a strong relationship between macroeconomic variables and economic growth. The outcomes from the existing works are mixed. While some studies found some macroeconomic variables impact positively on economic growth (Dickson, 2012; Taiwo, et al., 2012; Obansa et al., 2013; Chichi & Casmir, 2014; Apollos et al., 2015; Lawal et al., 2016; Jelilov et al., 2016; Okonkwo et al., 2017; Adeniyi & Olasunkanm, 2019; Okunnu et al., 2017; Anidiobu et al., 2018; Oshodi, 2018; Musa, 2019), others found that they have negative impact on growth in Nigeria (Ayadi & Ayadi, 2008; Perpetua, 2014; Ali et al., 2015a, 2015b; Ugochukwu, 2015; Ibrahim, 2016; Ahmed et al., 2018; Nwafor, 2018; Ehikioya, 2019; Adenomom & Ojo, 2020). Another category of studies found that foreign exchange rate has insignificant or little impact on Nigerian economic growth (Dada Eme & Oyeranti Olugboyega, 2012; Okorontah & Odoemena, 2016; Oshodi, 2018; Moses et al., 2020). In their view, even though improvements in foreign exchange rate are necessary, they are not adequate to spur economic growth. The studies employed different methodologies on a gamut of variables ranging from 1970 to 2019. However, as at the time this study was conceptualized, there is no study on the impact of macroeconomic variables on economic growth which captures the recent global economic developments such as the outbreak of COVID-19 pandemic and the Russian-Ukraine war. Also, aside from using quarterly data, the study equally extends the scope from the previous studies to third quarter, 2022. Knowing the direction and pattern of mechanisms among these variables could help in designing policy aimed at promoting economic growth. Therefore, it is important to investigate the relationship between these variables to correctly formulate policies in Nigeria.

## 2. Empirical Literature

There are studies on the impact of selected macroeconomic variables on economic growth. These include both cross-country and country specific studies.

In Indonesia, Fitriady et al. (2022) investigated the impact of macroeconomic variables on real economic growth using panel data regression for the period 2013 to 2021. The results affirm that poverty has a negative but not significant effect on growth while FDI and HDI have a positive and significant effect on growth. Also, domestic investment has a positive but not significant effect on real gross domestic

product. Also, [Wulandari et al. \(2020\)](#) conducted a study on the relationship between economic growth and macroeconomic indicators in Indonesia for the period 2010 to 2017. The results from the VECM revealed that investment has a positive impact on economic growth, whereas export and e-money transactions have a negative impact on economic growth. [Srichaikul, Yamaka, & Sriboonchitta \(2019\)](#) explored the impacts of macroeconomic variables on economic growth in Japan, China and South Korea. Annual data for the period 2000 to 2016 was used while Panel regression kink design based on the GME estimator. The results of the study showed that there are distinct and discontinuous impacts of macroeconomic variables on the GDP and all the considered variables significantly affected the GDP. However, the effects of FDI and POP were discontinuous due to the kink effect. For the case of FDI, the coefficients appeared to be negative and positive in the GDP, whereas the effects of POP were found to be positive in the GDP.

In Bangladesh, [Chowdhury et al. \(2019\)](#) utilised annual data for the period 1987 to 2015, to investigate the impact of macroeconomic variables on economic growth. The correlation and multiple regression results revealed that the selected macroeconomic variables (inflation, real interest rate, exchange rate and household consumption expenditure) have significant effect on the economic growth of Bangladesh. In their attempt to establish the link between macroeconomic variables and economic growth in Malaysia, [Omar & Nor \(2020\)](#), employed quarterly data spanning 2006 until 2016. The authors found that the Multiple Linear Regression (MLR) results confirmed the existence of a linear relationship between GDP, population, unemployment and export. In addition, unemployment has insignificant relationship with economic growth. However, in an earlier study, [Li et al. \(2013\)](#) applied the Error Correction Model (EC) to investigate the long-run and short-run relationship between some selected macroeconomic variables in Malaysia for the period 1974 to 2010 and found a positive relationship between GDP and tourism receipts, physical capital per labour, education and health per labour. However, exports of goods and government tourism expenditure were found to impact growth negatively.

[Oshodi \(2018\)](#) attempted to analyse certain macroeconomic indicators on economic growth in China and Nigeria. Utilising data for the period 1994 to 2015, the author OLS technique and found that trends in macro-economic variables can be used to predict the economic growth of the countries. [Taghizadeh-Hesary and Yoshino \(2016\)](#) conducted an empirical survey on monetary Policy, oil prices and the real macroeconomic variables in China, Japan and the United States. Employing the SVAR approach on annual data spanning 2000 to 2019, it was found that monetary policy had a significant positive impact on oil prices through two different channels (quantitative easing and exchange rate fluctuations). Also, the impact of oil price fluctuations on developed oil importers' GDP growth is much milder than on the GDP growth of an emerging economy. However, the impact on the China's inflation rate is found to be less severe compared to the two developed countries.

[Vincent \(2015\)](#) investigated the impact of macroeconomic variables on economic

growth using a panel data of 5 selected Sub-Saharan countries for the period 1993 to 2013. The analysis of the results showed that economic growth has a positive relationship with foreign direct investment and export. While interest rate, unemployment rate, and inflation have a negative relationship with economic growth. The impact of macroeconomic factors on total factor productivity in Sub-Saharan Africa was examined by [Akinlo \(2005\)](#). The author utilised panel data on annual series from 1980 to 2002. The findings from the study showed that human capital, export to GDP ratio, credit to the private sector, foreign direct investment, manufacturing value added, and liquid liabilities have positive and significant impact on total factor productivity. However, external debt, inflation rate, agricultural value added, lending rate and local price deviation from purchasing power parity are negatively and significantly related to total factor productivity. The study further revealed that policies that reduce population growth rate and debt promote openness and sound macroeconomic fundamentals that would lead to higher total factor productivity.

[Baran \(2021\)](#) conducted a study on the impact of macroeconomic and institutional factors on economic growth in the CEE-4 countries between 1995 to 2018. The findings from the Bayesian Model Sampling technique of analysis affirm that living longer may have initially a negative effect on growth, but once fertility declines the effect becomes significantly positive. Other variables such as fertility rate, service value added, trade, stock market capitalization, financial development and population have positive impact on GDP growth. [Batóg and Batóg \(2019\)](#) examined the impact of macroeconomic factors on the economic growth of 27 European Union countries from 2000 to 2016. The study employed multiple regression analysis and the results affirm that economic growth in the EU area is determined by consumption, investment, export and labour productivity. Also, public debt has impact on growth during economic recession. In another study, [Haseeb et al. \(2019\)](#) investigated the impact of macroeconomic indicators on development patterns of ASEAN countries with emphasis on tourism using annual data the cover the period 2001 to 2017. The empirical findings of the study revealed that key determinants for the change in tourism revenue in selected countries are exchange rate, stock market index, inflation and industrial growth. However, impact of GDP on tourism revenue is also significant for Malaysia, Indonesia, and Brunei.

### 3. Methodology

In this study, secondary data will be used on a quarterly frequency for the period 2000Q1 to 2022Q3, making a total sample size of 87 data points. The period covered was informed by the availability of data on the main variables for the study. The selected sample size met the requirement of the Central Limit Theorem which asserts that a sample size must not be less than thirty for normality purposes ([Gujarati, 2014](#)). These variables include nominal GDP growth, which will be used as a proxy for economic growth (EG). It is the independent variable of the study. The

choice of nominal GDP growth is premeditated to address the problem of multicollinearity between real GDP growth and inflation as noticed in some of past studies (Wang, 1996; Resurreccion, 2014; Adom, Zumah, Mubarik, Ntodi, & Dako, 2015). The selected macroeconomic variables are; the cost of Nigerian naira in terms of the US dollar, which is the exchange rate (EXR), Inflation rate (INF), and interest rate (INT); they are endogenous variables. Theoretically, many macroeconomic variables influence economic growth. However, these variables were carefully chosen because of their strong relationship with economic growth as established by the previous studies.

The cointegrated Autoregressive Distributed Lag (ARDL) model is the primary analytical tool used in this study, while the ordinary least squares (OLS) technique was used for estimation. This method is effective for determining the level of relationships between integrated variables of mixed orders.

The implicit form of the models is given below:

$$EG = F(EXR + INF + INT) \quad (1)$$

The above functional models can be presented in equation form as:

$$EG = \beta_0 + \beta_1 EXR + \beta_2 INF + \beta_3 INT + \varepsilon \quad (2)$$

where

$\beta_0$  = constant

$\varepsilon$  = error term

EXR = Exchange rate

INF = Inflation rate

INT = Interest rate.

Prior to identifying any possible long run relationship, it is important to test the series for stationarity as the key concept underlying time series processes. This is based on the finding of (Wasserfallen, 1988; Reddy, & Henze, 2023), wherein it was stated most economic variables are non-stationary in nature and yet the stationary properties can influence the behaviour and properties of a series. Therefore, the order of integration of the variables is tested using Argument Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Phillips-Perron (PP) (Phillips & Perron; 1988) Unit Root Test for the presence of unit root. Thereafter, the study employed the ARDL bound test approach to examine the long-run relationship of the variables since the variables were integrated of order {I (1) and I (0)}.

This study adopts the Auto-Regressive Distributive Lag (ARDL) approach by Pesaran, Shin and Smith (2001), for its flexibility to handle data, and its robustness for finite and small sample sizes (as applicable to this study) and allows conclusions to be drawn about the variables in the study. The underlying assumption of autoregressive distributed lag model (ARDL) is that all variables are integrated of Order I (1) and Levels I (0). This model is used to test long run impact of selected macroeconomic variables on economic growth. The autoregressive distributed lag (ARDL) model has several advantages in comparison with other cointegration techniques. First, ARDL model avoids endogeneity problems. Second, it estimates

the long run and short run parameters simultaneously. Third, pre-testing for unit roots is not required because the methodology is appropriate whether the primary variables are I (0), I (1) or mutually integrated. Fourth, all the variables are assumed to be endogenous. The model takes enough lags to capture the data gathering process and eliminate problem of serial correlation in general to specific modelling frameworks. Thus, endogeneity is less of a problem in the ARDL technique (Baharumshah et al., 2009).

The ARDL model is presented below:

$$\begin{aligned} \Delta EG_t = & \beta_0 + \beta_1 EXR_{t-1} + \beta_2 INF_{t-1} + \beta_3 INT_{t-1} \\ & + \sum \lambda_1 \Delta EXR_{t-i} + \sum \lambda_2 \Delta INF_{t-i} + \sum \lambda_3 \Delta INT_{t-i} + U_t \end{aligned} \quad (3)$$

where,

- $\Delta$  = the First difference operator
- $\beta$  = the drift component
- $U_t$  = white noise with zero mean
- $\lambda$  = speed of adjustment
- $\beta_i, \lambda_i$  = parameter coefficients of the variables
- EG = Economic growth
- EXR = Exchange rate
- INF = Inflation rate
- INT = Interest rate.

Having established evidence of cointegration among the variables in the models, the long run parameters are estimated based on the specifications below:

$$EG_t = \beta_0 + \beta_1 EXR_{t-1} + \beta_2 INF_{t-1} + \beta_3 INT_{t-1} + U_t \quad (4)$$

To estimate the short-run relationship between the variables and the speed of adjustment of the model to equilibrium, the corresponding error correction equation is estimated for model (4)

$$\Delta EG_t = \lambda_0 + \sum \lambda_1 \Delta EXR_{t-i} + \sum \lambda_2 \Delta INF_{t-i} + \sum \lambda_3 \Delta INT_{t-i} + \lambda_4 ECM_{t-1} + U_t \quad (5)$$

where,

- ECM = Error Correction Term
- $\lambda_4$  = Speed of adjustment of the model in respect of its convergence to equilibrium.

## 4. Results and Discussion

Result in **Table 1** shows that the mean of economic growth (EG) from 2000Q1 to 2022Q3 stood at 4.18 with a median of 5.55 and standard deviation of 6.33, indicating that the data points are close to the mean of the dataset. The skewness of -0.93 for economic growth mirrors a normal distribution and it is negatively skewed. While the Kurtosis of 3.92 is leptokurtic with higher values than the sample mean. The Jarque-Bera probability of 0.0003 shows that the variable is not normally distributed. Exchange rate (EXR) reveals a mean of 232.12 for the period under review. The median is 159.21 and the standard deviation is 139.51, indicating

**Table 1.** Descriptive Statistics: 2000Q1-2022Q3.

STATISTICS	EG	EXR	INF	INT
Mean	4.179841	232.1179	12.63934	25.04505
Median	5.549694	159.2063	12.17000	25.71552
Maximum	18.38224	674.6116	24.32000	31.95000
Minimum	-14.25024	105.5400	-1.430000	17.99817
Std. Dev.	6.331246	139.5129	4.487215	4.160595
Skewness	-0.932679	1.284085	0.070563	-0.148246
Kurtosis	3.915418	3.511711	3.416073	1.878154
Jarque-Bera	16.37071	26.00077	0.731919	5.105277
Probability	0.000279	0.000002	0.693531	0.077876
Sum	380.3656	21122.73	1150.180	2279.100
Sum Sq. Dev.	3607.621	1751745.	1812.159	1557.949
Observations	91	91	91	91

**Source:** Output from E-views.

that the observations are close to the sample mean. The skewness of 1.28 indicates positive skewness and mirrors an abnormal distribution. While the kurtosis of 2.41 is platykurtic with lower values than the sample mean. The Jarque-Bera probability of 0.000002 shows that EXR is not normally distributed, due to its significance level of 5 percent. Inflation (INF) shows the mean, median and standard deviation to be 12.63, 12.17 and 4.49 respectively. The value of the standard deviation indicates how far the data points are to the mean of the dataset. While the skewness reveals a positive skewness at 0.07, thereby mirroring a normal distribution. INF shows a leptokurtic distribution at 3.41 and a significant Jarque-Bera probability at 0.69, thereby indicating that the distribution is not normally distributed. The value of mean of Interest rate (INT) for the review period is 25.04 with a median of 25.72 and standard deviation of 4.16. The negative skewness of 0.15 indicates that the distribution has a long left-tail, while the kurtosis of 1.88 means that the distribution is platykurtic. The distribution is normally distributed, judging from the probability of the Jarque-Bera at 0.07.

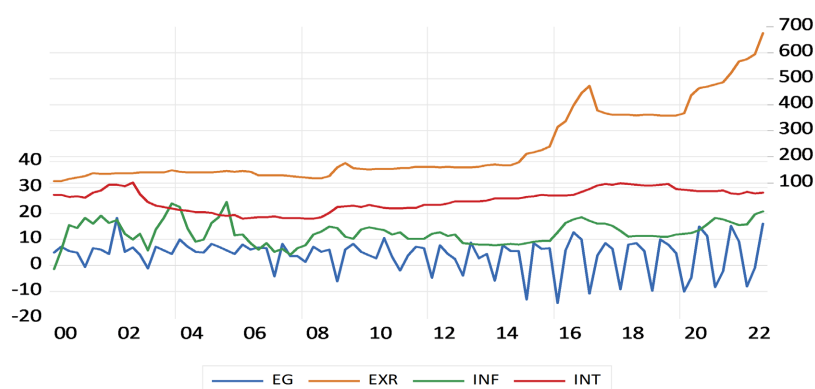
The unit root tests are performed at level and at first difference along the lines of unit root tests with constant (C), constant and trend (CT) and without constant and trend (WCT). The overall purpose of performing the stationarity tests is to know the technique of analysis to use to avoid spurious regression. Using the ADF and PP unit root test, the result presented shows that the variables are of mixed order of integration, which necessitated the conduct of the ARDL bounds test for co-integration (Pesaran, Shin, & Smith, 2001). Economic growth (EG) and Inflation rate (INF) were stationary at levels while Exchange rate (EXR) and Interest rate (INT) were stationary at first difference. It is therefore safe to concluded that all the variables are integrated of order  $d > 1$ , justifying their suitability for inclusion in the proposed ARDL Bound testing (Table 2).

**Table 2.** Augmented dickey-fuller and Philip-Perron unit root test.

Series		Level		1 <sup>st</sup> Difference		Integration Order
		ADF	PP	ADF	PP	
EG	t-Statistic	-4.4391 <sup>b***</sup>	-13.5584 <sup>b***</sup>			1(0)
	Prob.	0.0032	0.0000			
LEXR	t-Statistic	-1.2314 <sup>b</sup>	-1.0091 <sup>b</sup>	-6.6043 <sup>b***</sup>	-6.5637 <sup>b***</sup>	1(1)
	Prob.	0.8975	0.9370	0.0000	0.0000	
INF	t-Statistic	-2.7100 <sup>a*</sup>	-4.2045 <sup>b***</sup>	-7.8159 <sup>b***</sup>	-10.0876 <sup>b***</sup>	1(1)
	Prob.	0.0765	0.0066	0.0000	0.0000	
INT	t-Statistic	-1.9518 <sup>b</sup>	-1.9109 <sup>b</sup>	-6.9694 <sup>b***</sup>	-7.0809 <sup>b***</sup>	1(1)
	Prob.	0.6190	0.6407	0.0000	0.0000	

**Source:** Output from E-views; Note: \*\*\*, \*\* and \* represent significance level at 1%, 5% and 10% respectively. a, b and c denote test equation at constant, constant with trend and constant without trend.

**Figure 1** in shows the trends associated with the key variables in this study. The charts reveal that the variables experienced significant fluctuations at different intervals. Economic growth (EG) and Inflation rate (INF) were the most volatile variables in the study period. Exchange rate (EXR) trended upward from 2000Q1 and peaked during the 2016 economic recession. After the recovery, the pressure on the naira relatively stabilised between the period 2017 to 2019 and later picked in 2020 onward, following the outbreak of COVID-19 pandemic. Also, interest rate (INT) fluctuated during the period of study as it rose from 27 per cent in 2000Q1 to 32 per cent in 2002Q3. INT however, rose to 31 per cent in 2017Q3 and later fell to 28 percent in 2020Q3.

**Figure 1.** Trend and graphical analysis.

Under a null hypothesis of “no level relationship”, the rule of thumb requires that the statistic must lie above the lower and upper bounds at a chosen level of significance for the null hypothesis to be rejected. In this study, the F-statistic of 9.34726, is found to lie above the upper bound of I(1) at 1 percent, 2.5 percent, 5 percent and 10 percent levels of significance. This means there exists a long-run

relationship among these variables, which would be captured by the co-integrating ARDL model. This procedure was developed by Pesaran and Shin (1999) which was later expanded by Pesaran, Shin and Smith (2001) and it allows researchers to use variables which are not integrated in the same order (Table 3).

**Table 3.** ARDL bound test for cointegration.

	Value	K	Sig.	Bounds	
				I (0)	I (1)
<b>F-statistic</b>	9.34726	3	10%	2.72	3.77
			5%	3.23	4.35
			2.5%	3.69	4.89
			1%	4.29	5.61

**Source:** Output from E-views.

## 5. Presentation and Discussion of Regression Results

The Autoregressive Distributed Lag (ARDL) long run result on the impact of selected macroeconomic variables on economic growth in Nigeria is presented in Table 4.

**Table 4.** Long run coefficients.

	Long-run: Dependent Variable= EG				
	LEXR	INF	INT	Coint.	C
Lag 0	0.88 (-1.06)	0.88 (0.02)	0.99 (0.0007)		0.74 (2.89)

**Source:** Researcher's Computation; Note: The figures without parentheses are the probabilities while those in parentheses are the coefficients.

In Table 4, the coefficients revealed that Inflation rate (INF) and Interest rate (INT) have positive impact on economic growth in Nigeria. This implies that a unit increase in INF and INT will lead to 0.02 and 0.0007 units increase in economic growth, respectively. However, their probability values revealed they are statistically insignificant in explaining the variations of economic growth in Nigeria in the long run. On the other hand, Exchange rate (LEXR) was found to have negative impact on economic growth in Nigeria. Based on the results, percentage increase in exchange rate will decrease economic growth by 1.06 per cent. Also, the values were statistically insignificant in explaining the variations in economic growth in Nigeria in the long run. The long run coefficient of exchange rate has a sign that supports its apriori expectations, as exchange rate depreciation is expected to affect output negatively as increased prices of imported goods can reduce economic growth. However, inflation rate and interest rate go against their apriori expectations as they were found to be positively correlated with economic growth in Nigeria. Theoretically, increase in inflation rate reduces the purchasing power of consumers which will lead to a fall in aggregate demand and contraction

in economic growth. Similarly, increase in interest rate will raise the cost of borrowing thereby militating business expansion and hurts growth.

## 6. Error Correction Model (ECM)

The short run relationship between the independent variables and economic growth is estimated using the error correction approach and the results are presented in **Table 5**.

**Table 5.** Short run coefficients.

	Short-run: Dependent Variable = $\Delta EG$					
	$\Delta EG$	$\Delta LEXR$	$\Delta INF$	$\Delta INT$	Coint.	C
<b>Lag 0</b>		0.0003*** (-20.42)	0.0028*** (0.4305)			
<b>Lag 1</b>	0.0436** (0.4510)		0.0039*** (-0.4827)		0.0000*** (-1.7995)	0.0000*** (17.7612)
<b>Lag 2</b>	0.8603 (-0.0271)		0.1507 (-0.2227)			
<b>Lag 3</b>	0.0000*** (-0.3884)					

**Source:** Researcher's Computation; **Note:** The figures without parentheses are the probabilities while those in parentheses are the coefficients; \*\*\*, \*\* and \* represent significance level at 1%, 5% and 10% respectively.

Since the variables were found to be cointegrated, implying that they have a long run equilibrium relationship, it is necessary to test for a short run effects. From **Table 5**, the error correction coefficient (ECM) parameter of  $-1.80$  is negative ( $-$ ) and statistically significant at 5 percent level of significance considering the p-value of 0.00. The value of the error correction term implies a fast speed of adjustment to equilibrium after a shock. The result indicates that, 180% of the disequilibrium that occurred in the previous year's shock reverts or converges back to the long run equilibrium in the current year. It has therefore, been established that the variables are cointegrated and have a short run relationship as established from the ECM regression results.

From the short run result, the log of exchange rate (LEXR)'s coefficient is  $-20.42$ , indicating a negative relationship between economic growth and exchange rate in Nigeria 1% level of significance. Therefore, a percentage point depreciation in the exchange rate reduces economic growth by 2042 per cent. This implies that exchange rate has a significant impact on economic growth in Nigeria. This is in line with the findings of *Nwafor (2018)*, *Ayodele (2014)* and *Perpetua (2014)*. The coefficient of Inflation (INF) at 0.43 signifies a positive and insignificant relationship between INF and economic growth in Nigeria. This connotes that a percentage point increase in INF will contemporaneously increases economic growth by 43 per cent. The positive sign exhibited, is against the apriori expectations. However,

INF (in first and second lags) have negative impact on economic growth in the short-run but it is only significant in the first lag. This implies that the negative impact of inflation rate on economic growth begins at a lag of one and two quarters. This result supports the findings of Adenomom & Ojo (2020), Ehigiamusoe and Lean (2017) and Agwu (2015). Finally, Interest rate (INT) appears to have no impact on economic growth in the short-run.

From the long run and short run result, the magnitude of the coefficients shows the impact of the explanatory variables on the dependent variable. The results indicate that exchange rate (LEXR) and Inflation rate (INF) have greater impact on economic growth in the short run than the long run, due to the fact that they have larger coefficients in the short run than the long run. Also, LEXR and INF are significant in the short run but statistically insignificant in the long run. While Interest rate (INT) have impact on economic growth only in the long run but not in the short run.

In summary, looking at both the long run and short run results of the model, it was deduced that the magnitude of impact of the selected macroeconomic variables on economic growth is greater in the short run than the long run. This could mean that changes in the macroeconomic variables impacts economic growth within a quarter or two. This rules-out the incidence of impact lag effect.

## 7. Diagnostics/Robustness Tests

To ensure that the models (ECM and ARDL) used in the study are consistent with the standard assumptions of OLS, tests such as serial correlation, normality, heteroscedasticity, Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUM of squares) are carried out and the results are shown as follows:

**Table 6.** Robustness tests.

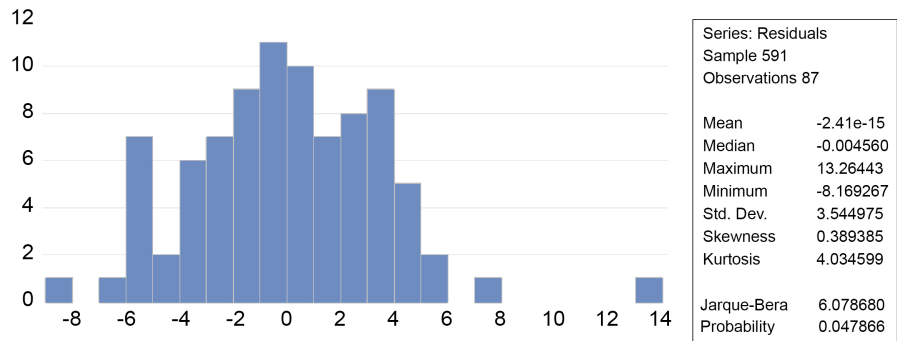
Test	Statistics	Probability
Jarque-Bera (normality test)	6.0786	0.0478
<b>Breusch-Godfrey Serial Correlation LM test:</b>		
F-Statistic	0.1291	0.8791
Obs R-squared	0.3066	0.8579
<b>Heteroskedasticity test (ARCH):</b>		
F-Statistic	0.0477	0.8276
Obs R-squared	0.0488	0.8251

**Source:** Researcher's Computation using E-views.

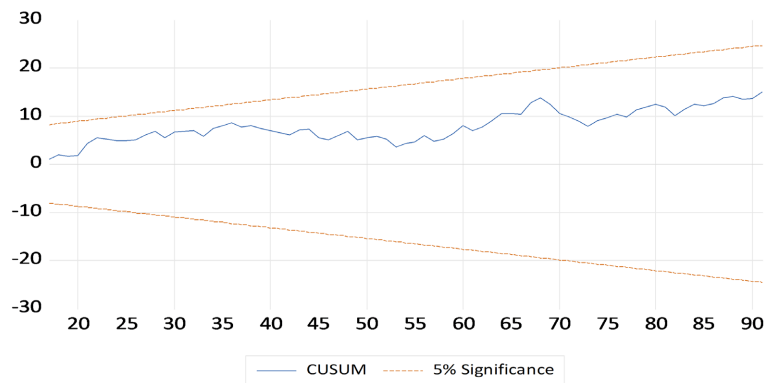
The results from Jarque-Bera normality test are insignificant, implying that the null hypothesis of normality errors cannot be rejected at 5 per cent level of significant (Table 6). Thus, the residuals are normally distributed. The null hypothesis of no heteroscedasticity tested by using ARCH approach fail to be rejected, since the probability for both F and Chi<sup>2</sup> statistics are insignificant. For the Breusch-

Godfrey serial correlation LM test examined, revealed that there is insignificant indication of serial correlation in the residuals since the null hypothesis of no serial correlation cannot be rejected.

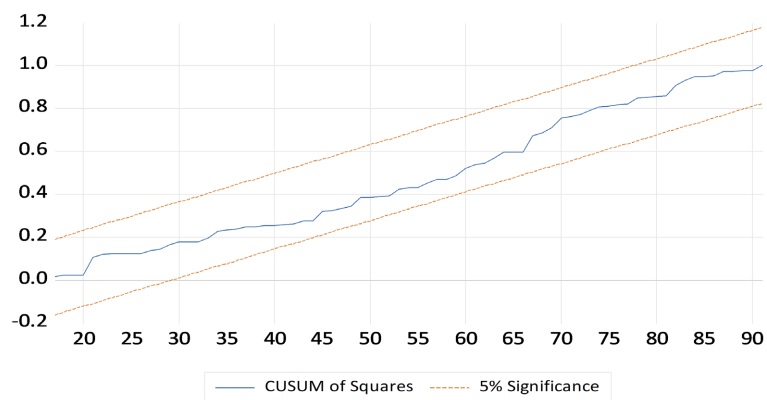
However, for examining the stability of short and long run coefficients, cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) are carried out. The findings are presented graphically in **Figures 2-4**, respectively. The null hypothesis of correct specification of the regression equations fails to be rejected, since the plots of CUSUM and CUSUMSQ of OLS recursive residuals lies between



**Figure 2.** Normality Test; Source: Researcher’s Computation using E-views.



**Figure 3.** CUSUM Test; Source: Researcher’s Computation using E-views.



**Figure 4.** CUSUM of Squares Test; Source: Researcher’s Computation using E-views.

the lower and upper critical boundaries at 5 per cent. Hence, suggesting that the long run coefficients of regressors are stable and confirming the results of unit root tests on OLS residuals. In summary for the diagnostic tests, the models examined are well specified functional form with stable regressors, normal distribution of residual, no autocorrelation and heteroscedasticity.

## 8. Conclusion and Recommendations

### 8.1. Conclusion

Based on the findings, it is safe to conclude that the selected macroeconomic variables have no significant impact on Nigeria's economic growth in the long-run. They, however, have significant impact on economic growth in the short-run. This is so, in the case of exchange rate and inflation rate but not interest rate.

### 8.2. Recommendations

In line with the findings in Chapter four, this section attempts to offer suggestions for policy recommendations as means for the improvement of Nigeria's economic growth. Firstly, to achieve desirable economic growth in Nigeria, macroeconomic policies that will bring about exchange rate appreciation should be implemented. There is need to improve the domestic productivity base of the Nigerian economy to reduce overreliance on imports. Also, other structural factors that affect the exchange such as insecurity and low or zero level of local refining of petroleum products should be addressed. Secondly, both monetary and fiscal authorities in Nigeria should do everything possible to address the increasing level of inflation rate in the country. Finally, the monetary authority in Nigeria should de-emphasize the use of interest rate as a tool that will influence economic growth, especially in the short-run. However, in the long-run, there is need to reduce interest rate in order to encourage credit and boost productivity that will improve economic growth.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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