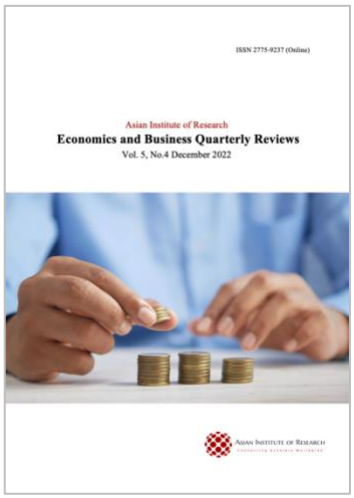

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The Nexus Between Some Selected Macroeconomic Variables on Growth Output in Nigeria: An Autoregressive Distributed Lag (ARDL) Approach

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Abstract
Macroeconomics remains an evolving science, but the goals of macroeconomic policy are consistent around the world. These include price stability, currency stability, unemployment, the balance of payments, and growth output. This study X-rayed the link between Real Gross Domestic Product (RGDP) which was considered a measure of growth output, Exchange Rate (EXR), Inflation Rate (IFR) and Money Supply (M2) for the current republic in Nigeria. The objectives of the study include: examining the short-run and long-run impact of growth output (RGDP) on EXR, IFR and M2 in Nigeria. A secondary source of data collection was employed for the study. The tools employed for data analysis include the Augmented Dickey-Fuller (ADF) test, Jarque-Bera test, Autoregressive Distributed Lag (ARDL) Co-integration technique, and the error correction parameterization of the ARDL model. The result of the Jarque-Bera test showed that the variables were approximately normally distributed. The findings showed that growth output (RGDP) was cointegrated with EXR, IFR and M2 and the existence of a long-run relationship amongst the variables. The study concludes that while seeking to foster economic growth, Nigerian banks should commit to their mandate of price stability and improve their regulatory framework to ensure a strong financial sector with effective intermediation.

Keywords: Economic Growth, Exchange Rate, Growth Output, Inflation Rate, Money Supply

1. Introduction

Since the Central Bank of Nigeria (CBN) announced on October 26, 2022, that it will redesign some of the Nigerian currency, there has been a lot of discussion among top Nigerian banks about the pros and cons of such a move. In addition, the policy's impact on economic output and the performance of key macroeconomic variables affecting the Nigerian economy is also debated. The main economic reason for the CBN's decision to consider redesigning the banknotes was the massive hoarding of banknotes, in this case, N2.73tn of the N3.23tn currency in circulation as of September 2022 outside of commercial vaults and banks across the country making this move.

Macroeconomics remains an evolving science, but the goals of macroeconomic policy are consistent across the globe. These include price stability, foreign exchange stability, unemployment, the balance of payments, economic growth and development. As important as these policies are, they cannot be implemented simultaneously because some of them conflict with each other. There are always trade-offs between various goals, so a country pursues policies related to its stage of development at different times and in different situations (Ebikila et al., 2018). However, it can be agreed that the main challenge facing any country is to achieve sustained and stable economic growth and development. One of the open research questions in the macroeconomic literature is the relationship between macroeconomic variables such as real GDP, EXR, IFR, and M2.

A crucial issue for policymakers and economists is the specific role of money in the economy, as changes in the quantity of money can have an impact on key macroeconomic indicators such as inflation, exchange rates, and vice versa (Yousfat, 2015). Last few years, the convergence problem between money supply and various macroeconomic variables has received more and more attention in the field of monetary and financial economics due to disagreements between economists and financial scholars on the association between money supply and various economic variables. In Nigeria, the government attempts to influence the performance of the national economy through fiscal and monetary policy, such as changing taxation levels, government spending, or the supply of money or credit to the economy. Changing macroeconomic policies affect national income, prices, interest rates and exchange rates, which in turn affect economic development (Aroriode and Ogunbadejo, 2014). Economists are divided on which policies can boost short- or long-term growth. Hence, the study by Antwi et al. (2013) argues that macroeconomic policies are necessary for long-term development. According to Gatawa et al. (2017), monetary variables are more effective and reliable than fiscal variables in influencing changes in economic activity. Previous attempts to understand the impact of macroeconomic variables on the economy of Nigeria have led to conflicting opinions. Existing research diverges on meaning lines and relational directions. Numerous findings highlight the significant influence of macroeconomic variables, especially the moderating role of money supply (Gatawa et al., 2017; Olawale, 2015). While agreeing that economic performance is responsible for macroeconomic changes, these studies disagree on the direction of the effect. Therefore, the motivation for this study was to conduct an X-ray of the relationship between Nigeria's real GDP and EXR, IFR, and M2.

Macroeconomic stability remains one of the bases for sustainable economic development because it increases national savings and private investment, and improves exports and balance of payments by enhancing competitiveness (Obidike and Nduka, 2022). Therefore, macroeconomic stability greatly guarantees people's economic well-being. To this end, several potential determinants of macroeconomic stability have been identified, such as low inflation, low budget deficits, real exchange rates and stability of exchange rate relations. The above factors are important drivers of economic growth. Surprisingly, at some Nigerian presidential debates for the scheduled Presidential election for 2023, some candidates have expressed aversion to saving, which is probably why Nigeria's economy has been unstable for so long. A study by Nse and Anietie (2018) considered a dynamic model using quarterly data from 1995 to 2016. The dynamic models considered are horizontal lag variables, differential lag variables, log-transformed lag variables, and differential log-transformed lag variables. The selection of the best predictive model is done using the Schwartz Information Criterion (SIC). The outcome of the study showed that the horizontal form model outperforms the differential form model. Based on model brevity, the horizontal lag model was the preferred model in the ensemble of selected models. The predictions obtained from the model indicate that the model is stable because the actual interest rate (IR) values fit well within the calculated 5% critical value. The study by Vorlak et al. (2019) assessed the impact of EXR on Cambodia’s economic growth. The study used variables such as gross domestic product (GDP), as well as explanatory variables such as EXR, M2 and trade openness (TOP), IFR and foreign direct investment (FDI)). The study employed the ordinary least squares (OLS) regression model for the analysis. According to estimates, the results show that the impact of the EXR and trade openness (TOP) on GDP is 1%. The EXR was positively correlated with GDP, and TOP is negatively correlated with GDP. During the study period (1995-2017), other variables such as M2, IFR and foreign direct FDI had no significant impact on Cambodia's GDP. The study by Jibril (2019) examined the determinants of exchange rate volatility using Nigeria's sticky price currency model. This article adopted secondary quarterly data for the period 2016 and 2017. The data analysis technique

employed is the Autoregressive Integrated Moving Average (ARIMA) regression technique. The study found that currency variables significantly affected exchange rate volatility in Nigeria during the period under review. The findings show that interest rates and inflation levels have a significant and positive impact on exchange rate volatility in Nigeria. While the negative impact of M2 on EXR volatility is negligible, the positive impact of productivity on exchange rate volatility is negligible. However, the number of observations/the period considered by the author (8 data points) seems not to be sufficient for the ARIMA technique employed in the study.

The study by Obidike and Nduka (2022) considered the following macroeconomic variables; EXR, IR, IFR, TOP, FDI and M2 for assessing the performance of the Nigerian economy. The tools used to analyze the data were the ADF test, ARDL and diagnostic tests to determine the reliability of the model. The outcome of the study showed that IFR, TOP, FDI and M2 have a significant positive impact on real GDP in the short run, while EXR and IR have a significant impact on real GDP in the short run. Therefore, the study concludes that the selected macroeconomic variables are an effective short-term policy tool, influencing the Nigerian economy to a large extent. However, the point of departure from the present study and the study by Nse and Anietie (2018) and Obidike and Nduka (2022) apart from the choice of macroeconomic variables considered in the various study is the period considered for the two studies. The current study examines quarterly data for macroeconomic variables from the fourth/current Republic of Nigeria from 1999 to 2021. It is on record that Nigeria has experienced so far four Republics; the first republic is the republican government of Nigeria between 1963 and 1966 which was governed by the constitution of the first republic, the second republic (1979–1983), the third republic (1993) and the fourth/current republic (1999–present).

2. Method

2.1. Source of Data Collection

In this research, the secondary data has been used. Secondary data is collected from the Central bank Statistical Bulletin for 2021. Quarterly data on macroeconomic variables such as Money supply (M2), Gross Domestic Product (GDP), Exchange rate (EXR) and Inflation (IFR) was obtained from 1999 to 2021.

2.2. Method of Data Analysis

The ADF was used to test for the presence of a unit root in the time series sample data obtained for the study. The result of the ADF will be useful in deciding the Cointegration method to adopt for the study. Assuming that the variable of interest has a unit root that is integral of the same order, the Cointegration method used to test the long-term relationship can be either the Engle-Granger method or the Johansen-Juselius method. However, Engle-Granger, when the variables are integrated into different orders, the appropriate method to use is the ARDL method. However, the present study employed the ARDL approach to examine the long-run relationship of the variables since the variables were integrated of order (I(1) and I(0)).

The ARDL models are usually specified and estimated when an appropriate lag length is determined. The generalized form of the ARDL (m, n; p) model with p exogenous variables can be expressed as

$$y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i y_{t-1} + \sum_{j=1}^{p} \sum_{i=1}^{n} \beta_{ij}\ x_{jt-1} + \varepsilon_t \tag{1}$$

where, $\varepsilon_t \sim iid(0,\sigma^2)$.

However, equation (1) can be expressed using the lag operator $L^n_{Z_t} = Z_{t-n}$ as

$$\alpha(L) y_t = \alpha_0 + \sum_{j=1}^{p} \beta_j(L)\ x_{ij} + \varepsilon_t \tag{2}$$

Where,

$$\alpha(L)=1-\sum_{i=1}^{m}\alpha_i L^i, \text{ and } \beta(L)=\sum_{j=1}^{n}\beta_{ji}L^i \quad (3)$$

In the present study, the obtained estimates for the ADRL model will be used to describe the relationships that exist between growth output (RGDP) and EXR, IFR, and M2. The decision rule for ARDL Bound tests of Cointegration is to reject the null hypothesis significance level of no Cointegration relationship between the variables of the ARDL model when the computed *F* statistic is found to be above the assumed 5% upper critical value.

3. Results

The descriptive statistics result of the variables considered in the study is presented in Table 1. The result found that the average real GDP growth rate during the study period was 70,815,236, while EXR, IFR, and M2 were: 185.4940, 25.04196 and 31474491. The standard deviations of real GDP growth, M2, inflation, and exchange rates indicate that the values in the dataset are close to the mean. Thus, reflecting small changes in variable data. All variables are positively skewed, as indicated by the positive skewness coefficient. The results of the Jarque-Bera test indicate that the variables are approximately normally distributed.

Table 1: Descriptive Statistics of RGDP, EXR, IFR and M2

	RGDP	EXR	IFR	M2
Mean	70815236	185.4940	25.04196	31474491
Median	43178983	150.7550	24.05000	29626482
Std. Dev.	60643111	88.86316	14.91931	31039554
Skewness	0.577068	1.162532	0.271564	0.615846
Kurtosis	1.920658	2.972482	2.018357	2.159946
Jarque-Bera	4.571871	4.72559	4.824682	5.520574
Probability	0.088346	0.084032	0.089605	0.094118
Observations	88	88	88	88

Source: Eview 9.0

The results of unit root testing of variables using the ADF test statistic presented in Table 2 found that real GDP (RGDP), EXR, and M2 were the first The difference has more negative values at the 5% significance level (-9.3342, -6.8975, and -9.8835, respectively), while the IFR has more negative values at the 5% significance level for the self-test statistic value (-3.772187). This result means that real GDP (RGDP), EXR and M2 are integrals of order 1 (I(1)), while IFR is of order 0 (I(0)) integral. Therefore, all series are stationary over the study period and there is a trend.

Table 2: Result of Augmented Dickey-Fuller unit root test for the variables

Variables	**Level**		**1st Difference**		**Order of integration**
	No Trend	With Trend	No Trend	With Trend	
RGDP	-1.902951	-2.561695	-9.385452	-9.334291	**I(1)**
EXR	1.424133	-0.504583	-6.358487	-6.897597	**I(1)**
IFR	-1.420051	-3.772187	-	-	**I(0)**
M2	-1.575183	-2.335636	-9.893695	-9.883508	**I(1)**
Critical values					
5%	**-2.893589**	**-3.459950**	**-2.894332**	**-3.156776**	

Source: Eview 9.0

From the results in Table 2, it can be seen that some variables are stationary at zero difference I(0), but after the first difference of I(1), they all become stationary. Differences are applied to avoid spurious regressions. Since the differenced variables were stationary, there may be Cointegration between the variables. The ARDL Bound test shall be employed to ascertain whether certain variables in the model are cointegrated, and the expected result shall show whether there is a long-term relationship between sets of variables. Assuming that the variables of interest have the unit root of the same order integral, the Cointegration method used to test the long-term relationship can be the Engle-Granger method or the Johansen-Juselius method (Aronu et al., 2020). However, this study employed the ARDL approach to examine the long-term relationship of variables, since it was found that the variables were integrated into different orders (I(1) and I(0)). The number of lags used in the Cointegration test is based on the information criterion used in the underlying model. Cointegration tracking tests for real output (RGDP), the EXR and M2, and IFR are shown in Table 3. The results of the ARDL bound test for Cointegration presented in Table 3 found a calculated F statistic of 4.8981, which was found to be greater than the upper critical value of 4.35 (assuming a significance level of 5%). This result indicates that the null hypothesis that there is no Cointegration relationship between the variables of the ARDL model was rejected. Therefore, the findings show that growth output (RGDP) is cointegrated with the EXR, IFR, and M2. Furthermore, this result further suggests that there is a long-term relationship between the variables.

Table 3: Result of test for the existence of level relationship amongst the variables in the ARDL

Number of regressors	**Value of statistic K=3**
Computed F-statistic	4.8981
5% critical value	
Lower bound value	3.23
Upper bound value	4.35

The critical bound values were extracted from Pesaran et al., (2001).

Hence, the findings from the result obtained in Table 3 revealed that there exist a long-run relationship amongst the variables of the ARDL model since the computed F-statistic value of 4.8981 was greater than the lower and Upper bound values at significant level of 0.05 (4.8981 > (4.35, 3.23)). Therefore, it is appropriate to obtain an estimate of the ARDL long-term coefficient for the model, and also an estimate of the error correction model (ECM). The results of the long-term estimation are shown in Table 4, and Table 5 shows the estimate of the corresponding ECM. After evaluating 5832 models, the ARDL (5, 0, 2, 5) model was chosen as the better model using the Hannan-Quinn criterion (HQ). The results indicate that the model has 0 lags in EXR, 2 lags in IFR, and 5 lags in M2. This can be seen from the results presented in Table 5.

Table 4: Estimated long-run coefficients: ARDL(5, 0, 2, 5) selected by Hannan-Quinn criterion (HQ).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR	632503.89	195955.82	3.227788	0.0019
IFR	-4210366.25	1130654.099	-3.723832	0.0004
M2	-2.005562	0.63539	-3.156384	0.0023
Constant	105639971.69	26279536.56	4.019857	0.0001

Source: Eview 9.0

The result of the long-run relationship between the growth output and variables such as EXR, IFR and M2 presented in Table 4 found that the coefficients for all the variables were significant since their p-values were obtained as 0.0019, 0.0004, and 0.0023 respectively since their p-values were all less than significant level of 0.05. It was found that IFR and M2 have negative coefficients while EXR has a positive coefficient. This result indicates that EXR, IFR and M2 have a significant long-run effect on group output in Nigeria.

From the result presented in Table 4, the Co-integration equation can be expressed as equation (4) below:

Cointeq = RGDP - (632503.89*EXR - 4210366.25*IFR-2.0056*M2 + 105639971.6978) (4)

The result presented in Table 5 showed that the error correction coefficient of -0.274250 (p-value = 0.0003) was significant and indicates that the system corrects its previous period disequilibrium at a speed of 27.4% quarterly. A further result showed that the lag of RGDP, IFR and M2 has an insignificant short-term effect on growth output (RGDP).

Table 5: Error correction representation of the selected ARDL model: ARDL(5, 0, 2, 5)selected by Hannan-Quinn criterion (HQ)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RGDP(-1))	0.182725	0.108688	1.681190	0.0971
D(RGDP(-2))	-0.037662	0.100940	-0.373113	0.7102
D(RGDP(-3))	0.019969	0.087460	0.228319	0.8201
D(RGDP(-4))	0.605668	0.150469	4.025201	0.0001
D(EXR)	173464.081950	73888.986397	2.347631	0.0217
D(IFR)	-2600975.706204	377429.915733	-6.891281	0.0000
D(IFR(-1))	894182.523279	444227.014701	2.012895	0.0479
D(M2)	-0.461900	0.195680	-2.360484	0.0210
D(M2(-1))	0.249340	0.261045	0.955160	0.3427
D(M2(-2))	-0.115892	0.258453	-0.448408	0.6552
D(M2(-3))	-3.935621	1.233645	-3.190238	0.0021
D(M2(-4))	4.497386	1.340876	3.354065	0.0013
CointEq(-1)	-0.274250	0.072953	-3.759263	0.0003

Source: Eview 9.0

4. Discussion

The study x-rayed the relationship between growth output, exchange rate, inflation and money supply with the current Republic in Nigeria. All variables were found to be positive skew, as indicated by the positive skew coefficients. The result of the Jarque-Bera test showed that the variables were approximately normally distributed. The variables considered in the study were found to be integrated in order (I(1) and I(0)). Hence, the study employed the ARDL approach to examine the long-run relationship of the variables since the variables were integrated in a different order. The lag used in the Co-integration test was based on the information criterion used in the underlying model. The findings showed that growth output (RGDP) was Cointegrated with EXR, IFR and M2 and the existence of a long-run relationship amongst the variables. After evaluating 5832 models, the ARDL (5, 0, 2, 5) model was selected as the better model using the Hannan-Quinn criterion (HQ). The result indicates that EXR has 0 lag, IFR has 2 lags and M2 has 5 lags in the model.

The result of the long-run relationship between the growth output and variables such as EXR, IFR and M2 found that the coefficients for all the variables were significant; further findings showed that IFR and M2 have negative coefficients while EXR has a positive coefficient. This result indicates that EXR, IFR and M2 have a significant long-run effect on group output in Nigeria. This result was contrary to the findings of Obidike and Nduka (2022) who noted that inflation rate and money supply have a significant positive impact on growth output while exchange rates have a significant impact on real GDP in the short run. This could be attributed to the choice of the present study to consider the current republic in Nigeria. The result of the error correction coefficient indicates that the system corrects its previous period disequilibrium at a speed of 27.4% quarterly. A further result showed that the lag of RGDP, IFR and M2 has an insignificant short-term effect on growth output (RGDP). This result is in line with the findings of Vorlak et al. (2019) who stated that variables such as M2 and IFR had no significant impact on Cambodia's GDP. Based on the conclusions drawn from this study, the following recommendations are hereby made: (i) It is therefore prudent that, in seeking to foster economic growth, Nigerian banks should commit to their mandate of price stability and improve their regulatory framework to ensure a strong financial sector with effective intermediation, and (ii) To avoid inflationary effects, the government should control the excessive expansion of Nigeria’s broad money supply.

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None

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