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Macroeconomic variables as determinant of economic growth in Nigeria. A dynamic generalized method of moment approach

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Abstract: This study investigates the impact of macroeconomic variables on economic growth in Nigeria. Employing a time series data from 1986Q1 – 2022Q4 and GMM as well as dynamic GMM models, the results show a significant contribution of all the macroeconomic variables to economic growth. Also, the short and long run equilibrium relationship were established among the variables. It was observed that the variables are stationary at different levels of integration leading to the fitted generalized method of moment models. Thus, it was revealed that previous economic growth, internal debt, interest rate, exchange rate and trade openness significantly contributed to economic growth to the turn of 76.21%, 3.79%, 7.01%, 4.45% and 40.12% respectively. It was further revealed that external debt led to a 0.3% decline in economic growth. As a policy implication and recommendation, both internal and external borrowing must be properly monitored and channeled to productive investment as well as the needed infrastructure that would improve economic growth. An enabling environment should be provided for foreign investors to attract better investment that could enhance economic growth. Trade openness barriers must be removed to engender free entry and exist of goods and services required to grow the economy.

Keywords: *Economic growth, Generalized method of moment and dynamic generalized method of moment, Macroeconomic variables.*
JEL Classification: *B22; C32; E4; E52*

1. Introduction

Economic growth is a fundamental requirement for a nation's development. This informs why the Nigeria's economic growth continuously dominates the main policy thrust of government and private sectors to achieve the developmental objectives. Essentially, economic growth is associated with policies aimed at transforming and restructuring the real economic sectors. Nevertheless, the lack of sufficient domestic resources, savings and investment to support and sustained the economic sectors are major impediment to development of the country due to the gap between savings and investment (Imimole & Imoughele 2012).

Given the need to bridge the gap between savings and investment in achieving sustainable economic growth in the country, this study seeks to investigate the impact of macroeconomic variables on economic growth in Nigeria. The findings from this study will allow policymakers to focus on the critical determining factors that can effectively drive economic growth in the country. In addition, it will reveal the alignment between the macroeconomic variables and the savings/investment gap needed to stimulate economic growth in the country. After an extensive review of the literature, this study is the first to seek to achieve these objectives in the country.

Several studies have defined economic growth. For instance, Ebiwonjumi *et al.*, (2022) viewed economic growth as an increase in the average rate of output produce per person usually measured on per annum basis. That is, it is the rate of change in national output or income in each period. According

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to Ullah and Rauf (2013), it was posited that whenever there is an increase in the real GDP of a country, it will boost the overall economic growth. This means that economic growth helps increase the incomes of society, helps the nation to bring unemployment to a low level and helps render public services to the populaces.

Haller (2012) opined that economic growth is a complex, long-run phenomenon, subjected to constraints like the excessive rise of population, limited resources, inadequate infrastructure, inefficient utilization of resources, excessive governmental intervention, and institutional and cultural models that make the increase difficult to achieve. Economic growth is obtained by an efficient use of the available resources and by increasing the production capacity of a nation. It facilitates the redistribution of incomes between the population and society. The cumulative effects, the small differences of the increase rates, become big for periods of one decade or more. It is easier to redistribute the income in a dynamic and growing society than in a static one.

To achieve economic growth, Dwivedi (2004) stressed that the rate of increase in total output must be greater than the rate of population growth. As a result, economic growth is an important objective of government since it is associated with a rising average in real incomes and living standards. In the same view, Samuelson and Nordhaus (2005) posited that economic growth is the single most important factor for determining the success of a nation in the long run. Hence, in this study the impact of the identified macroeconomic variables such as internal and external debt, interest and exchange rate, and trade openness on economic growth are examined.

2. Literature Review

Economic growth is a fundamental requirement for economic development. This informs why in Nigeria growth continuously dominates the main policy thrust of government's development objectives. Imimole and Imoughele (2012) and Ullah and Rauf (2013) noted that whenever there is an increased in real GDP of a country, it will boost the overall economic output termed as economic growth. Thus, Economic theory suggests that reasonable levels of borrowing by a developing country are likely to enhance its economic growth. When economic growth is enhanced, the poverty level in the economy reduces. To encourage growth, countries at early stages of development like Nigeria borrow to augment developmental expenditures because of the dominance small stock of capital. Hence, they are likely to have opportunities with rates of return higher than that of their counterpart in developed economies. According to Igbodika, Jessie and Andabai (2016), it was posited that borrowed funds becomes effective if it is properly utilized for productive investment and do not suffer from macroeconomic instability. Growth therefore is likely to increase and allow for timely debt repayment. When this cycle is maintained for a period of time, growth will affect per capita income positively which serve as a mean for poverty reduction. Igbodika *et al.* (2016) stressed that, even if debt overhang impact cannot be used to determine growth explicitly, the implication of large debt stock lowers growth by partly reducing investment.

Debt is created by the act of borrowing. Ebiwonjumi *et al.* (2023) defined debt as the resource or money used in an organization without the contribution of the owner and does not in any other way belong to them. It is the money used by the government for investment or infrastructural development which does not belong to the country. It is a liability represented by a financial instrument or other formal equivalent. Public debt is described as how much an economy owes its lenders such as individuals, businesses and other governments. Kimberly (2016) described public debt as the total of the nation's debts which covers debts of local and state and national governments indicating how much public spending is financed by borrowing. Government debt is one method of financing government operations, though not the only method as Governments can also create money to monetize their debts, thereby removing the need to pay interest (Martin, 2009). But this practice can result in hyperinflation if used unsparingly. Government debt is created through various instruments including bonds, treasury bills, borrowing from commercial banks, overdrafts from the Central Bank and external borrowing.

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External debt is the resources or money used in a country that is not generated internally and does not in any way come from local citizens whether corporate or individual. It is the amount of money at any given time disbursed and outstanding contractual liabilities of residents to pay interest, with or without principal. Many developing countries resort to external borrowing to bridge the domestic resource gap to accelerate economic growth and development. It means that the processes are utilized in a productive way that facilitates the external servicing and liquidation of the debt (Oke & Sulaiman, 2012; John, Udoka, Okon & Orok, 2022). Domestic debt is debt owed to holders of government securities such as treasury bills and treasury bonds. Governments usually borrow by issuing securities, government bonds and bills. Governments borrow for two reasons namely: when the projected revenue targets fall short of the projected expenditure and to pay off maturing loans (Ponzi games) which is typical with domestic debt (Babu, Kiprop, Kalio & Gisore, 2014). The fundamental factor causes rising debt is the reliance on external resources to complement capital formation in the domestic economy. The higher the interest payment, the heavier the deficit on the current account and the debt burden which have a serious impact on economic growth.

Interest rates to a large extent played a vital role in the economy. Interest rate facilitates the flow of funds from lenders to borrowers. It is the cost of borrowing and it shows what a borrower pays to the lender for the use of money. Interest rate aids the flow of credit in the economy and helps financial entities such as governments, corporate organizations, banks, mutual funds and insurance companies carry out their intermediate role. (CBN, 2016) emphasized that high interest rate discourages borrowing and thereby, slowing down the growth of the economy while, a low interest rate encourages borrowing and enhances economic growth. Thus, interest rate is the amount of charged on borrowed money and expressed as a percentage of the amount borrowed for one year period or others (CBN, 2016).

Mordi (2006) as cited in CBN (2021) described exchange rate as the price of one currency expressed in terms of another currency. It is a vital macroeconomic indicator used in determining the overall performance of economies. It remains a key price variable in any economy and performs the dual role of maintaining international competitiveness and serves as a nominal anchor for domestic prices. Overall, the main objective of the exchange rate management policy is to stabilize the exchange rate at levels consistent with prudent reserve management and growth prospects of the economy (CBN, 2021). The systems of exchange rate determination are known as exchange rate regimes. Basically, there are two extreme cases of exchange rate regimes, namely, fixed and floating exchange rate systems.

Trade openness is one of the most obvious aspects of globalization, and indeed one of its defining characteristics. Thus, to assess the effects of globalization on economic growth, development, and convergence in income levels across countries must take into account the effects of trade openness (Amirkhalkhali & Dar, 2019). It is not surprising then that the subject has attracted considerable attention from both theoretical and empirical points of view. Recent discussions surrounding international trade policy show just how difficult it is for countries to open up their economies. Rich countries urge poorer countries to follow more open trade policies, but continue to protect their own markets on a selective basis. Amirkhalkhali *et al.* (2019) emphasized the rise of economic openness in strengthening, growth and protecting the economy of the country involved. Thus, it is an indication that trade openness has an impact on economic growth.

Having discussed the concept of the macroeconomic variables to be considered in this study, it imperative to review some of the empirical study that has been carried by other researchers. For instance, Antoni., *et al.* (2018) examined the relationship between trade liberalization and the composition of economic growth in Indonesia, Singapore and Thailand (1995-2017). The time series and cross-sectional data collected were pooled together and analysed using a generalized least square regression method. Findings indicated the influence of economic growth by openness of trade, domestic investment and foreign investment. Antoni (2019) investigated the impact of macroeconomic indicators on economic growth in the United States and Indonesia (1998-2018). In the study, data were gathered on gross domestic product, foreign debt, export and foreign direct investment as the macroeconomic variables considered. A cointegration and vector error correction model were employed as the

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econometrics technique. Thus, from the results, it was found that a long-run equilibrium relationship existed among the identified macroeconomic variables in the countries under consideration.

Omar and Nor (2020) examined the link between macroeconomic variables namely population, unemployment and export with the economic growth in Malaysia. The quarterly time series data collected between 2006 and 2016 on the identified macroeconomic variables were analyzed using least square regression method. Thus, in the results, it was found that a linear relationship existed among the population, unemployment, export and economic growth. The result further revealed that population and export were negative and significantly related to economic growth. Also, it was found that the impact of unemployment on economic growth was insignificant. Khalid Zaman (2012) Analyzed macroeconomic factors determining foreign direct investment impacts on Pakistan growth. The techniques such as descriptive statistics, unit root test, cointegration and regression method were adopted for the study. In the study, the result revealed that foreign direct investment positively and significantly influenced economic growth. Also, the impact of trade liberalization was found to influence economic growth in the long run. Muhammad, Munir and Mirza (2022) examined the impact of the macroeconomic variables on economic growth in Pakistan (1972-2021). The secondary data source from World Bank's website were gathered on macroeconomic variables used. The regression analysis technique employed for the study revealed that foreign direct investment and exchange rate were significantly positive and negative in relation with the economic growth. Also, in the results, balance of trade effect on economic growth was insignificant.

Ndubuisi (2017) focused on how externally acquired debt impacted the growth of the economy in Nigeria spanning 1985-2015. The data gathered were explored using least square regression method, ADF stationary test, cointegration and error correction. Findings showed the impact of servicing an externally incurred debt in growing the economy was negative and insignificant in Nigeria. Also, externally secured debt was found to be positive and significant in impacting the index of a growing economy. Control variables have positive and significant effect in growing economy. The causality relationship between externally acquired debt and economic growth was unidirectional in the long run. Al Kharusi and Ada (2018) determined the externally borrowed funds by the government with economic growth between (1990-2015). The need for the study was spurred by an uninterrupted increase in Oman due to externally borrowed funds basically to finance the yearly budget. The statistical technique adopted for the analysis was the Autoregressive Distributed Lag cointegration method. Findings revealed a negative and significant effect of externally borrowed funds by the government in growing the economy. Furthermore, gross fixed capital impact in growing the economy was positive and significant as indicated during the period under investigation.

Ademola, Tajudeen and Adewumi's (2018) investigation was done on Nigeria's economic growth and external debt (1999-2015) to determine the impact of the latter on the former. Cointegration and Vector Error Correction models were employed as an econometric technique to analyze the data used. The results indicated an inverse relationship between external debt and economic growth in Nigeria. Odubuasi, Uzoka and Anichebe (2018) investigated the effect of debt externally incurred on the economic growth in Nigeria (1981-2017). Data sourced from CBN Statistical Bulletin and NBS were analyzed using Granger Causality and ECM techniques. Findings showed that debt incurred externally and spending by the government on investment schemes positively and significantly affected growth of the economy. Moh'd AL-Tamimi and Jaradat (2019) analyzed the effect of debt incurred externally on the growth of the economy in Jordan from 2010 to 2017. The result obtained using descriptive analytics method revealed that debt incurred externally was negatively and significantly affected the growth of the economy. Obayori, Krokeyi, and Kakain (2019) examined the impact of externally acquired debt on the growth of the economy in Nigeria spanning the period (1980-2016). The data were sourced from Central Bank Nigeria Bulletin and analyzed with the aid of the Generalized Method of Moments technique. Findings showed that externally acquired debt and economic growth were positive and significant in relation.

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Ajayi and Adewusi (2020) examined the consequence of government debt on Nigeria's economic growth using time series data between 1998-2018. The data collected were analysed using descriptive analytics, unit root test, cointegration test and vector error correction model. The findings revealed that external debt negatively affected economic growth in both the long run and short run while domestic debt positively influenced long run and short-run impact. Ekor, Orekoya, Musa and Damisah (2021) evaluated whether external debt impairs economic growth in Nigeria. The study was empirically carried out using the dynamic autoregressive distributed lag model for the analysis. The results indicated that in the long run, external debt accumulation negatively affected the economy. Ring, Abdullah, Osman, Hamdan, Hwang, Mohamad, Hassan and Khalid (2021) investigated the impact of external debt on economic growth: The influence of institutional quality using panel GMM least square analysis. A sample of twenty-three countries between 2011-2014 were used to examine the nexus between external debt and economic growth with institutional quality as a moderator. Findings revealed that institutional quality was a good moderator of the existing relationship between external debt and economic growth. It was further revealed that good governance practices have a significant impact on economic growth.

Amassoma (2017) examined the impact of exchange rate fluctuation on Nigerian economic growth (1970-2013). The study employed econometric techniques that include-, ADF unit root test, cointegration test, error correction model, regression method and standard deviation method to capture and estimate the integral fluctuation in the fitted model. It was revealed that exchange rate fluctuation had a positive and insignificant impact on economic growth. Akinmulegun and Falana (2018) assessed variability in exchange rate and output from the industries in Nigeria (1986-2015). gross domestic product was used to capture growth of industrial output, while variability of exchange rate, inflation, interest rate, and net exports served as explanatory variables. Data extracted from the NBS and CBN Statistical Bulletin were analyzed using ADF and PP unit root, cointegration, granger causality and VECM. Results showed that variability of exchange rate granger caused the growth of industrial output. There was a positive and significant effect of exchange rate variability on the growth of industrial output which was more visible when compared with other variables. Ajayi and Aluko (2017) evaluated the efficiency of monetary and fiscal policy in Nigeria using least square method. The results showed that export and money supply significantly stimulated economic growth while government spending had no impact. Also, the study found that monetary policy stimulates growth more than fiscal policy.

Saaed (2015) investigated trade openness and financial development and their causal link to economic growth in Kuwait (1977 -2012). The techniques adopted for the study were cointegration and Granger causality tests. In the result, it was found that both trade openness and financial development positively and significantly influenced the growth of the economy. Nelson, Nathaniel and Fredrick (2016) examined trade openness and exchange rate fluctuations in Nigeria (1984-2013). In the study OLS method and ADF test for stationarity were adopted. Findings revealed that trade openness had positive impact on exchange rate volatility. The result also indicated a unidirectional causality between trade openness and exchange rate fluctuations. Afolabi, Sotan and Salahudeen (2020) researched the impact of trade policy on the growth of Nigeria's economy using the ARDL technique. In the results., it was found that price-based variables and adjusted trade ratios positively influenced economic growth in both the short and long run. In the long run, dynamic response showed that gross domestic product responded positively related with trade policy. However, to add to existing literature, this study focuses on investigating the relationship and impact of the identified macroeconomic variables such as internal and external debt, interest and exchange rate, and trade openness on economic growth using the generalized method of moment and dynamic generalized method of moment technique. In the next section, the detailed research methods are discussed.

3. Research Method

This study is an explanatory research design focusing on the impact of macroeconomics on the economic growth in Nigeria. The secondary data used for this study were gathered from the CBN

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statistical bulletin that was used between 1986Q1-2022Q4. The preliminary analysis such as descriptive and correlation analysis were done. Also, being time series data, the unit root and cointegration tests were carried out to examine the short and long-run stability of the macroeconomic variables in determining economic growth during the period under study. The detailed discussion of tests and the model specification are as follows:

3.1. Test for Stationarity

A time series data set on macroeconomic variables is generally non-stationary as demonstrated by many studies including Nelson and Plosser (1982), Stock and Watson (1988) and Campbell and Peron (1991). Therefore, the mean and variance of the time series macroeconomic variables are not independent of time. Thus, to avoid spurious results from a non-stationary time series model and to generate possible long-run stability, optimal and efficient results, a test for stationarity on the macroeconomic variables under investigation is carried out using Augmented Dickey-Fuller (ADF) and Philips-Peron (PP)

3.1.1. The Augmented Dickey-Fuller (ADF) Test

The Augmented Dickey-Fuller (ADF) test is used to test for a unit root in a time series and the error term assumes a white noise process. The null hypothesis is that returns have a unit root or exhibit non-stationary. The ADF can be tested using the equation expressed in (1) as:

$$\Delta Y_t = \Phi + \psi t + \varphi Y_{t-1} + \delta_1 \Delta Y_{t-1} + \cdots + \delta_{k-1} \Delta Y_{t-k+1} + \varepsilon_t , \quad (1)$$

Where Φ is a constant, ψ is the coefficient on a time and k is the lag order of the autoregressive process? The equation has an intercept (Φ), time trend (ψt) and ε_t as the error term. The test statistic is given in (2) as:

$$ADF_T = \frac{\hat{\varphi}}{SE(\hat{\varphi})}, \quad (2)$$

In the ADF test, $\varphi = 0$ is tested. Once a value of the test statistic is computed, it can be compared to the critical value of the Dickey-Fuller test. The corresponding *p*-value can be calculated.

3.1.2. The Philip Perron (PP) Test

The PP test is used to test for a unit root in a time-series sample. In its simplest form, the PP test equation of the time series can be tested using the equation that is expressed in (3) by

$$Y_t = \Phi + \psi t + \varphi Y_{t-1} + \varepsilon_t , \quad (3)$$

The test equation has an intercept (Φ), time trend (ψt).and ε_t is a white noise error term. The test statistics for this unit root model are given in (4) and (5) as:

$$W_\varphi = T(\hat{\varphi} - 1) - \frac{T^6}{24\, D_Z} (\mathrm{M}^2 - \mathrm{M}_e^2) , \quad (4)$$

$$W_t = \frac{\mathrm{M}_e}{\mathrm{M}} t_{\hat{\varphi}} - \frac{T^3 (\mathrm{M}^2 - \mathrm{M}_e^2)}{4\sqrt{3}\; D_Z^{\frac{1}{2}} \mathrm{M}} , \quad (5)$$

Where, $D_Z = det\,(Z'Z\})$ and the regressors are $Z = (1.\ t,\ Y_{t-1})$, M^2 is the Newey-West consistent estimator of σ^2 (Newey and West, 1987), M_e^2 is the consistent estimator of σ_e^2,

$$\mathrm{M}_e^2 = \frac{1}{T}\sum_{t=1}^{T} \varepsilon_t^2 \text{ and } \mathrm{M}^2 = \frac{1}{T}\sum_{t=1}^{T} \varepsilon_t^2 + \frac{2}{T}\sum_{r=1}^{\varrho} G_{r\varrho} \sum_{t=r+1}^{\varrho} \varepsilon_t \varepsilon_{t-r} ,$$

Where $G_{r\varrho} = 1 - \frac{r}{\varrho+1}$ and $\varepsilon_t \varepsilon_{t-r}$ is the estimator of the covariance between error terms. The limiting distributions of W_φ and W_t are identical to those of $P = T(\hat{\varphi} - 1)$ and the t-statistics, respectively with $\mathrm{M}^2 = \mathrm{M}_e^2$. Thus, the asymptotic critical values of the tests are the same as the asymptotic critical values tabulated by Fuller (1976).

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3.1.3. Co-integration Test

The long run relationships among the macroeconomic variables is done using Johansen and Juselius (1990) approach. Thus, p-dimensional vector autoregressive model is constructed with normal errors express by its first differenced error correction form given in (6) as:

$$\Delta\Upsilon_{it} = \pi_1\Delta\Upsilon_{it} + \pi_2\Delta\Upsilon_{it} + \cdots + \pi_{K-1}\Delta\Upsilon_{it-K-1}\Delta\Upsilon_{it-K+1} - \Omega\Delta\Upsilon_{it-1} + \mu_{it} + \varepsilon_{it}\,, \quad (6)$$

Where the data series studied is independent and identically distributed with $\pi_i \sim N(0, \Sigma)$

The Ω matrix conveys information about the long-term relationship among the macroeconomic variables and the rank of Ω is the number of linearly independent and stationary linear combinations of macroeconomic variables under consideration. Hence, testing the co-integration entails testing for the rank r of matrix Ω by examining whether the eigenvalues of Ω are significantly different from zero. To determine the number of cointegrating vectors, trace (λ-trace) and maximum eigenvalue (λ-max) statistics are used. The trace statistic (λ-trace) is computed using the expression given in (7) by:

$$\lambda_{trace} = -T\sum_{j=r+1}^{n}\ln(1-\lambda j) \quad (7)$$

Trace test null hypothesis is, "at most" r co-integrating vectors, with "more than" r vectors being the alternative hypothesis. The maximum eigenvalue test is given in (8) as:

$$\lambda_{max} = -T\ln(1-\lambda r+1) \quad (8)$$

The null hypothesis is, r co-integrating vectors against the alternative hypothesis of r + 1 co-integration vectors and λ is the largest canonical correlation.

3.1.4. Model Specification

Consider the general linear model given in (9) as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + U_i\,, \quad (9)$$

was used. This can be written in vector and matrix form as expressed in (10):

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_n \end{bmatrix} \begin{bmatrix} X_1'X_1 & X_1'X_2 & \ldots & X_1'X_n \\ X_2'X_1 & X_2'X_2 & \ldots & X_2'X_n \\ \vdots & \vdots & \ddots & \vdots \\ X_n'X_1 & X_n'X_2 & \ldots & X_n'X_n \end{bmatrix} + \begin{bmatrix} U_1 \\ U_2 \\ \vdots \\ U_n \end{bmatrix}, \quad (10)$$

However, considered the general linear regression model stated in (2.9) and (2.10), the models were transformed where Y represents the dependent variable RGDP and $\boldsymbol{X}$ represent the explanatory variables INDT, EXDT, RINR, REXR and OPEN. This was stated in functional form according to the model given by Ebiwonjumi *et al.* (2022) and Ebiwonjumi *et al.* (2023) in relation to the aforementioned macroeconomic variables and expressed in (11) as:

$$\text{RGDP} = f(\text{INDT}, \text{EXDT}, \text{RINR}, \text{REXR}, \text{OPEN})\,, \quad (11)$$

The model (11) was modified and expressed in functional and econometric forms based on the macroeconomic variables for the static model given in (12) and (13) respectively as:

$$\text{GDP}_t = f(\text{IND}_t, \text{EXD}_t, \text{INR}_t, \text{EXR}_t, \text{TOP}_t)\,, \quad (12)$$

$$\text{GDP}_t = \beta_0 + \beta_1\text{IND}_t + \beta_2\text{EXD}_t + \beta_3\text{EXD}_t + \beta_4\text{EXD}_t + \beta_5\text{EXD}_t + \in_i\,, \quad (13)$$

Thus, the modified functional and econometric forms based on the macroeconomic variables for the dynamic models are expressed in (14) and (15) as:

$$\text{GDP}_t = f(\text{GDP}_{t-1}\ \text{IND}_t, \text{EXD}_t, \text{INR}_t, \text{EXR}_t, \text{TOP}_t)\,, \quad (14)$$

$$\text{GDP}_t = \beta_0 + \beta_1\text{GDP}_{t-1} + \beta_2\text{IND}_t + \beta_3\text{EXD}_t + \beta_4\text{EXD}_t + \beta_5\text{EXD}_t + \beta_6\text{EXD}_t + \in_i, \quad (15)$$

Where, β_i and $\in_i$ are the parameters and error term to be estimated respectively. In this study, GDP represents economic growth, IND represents internal debt, EXD represents external debt, INR represents interest rate, EXR represents exchange rate and TOP represents trade openness. All the variables are measured in percentage.

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3.2. Estimation Technique

The generalized method of moment (GMM) is used for the estimation of the static model and dynamic generalized method of moment is used for the estimation of the dynamic model. These methods are used because it generates unbiased estimates for the model parameters and solves any inconsistencies and generates an unbiased parameter estimate. The diagnostic test to be carried out include: probability test for the estimated parameters, coefficient of determination, overidentification of the instruments and predictive evaluation of the fitted static and dynamic models. Thus, analysis and discussion of results are presented in the next section.

Table 1.
Descriptive analysis.

	GDP	IND	EXD	INR	EXR	TOP
Mean	10.3046	6.6287	6.6572	3.1051	4.3175	0.1664
Median	10.2054	6.7392	6.4629	3.1139	4.3802	0.1200
Maximum	11.1422	9.0867	8.4950	3.5860	6.3196	0.4600
Minimum	9.6315	3.3477	3.7245	2.4849	2.7763	0.0100
Std. dev.	0.4503	1.4987	1.0654	0.1929	0.6951	0.1302
Skewness	0.3710	-0.4095	-0.1634	-0.5733	-0.1748	0.6709
Kurtosis	1.8571	2.5576	2.7076	4.1714	3.6271	2.1246
Jarque-Bera	10.9083	5.0905	1.1299	15.7879	3.0287	15.0810
Probability	0.0042	0.0784	0.5683	0.0003	0.2199	0.0005
Sum	1452.950	934.6548	938.6716	437.8212	608.7708	23.4700
Sum sq. dev.	28.3891	314.4906	158.9331	5.2110	67.6489	2.3743

4.1. Analysis and Discussion of Results

Table 1 shows the descriptive results of the variables under consideration that include GDP, IND, EXD, INR, EXR and TOP in this study. The average values of GDP, IND, EXD, INR, EXR and TOP during the period under study are 10.30%, 6.63%, 6.66%, 3.11%, 4.32% and 0.17% respectively. The minimum and the maximum values of the macroeconomic variables are 9.63% and 11.14%, 3.35% and 9.09%, 3.72% and 8.50%, 2.48% and 3.59%, 2.78% and 6.32% as well as 0.01% and 0.46% for GDP, IND, EXD, INR, EXR and TOP respectively. The rate at which GDP, IND, EXD, INR, EXR and TOP deviate from their expected average values as reveal by the results presented in Table 1 are 0.45%, 1.50%, 1.07%, 0.19%, 0.70% and 0.13% respectively.

In Table 1, the skewness result show that IND, EXD, INR and EXR are negatively skewed with skewness coefficient of -0.41, -0.16, -0.50, -0.57 and -0.17 respectively. Thus, the aforementioned macroeconomic variables are skewed to the left of their individual average values. The results further reveal that GDP and TOP are positively skewed with skewness coefficient values of 0.37 and 0.67 respectively and as such establish that the two macroeconomic variables are skewed to the right of their individual average values. The kurtosis results reveal that INR and EXR are leptokurtic with kurtosis coefficient index higher than 3. Also, the kurtosis of the GDP, IND, EXD and TOP are revealed to be platykurtic with the kurtosis coefficient index smaller than 3. Thus, emphasize the flattering of the distribution of the identified macroeconomic variables in this study. The Jarque-Bera statistic values of 10.91, 5.09, 1.13, 15.79, 3.03 and 15.08 for the GDP, IND, INR and TOP with associated ($p < 0.05$) indicate that the aforementioned macroeconomic variables are from normally distributed population.

Table 2.
Correlation matrix.

	GDP	IND	EXD	INR	EXR	TOP
GDP	1.0000	0.9028	0.3595	0.1104	0.1038	0.8838

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IND	0.9028	1.0000	0.6073	0.1275	-0.0923	0.8200
EXD	0.3595	0.6073	1.0000	0.3875	-0.2898	0.2534
INR	0.1104	0.1275	0.3875	1.0000	-0.4594	-0.0089
EXR	0.1038	-0.0923	-0.2898	-0.4594	1.0000	0.2416
TOP	0.8838	0.8200	0.2534	-0.0089	0.2416	1.0000

The correlation analysis results are presented in Table 2 and it show the degree of relationship among the identified macroeconomic variables considered in this study which include GDP, IND, EXD, INR, EXR and TOP respectively. From Table 2, it was revealed that all the aforementioned macroeconomic variables are positively correlated with GDP with correlation coefficient values of 0.90, 0.36, 0.11, 0.10 and 0.88 respectively for IND, EXD, INR, EXR and TOP. Thus, it can be emphasized that the growth of the economy measured by GDP depends on IND, EXD, INR, EXR and TOP respectively. In the results, it was found that IND correlation with EXD, INR and TOP are positive with the correlation coefficient values of 0.61, 0.13 and 0.82 respectively while, the correlation between IND and EXR, EXD and EXR, INR and EXR as well as INR and TOP are negative with correlation coefficient value of -0.09, -0.29, -0.46 and -0.01 respectively. Also, EXD was positively correlated with INR and TOP with correlation coefficient values of 0.39 and 0.25. It was further revealed that EXR positively correlated with TOP with the correlation coefficient of 0.24. It must be noted that the data set for this study are time series data on the aforementioned macroeconomic variables and as such the need to examine their stationarity in the short and long run (equilibrium relationship among the variables). Hence, in Table.3 and Table 4, the results of unit root and cointegration test are respectively presented.

Table 3.
Unit root or stationary test.

	ADF - fisher chi-Square				**PP - fisher chi-square**		
	Statistic	**5% level**	**Prob.**		**Statistic**	**5% level**	**Prob.**
GDP I(2)	-18.2769	-3.4434	0.0000	GDP (I(2))	-19.5909	-3.4427	0.0000
IND I(2)	-8.4346	-3.4444	0.0000	IND (I(1))	-3.7817	-3.4424	0.0204
EXD I(1)	-3.7531	-3.4434	0.0221	EXD (I(2))	-26.3790	-3.4427	0.0000
INR I(1)	-3.5556	-3.4444	0.0377	INR (I(0))	-3.5294	-3.4422	0.0401
EXR I(2)	-12.874	-3.4444	0.0000	EXR (I(1))	-3.9896	-3.4424	0.0111
TOP I(2)	-7.4920	-3.4455	0.0000	TOP (I(2))	-4.1772	-3.4424	0.0063

In Table 3, the results of the unit root test are presented to examine the short run equilibrium relationship among the macroeconomic variables considered in this study. The test is carried out using Augmented Dickey Fuller (ADF) test and Philip Perron (PP) test. From Table 3, it was revealed that in absolute term GDP, IND, EXR and TOP with ADF statistic values of 18.2769 (p-value < 0.05), 8.4346 (p-value < 0.05), 12.874 (p-value < 0.05) and 7.4920 (p-value < 0.05) respectively reveal that the aforementioned variables are stationary at second difference. Also, EXD and INR with ADF statistic values of 3.7531 (p-value < 0.05) and 3.5556 (p-value < 0.05) respectively establish the stationarity of the variables at first difference. However, for the PP test, the result presented in Table 3 show that, GDP, EXD and TOP with the PP statistic values of 19.5909 (p-value < 0.05), 26.3790 (p-value < 0.05) and 4.1772 (p-value < 0.05) respectively are stationary at second difference. Also, PP statistic value of 3.7817 (p-value < 0.05) and 3.9896 (p-value < 0.05) indicate that IND and EXR respectively are stationary at first difference while, the same vein, PP statistic value of 3.5294 (p-value < 0.05) establish the stationarity of INR at level during the period under consideration. These results evidently show that all the macroeconomic variables under consideration are stationary and as such established the short run equilibrium relationship among the identified macroeconomic variables. Having established the stationarity of the macroeconomic variables under investigation to show their short run stability, it

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also imperative to determine the long run equilibrium relationship among the macroeconomic variables. This is done using cointegration test and the results are presented in Table 4.

Table 4.
Co-integration test for GDP IND EXD INR EXR TOP model.

	Unrestricted cointegration trace test				Unrestricted cointegration maxi-eigenvalue test			
Hypothesized no. of CE(s)	**Eigen value**	**Trace statistic**	**5% critical value**	**Prob.**	**Eigen value**	**Max-eigen statistic**	**5% critical value**	**Prob.**
None *	0.5526	225.5264	95.7536	0.0000	0.5526	109.4134	40.0775	0.0000
At most 1 *	0.3633	116.1131	69.8188	0.0000	0.3633	61.4073	33.8768	0.0000
At most 2 *	0.2085	54.7057	47.8561	0.0099	0.2085	31.8061	27.5843	0.0135
At most 3	0.0941	22.8996	29.7970	0.2510	0.0941	13.4489	21.1316	0.4118
At most 4	0.0446	9.4506	15.4947	0.3253	0.0446	6.2113	14.2646	0.5862
At most 5	0.0235	3.239334	3.8414	0.0719	0.0235	3.2393	3.8414	0.0719

Note: Trace test indicates 3 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values; Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values.

The Trace test and Maximum eigenvalues statistic for co-integration test presented in Table 4 reveal the existence of 3 co-integrating vector at 5% level of significance. This implies that the variables such as GDP, IND, EXD, INR, EXR and TOP under investigation are co-integrated and thus, establish the stability and equilibrium relationship among the macroeconomic variables considered for this study in the long run. Following normalization of the above co-integrated vector, it can be inferred from this study that in the long run, the aforementioned macroeconomic variables such as IND, EXD, INR, EXR and TOP had an impact on the economic growth (GDP) in Nigeria. Having establish the short and long run equilibrium relationship among the identified macroeconomic variables considered for this study using unit root and cointegration test. It was observed that the variables are stationary at different level of integration such as I(0), I(1) and I(2) respectively. In view of this, a generalized method of moment and dynamic generalized method of moment are employed to examine the of the identified macroeconomic drivers on the economic growth in this study. Thus, the results of the fitted models are presented in Table 5.

Table 5.
Generalized method of moment (GMM) and generalized method of moment (GMM) models.

	GMM model				Dynamic GMM model			
Variable	**Coef.**	**Std. error**	**t-Stat.**	**Prob.**	**Coef.**	**Std. error**	**t-Stat.**	**Prob.**
C	7.4280	0.6328	11.7374	0.0000	1.8310	0.4112	4.4522	0.0000
GDP (-1)	-	-	-	-	0.7621	0.0490	15.5518	0.0000
IND	0.3091	0.0685	4.5069	0.0000	0.0379	0.0263	1.4364	0.1532
EXD	-0.1248	0.0486	-2.5650	0.0114	-0.0031	0.0114	-0.2776	0.7817
INR	0.3551	0.0966	3.6759	0.0032	0.0701	0.0444	1.5792	0.1167
EXR	0.1184	0.0297	3.9818	0.0001	0.0445	0.0135	3.2962	0.0026
TOP	0.2655	0.6601	0.4023	0.6881	0.4012	0.1721	2.3313	0.0212
R-squared	0.9115				0.9862			
Adj. R-squared	0.9082				0.9855			
Instrument	6				7			
J-statistic	0.0000				0.0000			

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In Table 5 the result of the fitted models that showed the existing relationship between the economic growth (GDP) and the macroeconomic variables considered as its drivers that include IND, EXD, INR, EXR and TOP. The fitted models are generalized method of moment (GMM) model and dynamic generalized method of moment (dynamic GMM) model for the identified macroeconomic variables in this study. Thus, in Table 5, the fitted GMM model revealed that IND, INR, EXR and TOP have positive impact on the economic growth (GDP) on one hand and EXD has negative impact on the economic growth on the other hand. Specifically, it was revealed that IND, INR, EXR and TOP contribution to the economic growth (GDP) are 30.91%, 35.51%, 11.84% and 26.65% respectively. It was further revealed by the method that EXD contributes a decline of 12.48% to the economic growth (GDP) in Nigeria during the period under investigation.

The examination of the statistical significance of the estimated parameters for the macroeconomic variables such as IND, EXD, INR, EXR and TOP reveal that all the estimated macroeconomic variables parameter values under consideration with p-value < 0.05 show their statistical significance in determining economic growth (GDP). Thus, it can be emphasized from this result, the positive impact of the macroeconomic variables identified in this study except EXD in determining economic growth in Nigeria.

The fitted dynamic GMM model revealed that GDP (-1), IND, INR, EXR and TOP show a positive relationship with the economic growth (GDP). It was specifically showed that the contribution of GDP (-1), IND, INR, EXR and TOP to economic growth (GDP) are 76.21%, 3.79%, 7.01%, 4.45% and 40.12% respectively. Also, it was further showed that EXD negatively influence economic growth measured by (GDP). In specific, the contributory impact of EXD to the economic growth is -0.31 which lead to 0.3% decline in economic growth during the period under consideration. The estimated parameter(s) of the macroeconomic variables under study with p-value < 0.05 show their statistical significance in examining economic growth (GDP) while, other parameter(s) with p-value > 0.05 are statistically insignificance. From the Table 5, it can be stressed that the present performance of the economy will contribute effectively in enhancing the economic growth in the future based on data set considered for this study. Also, the coefficient of determination of the fitted GMM and dynamic GMM model measured by the adjusted R-square value reveal that 90.82% and 98.55% variation in the economic growth in Nigeria can be explained by the identified macroeconomic variables such as IND, EXD, INR, EXR and TOP considered for this study. However, in considering the efficiency and the reliability of the fitted GMM models, the predictive efficiency of the models is examined using various performance metrics and the results are presented in Table 6.

Table 6.
Predictive evaluation or efficiency of the fitted GMM models.

Metrics	GMM model	Dynamic GMM model
RMSE	0.1324	0.0907
MAE	0.0958	0.0639
MAPE	0.9332	0.6205
TIC	0.0064	0.0043
Bias P	0.0000	0.0062
VarP	0.0105	0.0101
Covar P	0.9894	0.9836

In Table 6, we present the predictive efficiency of the fitted GMM and dynamic GMM models in modelling identified macroeconomic variables such IND, EXD, INR, EXR and TOP on economic growth. In this study, the predictive efficiency is determined by root mean square error (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE), Theil inequality coefficient (TIC) and variance proportion (VarP). Thus, from the results presented in Table 6, it is showed that the RMSE of dynamic GMM model with value 0.0907 is the smallest when compared with the GMM model with

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value 0.1324. The MAE of the fitted GMM models reveals that dynamic GMM model has the smallest value of 0.0639 when compared with the GMM model with value 0.0958.

Also, MAPE of the fitted GMM models for examining the impact of the identified macroeconomic variables on economic growth (GDP) reveal that dynamic GMM model with the value 0.6205 is smaller when compared with the GMM model with the value 0.9332. The results of TIC and VarP also show that dynamic GMM model has the smallest value in comparison with the GMM model. Therefore, it can be asserted that the fitted dynamic GMM model is optimal and the most efficient model to estimate and examine the contribution of identified macroeconomic variables such as IND, EXD, INR, EXR and TOP on economic growth (GDP) in Nigeria during the period under consideration in this study.

4.2. Implication of the Findings and Conclusion

A thorough examination of the impacts of macroeconomic variables on economic growth in Nigeria were investigated using generalized method of moment and dynamic generalized method of moment techniques. The preliminary analysis carried out on the time series data gathered for this study established short and long run equilibrium relationship among the identified macroeconomic variables considered. Thus, according to Ademola, Tajudeen and Adewumi (2018) and Ndubuisi (2017), the findings established the stability and reliability of the internal debt, external debt, interest rate, exchange rate and trade openness in determining economic growth in Nigeria. It was observed that the variables are stationary at different level of integration such as I(0), I(1) and I(2) respectively leading to the choice of generalized and dynamic generalized method of moment as the econometric techniques employed for this study. The fitted GMM models revealed that GDP (-1), IND, INR, EXR and TOP showed a positive relationship with the economic growth while, EXD has negative impact on the economic growth. Thus, it can be emphasized that the present growth in economy will contribute to the future growth. An examination of the study showed the positive impact of the internal debt as viable macroeconomic variable for the growth of the economy and according to Ajayi and Adewusi (2020), it can be stressed that internal debt is a positive key to enhance the growth of the economy. Also, it was further showed that external debt negatively influenced economic growth measured by (GDP). This affirmed the position of Ademola, Tajudeen and Adewumi (2018), Al Kharusi and Ada (2018), Moh'd AL-Tamimi and Jaradat (2019) and Ajayi and Adewusi (2020) that external debt negatively related with economic growth, thus emphasizing that a continuous increase in external debt leads to a continuous decline in economic growth and vice versa.

However, this is contrary to the result earlier obtained by Ndubuisi (2017), Odubuasi, Uzoka and Anichebe (2018) and Obayori, Krokeyi, Kakain (2019) where it was emphasized that external debt had a positive contribution toward economic growth. Also, Orekoya, Musa and Damisah (2021) emphasized the long run decline in economic growth as a result of accumulated external debt. Ring *et al.* (2021) opined the important of having quality institution in moderating the negative impact of external debt to enhance economic growth. This study revealed the positive impact of exchange rate stability in growing the economy and as such aligned with the position of Amassoma (2017), Akinmulegun and Falana (2018). Moreover, trade openness as posited by Saaed (2015), Antoni *et al.* (2018), Amirkhalkhali *et al.* (2019) and Afolabi *et al.* (2020) contributed significantly in enhancing economic growth as revealed in this study. Therefore, it can be concluded that a favourable and sustainable external borrowing should be incurred and must be properly channeled to engender the development of the needed infrastructure. The important of enabling environment cannot be overemphasized and as such, foreign investors must be attracted for better investment to enhance economic growth. Trade openness barriers must be removed to engender free entry and exist of goods and services require to grow the economy. There is a need to protect and strengthen the currency of the nation against incessant devaluation through viable policy implementation.

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