# Fiscal Policy and Macroeconomic Variables in Africa: A Bayesian VAR Approach

Raymond Osi Alenoghena, Samuel David Adebisi, Ayobola Olufolake Charles
*Department of Economics, Trinity University, Yaba Lagos, Nigeria*

***Abstract*: Government spending by African countries has generally been on the rise recently. This study investigates the effect of government spending on macroeconomic variables in 25 African countries from 2002 to 2019. The study utilises the Bayesian Vector Autoregression (BVAR) approach for the analysis. The study results indicate that fiscal policy positively and significantly impacts gross fixed capital formation and broad money. As a follow-up, the effect of fiscal policy is significant and negative on economic growth. Although fiscal policy's outcome positively affects inflation and trade openness, the effect is insignificant. Also, while the impact of fiscal policy on the industrial production index is negative, the impact is not significant. The study recommends a well-coordinated and further boost to government spending to promote capital investment in these African countries. The policy of a better-managed increase in government expenditure should enhance investment and productivity to correct the negative impact of government expenditure on industrial production. More specifically, the government should spend more on projects with the potential of increasing productivity rather than recurrent and non-productive ventures with the tendency to increase inflationary pressures.**

***Keywords*: Fiscal Policy, Economic Growth, Gross Fixed Capital Formation, Crowding Out.**

## I. INTRODUCTION

One of the most traditionally potent tools for regulating an economy over the years is the use of fiscal policy tools, that is, the discretionary use of government expenditure and taxes, to determine the outcomes of the macroeconomic goals. Both instruments are demand management tools often targeted at regulating the aggregate demand in an economy to fast-track or slow down any macroeconomic objectives. Another dimension of fiscal policy tool recently adjudged to be equally potent, although not without its implications on the economy, is fiscal deficit financing. For instance, Reinhart & Rogoff (2010) confirmed that it could impede growth whenever the debt-to-income ratio exceeds 90 per cent. The position of Reinhart & Rogoff (2010) is strongly reinforced by mainstream economists (Ko, 2018).

Fiscal policy expansionary shocks have been found in the literature to have either positive or negative effects on growth, private consumption and private investment, respectively. Expansionary fiscal policy has been found to influence growth and consumption positively but crowding out private investment (Blanchard & Perotti, 2002; Perotti, 2004; Biau & Girard, 2005). Another argument that has been filtered through in the literature is the non-linearity of the relationship between fiscal policy expansion and growth. An expansionary fiscal policy could positively affect growth in the short run, especially deficit financing through borrowing. However, it will negatively affect the economy in the medium to the long run (De Castro and Hernández de Cos, 2006). Implementing expansionary fiscal policy through deficit financing will boost growth and reduce unemployment. However, the policy could trigger inflationary pressure, especially for economies at or near full employment. However, the net effect of the increase in income is not as anticipated by Keynes.

The experiences of different countries in the business cycle have called to question the capability of fiscal policy tools in stabilising the economies. From the standpoint of Keynesians, fiscal policy is most potent in a recession, as proposed by Keynes (1936). The policy is anchored on the fact that it can stimulate aggregate demand and, with the multiplier effect, could quickly turn around the economy to the path of growth. Nevertheless, on the other hand, government expenditure financed through taxes could have contradictory effects. Supposing taxes are reduced to boost private domestic consumption, it will harm the income to be generated by the government to boost their expenditure. This implies that the two instruments may be applied separately; otherwise, it will neutralise the outcome.

For economies operating below full employment like the African countries, fiscal policy expansion is expected to have a minor positive impact on inflation. An increase in government expenditure would stimulate productivity and decrease prices. Instead, prices are increasing in these countries, which can be explained by the structural rigidities that characterise these countries. Persistent price increases in developing economies may not be due to fiscal policy expansion but can be explained by supply elasticity in these economies. Similarly, a reduction in taxes is meant to boost agricultural and manufacturing productivity to reduce the price level. In reality, we see increases in prices of food items, energy commodities, and manufactured items because tax reduction may be a minor factor driving these sectors. It has been observed that exchange rate shortages, the cost of imported inputs, and many others are responsible for the high cost of produced goods (Fischer, 2015; Forbes, 2015; Mishkin, 2008).

On the other hand, an attempt to fight inflation through tax increases will also have a counter-effect. The household demand will be contained when the government raises taxes, but the cost of production of firms will go up, which will spill over into higher prices of goods and services. The aggregate demand will fall because the prices are too high, so the inflation

problem still needs to be addressed. The effect of taxation on inflation and productivity has been mixed (Gravelle & Hungerford, 2007; Romer & Romer, 2007). The question then is, what is the net effect of tax regulation on inflation? View the impact of tax on inflation from the supply side. A reduction in corporate taxes can boost productivity and drive down the prices of goods and services. A decrease in income tax from the supply side, too, can help individuals choose to work more and give up leisure, producing more and driving down the price level.

In order to generally increase production in the industrial sector, the most relevant policy would be to reduce taxes. This will increase the tax base and increase income for the government. That will also incentivise the firms to produce more, pay more sales taxes and company income taxes, hire more workers, and the workers will pay more taxes, which will generally boost productivity. The tax revenue to GDP in most countries has been relatively stable over the years. For example, South Africa's data showed that the ratio is 2001 was 21.70 and increased to 22.5 in 2010 and 23.45 in 2020. On the other hand, Ghana had a ratio of 17.1 in 2001, rose to 13.33 in 2010 and then fell to 11.34 in 2020 (WDI, 2022).

This research study focuses more on the government expenditure component of fiscal policy as it affects some macroeconomic variables in the economies of 25 selected African countries. Inadequate tax data in most economies prompts the restriction to government expenditure as the main proxy for fiscal policy. The value addition of this work to the body of knowledge is principally on the scope and the methodology used. The study examined the effect of government expenditure on the macroeconomic variables in these countries with the help of Bayesian Vector Autoregressive (BVAR) methodology, which none of the studies before now has been able to use. The BVAR approach has the advantage over other VAR models as it gives more realistic estimations and considers prior information steady states in the analysis.

The remaining sections of this work is divided into seven sections. The following section will present the literature review, while section three will provide the theoretical framework on which the work is anchored. Section four presents the methodology and the model specification, while section five shows the nature and sources of data used in this work. Section six presents the analysis of the results obtained and section seven shows the work's conclusion and the policy recommendations.

## II. LITERATURE REVIEW

As observed in this work, the theoretical postulations and the empirical findings of the links between fiscal policy instruments and the macroeconomic variables could be more straightforward. Therefore, this section will reveal the findings of most recent works on how government expenditure, tax regulation and fiscal deficit have affected the economies of most African countries.

The work of Cynthia and Code (2018), carried out on Nigeria between 1970 and 2017 using the Autoregressive Distributed Lag model, showed a positive long-run relationship between fiscal policy and macroeconomic indicators in the country. Agu et al. (2015) used descriptive statistics and Ordinary Least Squares to assess the relationship between government spending and economic growth in Nigeria. The findings revealed a positive correlation between the two, which implies that as government expenditure increases, working through the multiplier effect boosts the Gross Domestic Product growth.

Mavodyo (2020), in their assessment of the effect of budget deficit on economic growth in South Africa, using the Dynamic Ordinary Least Squares (DOLS), found out that budget deficit tends to promote and stimulate growth in the country. Note that the money borrowed is expended on export promotion activities. On the other hand, Molefe and Maredza (2017) analysed the effect of budget deficit on economic growth in South Africa using Vector Error Correction Model, and they observed an inverse relationship between them. The implication is that as the country goes deeper into debt burden, it becomes harmful to the economy's growth. Finally, Khumalo (2013) investigated the nexus of the budget deficit and inflation in South Africa using the Vector Autoregressive model. This work discovered that there is causality running from budget deficit to inflation with a long-run relationship, suggesting that budget deficit can be inflationary.

Mackson et al. (2018) analysed the effect of government fiscal policy on economic growth in South Africa between 1960 and 2014 using the VECM methodology. The findings showed that tax revenue has a long-run and significant relationship with economic growth. In contrast, domestic investment proxied by Gross Fixed Capital Formation (GFCF) and budget deficit negatively affect economic growth. Burger et al. (2020) attempted to find out if more government expenditure will stimulate growth, especially just coming out of COVID-19 and, more importantly, to find if the Debt to GDP ratio will improve, but their findings negated the expectation.

However, Nkrumah et al. (2016) studied the link between budget deficit and economic growth in Ghana using trend analysis and the Autoregressive Distributed Lag Model. The findings of the trend showed a negative relationship. In contrast, the result of the econometric analysis showed a significant negative relationship, and the authors found that a 100 per cent increase in deficit financing will lead to an about 3 per cent fall in Gross Domestic Product in the country.

Ahmad (2013) attempted to confirm the nature of the relationship between government budget deficit and economic growth in Pakistan. This study aimed to verify whether the Keynesian of a positive relationship, the Neo-Classical of a negative relationship, or the Ricardian theory of neutrality can be secured with data from Pakistan. The finding showed a bi-directional causality between the country's budget deficit and economic growth.

While trying to investigate the role of the public sector, whether it serves as the balancing factor for the economy as claimed by

Keynes or not, Arjomand et al. (2016) examined the role of fiscal deficit on economic growth and labour productivity in some selected MENA countries between 2000 and 2013. The study Using a static panel model, the findings showed a positive relationship between labour productivity and economic growth. However, there was a negative relationship between budget deficit and economic growth in the countries selected.

Onwioduokit et al. (2014) undertook a study in the Gambia to confirm the budget deficit threshold that would be healthy for the country between 1980 and 2009. Adopting the Threshold Autoregressive model, their findings showed a positive relationship between government budget deficit and economic growth in the country for the study period, which supports the Keynesian claim. In another related study, Alam et al. (2021) found a long-run relationship between government budget deficit financing and economic growth in Bangladesh between 1981 and 2018 using the Vector Error Correction model for the estimation. Their findings showed that the budget deficit has a positive relationship with economic growth in the long run but a negative one in the short run. Also, the results showed causality from domestic debt to real GDP.

Yusuff & Abolaji (2020) examined the effect of fiscal deficit on national output in Nigeria between 1981 and 2016 using the Autoregressive Distributed Lag model. The findings showed that budget deficit had a long-run relationship with economic growth, although they did not confirm if it was negative or positive. In addition, it was also concluded in their work that budget deficit had a positive relationship with economic growth. According to the authors, this result confirms Keynes's postulation on the relationship. Also, on investigating the nonlinear relationship between domestic borrowing and economic growth in Nigeria covering the 1980 to 2019 and utilizing the threshold regression analysis, Alenoghena et al. (2022A) found that domestic borrowing is nonlinear at 14.88% of GDP with an inverted U-shaped curve. The existence of a significant switching point in the study confirmed the application of the debt-Laffer Curve in Nigeria, indicating that domestic borrowing is favourable to the economy before the threshold.

Odhiambo et al. (2013) wanted to know how the country had fared over the years in their fiscal balance. Therefore, they investigated the relationship between government fiscal deficit and economic growth in Kenya between 1970 and 2007 using econometric testing and estimation methods. As a result, it was discovered that fiscal deficit and economic growth in Kenya were positively related over the sampled period, confirming the assertion of the Keynesian school. Similarly, Phillip (2021) examined the link between budget deficit and some macroeconomic variables in Kenya between 1976 and 2018 using the VAR model and impulse response function analysis. The findings showed that debt servicing had a negative effect on the budget deficit in the country.

Mansouri (2008) empirically investigated the impact of government fiscal policy on economic growth in three North African countries: Egypt, Morocco, and Tunisia and using time series data with an error correction mechanism, the findings showed that public spending crowds-in economic growth in the three countries, but government spending has a long run positive effect on economic growth in Egypt and Tunisia, but the positive impact on Morocco is both short and long run. Omar (2021), on the other hand, investigated the effect of fiscal policy on output in Egypt using quarterly data from 2007 to 2019 and employed disaggregated structural VAR; the finding of the work showed that fiscal policy exerts a positive impact on output, but taxation has a negative effect. The study also revealed that public investment and consumption crowd out private investment.

The literature review section covered an overview of several empirical studies on the relationship between budget deficit, government borrowing and fiscal policy with economic growth in single-country studies and regional studies. While some studies utilised panel regression, ARDL, DOL and VAR for analysis. There is non of the existing studies deployed the Bayesian VAR for analysing the effect of fiscal policy on macroeconomic variables in Africa in a more recent study. Therefore, this study utilises the Bayesian VAR approach to investigate the effect of fiscal policy on macroeconomic variables covering 25 countries in Africa for the period 1975 to 2020.

## III. THEORETICAL FRAMEWORK

This study is anchored on the dual Keynesian and Neo-Classical theories of deficit financing. First, the Keynesian postulation asserts that an increase in government expenditure, either generated from taxes or borrowing (internal and external), has a full multiplier effect on the national income. The claim on multiple growths in income implies that every time the government spends money to improve infrastructure or any capital project, the effect is transmitted through the multiplier effect on the national income. The income growth could reduce unemployment but, of course, could be inflationary, especially for economies at full employment levels. However, for economies below full employment, where there is still room for output expansion, an increase in government expenditure should only lead to increased output and reduced employment.

On the other hand, the Neo-classical position is that, as the government spends through borrowing, especially domestic borrowing, it creates a scarcity of funds in the funds market and forces the interest rate to rise, which becomes a disincentive for private investors. The neo-classical thought claims that even as the increase in expenditure by the government will raise income, the rise in income cannot get to the level advocated by Keynesians. The difference between the Keynesian and Neo-classical outcomes is the crowded-out effect of the private sector.

## IV. METHODOLOGY AND MODEL SPECIFICATION

The study adopts the typical Cobb-Douglas production function with the constant returns to scale chosen to determine the relationship between fiscal policy and macroeconomic

variables in Nigeria. The selection of this model falls in line with previous studies such as Amassoma (2011) and Olowo et al. (2022). The proposal on the expression of the relationship is shown in equation (1) as follows:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} e^{u_t} \quad - \quad - \quad - \quad (1)$$

It is the economy's national output representing gross national product (GDP) at time t; $A_t$, $L_t$, and $K_t$, are productivity factors, the labour force and the physical capital stock, respectively, at time t. Also, μt is the stochastic error term, while e refers to the base of natural logs. As a follow-up, the impact of government expenditure is captured through the $A_t$ component of ($Y_t$). Since the objective of this study is to assess the effect of fiscal policy on the macroeconomic variables, the assessment is extended to cover the economy's overall performance through the changes in $A_t$. Consequently, the study assumes that $A_t$ is a function of fiscal policy and the other incorporated components.

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$$A_t = f\,(\text{GEXPDT}_t, Z_t) \quad - \quad - \quad - \quad (2)$$

Where: GEXPDT represents government expenditure, and Z indicates the control variables, including financial development, national output, population growth rate, industrial production, external borrowing, inflation, interest rate and trade openness. Therefore, equations (1) and (2) can be harmonized to obtain equation 3 as follows:

$$Y_t = K_t^{\alpha_1} L_t^{\alpha_2} \text{GEXPDT}_t^{\alpha_3} Z_t^{\alpha_4} e^{\mu_t} \quad - \quad (3)$$

Thus, taking the natural logarithm of equation (3) gives equation (4) as follows:

$$LnY_t = \alpha_0 + \alpha_1 LnK_t + \alpha_2 LnL_t + \alpha_3 Ln\text{GEXPDT}_t + \alpha_4 LnZ_t + \mu_t \quad (4)$$

The complete model can be presented in equation (5) such that $K_t$ defined is estimated with gross fixed capital formation, $L_t$ is proxied by population growth rate and the control variables in $Z_t$ are expressed in equation 5. Also, financial development is represented by broad money supply and credit to the private sector.

$$LnGDP_t = \alpha_0 + \alpha_1 LnGFCF_t + \alpha_2 Ln\text{GEXPDT}_t + \alpha_3 LnBMON_t + \alpha_4 LnINFL_t + \alpha_5 LnIPI_t + \alpha_6 LnTOP_t + \mu_t \quad - \quad - \quad (5)$$

Where $\alpha_0$, …$\alpha_6$ are the estimated coefficients and $\mu_t$ is the stochastic error term.

Where GDP represents the real gross domestic product, GFCF is the gross fixed capital formation, and GEXPDT is the fiscal policy. Also, BMON refers to broad money supply, INFL is inflation, IPI is industrial production index, and TOP represents trade openness.

*4.1 Analytical Framework*

In the Bayesian statistical analysis, the prior, likelihood, and posterior distribution characteristics are critical to the model. The random variable epitomises the uncertainty in the model and presents the probability distribution. As a follow-up, the prior segment is established on the associated constraints presented in the model, while the likelihood denotes the sample information (Olaniyi & Alenoghena, 2017). Finally, in applying Bayes' theorem, the fusion of the prior information and the likelihood information yields the posterior information distribution.

Given a parameter is represented by θ = (β, ∑), with data *y*, then the prior distribution may be expressed by $\boldsymbol{\pi}(\theta)$; hence, the likelihood information is given by $l(y|\theta)$ and the posterior distribution $\boldsymbol{\pi}(\theta|y)$ is characterized as follows:

$$\pi(\theta \mid y) = \frac{\pi(\theta) l(y \mid \theta)}{\int \pi(\theta) l(y \mid \theta) d\theta} \quad - \quad - \quad (6)$$

Equation (6) is related to the specific Bayesian VAR analysis, which highlights the VAR(p) model as follows

$$y_t = \alpha_0 + \sum_{j=1}^{p} C_j y_{t-j} + \varepsilon_t \qquad t = 1, \ldots, T \quad (7)$$

Where $y_t$ is an n x 1 vector of n series and $\varepsilon_t$ is an n x 1 vectors of random errors. For strict conciseness, equation (7) may be reposted as:

$$Y = BC + E \quad - \quad - \quad - \quad - \quad (8)$$

Or

$$y = (L_n \otimes B)\theta + e \quad - \quad - \quad (9)$$

Y and E are T x n matrices while B = ($b_1$, …., $b_t$)' is a T x (np + 1) matrix for $b_t$ = (1, y'$_{t-1}$, …, y'$_{t-q}$), $L_m$ represents the identity matrix of dimension n, θ = vec(C), and e ~ N(0, $\sum_E \otimes L_m$).

Hence, the likelihood function may be presented as:

$$l(\theta, \Sigma_t) \propto \left|\Sigma_t \otimes L_T\right|^{-1/2} \exp\left\{-\frac{1}{2}(y-(L_n \otimes B)\theta)'(\Sigma_t \otimes L_T)^{-1}(y-(L_n \otimes B)\theta)\right\} \quad (10)$$

Assuming $\Sigma_t$ is the multivariate normal prior for θ, then

$$\pi(\theta) \propto \left|V_0\right|^{-1/2} \exp\left\{-\frac{1}{2}(\theta-\theta_0)'V_0^{-1}(\theta-\theta_0)\right\} \quad (11)$$

Where $V_0$ refers to the prior covariance and $\theta_0$ the prior mean. Conjoining the prior with the likelihood functions in (5), the posterior density information becomes

$$\pi(\theta \mid y) = \exp\left\{-\frac{1}{2}.((V_0^{-1/2}(\theta-\theta_0))'V_0^{-1/2}(\theta-\theta_0) + \left(\left(\Sigma_t^{-1/2}\otimes L_T\right)y - \left(\Sigma_t^{-1/2}\otimes B\right)\theta\right)'\left(\left(\Sigma_t^{-1/2}\otimes L_T\right)y - \left(\Sigma_t^{-1/2}\otimes B\right)\theta\right)\right\} \quad (12)$$

(7) is a multivariate regular probability distribution function (pdf). For simplicity, we explore some definitions:

$$w = \begin{bmatrix} V_0^{-1/2}\theta_0 \\ \left(\sum_t^{-1/2}\otimes L_T\right)_y \end{bmatrix} \quad - \quad -(13)$$

$$\mathrm{W} = \begin{bmatrix} V_0^{-1/2}\theta_0 \\ \left(\sum_t^{-1/2}\otimes B\right) \end{bmatrix} \quad - \quad - \quad -(14)$$

At this stage, the exponent in equation (7) can be restated as

$$\pi(\theta \mid y) \propto \exp\left\{-\frac{1}{2}(w-W\theta)'(w-W\theta)\right\} \propto \exp\left\{-\frac{1}{2}(\theta-\bar{\theta})'W'W(\theta-\bar{\theta}) + (w-W\bar{\theta})'(w-W\bar{\theta})\right\} \quad (15)$$

The posterior mean, $\bar{\theta}$, is

$$\bar{\theta} = (W'W)^{-1}W'w = \left[V_0^{-1} + (\Sigma_t^{-1/2}\otimes B'B)\right]^{-1}\left[V_0^{-1}\theta_0 + (\Sigma_t^{-1/2}\otimes B)'y\right] \quad (16)$$

Since $\Sigma_t$ is known, the second part of (12) is the proposed random around $\bar{\theta}$. The posterior part of the distribution can be summarized in equation 16

$$\pi(\theta \mid y) \propto \exp\left\{-\frac{1}{2}(\theta-\bar{\theta})'W'W(\theta-\bar{\theta})\right\} \quad (17)$$

In another way,

$$\pi(\theta \mid y) = \exp\left\{-\frac{1}{2}(\theta-\bar{\theta})'\bar{V}^{-1}(\theta-\bar{\theta})\right\} \quad (18)$$

Therefore, the posterior covariance $\bar{V}$ may be expressed as

$$\bar{V} = \left[V_0^{-1} + (\Sigma_t^{-1/2}\otimes B'B)\right]^{-1} \quad (19)$$

*4.2 Litterman or Minnesota prior*

The prior distribution strictures can now be involved to reinforce the inferences and reflect their true values as part of the basic Bayesian analysis. In the BVAR literature, there are several illustrations of the prior analysis (i.e. Normal-Wishart prior, Sims-Zha normal-Wishart prior, Sims-Zha normal-flat and Litterman/Minnesota prior). This study uses the Litterman/Minnesota prior because it presumes that $\Sigma_t$ is known and obliges simplifying the posterior analysis. Thus, this study utilizes the univariate AR approach from the three existing choices of an estimator of $\Sigma_t$ (i.e. diagonal VAR, full VAR and univariate AR). The univariate approach $\hat{\Sigma}_\varepsilon$ holds a diagonal matrix with constraint, where $\hat{\sigma}_{ii}^2$ is (i, i) –th element for $\hat{\Sigma}_\varepsilon$. The error variance formulation of the *i*-th variable is secured from the regression of univariate AR model. Hence, the Litterman /Minnesota prior undertakes the prior presentation of θ

$$v \sim N(v_0, V_0) \quad (20)$$

$\theta_0 = 0$ and $V_0 \neq 0$.

The independent variables in a VAR analysis consist of the lag of the dependent variable, declared a constant term and the lags of the other endogenous variables. The other explanatory variable in the model with the component of $V_0$ compliant in consonance with the explanatory variable is set to infinity. The residue of $V_0$ transforms to a diagonal matrix containing elements of ${}_v{}^l ij$ for $l = 1, \ldots, p$

$$v_{ij}^l = \left\{\frac{\lambda_1}{l^{\lambda_3}}\right\}^2 \text{ for (i = j)}$$

$$v_{ij}^l = \left\{\frac{\lambda_1\lambda_2\sigma_i}{l^{\lambda_3}\sigma_j}\right\}^2 \text{ for (i} \neq \text{j)} \quad (21)$$

Such that $\sigma_i^2$ becomes the *i*-th diagonal element and $\Sigma_\varepsilon$. $\lambda_1$, $\lambda_2$ and $\lambda_3$ create the scalars for overall rigidity, lag decay and relative cross-variable weight, respectively.

Hence, the estimated posterior for θ will take the form

$$\theta \sim N(\bar{\theta}, \bar{V}) \quad (22)$$

Where

$$\bar{V} = \left[V_0^{-1} + (\hat{\Sigma}_\varepsilon^{-1/2}\otimes B'B)\right]^{-1} \quad (23)$$

And finally,

$$\bar{\theta} = \bar{V}\left[V_0^{-1}\theta_0 + (\hat{\Sigma}_\varepsilon^{-1/2}\otimes B)'y\right] \quad (24)$$

Equation (24) connoted the approximation technique to the posterior distributional qualities that take cognizance of the prior and likelihood information conditions.

## V. DATA DEFINITION, DESCRIPTION AND SOURCES

The study adopted the Bayesian VAR model for analysis covering the period 1975 to 2020, providing 46 annual observations. The countries covered in this work are: Angola, Benin, Cameroon, Chad, Congo DR, Ghana, Guinea, Kenya, Namibia, Niger, Nigeria, Mauritania, Botswana, Burkina Faso, Central African Republic, Egypt, Mali, Mozambique, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Tanzania and Tunisia.

Table 1: Variables, Data Description and Sources

| Variable | Description and Measurement | Source |
|---|---|---|
| GEXPDT | Includes all current government expenditures for purchases of goods and services, social security, employee compensation and national defence and security but excludes military expenditures which form part of government capital formation. | World Development Indicators (WDI) |
| GDP | Economic growth is the yearly percentage rate of growth of GDP at market prices: defined as $\left(\frac{Y_t - Y_{t-1}}{Y_{t-1}}\right)\%$ for each year. | WDI |
| BMON | Broad money is defined by the value of currency held outside banks; including demand deposits other than those held by the federal government; the savings, time, and foreign currency deposits of the resident sectors other than the federal government. Hence, it is divided by the GDP. | WDI |
| INFL | The inflation rate on consumer price index indicates the annual percentage change in the average consumer's cost in acquiring a basket of goods and services yearly. The Laspeyres formula is used. | WDI |
| IPI | Industrial Production Index refers to the value-added and is the net output of Industrial sectors obtained after adding up all the sector outputs and subtracting intermediate inputs (Estimated as a share of GDP) | WDI |
| GFCF | Gross fixed capital formation refers to land improvements (fences, ditches, drains, and so on); equipment purchases, plant, machinery; and the construction of railways, roads, and the like, including schools, offices, hospitals and the like. | WDI |
| TOP | Trade Openness, measured as imports plus exports divided by GDP | WDI |
| PGR | Population growth rate (annual) for year t refers to the exponential rate of population growth at the midyear from year t-1 to t, expressed as a percentage. | WDI |

The variables utilised for the study specified: economic growth, broad money supply, inflation, industrial production index, gross fixed capital formation, trade openness and population growth rate. The data for this study are sourced primarily from secondary sources. The 25 African Countries data are sourced from the World Development Indicators (WDI). The full name, description and source of the data are presented in table 1.

## VI. EMPIRICAL RESULTS AND ANALYSIS

### *6.1 Descriptive Statistics*

This segment of the study analyses the statistical attributes of the variables adopted in the study. The attributes of the variables presented in Table 4.1 include the mean, median, standard deviation, skewness, kurtosis, Jarque–Bera, probability and sum. The means of the variables government expenditure, gross fixed capital formation, inflation, broad money, industrial production index, economic growth and trade openness are 13.72, 22.34, 8.11, 30.81, 25.40, 23.66 and 61.59, respectively. Also, the maximum values associated with the respective variables government expenditure, gross fixed capital formation, inflation, broad money, industrial production index, economic growth and trade openness are 35.35, 59.72, 150.32, 98.14, 61.88, 27.03 and 127.20. Furthermore, the data from 25 African countries covers 2002 - 2020, providing 475 annual observations.

The variables possessing the highest variability values (standard deviation) for the study period are trade openness and broad money, with 24.55 and 19.19, respectively. The kurtosis value showing the distribution's peak is inflation, with a value of 62.98. Three other variables have kurtosis values greater than three and include government expenditure, gross fixed capital formation, broad money and industrial production index, indicating that the distribution may be classified as platykurtic (short-tailed and fat). The analysis also compares the probability estimates with the test of normality (Jarque-Bera) to classify the asymptotic test. The table values indicate that the estimated values of the probability of the variables are generally low, and the values of the means are closely related to the median values; hence, the study concludes that the residual values for the distribution indicate a normal distribution.

Table 2: Descriptive Statistics

| | GEXPDT | GFCF | INFL | BMON | IPI | LGDP | TRADE |
|---|---|---|---|---|---|---|---|
| Mean | 13.7248 | 22.3440 | 8.1069 | 30.8149 | 25.3992 | 23.6566 | 61.5904 |
| Median | 13.5546 | 20.8471 | 5.5882 | 24.5682 | 24.2086 | 23.3881 | 57.4973 |
| Maximum | 35.3508 | 59.7231 | 150.3227 | 98.1361 | 61.8835 | 27.0271 | 127.2042 |
| Minimum | 0.9517 | 6.3498 | -8.9747 | 2.9173 | 4.5559 | 20.7146 | 0.7846 |
| Std. Dev. | 5.3930 | 7.6671 | 11.9064 | 19.1906 | 9.2627 | 1.3863 | 24.5503 |
| Skewness | 0.6424 | 1.0134 | 6.3877 | 1.3924 | 1.0076 | 0.5126 | 0.3908 |
| Kurtosis | 3.7442 | 4.8208 | 62.9764 | 4.4935 | 4.9937 | 2.8650 | 2.7123 |
| Jarque-Bera | 43.6310 | 146.9221 | 74424.1700 | 197.6312 | 159.0386 | 21.1655 | 13.7277 |
| Probability | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0010 |
| Sum | 6519.263 | 10613.42 | 3850.754 | 14637.08 | 12064.62 | 11236.86 | 29255.45 |
| Sum Sq. Dev. | 13786.04 | 27863.84 | 67194.96 | 174564.1 | 40668.27 | 910.9142 | 285688.3 |
| Observations | 475 | 475 | 475 | 475 | 475 | 475 | 475 |

Source: Authors' generated using Eviews 10

*6.2 Correlation Matrix of Regressors*

The values of the correlation analysis results of the variables are shown in Table 3. The values of the results show that the variables are not highly correlated. The highest correlation values in the table are 0.498 and 0.437 in the relationship between broad money and economic growth and broad money and government expenditure. Since the truncated values of estimated correlation among the variables are low, the conclusion may be drawn that the models in the study do not suffer from multicollinearity

Table 3: Correlation Analysis

| **Covariance Analysis: Ordinary** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Included observations: 475 | | | | | | | |
| Correlation | GEXPDT | GFCF | INFL | BMON | IPI | LGDP | TRADE |
| GEXPDT | 1 | | | | | | |
| GFCF | 0.195951 | 1 | | | | | |
| INFL | 0.05656 | 0.101651 | 1 | | | | |
| BMON | 0.436933 | -0.057313 | -0.037393 | 1 | | | |
| IPI | 0.133779 | 0.179797 | 0.214018 | 0.208032 | 1 | | |
| LGDP | -0.063103 | -0.011236 | 0.104655 | 0.498441 | 0.320394 | 1 | |
| TRADE | 0.349428 | 0.311179 | -0.064152 | 0.259394 | 0.373958 | -0.11964 | 1 |

Source: Authors' generated using Eviews 10

*6.3 Panel Unit Root*

The unit root test is conducted with Levin, Lin & Chu (LLC) and Im, Pesaran & Shin W-Stat (IPSW). The test results reveal that the variables are non-stationary in levels for LLC and IPSW; more specifically, they all exhibit a unit root except for trade openness. Moreover, at first difference [I (1)] all the variables become stationary, which indicates the possibility of a long-run equilibrium relationship among the variables.

Table 4: Panel Unit root

| | Level | | First Difference | |
|---|---|---|---|---|
| Variable | LLC | IPSW | LLC | IPSW |
| GEXPDT | -1.4628 | -0.48154 | -16.1224*** | -14.1498*** |
| GFCF | -4.0139 | -2.8856 | -15.3229*** | -13.0788*** |
| INFL | -8.9815 | -8.4523 | -22.5037*** | -22.1759*** |
| BMON | 0.1733 | 3.0424 | -13.4981*** | -11.6787*** |
| IPI | -2.8299 | -1.4512 | -15.7409*** | -13.5600*** |
| LGDP | -11.7781 | -7.7373 | -12.3508*** | -86973*** |
| TRADE | -2.1969** | -1.2375** | -18.8421*** | -15.1560*** |

Source: Authors' generated using Eviews 10

Note: LLC represents Levin, Lin & Chu (2002), IPSW represents Im, Pesaran and Shin W-stat; ** means 5%; *** means 1% significance levels

*6.4 Panel Cointegration Results*

The panel cointegration tests is conducted using the Pedroni Residual approach with eleven (11) computed statistics. With the results, a majority (seven) support the null hypothesis of no cointegration. Therefore, the study concludes that a long-run equilibrium relationship flows from government expenditure to the other macroeconomic variables in the study.

Table 5: Panel Cointegration Test

| **Pedroni Residual Cointegration Test** | | | | |
|---|---|---|---|---|
| Series: GEXPDT GFCF INFL BMON IPI LGDP TRADE | | | | |
| Sample: 2002 2020 | | | | |
| Included observations: 475 | | | | |
| Cross-sections included: 25 | | | | |
| Null Hypothesis: No cointegration | | | | |
| User-specified lag length: 1 | | | | |
| Alternative hypothesis: common AR coefs. (within-dimension) | | | | |
| | | | Weighted | |
| | Statistic | Prob. | Statistic | Prob. |
| Panel v-Statistic | -1.9126 | 0.9721 | -1.9491 | 0.9744 |
| Panel rho-Statistic | 3.6581 | 0.9999 | 4.4143 | 1.0000 |
| Panel PP-Statistic | -3.4246 | 0.0003 | -1.9482 | 0.0257 |
| Panel ADF-Statistic | 0.7530 | 0.7743 | 0.3798 | 0.6479 |
| Alternative hypothesis: individual AR coefs. (between-dimension) | | | | |
| | Statistic | Prob. | | |
| Group rho-Statistic | 6.2069 | 1.0000 | | |
| Group PP-Statistic | -4.9106 | 0.0000 | | |
| Group ADF-Statistic | 0.4494 | 0.6734 | | |

Source: Authors' generated using Eviews 10

*6.5 Lag Order Selection Process*

The test results reveal that the final prediction error (FPE), Akaike information criterion (AIC), Schwarz information

criterion (SC) and Hannan-Quinn information criterion (HQ) all have the same results in recommending that the first (1) lag is selected by VAR to be used for the data estimation.

Table 6: Lag Order Selection

| **VAR Lag Order Selection Criteria** | | | | | | |
|---|---|---|---|---|---|---|
| Endogenous variables: GEXPDT GFCF INFL BMON IPI LGDP TRADE | | | | | | |
| Included observations: 275 | | | | | | |
| Lag | LogL | LR | FPE | AIC | SC | HQ |
| 0 | -6566.124 | NA | 1.36E+12 | 47.8045 | 47.8966 | 47.8415 |
| 1 | -4233.007 | 4530.489 | 83096.28* | 31.1928* | 31.9293* | 31.4884* |
| 2 | -4184.407 | 91.898 | 83392.07 | 31.1957 | 32.5766 | 31.7499 |
| 3 | -4136.922 | 87.372 | 84454.40 | 31.2067 | 33.2321 | 32.0196 |
| 4 | -4105.20 | 56.755 | 96060.24 | 31.3324 | 34.0022 | 32.4038 |
| 5 | -4069.631 | 61.824 | 106455.70 | 31.4301 | 34.7443 | 32.7602 |
| 6 | -4025.686 | 74.147 | 111276.70 | 31.4668 | 35.4255 | 33.0556 |
| 7 | -3972.10 | 87.693* | 108760.70 | 31.4334 | 36.0366 | 33.2808 |
| 8 | -3939.359 | 51.903 | 124147.00 | 31.5517 | 36.7993 | 33.6577 |
| * indicates lag order selected by the criterion | | | | | | |
| LR: sequential modified LR test statistic (each test at 5% level) | | | | | | |
| FPE: Final prediction error | | | | | | |
| AIC: Akaike information criterion | | | | | | |
| SC: Schwarz information criterion | | | | | | |
| HQ: Hannan-Quinn information criterion | | | | | | |

Source: Authors' generated using Eviews 10

*6.6 Bayesian VAR Regression Results*

Table 7 shows the BVAR analysis estimates. The results indicate that government expenditure significantly positively impacts gross fixed capital formation and broad money. On the other hand, the effect of government expenditure is significant and negative on economic growth. Although the effect of government expenditure is positive on inflation and trade openness, the effect is not significant. Also, while the effect of government expenditure on the industrial production index is negative, the effect is not significant.

Table 7: Bayesian VAR Analysis

| **Bayesian VAR Estimates** | | | | |
|---|---|---|---|---|
| Prior type: Litterman/Minnesota | | | | |
| Independent Variable: GEXPDT | | | | |
| | Coefficient | Standard Errors | t-statistic | Probability |
| GEXPDT | 0.9472 | -0.0180 | [ 52.7469] | 0.0000 |
| GFCF | 0.1087 | -0.0428 | [ 2.5386] | 0.0306 |
| INFL | 0.1338 | -0.0823 | [ 1.6244] | 0.1226 |
| BMON | 0.1191 | -0.0352 | [ 3.3817] | 0.0030 |
| IPI | -0.0135 | -0.0352 | [-0.3829] | 0.5625 |
| LGDP | -0.0038 | -0.0014 | [-2.7849] | 0.0076 |
| TRADE | 0.0519 | -0.0910 | [ 0.5709] | 0.6743 |

Source: Authors' generated using Eviews 10

*6.7 Impulse Response Function*

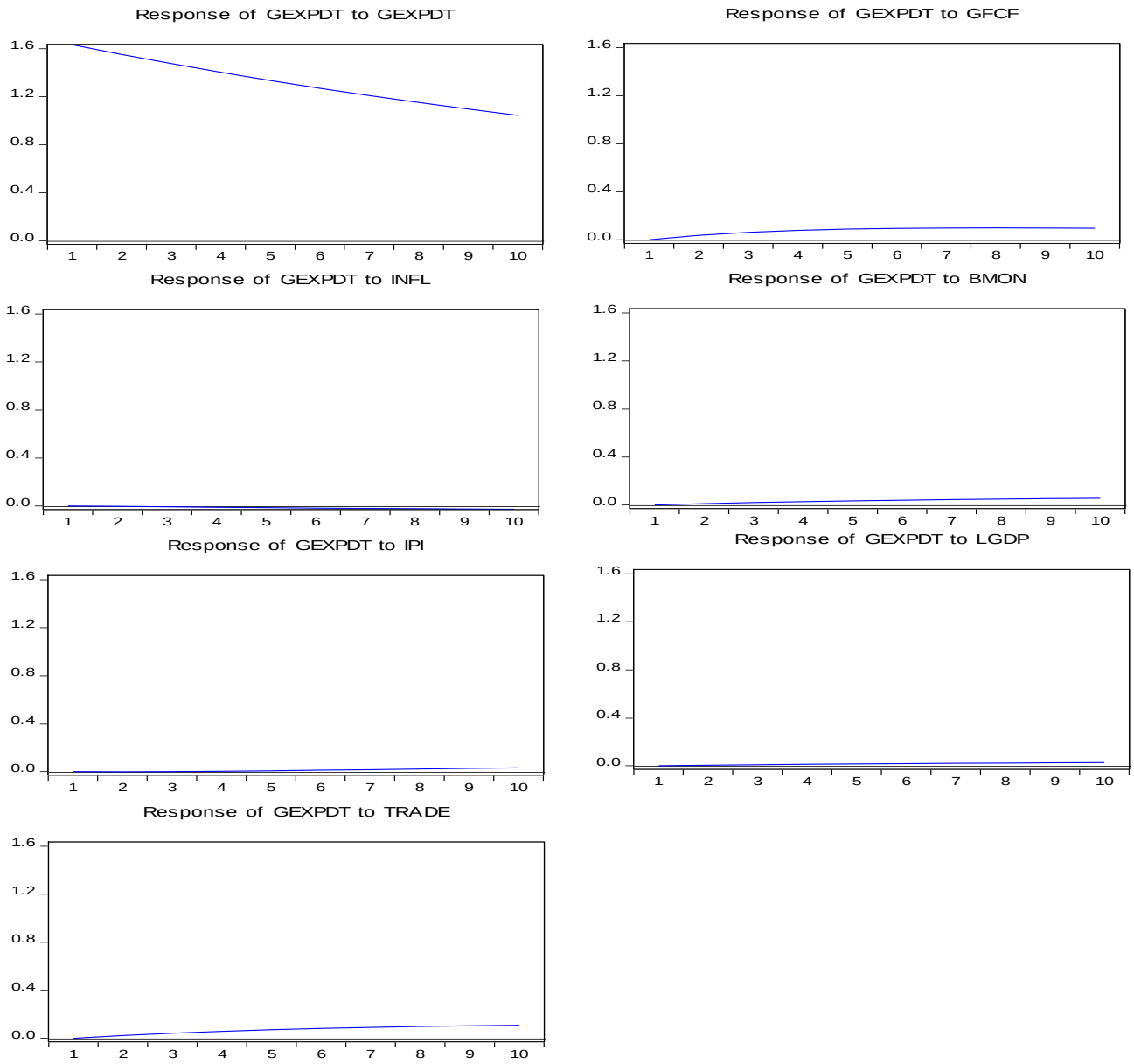
This study deploys the impulse-response function approach to examine the interaction between government expenditure and the other macroeconomic variables of the study in the short run. The approach of the impulse-response function reveals the responses of other macroeconomic variables like inflation, industrial production index, broad money, economic growth, gross fixed capital formation and trade openness to a one-time shock change in government expenditure. Figure 1 shows the results of impulse-response functions for the responses of key macroeconomic variables to oil price shocks in Nigeria. While the responses of gross fixed capital formation, broad money and trade openness to a unit shock in government expenditure are visibly positive over the ten-unit period of analysis, the response of government expenditure to a unit shock from itself is firmly and visibly negative. Finally, the responses of economic growth, industrial production and inflation are flat and neither positive nor negative to a unit shock from government expenditure.

The analysis of the combined response from the Bayesian VAR analysis and the Cholesky impulse response function from each macroeconomic variable to the change in government expenditure can be discussed as follows.

The effect of government expenditure on gross fixed capital formation is positive and significant. Over the years, it has been a veritable source for acquiring and growing fixed capital for African countries. The positive effect of government

expenditure on gross fixed capital formation is in tandem with the studies by Akinlo et al. (2018) and Idowu et al. (2020). This shows that as government expenditure increases, it creates an enabling environment for investors to make more investments, which would spill over into higher productivity and growth.

Figure 1: The Response to Cholesky One S. D. Innovation




Source: Authors' generated using Eviews 10

Similarly, the effect of government expenditure on the money supply is positive and significant in this study. Therefore, government expenditure has been a veritable source of a steady growth of broad money supply in the African Continent. Oyerinde (2019) supports the positive effect of government spending on the broad money supply in developing countries.

Furthermore, the impact of government spending on economic growth has been minimal, significant and negative throughout the study. The study also exemplifies the discordant tunes on the specific direction of government spending on economic growth in developing countries. The inability to record a clear direction on the effect of government spending on economic growth is echoed in the study by Onifade et al. (2020).

The effect of government spending on inflation is positive but not significant in this study. The level of inflation has been high and double-digit for African countries, so it is pertinent to underscore the role of government spending in contributing to it. However, the evidence from this study needs to be more conclusive on the impact of government spending in contributing to the inflationary trend in African countries.

Along this line, the study by Mehrara & Sujoudi (2015) indicates that government spending has minimal effect on inflation in some developing countries. The economic rationale for the increase in inflationary pressures consequent upon the increase in government expenditure is generally borne out of the fact that most expenditures are not directed at productive activities. Instead, most government expenditure is on recurrent and non-productive activities that could spur inflationary tendencies.

The effect of government expenditure on industrial production is minimal and negligible. It means that government fiscal policy has had minimal effect on the industrialisation effort in African countries. This study's revelation underscores African countries' inability to industrialise despite the efforts of the continent's governments over the past many years. This situation is in tandem with the findings of Jeff-Anyene et al. (2019) and Alenoghena et al. (2022B).

Similarly, the effect of government expenditure on trade openness is positive and insignificant. Implementing fiscal policy in Africa has hardly improved the volume of trade in the African continent.

## VII. CONCLUSIONS AND POLICY RECOMMENDATIONS

This study investigated the effect of government expenditure on macroeconomic variables in Africa. The study deploys the Bayesian VAR methodology to analyse the effect of government expenditure on macroeconomic variables over the period 2002 to 2020. The macroeconomic variables selected include economic growth, broad money supply, industrial production, gross fixed capital formation inflation and trade openness. The study also sought to know whether the Keynesian model of crowding in hypothesis applies to the African continent or the classical model.

The findings reveal that while government expenditure has a positive and significant effect on gross fixed capital formation and broad money supply, it has a minimal negative effect on economic growth. In light of the preceding, the study concludes that the Keynesian model of crowding hypothesis is applicable in Africa. Also, while the effect of government expenditure was positive and not significant on inflation, the effect was negative and also not significant on industrial production.

Based on the results obtained, it is recommended that investment be spurred by boosting government expenditure in these African countries. Increasing government expenditure will increase investment and productivity, which will correct the negative effect of government expenditure on industrial production. Moreover, increasing productivity will similarly reduce inflation in these countries as well. Therefore, the government should spend more on projects with the potential of increasing productivity rather than recurrent and non-productive ventures with the tendency to increase inflationary pressures.

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