EVALUATING THE EQUALITY OF REGRESSION MODELS WITH SELF-DEVELOPED STRATOCRACY AND BUREAUCRACY MODELS

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Abstract

This research investigated and compared regression models to determine if there was equality between federal government capital expenditure and economic growth from 1981 to 2022. This research utilized secondary data obtained from the National Bureau of Statistics and Federal Ministry of Finance, Office of the Accountant General of the Federation, and also utilized multiple regression models to analyze the data. The Durbin method was utilized to identify the important variables in a multiple regression model, and a test was conducted to assess if the models were equal; this revealed that all the models' parameters estimate were significant at 5% except constant parameter, which seem biased. It was discovered that the most suitable model among the three regression models (Stratocracy, Bureaucracy and Pooled) was the Pooled Model, which has the highest R^2 value with 100%, have the smallest HQC value of -408.150 and the highest F-value of 79773673382 respectively.

Keywords: *Stratocracy, Bureaucracy, Regression Model, Equality, Evaluation*

I. Introduction

Regression analysis is commonly employed in the examination of survey data when intricate sampling methods are employed. Okafor (2002) opined that the regression estimation method utilizes additional information to enhance the accuracy of estimates for population parameters, such as the average and overall total. In addition, he stated that the population imply is estimated using regression estimation when the regression line of y on x intercepts along the y - axis rather than passing through the origin. The mathematical determination of which variables may also have an impact on regression evaluation is called regression evaluation.

There are numerous benefits to regression analysis. The regression method is used to forecast and establish the cause-and-effect relationship between variables, as its name implies. A crucial as well as closely similar concept involves the advantages of linear regression, which is a method used to predict the value of a variable by sacrificing another. Having a grasp on the significance of regression analysis, the strengths of linear regression, and the perks of evaluating and forecasting using regression can greatly aid a small business, or any business for that matter, in comprehending the factors that could impact its success in the upcoming future.

Understanding that regression evaluation is fundamentally a statistical issue is crucial. Businesses have adhered to numerous standards derived from factual information, as they prove to be beneficial in assisting enterprises to make crucial decisions. This enables businesses to make well-informed and thoroughly analyzed choices, taking into account various aspects of the available data. According to the Merriam-Webster dictionary, statistics refers to factual data, measurements, or records that are employed as a foundation for reason, discussion, or calculation. Regression evaluation uses data, specifically data with multiple variables, to give an indication of possible future information factors. Regression evaluation is advantageous because it provides agencies with a means of analyzing destiny. The forecasting technique of regression enables organizations to utilize accurate approaches in generating significant data related to future earnings, future labor or supply requirements, or other challenging circumstances that lie ahead.

For sustainable development, economic growth is crucial. A developing nation cannot enhance the living standards of its expanding population without the presence of economic growth. The above-mentioned factors primarily contribute to the advancement of infrastructure maintenance, betterment of educational and healthcare facilities, promotion of both foreign and domestic investments, affordable housing, environmental revival, and the bolstering of the agricultural industry. The goal of this strategy is to stimulate the economy by focusing on the primary needs of the nation. According to Saad and Kalkechi (2009), in order to tackle these problems, the government will have to allocate a significant amount of funds, leading to considerable budget shortfalls. However, this situation also presents a chance to generate numerous beneficial employment opportunities and prospects for businesses. The impact of government expenditure on economic growth remains a topic that lacks a definitive answer both in theory and in real-world observation. A number of theoretical perspectives exist on the subject, but it is commonly believed that economic instability or stagnation can result from excessive government spending. The conventional wisdom is not supported by empirical research in a conclusive manner. According to Taiwo and Abayomi (2011), there are varying findings regarding the relationship between government spending and economic growth. Some studies indicate a strong and positive correlation, while others point to a negative or insignificant correlation between increased government spending and actual output growth.

The government's spending has been rapidly rising due to its engagement and operations with various government agencies, departments, and ministries. The ongoing expansion efforts by the state and federal government in Nigeria have led to a consistent increase in government spending, a trend that is observed in many other countries around the globe. The increase in government spending has greatly been driven by the advancements in state activities during the 20th century, such as manufacturing innovations, public health improvements, education enhancements, and expanded commercial endeavors. Abdullah (2010) suggests that public spending is the single most influential economic factor in modern societies. According to Akpan (2005), the structure and magnitude of public spending in an economy play a crucial role in shaping the form and trend of its output growth.

The Nigerian public spending structure can be divided into capital expenditure and recurrent expenditure. Recurrent expenditure consists of costs related to administration, such as loan interest, maintenance expenses, and salaries. On the other hand, capital expenditure refers to government initiatives focused on areas like electricity generation, education, telecommunications, airports, and roads. The allocation of public funds has primarily focused on the development of public infrastructure. It required a huge amount of financing to provide and maintain these infrastructural amenities. Therefore, the economy is anticipated to experience positive growth as a result of investments in infrastructure and productive activities, while government spending on consumption is likely to hinder growth. There is a

contention that the nation will experience both social and economic advantages through the government's allocation of funds towards areas such as healthcare, infrastructure, education, agriculture, and others. The question of the impact of public spending on economic growth has been a topic of constant debate among scholars (Abu & Abdullahi, 2010).

One of the main indicators used to look at the health of a country's economy is the Gross Domestic Product (GDP). Additionally, it is employed to gauge the quality of life for individuals within an economy. The Gross Domestic Product represents the total worth of all officially acknowledged finished products and services generated within a nation during a specific timeframe. This means that the Gross Domestic Product would consider the market worth of every good or service, instead of just summing up their quantities. The Gross Domestic Product (GDP) plays a vital role in an economy as it serves as a measure to assess the pace and slowdown of economic growth. Additionally, it is employed to make comparisons between the magnitudes of various global economies. The rate at which economies around the world grow in comparison to each other is determined by the Gross Domestic Product. As an example, the Federal Reserve in the United States makes use of it as a means to determine if the economy requires limitations or boosts.

The elements of the Gross Domestic Product, as determined through the expenditure approach, consist of Consumption, Investment, Government spending, Gross exports, and Gross imports. While GDP can be calculated using the formula C I G (X - M), there are two alternative methods for determining the Gross Domestic Product. These methods include the Value Added approach, also referred to as the Production approach, and the Income approach, also referred to as the By Type approach. The computation of Gross Domestic Product (GDP) through any of the three approaches does not take into account intermediate goods. Instead, it focuses solely on "new" products and services (final goods) to stay away from duplicating their contribution and providing an incorrect portrayal of GDP. There are two categories of GDP: Real GDP and Nominal GDP. Real GDP represents a country's economic output after adjusting for inflation, while Nominal GDP is an estimate that does not consider changes in prices.

This research aims to create a representation of the four repetitive patterns of the Nigerian Federal Government's capital expenditures, which are associated with the country's economic growth measured by GDP. Most of the research conducted on Federal government Capital expenditures has primarily concentrated on explaining the origins, factors, magnitude, and long-term viability of the Government's financial issue and its impact on the nation's GDP. Only a limited number of studies have examined the impact of specific expenditure series on the economic growth of Nigeria's GDP. These studies include Ajayi and Oke (2012), Adepoju (2007), and Anyamu (2013). In addition, research conducted in Nigeria, Europe, and other advanced economies has examined the extent of Government spending by analyzing recurrent expenses, debt servicing, security expenditure, and education spending. However, none of these studies have assessed the actual influence of these four recurring categories of Federal Government Capital expenditures on the economic growth of Nigeria, as measured by its GDP.

Problem Statement

Due to the substantial earnings from crude oil production and sales, Nigeria has sustained a significant level of government expenditure, meeting the rising need for public services like transportation, telecommunications, electricity, education, and healthcare. The present difficulties posed by the Boko Haram insurgency, Niger Delta Avengers crises, and Fulani herdsmen threat are intensifying the requirement for ensuring the safety and protection of both the citizens and the country, both domestically and internationally. It is disheartening that despite the rising revenue from oil sales, there is a lack of concrete proof to support how

Nigeria's income is utilized. The majority of the nation's ongoing expenses prioritize the administrative sector, neglecting economic, social, and community services. The suggestion is that a smaller portion of the income is being used for the well-being of the people over time, raising the question of whether the Nigerian government is genuinely making a difference in the life of its people, or if the money is being trapped within corrupt bureaucratic obstacles.

The unexpected slow expansion of the Nigerian economy, in spite of the rise in government spending, is quite remarkable considering that Nigeria has been categorized as a low income developing nation by the World Bank. According to the United National Development Report (UNDP, 1998), the wide prevalence of poverty in Nigeria is evident as more than 60 % of the population falls below the poverty line. This demonstrates her notable characteristic.

The Nigerian situation isn't improving as the poverty line continues to worsen. Over fourteen million Nigerians are living in extreme poverty, surviving on less than N320 per month, and that is barely enough to meet a quarter of their nutritional needs for a healthy life (Nnamdi, 2013). Due to this factor, as well as various other factors, the discussion remains inconclusive regarding the impact of raising federal capital expenditures on stimulating economic growth. This study employed up-to-date and exact data (spanning from 1981 to 2022) to compare regression models with stratocracy and bureaucracy models that were developed by the researchers themselves.

Aim and Objectives of the Study

The aim of this study is to examine a comparative analysis and test for equality of regression models using federal government capital expenditure and economic growth (Nigeria GDP) between the period 1981 to 1999 (Stratocracy) and 2000 to 2022 (Bureaucracy); then compare their effect. That is two models, Stratocracy model and Bureaucracy model. Specifically, the objectives of the study are:

1. Obtain the series plots of the various recurrent series on the federal government capital expenditure in Nigeria.
2. Obtain the parameter estimates for each of the regression models (Stratocracy, Bureaucracy and Pooled) under consideration.
3. Assess the models' performance using suitable evaluation metrics, such as Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE), R-squared (R^2), AIC or BIC.
4. Test for model equality and Check for significance variables (i.e. compare the result of the two regression methods used).
5. Check for significant effect of each of the recurrent series of the federal government capital expenditure in Nigeria on economic growth (Nigeria GDP).

II. Literature Review

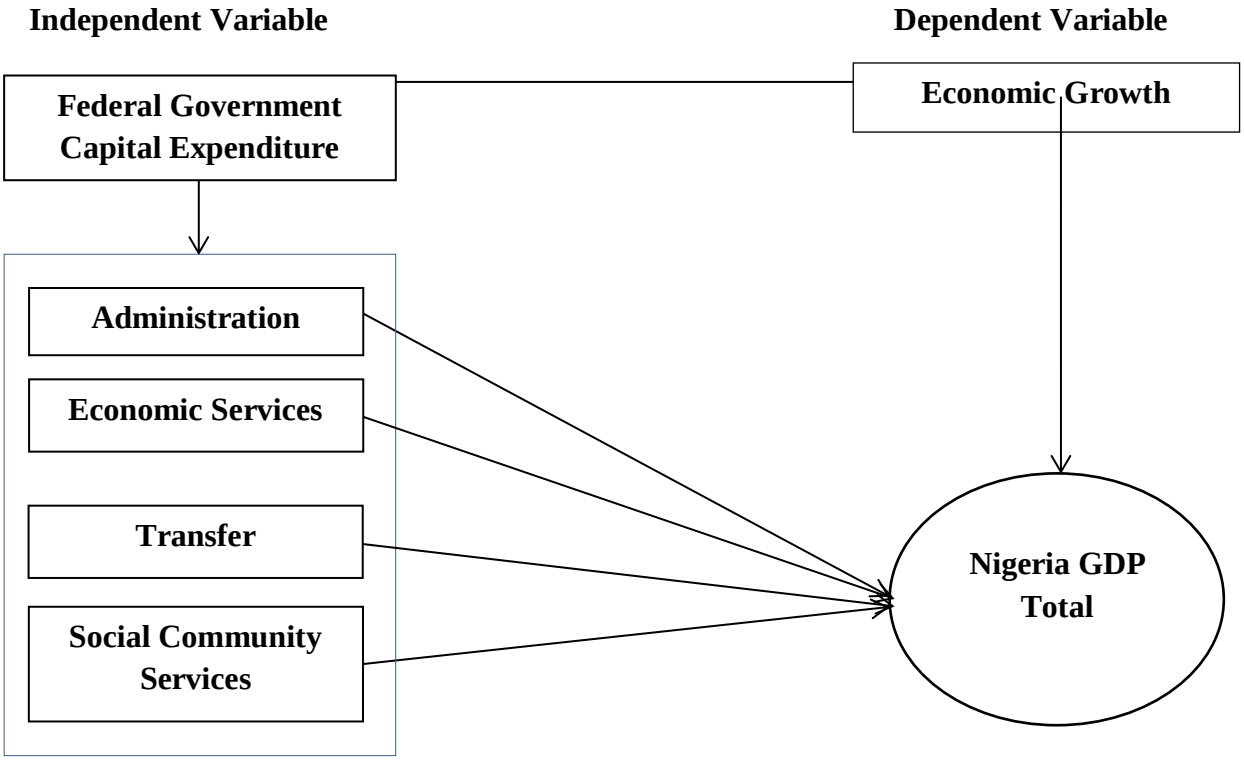

Figure 1: Conceptualization on FGCE and EG Adopted from Brette & Weast (2012)

Stratocracy Model: This refers to a model developed from the military government regime (from 1981 to 1999).

Bureaucracy Model: This refers to a model developed from the civilian government regime (from 2000 to 2022).

Oliaya et al. (2011) investigated the cause-and-effect connections between economic growth, public expenditure, and inflation in Nigeria from 1970 to 2010. In their study, the researchers analyzed the characteristics of the variables by conducting the Augmented Dickey-Fuller (ADF) and Philip Perron tests. The variables were noted to exhibit stationarity, although not in their original form, but rather after taking their first difference. The co - integration method used by Johansen and Juselius (JJ) demonstrated that the variables were co-integrated. Additionally, the tri-variate vector error correction model (VECM) indicated a two-way relationship between government expenditures and economic growth, both long and short term. Furthermore, it was discovered that there was a one-way relationship between economic growth and government spending, as well as the inflation rate in the short term. This relationship did not involve any influence or impact from the inflation rate.

In a study conducted by Okoro in 2013, the researcher examined how government spending influenced economic growth using data from the years 1980 to 2011. He utilized a number of statistical methods such as the Johansen co-integration test, ordinary least squares (OLS) multiple regression analysis, the error correction model, and the causality test. Through these analyses, he discovered a stable and lasting link between economic growth and government expenditure in Nigeria. Additionally, the short-term dynamics adapt at a speed of 60 percent each year to reach a long-term balance. This implies that both immediate and long-term

spending have substantial impacts on the growth of the economy. He concluded that there was unidirectional causality between government spending and economic growth.

In his study, Khalaf (2013) investigated the differences between biased and unbiased estimators within the context of standard least squares regression. In this study, Ridge regression is seen as a collection of estimators for' that are classified based on a single scalar parameter k. Simulation techniques are used to propose and assess two different approaches for determining the value of k, with the evaluation based on Mean Square Error (MSE). A comparison with other Ridge estimators of the same type was made elsewhere. As found, the suggested estimators have a lower estimated mean squared error (MSE) when compared with other estimators for the ridge parameter as well as the regular least squares (OLS) estimator. Other factors that were selected to be different included the size of the sample and the quantity of regressions. They generate models using different sample sizes of 25, 50, 100, as well as 150 data points, as well as varying numbers of explanatory variables, including 2 and 4. The findings indicated that when the number of factors is increased and non-normal pseudo random numbers are used to produce results, the estimated mean squared error (MSE) is higher. On the other hand, when the sample size is increased, the estimated mean squared error (MSE) is higher.

In a study conducted by Ekundayo and Odhigu (2016), the authors examined the factors that influence the accounting of human capital in Nigeria. The research utilized information obtained from the annual reports of thirty companies that have been listed on the Nigerian stock exchange (NSE) fact-book as of December 31, 2014. The data used in the study was not directly collected by the researchers, but rather obtained from existing sources. This study used a pooled data research design and ordinary least square regression to test the correlation between variables. The research discovered that the employee's physical dimensions have a notable impact on the measurement of human capital in accounting. The research suggests that welfare and training expenses play a significant role in shaping the human capital of Nigeria.

Within the Nigeria banking sector, Ekwe (2012) conducted research on how intellectual capital is connected to the financial performance. The study utilized the method of multiple regression analysis to examine all of the hypotheses. The research utilized information gathered from 66 companies that were listed on the Nigerian stock Exchange between 1999 and 2007, which had been previously collected and was not the primary focus of the study. The VAIC components exhibited a strong and meaningful association with the banks' Return on Assets in Nigeria. The different elements of VAIC were found to have a strong positive relationship with the banks' Return on Equity in Nigeria. The study also showed a positive and significant correlation between VAIC components and bank employee productivity in Nigeria. The findings also suggested that there was no notable connection between the different aspects of VAIC and a rise in banks' revenue. In Nigeria the elements of VAIC showed a positive correlation with the market to book value ratio of banks.

In their study, Nwaeze et al. (2014) investigated how Federal Government Expenditure affected the economic growth of Nigeria from 1992 to 2011, analyzing both the characteristics and consequences of this expenditure. The researchers collected time series data for a twenty-year period from secondary sources. They then used the Ordinary Least

Square (OLS) multiple regression method to analyze the data and estimate the hypothesis they had formulated to align with their study objectives. The dependent variable chosen to measure economic growth is the Real Gross Domestic Product. The independent variables used for analysis are Total Recurrent Expenditure and Total Capital Expenditure. The findings of their research indicate that during the time period analyzed, the Federal Government Expenditure in Nigeria had a positive effect on economic growth, but this effect was not statistically significant.

In their study, Shabana et al. (2017) examined the correlation between Government expenditure, healthcare, security expenditure, and economic development in Nigeria. In analyzing the data, the study applied the vector error correction model as well as the standard least square regression. According to the research, the allocation of funds by the government towards healthcare, security, and development initiatives in South Africa between 2012 and 2015 has both immediate and prolonged effects on the country's economic growth.

III. Methods and Materials

Nature and Source of Study Data: The researcher used a yearly secondary statistics data of a periodic range of 42 years 1981-2022 extracted from the National Bureau of Statistics and Federal Ministry of Finance, Office of the Accountant-General of the Federation for this study in Nigeria.

Data Analysis Tools: The following programmes are used to obtain the parameters which constitute the models; some of which include MINITAB (version 18.0) and Microsoft Excel 2010.

Model Specification

The hypothesis below was tested:

H_0: There is no significant relationship between federal government capital expenditure on administration, economic services, transfer, social community services and economic growth.

H_1: There is significant relationship between federal government capital expenditure on administration, economic services, transfer, social community services and economic growth.

Suppose we have regression models of the form;

$$y = f(x)$$

$$y = \beta_0 + \beta_1 x + \varepsilon_i = (x'x)^{-1} x'y \tag{1}$$

Equation (1) is a simple linear regression model and

$$y = f(x_1, x_2, x_3, x_4)$$

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_k x_k + \varepsilon_i \tag{2}$$

$$= (x'x)^{-1} x'y$$

where,

y_i = Response (Nigerian GDP)

x_i = k^{th} predictor (some series expenditures) or independent variables

β_k = k^{th} population regression coefficient

Then, X_i is the matrix of the explanatory variables and is of the form:

$$X = \begin{bmatrix} 1 & x_{11} & x_{12} & x_{13} & \ldots\ x_{1k} \\ 1 & x_{21} & x_{22} & x_{23} & \ldots\ x_{2k} \\ 1 & x_{31} & x_{32} & x_{33} & x\ldots_{3k} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & x_{n1} & x_{n2} & x_{n3} & \ldots\ x_{nk} \end{bmatrix} \tag{3}$$

Y and β are of the form:

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \vdots \\ y_n \end{bmatrix}, \qquad \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \vdots \\ \beta_n \end{bmatrix}$$

Where

$$x'x = \begin{bmatrix} n & \Sigma x_1 & \Sigma x_2 & \Sigma x_3 & \Sigma x_4 \\ \Sigma x_1 & \Sigma x_1^2 & \Sigma x_1 x_2 & \Sigma x_1 x_3 & \Sigma x_1 x_4 \\ \Sigma x_2 & \Sigma x_1 x_2 & \Sigma x_2^2 & \Sigma x_2 x_3 & \Sigma x_2 x_4 \\ \Sigma x_3 & \Sigma x_1 x_3 & \Sigma x_2 x_3 & \Sigma x_3^2 & \Sigma x_3 x_4 \\ \Sigma x_4 & \Sigma x_1 x_4 & \Sigma x_2 x_4 & \Sigma x_3 x_4 & \Sigma x_4^2 \end{bmatrix}, \tag{4}$$

$$x'y = \begin{bmatrix} \Sigma y \\ \Sigma x_1 y \\ \Sigma x_2 y \\ \Sigma x_3 y \\ . \\ . \\ . \\ \Sigma x_k y \end{bmatrix} \tag{5}$$

The matrix form of the model is giving by:

$$\begin{bmatrix} \Sigma y \\ \Sigma x_1 y \\ \Sigma x_2 y \\ \Sigma x_3 y \\ . \\ . \\ . \\ \Sigma x_k y \end{bmatrix} = \begin{bmatrix} n & \Sigma x_1 & \Sigma x_2 & \Sigma x_3 & \dots \Sigma x_k \\ \Sigma x_1 & \Sigma x_1^2 & \Sigma x_1 x_2 & \Sigma x_1 x_3 & \dots \Sigma x_1 x_k \\ \Sigma x_2 & \Sigma x_1 x_2 & \Sigma x_2^2 & \Sigma x_2 x_3 & \Sigma x_2 x_k \\ \Sigma x_3 & \Sigma x_1 x_3 & \Sigma x_2 x_3 & \Sigma x_3^2 & \Sigma x_3 x_k \\ \Sigma x_4 & \Sigma x_1 x_4 & \Sigma x_2 x_4 & \Sigma x_3 x_4 & \Sigma x_4^2 \end{bmatrix}^{-1} \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ . \\ . \\ . \\ \beta_4 \end{bmatrix} \quad (6)$$

$$\begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} = (x'x)^{-1}x'y = \begin{bmatrix} n & \Sigma x_1 & \Sigma x_2 & \Sigma x_3 & \Sigma x_4 \\ \Sigma x_1 & \Sigma x_1^2 & \Sigma x_1 x_2 & \Sigma x_1 x_3 & \Sigma x_1 x_4 \\ \Sigma x_2 & \Sigma x_1 x_2 & \Sigma x_2^2 & \Sigma x_2 x_3 & \Sigma x_2 x_4 \\ \Sigma x_3 & \Sigma x_1 x_3 & \Sigma x_2 x_3 & \Sigma x_3^2 & \Sigma x_3 x_4 \\ \Sigma x_4 & \Sigma x_1 x_4 & \Sigma x_2 x_4 & \Sigma x_3 x_4 & \Sigma x_4^2 \end{bmatrix}^{-1} \begin{bmatrix} \Sigma y \\ \Sigma x_1 y \\ \Sigma x_2 y \\ \Sigma x_3 y \\ \Sigma x_4 y \end{bmatrix}$$

and $$v(\hat{\beta}_{iv}) = MSE(x'x)^{-1}x'y \quad (7)$$

If *n* is odd, then the middle observation can be deleted. Using this approach, the estimators are constant but likely to have large variance which is the limitation of this Method.

Akaike Information Criteria (AIC)

Akaike (1974) developed a manner that's called Akaike Information criteria. The form of this information is given under:

$$AIC = n\ln\left[\frac{SSE}{n}\right] + 2(k) \quad (8)$$

Where;

- N = Sample size
- K = Number of parameter and
- SSE = Sum of square error.

SCHWARZ Bayesian Information Criterion (BIC)

Schwarz (1978) advanced a method that's referred to as SCHWARZ (BIC) criteria. The form of this method is given below as:

$$BIC = n\ln\left[\frac{SSE}{n}\right] + k\ln(n) \quad (9)$$

The fee of SCHWARZ (BIC) will also decrease provided there are as a minimum of eight observations.

Coefficient of Determination (R^2)

R^2 is one of the essential statistical parameters used in decision making and for statistical inferences. It is a manner used to determine the share of results of 1 or extra variables over the others. The form of this process is represented as:

$$R^2 = \frac{SSR}{SST} \tag{10}$$

Where; SSR= Sum of square Residual

SST= Sum of Square Total

Mean Square Error

Mean square error, which is the variance around the fitted regression line. MS Error = s^2.

The formula is:

$$MSE = \frac{SS_{Error}}{DF_{Error}} = \frac{\sum (y_i - \hat{y}_i)^2}{n - p - 1} \tag{11}$$

F-value (F)

If the calculated F-value is greater than the F-value from the F-distribution, then at least one of the coefficients is not equal to zero. The F-value is used to determine the p-value. The formula for the calculated F-value is:

$$F = \frac{MS_{Rgression}}{MS_{Error}} \tag{12}$$

IV. Results

A. Series Plots of the Various Services on the Nigeria GDP

In this section, the yearly federal government capital expenditure and the series plots (FGC expenditures on Gross Domestic Product) were done to examine the relationships, trend component and seasonality effect, if presence in the data sets.

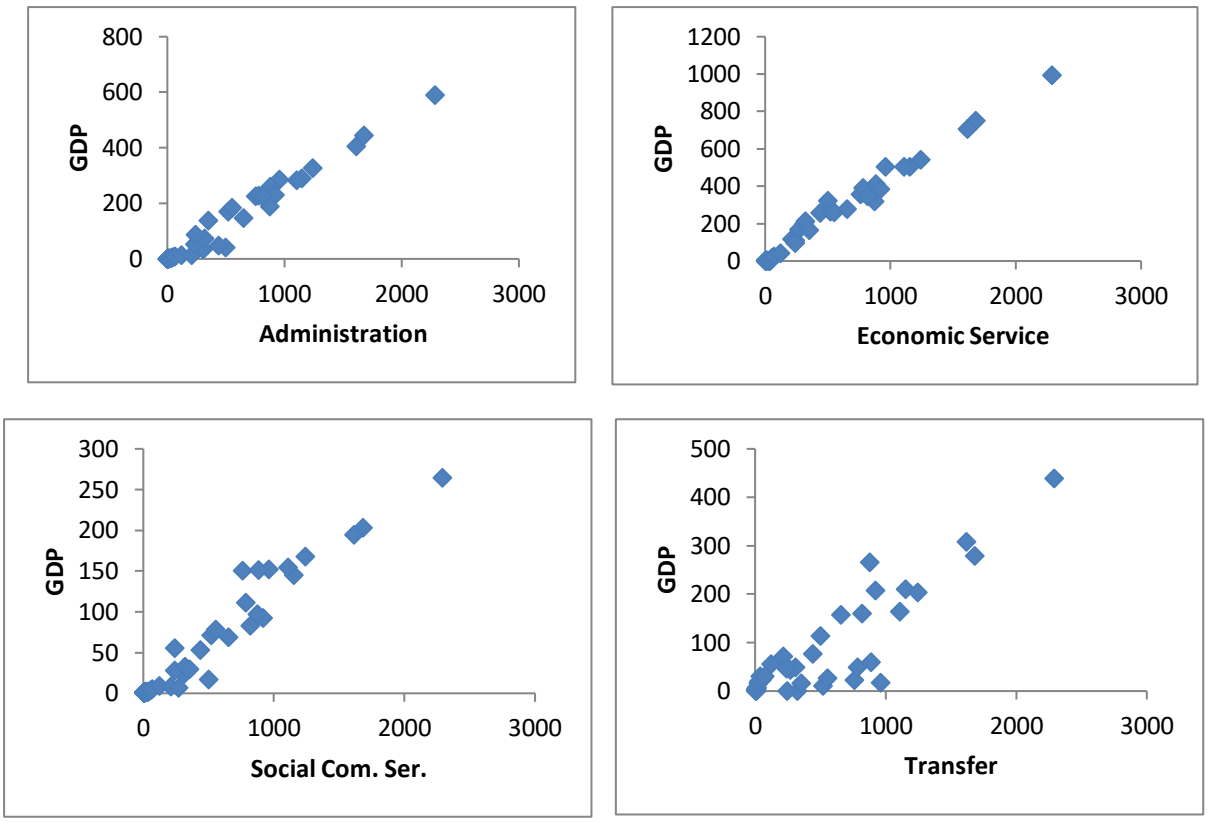

Figure 2: Scatter Plot of the FGC Expenditures against GDP of Nigeria

Figure 2 shows an upward trend for the entire plot above. These are suggesting a nonlinear relationship between the FGC expenditures and the GDP of Nigeria. Hence, the Durbin method of estimated a multiple regression model was applied to determine the significant parameters and test for model equality. Thereafter, the data set was slipped into two models, Stratocracy model (period of 1981 to 1999) and Bureaucracy model (period of 2000 to 2022).

B. Stratocracy Regression Model

$n_1=19$, $\Sigma x_1=193.55$, $\Sigma x_2=928.78$, $\Sigma x_3=89.23$, $\Sigma x_4=482.56$, $\Sigma y_1=1694.05$, $\Sigma x_1x_2=32089.28$, $\Sigma x_1x_3=2262.366$, $\Sigma x_1x_4=11363.43$, $\Sigma x_2x_3=13106.01$, $\Sigma x_2x_4=66713.85$, $\Sigma x_3x_4=4958.763$, $\Sigma x_1^2=6129.186$, $\Sigma x_2^2=190712.4$, $\Sigma x_3^2=1112.487$, $\Sigma x_4^2=28841.82$, $\Sigma x_1y_1=51843.95$, $\Sigma x_2y_1=302621$, $\Sigma x_3y_1=21439.44$, $\Sigma x_4y_1=111876.5$, $\bar{y}_1=89.1605$

$$x'x=\begin{bmatrix}19 & 193.55 & 928.78 & 89.23 & 482.56\\ 193.55 & 6129.186 & 32089.277 & 2262.366 & 11363.43\\ 928.78 & 32089.28 & 190712.441 & 13106.01 & 66713.85\\ 89.23 & 2262.366 & 13106.0106 & 1112.487 & 4958.763\\ 482.56 & 11363.43 & 66713.8485 & 4958.763 & 28841.82\end{bmatrix}, \quad x'y_1=\begin{bmatrix}1694.05\\ 51843.9521\\ 302620.9736\\ 21439.4364\\ 111876.5379\end{bmatrix}$$

$$x'y_1 = \begin{bmatrix} 1694.05 \\ 51843.9521 \\ 302620.9736 \\ 21439.4364 \\ 111876.5379 \end{bmatrix} = \begin{bmatrix} 19 & 193.55 & 928.78 & 89.23 & 482.56 \\ 193.55 & 6129.186 & 32089.277 & 2262.366 & 11363.43 \\ 928.78 & 32089.28 & 190712.441 & 13106.01 & 66713.85 \\ 89.23 & 2262.366 & 13106.0106 & 1112.487 & 4958.763 \\ 482.56 & 11363.43 & 66713.8485 & 4958.763 & 28841.82 \end{bmatrix}^{-1} \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix}$$

$$\begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} = (x'x)^{-1}x'y_1 = \begin{bmatrix} 0.131915 & -0.00546 & 0.001954221 & -0.009 & -0.00303 \\ -0.00546 & 0.001626 & -0.000288062 & 1.35E-05 & 0.000115 \\ 0.001954 & -0.00029 & 9.792E-05 & -0.00032 & -9E-05 \\ -0.009 & 1.35E-05 & -0.000321311 & 0.00607 & -0.00016 \\ -0.00303 & 0.000115 & -9.04578E-05 & -0.00016 & 0.000276 \end{bmatrix} \begin{bmatrix} 1694.05 \\ 51843.9521 \\ 302620.9736 \\ 21439.4364 \\ 111876.5379 \end{bmatrix}$$

$$\begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} = (x'x)^{-1}x'y_1 = \begin{bmatrix} -0.00298018 \\ 0.999896199 \\ 1.000074979 \\ 0.999863954 \\ 0.999894757 \end{bmatrix}$$

Table 1: Descriptive Statistics of the Stratocracy Model

Stratocracy Model	Parameter ± SE	t-test	P	Remark
β_0	-0.002980 ± 0.001787	-1.67	0.118	Not Significant
β_1	0.999896 ± 0.000198	5039.90	0.000**	Significant
β_2	1.000075 ± 0.00005	20542.32	0.000**	Significant
β_3	0.999864 ± 0.000383	2608.50	0.000**	Significant
β_4	0.999895 ± 0.000082	12230.63	0.000**	Significant

Footnote: **= Significant at p< 0.05

The required estimated model is

$$\hat{y}_1 = -0.00298 + 0.999896x_1 + 1.000075x_2 + 0.999864x_3 + 0.999895x_4 \quad (12)$$

Table 1 summarised parameter estimates, t-test, p-value and standard error of the Durbin method for the federal government capital expenditure on administration, economic service, social community service, transfer and economic growth (GDP of Nigeria) respectively. Similarly, the results of parameters obtained showed that all the parameters are significant at 5% except the constant.

C. Bureaucracy Regression Model

n_2=21, Σx_1=4908.11, Σx_2=8390.31, Σx_3=2387.57, Σx_4=2720.23, Σy_2=18406.18, Σx_1x_2 =2535788, Σx_1x_3=722111.4, Σx_1x_4=894580.4, Σx_2x_3=1222564, Σx_2x_4=1527205, Σx_3x_4 =421367.5, Σx_1^2=1506893, Σx_2^2=4322314, Σx_3^2=353331.9, Σx_4^2=657825.3, Σx_1y_2=5659366, Σx_2y_2=9607858, Σx_3y_3=2719372, Σx_4y_2=3500974, $\bar{y}_2$= 876.4848

$$x'x = \begin{bmatrix} 21 & 4908.11 & 8390.31 & 2387.57 & 2720.23 \\ 4908.11 & 1506893 & 2535787.985 & 722111.4 & 894580.4 \\ 8390.31 & 2535788 & 4322313.602 & 1222564 & 1527205 \\ 2387.57 & 722111.4 & 1222564.436 & 353331.9 & 421367.5 \\ 2720.23 & 894580.4 & 1527204.506 & 421367.5 & 657825.3 \end{bmatrix}, \quad x'y_2 = \begin{bmatrix} 18406.18 \\ 5659366.493 \\ 9607858.25 \\ 2719371.998 \\ 3500974.145 \end{bmatrix}$$

$$\begin{bmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix} = (x'x)^{-1}x'y_2 = \begin{bmatrix}21 & 4908.11 & 8390.31 & 2387.57 & 2720.23\\ 4908.11 & 1506893 & 2535787.985 & 722111.4 & 894580.4\\ 8390.31 & 2535788 & 4322313.602 & 1222564 & 1527205\\ 2387.57 & 722111.4 & 1222564.436 & 353331.9 & 421367.5\\ 2720.23 & 894580.4 & 1527204.506 & 421367.5 & 657825.3\end{bmatrix}^{-1}\begin{bmatrix}18406.18\\ 5659366.493\\ 9607858.25\\ 2719371.998\\ 3500974.145\end{bmatrix}$$

$$\begin{bmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix} = (x'x)^{-1}x'y_2 = \begin{bmatrix}0.238618 & 0.000177 & -0.00078789 & 0.00015 & 0.000508\\ 0.000177 & 6.35E-05 & -2.36645E-05 & -4.6E-05 & -3E-06\\ -0.00079 & -2.4E-05 & 2.73317E-05 & -3.2E-05 & -7.7E-06\\ 0.000146 & -4.6E-05 & -3.16589E-05 & 0.000185 & 1.64E-05\\ 0.000508 & -3E-06 & -7.73462E-06 & 1.64E-05 & 1.09E-05\end{bmatrix}\begin{bmatrix}18406.18\\ 5659366.493\\ 9607858.25\\ 2719371.998\\ 3500974.145\end{bmatrix}$$

$$\begin{bmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix} = (x'x)^{-1}x'y_2 = \begin{bmatrix}-0.00319273\\ 1.000076045\\ 0.999965918\\ 0.999976212\\ 0.999998738\end{bmatrix}$$

Table 2: Descriptive Statistics of the Bureaucracy Model

Bureaucracy Model	Parameter ± SE	t-test	P	Remark
β_0	-0.0031927 ± 0.00006	-0.92	0.373	Not Significant
β_1	1.0000761 ± 0.00006	17612.96	0.000**	Significant
β_2	0.9999659 ± 0.00004	26843.42	0.000**	Significant
β_3	0.999976 ± 0.00010	10318.66	0.000**	Significant
β_4	0.9999987 ± 0.00002	42428.25	0.000**	Significant

Footnote: **= Significant at p< 0.05

The required estimated model is

$$\hat{y}_2 = -0.003193 + 1.000076x_1 + 0.999966x_2 + 0.999976x_3 + 0.9999987x_4 \quad (13)$$

Table 2 summarised parameter estimates, t-test, p-value and standard error of the Durbin method for the federal government capital expenditure on administration, economic service, social community service, transfer and economic growth (GDP of Nigeria) respectively. Similarly, the results of parameters obtained showed that all the parameters are significant at 5% except the constant.

D. Pooled Regression Model

n_p=40, Σx_1=5101.66, Σx_2=9319.09, Σx_3=2476.8, Σx_4=3202.79, Σy_p=20100.23, Σx_1x_2 =2567877, Σx_1x_3=724373.8, Σx_1x_4=905943.8, Σx_2x_3=1235670, Σx_2x_4=1593918, Σx_3x_4 =426326.3, Σx_1^2=1513022, Σx_2^2=4513026, Σx_3^2=354444.4, Σx_4^2=686667.2, Σx_1y_p=5711210, Σx_2y_p=9910479, Σx_3y_p=2740811, Σx_4y_p=3612851, $\bar{y}_p$= 502.5058

$$x'x = \begin{bmatrix}40 & 5101.66 & 9319.09 & 2476.8 & 3202.79\\ 5101.66 & 1513022 & 2567877 & 724373.8 & 905943.8\\ 9319.09 & 2567877 & 4513026 & 1235670 & 1593918\\ 2476.8 & 724373.8 & 1235670 & 354444.4 & 426326.3\\ 3202.79 & 905943.8 & 1593918 & 426326.3 & 686667.2\end{bmatrix}, \quad x'y_p = \begin{bmatrix}20100.23\\ 5711210.445\\ 9910479.224\\ 2740811.434\\ 3612850.683\end{bmatrix}$$

$$x'y_p = \begin{bmatrix}20100.23\\ 5711210.445\\ 9910479.224\\ 2740811.434\\ 3612850.683\end{bmatrix} = \begin{bmatrix}40 & 5101.66 & 9319.09 & 2476.8 & 3202.79\\ 5101.66 & 1513022 & 2567877 & 724373.8 & 905943.8\\ 9319.09 & 2567877 & 4513026 & 1235670 & 1593918\\ 2476.8 & 724373.8 & 1235670 & 354444.4 & 426326.3\\ 3202.79 & 905943.8 & 1593918 & 426326.3 & 686667.2\end{bmatrix}^{-1}\begin{bmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix}$$

$$\begin{bmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix} = (x'x)^{-1}x'y_p = \begin{bmatrix}40 & 5101.66 & 9319.09 & 2476.8 & 3202.79\\ 5101.66 & 1513022 & 2567877 & 724373.8 & 905943.8\\ 9319.09 & 2567877 & 4513026 & 1235670 & 1593918\\ 2476.8 & 724373.8 & 1235670 & 354444.4 & 426326.3\\ 3202.79 & 905943.8 & 1593918 & 426326.3 & 686667.2\end{bmatrix}^{-1}\begin{bmatrix}20100.23\\ 5711210.445\\ 9910479.224\\ 2740811.434\\ 3612850.683\end{bmatrix}$$

$$\begin{bmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix} = (x'x)^{-1}x'y_p = \begin{bmatrix}0.050224 & 0.000196 & -0.00023 & -2.5E-06 & 3.73E-05\\ 0.000196 & 4.52E-05 & -7.7E-06 & -6.2E-05 & -4.5E-06\\ -0.00023 & -7.7E-06 & 9.28E-06 & -1E-05 & -3.9E-06\\ -2.5E-06 & -6.2E-05 & -1E-05 & 0.000151 & 1.18E-05\\ 3.73E-05 & -4.5E-06 & -3.9E-06 & 1.18E-05 & 9.04E-06\end{bmatrix}\begin{bmatrix}20100.23\\ 5711210.445\\ 9910479.224\\ 2740811.434\\ 3612850.683\end{bmatrix}$$

$$\begin{bmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix} = (x'x)^{-1}x'y_p = \begin{bmatrix}-0.003964455\\ 1.000038478\\ 1.000007996\\ 0.999924978\\ 0.999988628\end{bmatrix}$$

Table 3: Descriptive Statistics of the Pooled Model

Pooled Model	Parameter ± SE	t-test	P	Remark
β_0	-0.00396 ± 0.001357	-2.92	0.006**	Significant
β_1	1.0000385 ± 0.00004	24560.49	0.000**	Significant
β_2	1.000008 ± 0.00002	54203.73	0.000**	Significant
β_3	0.999925 ± 0.000074	13443.83	0.000**	Significant
β_4	0.999989 ± 0.00002	54926.09	0.000**	Significant

Footnote: **= Significant at p< 0.05

The required estimated model is

$$\hat{y}_p = -0.00396 + 1.0000385x_1 + 1.000008x_2 + 0.999925x_3 + 0.999989x_4 \quad (14)$$

Table 3 summarised parameter estimates, t-test, p-value and standard error of the Durbin method for the federal government capital expenditure on administration, economic service, social community service, transfer and economic growth (GDP of Nigeria) respectively. Similarly, the results of parameters obtained showed that all the parameters are significant at 5%.

E. Computation of the Model Selection Criteria

a. Akaike Information Criteria (AIC) for the Three Models

$$AIC_1 = 19\ln\left[\frac{0.00035}{19}\right] + 2(4) = -199.138$$

$$AIC_2 = 21\ln\left[\frac{0.00108}{21}\right] + 2(4) = -199.382$$

$$AIC_{Pooled} = 40\ln\left[\frac{0.0013}{40}\right] + 2(4) = -405.371$$

b. SCHWARZ Bayesian Information Criterion (BIC) for the Three Models

$$BIC_1 = 19\ln\left[\frac{0.00035}{19}\right] + 4\ln(19) = -195.361$$

$$BIC_2 = 21\ln\left[\frac{0.00108}{21}\right] + 4\ln(21) = -195.204$$

$$BIC_{Pooled} = 40\ln\left[\frac{0.0013}{40}\right] + 4\ln(40) = -398.615$$

c. Hannan-Quinn Criteria (HQC) for the Three Models

$$HQC_1 = 19\ln\left[\frac{0.00035}{19}\right] + 4\ln[\ln(19)] = -202.819$$

$$HQC_2 = 21\ln\left[\frac{0.00108}{21}\right] + 4\ln[\ln(21)] = -202.928$$

$$HQC_{Pooled} = 40\ln\left[\frac{0.0013}{40}\right] + 4\ln[\ln(40)] = -408.150$$

F. Comparison of the three Identified Regression Models

We compared the three identified regression models for the various federal government capital expenditures on the Nigeria GDP to determine the model that has more effect on total GDP of Nigeria in table 4.

Table 4: Regression Analysis Summary of the Parameter Estimates for the three Models

MODELS	PARAMETER ESTIMATES β_0 (p-value) t-test	β_1 (p-value) t-test	β_2 (p-value) t-test	β_3 (p-value) t-test	β_4 (p-value) t-test	MSE	R^2	R^2(a	AIC	BIC	HQC	F
Stratocracy	-0.002980 ± 0.001787(0.118) -1.67	0.999896 ± 0.0002 (0.000**) 5039.90	1.000075 ± 0.00005 (0.000**) 20542.32	0.999864 ± 0.000383(0.000**) 2608.50	0.99989 ± 0.00008(0.000**) 12230.63	0.000025	100.0%	100.0%	-199.138	-195.361	-202.819	3.37E+09
Bureaucracy	-0.0032 ± 0.00006(0.373) -0.92	1.000076 ± 0.00006 (0.000**) 17612.96	0.9999659 ± 0.00004 (0.000**) 26843.42	0.999976 ± 0.00010 (0.000**) 10318.66	0.999998 7 ± 0.00002(0.000**) 42428.25	1338702	100.0%	100.0%	-199.382	-195.204	-202.928	1.000007
Pooled Model	**-0.00396 ± 0.00136(0.006**) -2.92**	**1.000038 5 ± 0.00004 (0.000**) 24560.49**	**1.000008 ± 0.00002(0.000**) 54203.73**	**0.999925 ± 0.000074(0.000**) 13443.83**	**0.999989 ± 0.00002(0.000**) 54926.09**	**3.721E-05**	**100.0%**	**100.0%**	**-405.371**	**-398.615**	**-408.150**	**7.98E+10**

Footnote: **= Significant at p< 0.05

The outcomes in table four shows that all of the models parameters estimates are important at 5 % except the continual parameters in Stratocracy model and also Bureaucracy model only, that seem biased. The greatest fitted model among the three regression models in table four will be the Pooled Model which was created from the information set of (1981 2022). The Pooled Model, that has the highest R square value of 100%, has probably the smallest HQC values of 408.150 and the highest F value of 79773673382 calculated. Thus, the pooled item will be the very best appropriate design which has much more impact on total GDP of Nigeria. Thus, the 4 variables have been substantial for any pooled design; that's FGC expenditure on Administration (X_1), Economic Service (X_2), social community service (X_3), transfer (X_4) as well as others variable not incorporated in the product, and that is represented by the regular parameter β_0. For the Stratocracy and Bureaucracy regression models, all the estimated parameters performance well and were also significant and adequate except their constant parameters β_0.

V. Conclusion

The researchers utilized regression analysis, specifically scatter plots created using Microsoft Excel 2010, to generate a series plot for both the individual federal government capital expenditures and their combined plot. This analysis revealed a fluctuating pattern of both increases and decreases throughout the entire plot. Additionally, it demonstrated a non-linear relationship between the federal government capital expenditures and the entire Nigerian GDP. The Durbin approach was employed to estimate a multiple regression model, with the aim of determining the significant variables and assessing the equality of the model. Afterwards, the dataset was split into two distinct models: the Stratocracy model and the Bureaucracy model. All of the estimated parameters in the model were found to be statistically significant at a 5 % level, with the exception of the constant parameter which represents some other variables not included in the model β_0, which seem biased. Only all the variables were significant, that is FGC expenditure on Administration (X_1), Economic Service (X_2), social community service (X_3), transfer (X_4) and the constant parameter in the pooled model represented by β_0. It was discovered that the best fitted model among the three regression models was the Pooled Model that was built from the data set of (1981-2020); the Pooled Model, which has the highest R-square value with 100%, have the smallest HQC values of -408.150 and the highest F-value of 79773673382 calculated. Hence, the pooled model is the best suitable model that has more effect on total GDP of Nigeria.

VI. Recommendations

The following recommendations are made based on the findings of this present study that:

1. The government should reduce its spending on regular expenses and focus more on investing in capital expenses, such as economic and social community services, as they play a crucial role in driving economic growth.

2. The government should make an effort to allocate more funds towards social community services in order to reach citizens residing in rural areas. Increasing her investment in social community service will have the outcome of improving the overall well-being of individuals residing in rural regions, enabling them to engage in their daily fishing and farming routines with good health.
3. The majority of funds allocated for service expenditures must be primarily focused on investing in economically productive activities, both in terms of initial capital investments and ongoing expenses. The economic sectors will experience an increase in activity and the negative impact on economic growth could be reversed.
4. The Nigerian Federal Government should allocate more funds towards administration in order to improve infrastructure, which will benefit both the private and public sectors. This investment will also help in the efficient distribution of raw materials and contribute to overall economic growth.

References

Abdullah, H. A. (2010). The relationship between government expenditure and economic growth in Saudi Arabia. *Journal of Administrative Science*, 12(2), 173-191.

Abu, N. & Abdullahi, U. (2010). Government expenditure and economic growth in Nigeria 1970-2008: A disaggregated analysis. *Business and Economic Journal*, 4(3), 330. Available at *http://astoujournals/com.*

Adepoju, S. (2007). Government spending on infrastructure and economic growth in Nigeria. *Economic Research-Ekonomska Istraživanja, 31* (1), 997–1014.

Ajayi, S. & Oke, A. (2012). Public expenditure and financial accountability in Nigeria. *Paper presented at the Joint Government of Nigeria – World Bank Workshop on Improving Public Expenditure and Financial Accountability in Nigeria, Kaduna*, April 24 – 26.

Akaike, H., (1974). *A* new look at the statistical model identification. *IEEE Transactions on Automatic Control,* 19(6): 716-723.

Akpan, A. M. (2005). *Public finance in a developing economy; The Nigerian case*, Enugu: B & J Publications.

Anyanwu, J. C. (2013). *Monetary economics: Theory, policy and institutions*. Hybrid Publishers Limited, Onitsha.

Ekundayo, O. U. & Odhigu, F. (2016). Determinants of human capital accounting in Nigeria. *Igbinedion University Journal of Accounting, 1*(1), 103-115.

Ekwe M. C. (2012). *Relationship between intellectual capital and financial performance in the Nigerian banking sector*. Ph.D. Dissertation submitted to the Department of Accountancy, Faculty of Business Administration University of Nigeria.

Khalaf, G. (2013). A Comparison between Biased and Unbiased Estimators in Ordinary Least Squares Regression. *Journal of Modern Applied Statistical Methods*: 12(2), 17-28.

Nwaeze, C., Njoku, R., & Nwaeze, O. Pl. (2014). The nature and impact of Federal Government Expenditure on Nigeria's economic growth. *The Macrotheme Review* 3(7), 65-81.

Okafor, F.C. (2002). *Sample survey theory with applications*. Afro-Orbis Publishers, Nsukka, Nigeria.

Okoro, A. S. (2013). Government spending and economic growth in Nigeria, 1980-2011. *Global Journal of Management and Business Research, Economics and Commerce*, 13(5): 20-29.

Saad, W. & Kalkechi, K. (2009). The nature of government expenditure and its impact on sustainable economic growth. *Middle Eastern Finance and Economics*, 1(4), 39-47.

Shabana, N., Mohd, S. & Nazia, M. (2017). An examination of the relationship between government spending and economic growth in Namibia. *West African Journal of Monetary Economics*, 81-116.

Schwarz, G. (1978). Estimating the dimension of a model. *Annuals of statistical Journal, 6*(1), 461-48.

Taiwo, S. & Abayomi, M. A. (2011). External debt burden and health expenditure in Nigeria: An empirical investigation, *Nigeria Journal of Health and Biomedical Science,* 1(1), 1-5.