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Multivariate Time Series Analysis to Impact Assessment of Nominal Economic Indicators on Federal Government Revenue and Economic Growth in Nigeria

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Abstract Nigeria has all it takes to become Sub-Saharan Africa's largest economy and a key contributor in the global economy as a result of her agricultural and natural resource endowment. Unfortunately, these resources are not sufficiently and efficiently utilized, resulting to some negative economic implications such as underdeveloped economy in world ranking, high unemployment status, poor standard of living, abject poverty, devaluating currency, lack of technological innovations and unstable economy among others. This paper investigates the impact of the Oil and Non-Oil producing sectors to Federal Government Revenue and Economic Growth in Nigeria, using the concept of multivariate time series vector autoregressive (VAR) model. The basic concepts and techniques of multivariate time series modelling and analysis such as Granger Causality tests; Lag Length Selection based on Information Criteria; Augmented Dickey-Fuller and Phillips-Perron Unit Root tests; Kwiatkowski-Phillips-Schmidt-Shin (kpss) Trend & Level Stationarity tests; Sectoral Contributions to Federal Government Revenue, Economic Growth and Growth Rates using Line & Bar Graphs are discussed in detail. The study applied a model for predicting annual Federal Government Revenue and Economic Growth at any time using their respective historical monetary values together with the historical monetary values of the other economic indicators. The empirical findings in this paper revealed that the Federal Government Revenue and Economic Growth are predictable using their historical values together with the historical values of the other indicators. Furtherance to the statistically significant contribution of both the Oil and Non-Oil producing sectors, it is imperative to diversify the Nigerian economy in order to boost Federal Government Revenue, improve the standard of living, alleviate poverty, create employment opportunities and accelerate a long-run sustainable Economic Growth and stability.

Keywords*: oil & non-oil sectors, federal government revenue, economic growth, VAR, granger causality, Augmented Dickey-Fuller (ADF)*

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1. Introduction

The main priority in the scale of preference of any developing country is geared towards effective utilization of prominent significant economic indicators for revenue generation and achievement of sustainable economic development, growth and stability within the shortest possible time frame. Nigeria among other developing countries especially in Africa has been grappling with the realities of developmental and stability processes not only socially and politically but also economically [1]. Empirical literature have documented that Nigeria is mainly depending on the oil producing sector for revenue generation; but will the oil sector alone be consistent and stable to sustain the Nigerian economy on a long-run? A suitable answer to this question requires a quantitative investigation and hence, the quest to examine the time series structure and impact of all sectoral contribution especially the oil and non-oil producing sectors with other economic indicators in revenue generation and economic growth over time. The study therefore, employed the basic concepts and techniques of time series modelling and analysis to predict annual federal government revenue generation and economic growth at any time given their respective historical monetary values, examine the impact of the oil and non-oil producing sectors on federal government revenue generation and economic growth respectively. The techniques include multivariate Vector Autoregressive (VAR) models, Granger Causality test, Augmented Dickey-Fuller (ADF) tests, Phillips-Perron (PP) test, Kwiatkowski-Phillips-Schmidt-Shin (kpss) test and graphical representation of proportionate and sectoral contributions of the major indicators. A multivariate time series consists of multiple single series referred to as components, which adopts the basic concept of vectors and matrices in its analysis [2]. It extends the ideas of a

univariate time series analysis to a system of equations. The predictive model is based on the result of the Granger Causality test and the stationarity condition, and if both sectors proved positively significant with the revenue generation and economic growth, then it will be imperative to diversify the country's economy in order to improve federal government revenue generation, boost the country's federation account, and achieve a long-run sustainable economic development, growth and stability.

1.1. Statement of the Problem

The non-oil sector was the mainstay of the Nigerian economy prior to independence. A collection of previous findings from relevant literature has shown that the country's dependency on a single booming sector does not translate positive sustainable economic development and growth to enhance the welfare status of the citizenry [3]. The oil booms of the early 1970s results to a gradual shift from non-oil sector to oil sector, making Nigeria to depend heavily on petroleum as a main source of revenue as well as foreign exchange earnings. Whereas the non-oil producing sector that has been providing Nigeria with a bulk of food requirements, accounting for over 75% of the country's employment generation and contributing significantly to Federal Government Revenue through export taxes and marketing board's surpluses, is unjustifiably neglected without considering the future economic implication, simply because of oil boom. The National Bureau of Statistics in its 1999 reports indicated that Agriculture being the major component of the non-oil producing sector accounted for about 65-70% of GDP in 1957, declined to 41% in the late 1970s and crashed below 2% in the late 1990s [4]; and this was primarily caused by over-dependency on the oil producing sector, neglecting other significant sectors that are also generating revenue and contributing positively to sustainable development, growth and stability of the country's economy. The National Bureau of Statistics and National Planning Commission reported that 112.52 million out of the Nigeria's teeming population live in relative poverty. Suffice it to say that the average Nigerian is a poor man. It is a nation of riches and poverty, splendid wealth in the hands of few and abject poverty at the doorsteps of many citizens. Several researchers and economic organizations have observed that Nigeria is still struggling to alleviate poverty, create wealth and maintain a good standard of living for the approximately 200 million teeming population with annual growth rate of 3%, appreciate her currency to compete with developed countries in international market, boost the country's revenue, and to attain a sustainable economic development, growth and stability [5,6,7]. Unfortunately, the GDP of Nigeria decreases adversely in the late 1970s, early 1990s and 2000s, and in the mid 2009 as a result of low quantity and fall in oil prices, and consequently, the country experienced a huge economic crisis known as "economic recession or economic meltdown" especially during the 2009 administration of Late President Umaru Musa Yar' Adua.

1.2. Objective of the Study

The main objective of this research is to fit a multivariate vector autoregressive time series model that can predict annual Federal Government Revenue generation and Economic Growth at any time given the historical monetary values of all significant indicators, and to assess the impact of the oil and non-oil producing sectors on federal government revenue generation and economic growth respectively. A review of relevant literature reveals that revenue generation and economic growth mostly depend on the oil and non-oil producing sectors; hence, both the federal government revenue generation and economic growth can be modelled as a lag linear function of the oil and non-oil producing sectors. Hopefully, the outcome of this study shall proffer reliable solution to the afore-mentioned confronting issues and make valid recommendations to the Federal Government of Nigeria in order to yield higher revenue, alleviate poverty, create gainful employment opportunities, improve the peoples' standard of living and achieve a long-run sustainable economic development, growth and stability.

1.3. Significance of the Study

There is no doubt that this research shall enrich empirical literature to tackle the observable economic ills of various countries, especially in areas of impact assessment, revenue generation, sustainable development, growth and stability. In particular, it shall provide useful aids and benefits to the Federal Government of Nigeria and other oil and non-oil producing countries, private and public sector organizations, various economic governing bodies such as Economic Community of West African States (ECOWAS) and Organization of Petroleum Exporting Countries (OPEC) etc., multinational firms, oil producing companies (Shell), academic research institutes and professional bodies, and co-researchers in African countries and globally at large. It shall aid these beneficiaries immensely by providing a suitable predictive model for making appropriate economic adjustments, policies and decisions to generate revenue, boost and stabilize the economy.

1.4. Research Questions

The following questions are of great importance to the desirable task in this study:

1. Does the Non-Oil Revenue grow significantly with Federal Government Revenue and Economic Growth?
2. Does the Oil Revenue grow significantly with Federal Government Revenue and Economic Growth?
3. Does Federal Government Revenue grow significantly with Economic Growth?
4. Does Economic Growth grow significantly with Federal Government Revenue?
5. Does the proportion of Non-Oil Revenue affect the proportion of Oil Revenue?
6. Will proportionate (percentage) increase in Oil & Non-Oil Revenues improve or boost Federal Government Revenue and Economic Growth?
7. Are the time series' of these indicators stationary (in terms of unit root)?
8. Are the time series' of these indicators stationary in trend or level?

1.5. Statement of Hypotheses

The hypotheses for this study are as follows:

(1) H_0 : Non-Oil Revenue does not Granger cause Economic Growth

versus

H_A: Non-Oil Revenue Granger cause Economic Growth

(2) H_0: Oil Revenue does not Granger cause Economic Growth

versus

H_A: Oil Revenue Granger cause Economic Growth

(3) H_0 : Non-Oil Revenue does not Granger cause Federal Government Revenue

versus

H_A: Non-Oil Revenue Granger cause Federal Government Revenue

(4) H_0: Oil Revenue does not Granger cause Federal Government Revenue

versus

H_A: Oil Revenue Granger cause Federal Government Revenue

(5) H_0: Non-Oil Revenue does not Granger cause Oil Revenue

versus

H_A: Non-Oil Revenue Granger cause Oil Revenue

(6) H_0: Federal Government Revenue does not Granger cause Economic Growth

versus

H_A : Federal Government Revenue Granger cause Economic Growth

(7) H_0: The time series Y_t is not stationary (has a unit root)

versus

H_A: The time series Y_t is stationary (has no unit root)

(8) H_0: The time series Y_t is stationary in trend or level

versus

H_A: The time series Y_t is not stationary in trend or level

where the statement "X Granger cause Y" implies that the time series Y can be better predicted using the historical values of both X and Y rather than the history of Y alone. The details of these hypotheses together with other relevant hypotheses for this research are highlighted in the research methodology (see section 3).

2. Literature Review

The World Bank has classified the Nigerian economy as a mixed economy emerging market that has attained middle income status through its abundant supply of natural resources, well-developed financial, legal, communications, transportation sectors and stock exchange which was ranked 2nd in Africa [5,8]. This made the country to be branding herself as the "giant of Africa". However, it requires an economic proof of its potentials by raising its standards comparatively equivalent to other fast developing economies of the world. Suffice it to say that Nigeria has the potential to become Sub-Saharan Africa's largest economy and a major player in the global economy by virtue of her natural resource endowment. These potentials have remained untapped, and if current trends persist, Nigeria runs the risk of not meeting the internationally agreed millennium development goals (MDGs) in the next decade [9]. It is as a result of the fact that the most desirable words in any economy are sustainable development, growth and stability. Most researchers contend that sustainable development is one that is likely to achieve lasting satisfaction of human needs and improvement in the quality of human life. This is expected to be a main focus by the Federal Government of Nigeria in order to overcome present and future challenges in the country.

It is noticeable that the development in underdeveloped countries is concerned with the development of unused resources even when their usefulness is well-known [3]. This implies the employment of idle resources in order to increase real production. Historically, Agriculture was the principal foreign earner of Nigeria before the year 1960, which is the year of independence and liberation from our colonial masters. Nigeria was the world's largest exporter of cash crops such as groundnuts, cocoa, palm oil, palm kernel and a producer of coconuts, citrus fruits, maize, pearl millet, cassava, yams and sugar cane; providing food abundantly for local and foreign consumption [1,10]. Several factors affect the non-oil sector from taking its pride of place in revenue generation for sustainable economic growth and development. Sustainable development through the non-oil sector requires that government policies towards non-oil sectoral production be multidimensional. This implies that there has not been adequate investment in equipment, infrastructures, intellectual capital, human capital, and in utmost transparency to spur on the sector, which would have reflected positively to boost the country's revenue generation, achieve sustainable economic growth and attain a stable status. Prominent among the non-oil producing sector is agriculture, which was the major source of revenue generation and foreign exchange earning in Nigeria through the sales of relatively diversified crops such as cocoa, rubber, coffee, cotton, palm produce, groundnut etc. The other components of the non-oil producing sector are non-oil industries (plastic, leather, steel etc.), trade and investment, taxes, services etc. Nigeria is very popular in the area of production and export of top quality produce like gum Arabic, sesame seed, rubber, ginger, mangoes, pineapples and a host of other crops. Cocoa production, mostly from obsolete varieties and overage trees has nevertheless increased from around 180,000 tons annually to 350,000 tons [9,10,11,12]. Nigeria was once the biggest poultry producer in Africa; now corporate poultry output has been slashed from 40 million birds to about 18 million.

Recent developments in the Nigerian economy had led to the recognition of the ultimate significance of producing and marketing agricultural goods as a means of enhancing the foreign exchange capacity of the country. Sequel to this awareness is the growing concern of adherence to standard in order to maintain a reputation in the export market. It is therefore imperative to employ quality and standards as necessary conditions, requiring adequate attention in order to ensure the sustenance of Nigeria's competiveness in the global market. Export markets for the non-oil products exist in United States of America, European Union, Gulf States, Japan, Singapore, China and other countries of the world. Nigeria has an added advantage over many agricultural producing and

exporting nations within Africa in terms of fertile land, proximity to traditional and terminal markets in Europe either by air or sea [13,14]. Agriculture accounted for about 70% of GDP and about 90% of foreign exchange earnings at the period of political independence. Manufacturing which contributed 3.9% from 1960 to 1961, reached a peak of about 10% in 1981, and since then, it declined gradually to the lowest level of 2.57% in 2006. The 1999 summary reports from the National Bureau of Statistics indicated that agriculture among the other non-oil producing sector accounted for about 65-70% GDP in 1957, declined to 41% in the late 1970s and crashed below 2% in the late 1990s. The growth of the non-oil sector in recent time contributes about 5.9% of GDP. The share of non-oil sector decreased from 94% in 1970 to 52% in 2004. The decreased affected the whole sector but in different magnitude. Nigeria's non-oil sector is inefficiently servicing the domestic market as non-oil export is negligible, only about 1% of GDP in 2005 [15]. The agricultural sector has not been able to fulfil its traditional role of feeding the nation, meeting the raw material needs of industries, and providing substantial surplus for export. Consequently, the contribution of the sector to GDP has fallen over the decades, from a dominant position of 55.8% between 1960 and 1970 to 28.4% between 1971 and 1980, and later risen to 32.3%, 34.2% and 40.3% during the decades 1981-1990, 1991-2000 and 2001-2009 respectively [9]. The fall is as a result of low productivity, owing to the dominance of peasant farmers and their reliance on rudimentary farm equipment and low technology, mainly caused by the government's inadequate attention to promote the sector.

Prior to independence, the Nigerian economy was mainly agrarian, but on attainment of independence, the government embarked on the process of transforming the country into an industrial economy. Oil exploration brought Nigeria a mono-cultural economy and the abandonment of the production and export of cash crops being the major foreign exchange earners before the advent of oil. Nigeria has about 75% of its land fertile and suitable for agriculture, but only 40% is cultivated [11]. This addresses the food security and agriculture component of the government's plan along with the focus on employment for the citizens. However, in order to achieve this goal, the country should increase the productivity of current agricultural companies, embrace competition within the agricultural sector, develop domestic policies and increase funding. Even if the non-oil sector is no longer a primary contributor to revenue generation and nominal GDP, it is still feasible for sustainable development, growth and stability. There should be a proper evaluation of both internal and external factors, along with the historical factors, that could impact the Nigerian agricultural market and the entire non-oil producing sector in order to boost the country's economy. It was also noted that foreign trade creates an avenue for foreign capital to flow into the country which could as well be regarded as foreign direct investment. This increases the earnings of the country and promoted economic growth by raising the national income of the country. Over the years, the non-oil sector especially agriculture increases the level of employment generation in the Nigerian economy as a higher demand for exports reflects more production that will in turn lead to the recruitment of more workers [3,9,12]. In a country like Nigeria where the level of investment is low, foreign capital is highly needed in order to accelerate the creeping rate of economic development and growth. This is due to the fact that the economy depends largely on one export commodity (crude oil) as well as foreign trade for growth. The Nigerian educational system in real terms does not support the development of appropriate critical skills or knowledge to backup technologies for local production intensities that can enhance sustainable development and growth in the non-oil producing sector. The existence of high trade barriers in form of duties, tariffs, documentations and procedures make production for export of non-oil cumbersome and uninteresting [14].

The crude oil or petroleum sector is now the leading sector of the Nigerian economy, but unfortunately, it has not immensely stimulate the growth and stability in the economy as some other significant sectors have been neglected and growth has been impeded on them, placing the country in the category of underdeveloped or developing countries. The oil producing sector has replaced the non-oil producing sector since the early 1970s, and it is the major country's export because of the large revenue it generates. It may be too late to notice that agriculture is presently suffering from mismanagement, inconsistency and poorly conceived government policies, neglect and lack of basic infrastructures. Notwithstanding, the sector accounts for over 26.8% of GDP and two-third of gainful employment in the country [1,16,17]. It should be noted that excessive dependence on oil export as a major contributor to the country's GDP poses an economic threat to the continuing sustenance of the economy. This happens because agriculture has failed to keep pace with the country's rapid population growth, so that the country, which once exported food, now relies on imports to sustain itself. The negligence has rendered the objectives of the government for establishment of Federal Colleges and Universities of Agriculture and several agricultural decrees and programmes ineffective. They include Land Use Decree and Land Use Act, Operation Feed the Nation (OFN), Food and Agricultural Organization (FAO), River Basin Development Authority (RBDA), Directorate of Food Roads and Rural Infrastructure (DFRRI), Green Revolution Programme, Tree Crop Programme, Commodity Boards Decree, Rural Banking Scheme, Agricultural Credit Scheme, Strategic Grains Research Scheme, Agricultural Policy Initiative and Reforms, National Accelerated Food Production Project (NAFPP), Agricultural Development Project (ADP) etc.

Traceable to the petroleum industry in Nigeria, crude oil was discovered in 1956 at Oloibiri, located in the Niger Delta region of Nigeria in Africa, after half a century of exploration. The discovery was made by an oil producing company known as Shell-BP. In 1958, Nigeria joined the ranks of oil producers when her first oil field came on stream producing about 5,100 barrels per day, and eventually became the world's seventh-largest petroleum producer in 1971 [7]. Nigeria became a member of the Organization of Petroleum Exporting Countries (OPEC) and established the indigenous Oil Minerals Producing Areas Development Commission (OMPADEC), Nigerian

National Petroleum Corporation (NNPC) which is under the management of a company called Shell Petroleum Development Company of Nigeria (SPDC). The SPDC is a major operator of both the upstream and downstream sectors, in accordance with the offshore and onshore dichotomies [18]. The other oil producing companies are Texaco, Mobil, Chevron, elf, Agip etc. Since the mid-1970s oil has accounted for a very significant proportion from about 77.5% in 1975 to 88.6% in 2011 of total revenue generation in Nigeria. The increase in oil generating revenue over the year coupled with its booming wealth has made several economic projects, programmes, expenditures at the federal and state levels to anchor their budgets wholly on the oil generating revenue. Nigeria attained a production level of about 2million barrels per day between the late 1960s and early 1970s, managed a GDP of US$352.3billion and was ranked 33rd worldwide; recent development strategies aimed at increasing production level above 4 million barrels per day [5,7,18]. The Niger Delta region is made up of 9 States, namely Bayelsa, Rivers, Delta, Akwa Ibom, Ondo, Edo, Imo, Abia and Cross River; with 1600 communities and a population of about 45 million.

The Nigerian manufacturing sub-sector is made up of large, medium and small enterprises, as well as cottage and hand craft units. Inspite of spirited efforts made to boost manufacturing output at various policy regimes, it has not reflects any significant contribution to the growth of the economy. Industry as a whole contributed only 11.3% of the GDP from 1961 to 1970, growing significantly in the next two decades to 41% from 1971 to 1990, owing largely to the petroleum and gas production during the decades [11,12,13]. The contribution contracted to 38.6% in the 1990s and further to 29.4% during 2001-2009. It was caused by the inability of the manufacturing sub-sector to aggregate output in Nigeria compared to her pears in Asia and Latin America. Revenue from oil accounts for about 95% of Nigeria's total export earnings and 80% of its revenue. The World Bank estimated that the oil producing sector accounts for 95% of the Nigerian export earnings and 75% of the government revenue in 2014. Nigeria is the USA's largest oil trading partner in Sub-Saharan Africa and supplies about 11% of USA's oil imports. As at 2013, Nigeria has been adjudged the 6th largest exporter of crude oil worldwide with the USA as her biggest trading partner [15]. Recently, Nigeria is shifting the partnership from USA to Asia, particular China and the oil prices are gradually falling beyond imagination. The favourable increase in oil prices in 1974 results in a sudden boom of wealth, in which much of the generated revenue intended for investment to diversify the country's economy, abruptly spurred inflation and underscored inequalities in the distribution [13]. The concentration on the oil sector and gross neglect of other significantly contributing sectors of the economy, especially agriculture, limits the ability of the country to be self-sufficient in food production. Paradoxically, Nigeria being the largest producer of crude oil in Africa and the sixth producer in the world has resorted to the importation of refined oil. This is due to frequent breakdown of the four refineries in the country. About 310,000 barrels of oil are consumed in Nigeria every day. However, the four refineries in the country produce about 214,000 barrels per day out of their combined total capacity of 438,750 barrels [14,15]. This shortage in the domestic supply of refined oil has to be imported from countries that originally purchased the oil from Nigeria in its crude form. This acute shortage of petrochemicals for local consumers together with the practice of importing refined petrol-products has drastically added to corruption and petro-violence in Nigeria. It is assumed that the phenomenal increase in oil generating revenue would translate into meaningful growth of the non-oil sector as was experienced in some East Asian countries like China, Malaysia, Indonesia, Dubai etc., but the reversed is the case. Poverty in Nigeria is rising with about 100 million of its population living on less than US$1 per day despite a strong growth in Africa's second largest economy [5,6,19]. About 54.7% were living in abject poverty (cannot afford the bare essentials of food, shelter and clothing) as at 2004, and rose to about 60.9% in 2010. Although the Nigerian economy is projected to continue growing, poverty is likely to get worse as the gap between the rich and the poor has continued to expand annually. Suffice it to say that the average Nigerian is a poor man. It is a nation of riches and poverty, splendid wealth in the hands of few and abject poverty at the doorsteps of many citizens. This makes the divergence between the economic indicators and the reality a huge source of concern in this study.

Crude oil exploration has caused a number of environmental degradations and health hazards such as pollution, spillage that has damaged the outcome of some non-oil producing sectors in the country, and consequently, part of the oil generated revenue is used to compensate victims in the affected areas, especially in Ogoni and Oloibiri within the Niger Delta region in South-South Nigeria [20]. The liquefied natural gas pipeline that transverses through Kala-Akama in Okrika mangrove forest area of Rivers State, leaked, set ablazed and burnt for three consecutive days which engulfed the local plants and animals within the affected areas [21]. As the GDP neither reflects the wealth distribution nor accounts for the size of the population, which is an indication of Nigeria's emerging economic power. If these growing resources are properly invested, managed and harnessed intelligently, the country can benefit enormously and exceed the International Monetary Fund's estimated GDP's growth rate of 7% annually. Thus, an assessment of the prominent indicators (oil and non-oil) in proportionate contribution to economic growth and revenue generation and diversification of the country's economy without further negligence based on the expected output of this study shall handle the scenario, alleviate poverty, promote and boost the country's economy. This will favourably reflect good standard of living among the populace.

Several economic and political committees were set-up in Nigeria from pre-independence, military to civilian regimes with the task of developing a suitable formula for allocating the country's revenue to the various tiers of government (Federal Government, the 36 States and the 774 Local Governments). The Revenue Allocation Act No.1 of 1981 promulgated by the Federal Government of Nigeria, provided that the federation account shall be shared amongst the various tiers of government as follows: Federal Government 58.5%; State Governments 31.5%;

Local Governments 10% [22,23,24,25]. The essence of revenue allocation is that a certain percentage of the revenue from 100% to 13% should be sent back to States from which the oil has been extracted. This led to a further enactment of the principle of derivation which is a constitutional device set-up by the Federal Government to compensate oil bearing communities. The principle of derivation is the basis for revenue allocation under the past, present and future administrations, and dates back to the pre-independence era. The intention was that host governments should be able to use funds to reduce the amount of environmental degradation created by the extraction of crude oil and minerals, but unfortunately, the allocation to States drastically declined to less than 13% [19,26]. At this point, States could no longer meet their obligations and this became the turning point for their agitation of resource control, in order to sufficiently utilize the oil generating revenue to service the host communities, reduce poverty and improve the peoples' standard of living.

3. Methodology

3.1. Source of Data and Variables

This study uses annually recorded data collected from a secondary source jointly published by Central Bank of Nigeria (CBN) and Federal Ministry of Finance in the 2010 Statistical Bulletin, covering the Public Finance Statistics (NGN' million) as shown in Table B.1.1-Summary of Federal Government Finances, obtained from the website: www.cenbank.org/OUT/2011/publications/statistics/2010/PartB/PartB.html. It covers 50 observations in years, ranging from 1961 to 2010, and comprises Nominal Gross Domestic Product, Oil Revenue, Non-Oil Revenue, Federal Government Revenue, Total Expenditure, Net Foreign Investment and Net Domestic Investment. The Nominal GDP, Oil Revenue and Non-Oil Revenue are the prominent economic indicators in the country. The variables used for this research are Nominal GDP which measures the economic growth of the country; Federal Government Revenue which measures the actual revenue generated in the country; Oil Revenue which measures the amount of sales realized from crude oil and petroleum products; Non-Oil Revenue which measures the amount of sales realized from Agriculture etc. (non-oil sector). The other three variables added to improve (or otherwise) the predictive task of the VAR model are Total Expenditure, Net Foreign Investment and Net Domestic Investment, all are expressed in monetary value (NGN).

3.2. Multivariate Time Series

A multivariate time series consists of multiple single series referred to as components, which adopts the basic concept of vectors and matrices in its analysis [2]. It extends many of the ideas of a univariate time series analysis to a system of equations. In this research, the primary model in multivariate time series analysis, being the vector autoregressive (VAR) model can be used, since the VAR captures the linear interdependencies among the multiple time series. This is as a result of the existing interaction and co-movements among the group of time series variables ($NOMGDP_t$, $FEDREV_t$, $OILREV_t$, $NOILREV_t$, $TEXP_t$, NFI_t, NDI_t).

According to Chris Sims, "if there is true simultaneity among a set of variables, they should be treated on an equal footing, and there should not be any a priori distinction between endogenous and exogenous variables", and hence, the use of vector autoregression [27,28,29].

Given a *kx1* vector of time series $(y_{it}) = \begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{kt} \end{pmatrix}$ for i=1,2,…,k then a multivariate time series is the *kx1* vector of time series Y_t, in which the i^{th} row of Y_t is (y_{it}). Thus, for any time, t,

$$Y_t = \begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{kt} \end{pmatrix}. \quad (1)$$

3.3. The Stationary Vector Autoregressive (VAR) Model

The p^{th} order vector autoregressive model, denoted by VAR(p), is defined as

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + ... + \beta_2 Y_{t-2} + \epsilon_t,\ p > 0. \quad (2)$$

where Y_t is a *kx1* vector of multivariate time series; β_0 is a *kx1* vector of unknown constants, called intercepts; β_1, β_2 ,…, β_p are time invariant *kxk* matrices of unknown coefficients; Y_{t-1} , Y_{t-2} ,…, Y_{t-p} are then *kx1* lagged vectors of Y_t; t=1,2,…,T and T is the sample size; p is the lag order or lag length; ϵ_t is a sequence of uncorrelated random vector of white noise with unobservable zero mean and a positive definite covariance matrix, denoted by Ω [2,30,31].

3.3.1. Assumptions

(1) E(ϵ_t)=0; the error term (white noise) has zero mean;
(2) E($\epsilon_t \epsilon_t'$)=Ω; the residual allows a contemporaneous multivariate white noise;
(3) E($\epsilon_t \epsilon_{t-r}'$)=0 for r≠0; there is no serial correlation across time;
(4) ϵ_t ~WN(0, Ω); the white noise is distributed with mean zero and variance-covariance matrix Ω [2,28,32].

3.3.2. The Concise Matrix Notation of the VAR(p) Model

The VAR(p) model in (2) can be re-written in a concise matrix notation as

$$Y_t = \beta Z_t + \epsilon_t \quad (3)$$

where $Z_t = \begin{pmatrix} 1 \\ Y_{t-1} \\ Y_{t-2} \\ \vdots \\ Y_{t-p} \end{pmatrix}$; $\beta = (\beta_0, \beta_1, \beta_2 \ldots, \beta_p)$; $\epsilon_t = Y_t - \beta Z_t$ is a kx1 vector of OLS residuals at time, t.

3.3.3. The Back Shift or Lag Operator of the VAR(*p*) Model

Using the back shift or lag operator L, the VAR(p) model in (2) can also be written as

$$\left(I-\beta_1 L-\beta_2 L^2-\ldots-\beta_p L^p\right)Y_t=\beta_0+\epsilon_t \quad (4)$$

or

$$\beta(L)Y_t=\beta_0+\epsilon_t \quad (5)$$

where $\beta(L)=I-\beta_1 L-\beta_2 L^2-\cdots-\beta_p L^p$ is a matrix polynomial of order p; I is the kxk identity matrix; $IY_t=Y_t$, $LY_t=Y_{t-1}$, $L^2Y_t=Y_{t-2}$,…, $L^pY_t=Y_{t-p}$; L is the lag operator; β_0 and ϵ_t are as defined in model (2) above [29,33].

3.3.4. Estimation of Parameters in the VAR(*p*) Model

The parameters $(\beta_0,\beta_1,\ldots,\beta_p)$ in the VAR(p) model can be estimated by ordinary least squares (OLS) regression approach, since each individual residual series is assumed to be serially uncorrelated, having finite constant variance, and simultaneous correlation of the shocks between different series is allowed [28,34]. The null hypothesis is that all the coefficients are zero (i.e. the endogenous variable(s) are insignificant in the VAR model) while the alternative hypothesis is that some coefficients are non-zeros (i.e. the endogenous variable(s) are significant in the VAR model). The decision on whether to reject the null hypothesis or not, is based on the result of the t-test ratio (t-value). If the t-value is greater than the t-critical value (tabulated), then the null hypothesis can be rejected in favour of the alternative hypothesis; otherwise do not reject the null hypothesis (see subsection 3.5.3 for detail mathematical statement of the null and alternative hypotheses) .

3.4. Model Specification and Derivation of the Predictive Models for Federal Government Revenue and Economic Growth

Given that the multivariate time series for the seven variables is

$$Y_t=\begin{pmatrix}NOMGDP_t, FEDREV_t, OILREV_t,\\ NOILREV_t, TEXP_t, NFI_t, NDI_t\end{pmatrix}',$$

where $NOMGDP_t$ = f($L(NOMGDP_t, FEDREV_t, OILREV_t, NOILREV_t, TEXP_t, NFI_t, NDI_t)$)
and

$$FEDREV_t=t\left(L\begin{pmatrix}NOMGDP_t, FEDREV_t, OILREV_t,\\ NOILREV_t, TEXP_t, NFI_t, NDI_t\end{pmatrix}\right)$$

then the multivariate vector autoregressive model of order p with lag operator L is defined as

$$\begin{pmatrix}NOMGDP_t\\ FEDREV_t\\ OILREV_t\\ NOILREV_t\\ TEXP_t\\ NFI_t\\ NDI_t\end{pmatrix}=\begin{pmatrix}\beta_{1,0}\\ \beta_{2,0}\\ \beta_{3,0}\\ \beta_{4,0}\\ \beta_{5,0}\\ \beta_{6,0}\\ \beta_{7,0}\end{pmatrix}+\begin{pmatrix}\beta_{11,1}&\beta_{12,1}&\beta_{13,1}&\beta_{14,1}&\beta_{15,1}&\beta_{16,1}&\beta_{17,1}\\ \beta_{21,1}&\beta_{22,1}&\beta_{23,1}&\beta_{24,1}&\beta_{25,1}&\beta_{26,1}&\beta_{27,1}\\ \beta_{31,1}&\beta_{32,1}&\beta_{33,1}&\beta_{34,1}&\beta_{35,1}&\beta_{36,1}&\beta_{37,1}\\ \beta_{41,1}&\beta_{42,1}&\beta_{43,1}&\beta_{44,1}&\beta_{45,1}&\beta_{46,1}&\beta_{47,1}\\ \beta_{51,1}&\beta_{52,1}&\beta_{53,1}&\beta_{54,1}&\beta_{55,1}&\beta_{56,1}&\beta_{57,1}\\ \beta_{61,1}&\beta_{62,1}&\beta_{63,1}&\beta_{64,1}&\beta_{65,1}&\beta_{66,1}&\beta_{67,1}\\ \beta_{71,1}&\beta_{72,1}&\beta_{73,1}&\beta_{74,1}&\beta_{75,1}&\beta_{76,1}&\beta_{77,1}\end{pmatrix}\begin{pmatrix}NOMGDP_{t-1}\\ FEDREV_{t-1}\\ OILREV_{t-1}\\ NOILREV_{t-1}\\ TEXP_{t-1}\\ NFI_{t-1}\\ NDI_{t-1}\end{pmatrix}+\cdots+$$

$$\begin{pmatrix}\beta_{11,p}&\beta_{12,p}&\beta_{13,p}&\beta_{14,p}&\beta_{15,p}&\beta_{16,p}&\beta_{17,p}\\ \beta_{21,p}&\beta_{22,p}&\beta_{23,p}&\beta_{24,p}&\beta_{25,p}&\beta_{26,p}&\beta_{27,p}\\ \beta_{31,p}&\beta_{32,p}&\beta_{33,p}&\beta_{34,p}&\beta_{35,p}&\beta_{36,p}&\beta_{37,p}\\ \beta_{41,p}&\beta_{42,p}&\beta_{43,p}&\beta_{44,p}&\beta_{45,p}&\beta_{46,p}&\beta_{47,p}\\ \beta_{51,p}&\beta_{52,p}&\beta_{53,p}&\beta_{54,p}&\beta_{55,p}&\beta_{56,p}&\beta_{57,p}\\ \beta_{61,p}&\beta_{62,p}&\beta_{63,p}&\beta_{64,p}&\beta_{65,p}&\beta_{66,p}&\beta_{67,p}\\ \beta_{71,p}&\beta_{72,p}&\beta_{73,p}&\beta_{74,p}&\beta_{75,p}&\beta_{76,p}&\beta_{77,p}\end{pmatrix}\begin{pmatrix}NOMGDP_{t-p}\\ FEDREV_{t-p}\\ OILREV_{t-p}\\ NOILREV_{t-p}\\ TEXP_{t-p}\\ NFI_{t-p}\\ NDI_{t-p}\end{pmatrix}+\begin{pmatrix}\epsilon_{1t}\\ \epsilon_{2t}\\ \epsilon_{3t}\\ \epsilon_{4t}\\ \epsilon_{5t}\\ \epsilon_{6t}\\ \epsilon_{7t}\end{pmatrix}\ldots \quad (6)$$

Therefore, the specific predictive models for both Economic Growth (NOMGDP) and Federal Government Revenue (FEDREV) can be derived from the multivariate vector autoregressive model (6); which is the first and second equations in the model respectively:

$$\begin{aligned}NOMGDP_t=&\beta_{1,0}+\beta_{11,1}NOMGDP_{t-1}+\beta_{12,1}FEDREV_{t-1}+\beta_{13,1}OILREV_{t-1}+\beta_{14,1}NOILREV_{t-1}\\&+\beta_{15,1}TEXP_{t-1}+\beta_{16,1}DFI_{t-1}+\beta_{17,1}NDI_{t-1}+\ldots+\beta_{11,p}NOMGDP_{t-p}+\beta_{12,p}FEDREV_{t-p}\\&+\beta_{13,p}OILREV_{t-p}+\beta_{14,p}NOILREV_{t-p}+\beta_{15,p}TEXP_{t-p}+\beta_{16,p}NFI_{t-p}+\beta_{17,p}NDI_{t-p}+\epsilon_{1t}\end{aligned} \quad (7)$$

and

$$\begin{aligned}FEDREV_t=&\beta_{2,0}+\beta_{21,1}NOMGDP_{t-1}+\beta_{22,1}FEDREV_{t-1}+\beta_{23,1}OILREV_{t-1}+\beta_{24,1}NOILREV_{t-1}\\&+\beta_{25,1}TEXP_{t-1}+\beta_{26,1}NFI_{t-1}+\beta_{27,1}NDI_{t-1}+\ldots+\beta_{21,p}NOMGDP_{t-p}+\beta_{22,p}FEDREV_{t-p}\\&+\beta_{23,p}OILREV_{t-p}+\beta_{24,p}NOILREV_{t-p}+\beta_{25,p}TEXP_{t-p}+\beta_{26,p}NFI_{t-p}+\beta_{27,p}NDI_{t-p}+\epsilon_{2t}\end{aligned} \quad (8)$$

where $NOMGDP_t$ is the Nominal GDP used to measure the Economic Growth at any time, t; $FEDREV_t$ is the Federal Government Revenue at any time, t; $\beta_{1,0}$ is the intercept (constant) of the Economic Growth model; $\beta_{2,0}$ is the intercept (constant) of the Federal Government Revenue model; $\beta_{11,1}$, $\beta_{12,1}$,…, $\beta_{16,1}, \beta_{17,1}$ & $\beta_{11,p}$, $\beta_{12,p}$,…, $\beta_{16,p}, \beta_{17,p}$ are p^{th} order time invariant coefficients for the Economic Growth model; $\beta_{21,1}$, $\beta_{22,1}$,…, $\beta_{26,1}, \beta_{27,1}$ & $\beta_{21,p}$, $\beta_{22,p}$,…, $\beta_{26,p}$, $\beta_{27,p}$ are p^{th} order time invariant coefficients for the Federal Government Revenue model; ϵ_{1t} and ϵ_{2t} are the error terms for the Economic Growth and Federal Government Revenue models respectively, which may be contemporaneously correlated, but are uncorrelated with any past or future disturbances; t=1,2,…,T and T is the sample size [35,36,37].

The two models, (7) and (8) implies that it is possible to predict both the country's Economic Growth and the Federal Government Revenue at any time, using their historical monetary values together with the historical monetary values of the other significant economic indicators (variables).

3.4.1. Stationary and Non-Stationary Multivariate Time Series

A time series Y_t is stationary if its statistical properties such as mean, variance, autocovariances and autocorrelations are all constant over time. Y_t is non-stationary if its mean and variance are time dependent.

A multivariate time series Y_t is covariance stationary if

1. $E(Y_t) = \mu$, where μ is a vector of constants (means);
2. $Cov(Y_t, Y_{t-r}) = E(Y_t-\mu)(Y_{t-r}-\mu)' = \Omega$;

where

$$\Omega = \begin{pmatrix} Var(y_{1t}) & \text{cov}(y_{1t}, y_{2t}) & \cdots & \text{cov}(y_{1t}, y_{kt}) \\ \text{cov}(y_{2t}, y_{1t}) & Var(y_{2t}) & \cdots & \text{cov}(y_{2t}, y_{kt}) \\ \vdots & \vdots & \ddots & \vdots \\ \text{cov}(y_{kt}, y_{1t}) & \text{cov}(y_{kt}, y_{2t}) & \cdots & Var(y_{kt}) \end{pmatrix}$$

is a finite kxk variance-covariance matrix, independent of time, t.

The autocorrelation function is defined as

$$\rho^r = Cov(Y_t, Y_{t-r}) / \sqrt{Var(Y_t)}\sqrt{Var(Y_{t-r})} \quad for\ r = 0,1,2,\ldots$$

In terms of characteristic roots of a polynomial, the *kx1* time series Y_t is stationary if the roots of z in the determinant

$$|\beta_p(z)| = |I - \beta_1 z - \beta_2 z^2 - \cdots - \beta_p z^p| = 0 \qquad (9)$$

lie outside the unit circle and satisfied the condition $|z|>1$ for $|\beta|<1$ [38,39].

3.4.2. Covariance and Correlation Matrices of Residuals

The covariance matrix of residuals for the multivariate time series Y_t is defined as

$$Cov(\epsilon_t) = \begin{pmatrix} Var(\epsilon_{1t}) & \text{cov}(\epsilon_{1t}, \epsilon_{2t}) & \cdots & \text{cov}(\epsilon_{1t}, \epsilon_{kt}) \\ \text{cov}(\epsilon_{2t}, \epsilon_{1t}) & Var(\epsilon_{2t}) & \cdots & \text{cov}(\epsilon_{2t}, \epsilon_{kt}) \\ \vdots & \vdots & \ddots & \vdots \\ \text{cov}(\epsilon_{kt}, \epsilon_{1t}) & \text{cov}(\epsilon_{kt}, \epsilon_{2t}) & \cdots & Var(\epsilon_{kt}) \end{pmatrix}$$

and the correlation matrix of residuals is given by

$$Corr(\epsilon_t) = \begin{pmatrix} Corr(\epsilon_{1t}) & Corr(\epsilon_{1t}, \epsilon_{2t}) & \cdots & Corr(\epsilon_{1t}, \epsilon_{kt}) \\ Corr(\epsilon_{2t}, \epsilon_{1t}) & Corr(\epsilon_{2t}) & \cdots & Corr(\epsilon_{2t}, \epsilon_{kt}) \\ \vdots & \vdots & \ddots & \vdots \\ Corr(\epsilon_{kt}, \epsilon_{1t}) & Corr(\epsilon_{kt}, \epsilon_{2t}) & \cdots & Corr(\epsilon_{kt}) \end{pmatrix}$$

where $\text{Corr}(\epsilon_{1t}) = \text{Corr}(\epsilon_{2t}) = \ldots = \text{Corr}(\epsilon_{kt}) = 1$, since the correlation of any item to itself is a perfect correlation [34,40,41].

3.5. Granger Causality Test

The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. It is based on the argument that regression "reflects mere correlation" while causality could be tested for by "measuring the ability to predict" the future values of a time series using prior values of another time series [27,41]. A univariate time series X_t is said to Granger cause another univariate time series Y_t if it can be shown through t-tests or F-tests on lagged values of X_t (and with lagged values of Y_t also included), that those X_t values provide statistically significant information about future values of Y_t. This implies that "the time series variable X_t Granger causes Y_t if Y_t can be better significantly predicted using the historical values of both X_t and Y_t rather than using the historical values of Y_t alone".

3.5.1. Assumptions of Granger Causality

(1) Temporality: It assumes that only historical values of X_t can significantly predict Y_t

(2) Exogeneity: X_t is said to be exogenous of Y_t if X_t fails to significantly predict Y_t

(3) Endogeneity: X_t is endogenous of Y_t if it can significantly predict Y_t

(4) Independence: X_t and Y_t are said to be independent if both fail to predict each other [38,40].

3.5.2. The VAR(*p*) Model for Granger Causality

It is necessary to develop the VAR model of lagged order *p* before testing for Granger causality. The VAR(*p*) for "X_t Granger cause Y_t" and "Y_t Granger cause X_t" are respectively:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \ldots + \alpha_p Y_{t-p} + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \ldots + \beta_p X_{t-p} + \epsilon_t \qquad (10)$$

or

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{i=1}^{p} \beta_i X_{t-i} + \epsilon_t \qquad (10.1)$$

and

$$X_t = \phi_0 + \phi_1 Y_{t-1} + \ldots + \phi_p Y_{t-p} + \psi_1 X_{t-1} + \psi_2 X_{t-2} + \ldots + \psi_p X_{t-p} + u_t \qquad (11)$$

or

$$X_t = \phi_0 + \sum_{i=1}^{p} \phi_i Y_{t-i} + \sum_{i=1}^{p} \psi_i X_{t-i} + u_t \qquad (11.1)$$

where α_0 and ϕ_0 are unknown constants (intercepts); α_1, α_2,..., α_p, β_1, β_2,..., β_p and ϕ_1, ϕ_2,..., ϕ_p, ψ_1, ψ_2,..., ψ_p are unknown coefficients; ϵ_t and u_t are the error terms.

In particular, if Federal Government Revenue "Granger cause" Economic Growth at any time t, then

$$NOMGDP_t = \phi_0 + \sum_{i=1}^{p} \phi_i NOMGDP_{t-i} + \sum_{i=1}^{p} \psi_i FEDREV_{t-i} + u_t \qquad (11.2)$$

which implies that Federal Government Revenue significantly predict Economic Growth, if the null hypothesis is rejected in favour of the alternative hypothesis.

Similarly, if Non-Oil Revenue "Granger cause" Federal Government Revenue at any time t, then

$$FEDREV_t = \lambda_0 + \sum_{i=1}^{p} \lambda_i FEDREV_{t-i} + \sum_{i=1}^{p} \theta_i NOILREV_{t-i} + \xi_t. \qquad (11.3)$$

3.5.3. Statement of Hypothesis for Granger Causality Test

The null and alternative hypotheses for the Granger causality in model (10) can be stated as follows:

$$H_0: \beta_1 = \beta_2 = \ldots = \beta_p = 0$$

i.e. H_0: X_t does not Granger cause (significantly predict) Y_t

versus

$$H_A: \text{atleast one } \beta_{i's} \neq 0$$

i.e. H_A: X_t Granger cause (signifiantly predict) Y_t.

3.5.4. F-test Statistic, F-critical Value and Analysis of Variance (ANOVA) Table

From model (10), an F-test of the null hypothesis can be conducted by estimating the following restricted model by OLS:

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \eta_i Y_{t-i} + v_t. \qquad (10.2)$$

The sums of squared residuals for the null and full models are respectively:

$$RSS_0 = \sum_{t=1}^{T} v_t^2$$

and

$$RSS_1 = \sum_{t=1}^{T} \epsilon_t^2$$

at *T-2p-1* degrees of freedom;

Model difference = RSS_0 - RSS_1 at p degree(s) of freedom;

The F-test statistic is:

$$F = \frac{(RSS_0 - RSS_1)/p}{RSS_1/(T-2p-1)} \sim F_{(p,T-2p-1;\alpha\%)}.$$

That is $F_{test\ statistic} \sim F_{critical\ value}$ with numerator $V_1 = p$ and denominator $V_2 = T\text{-}2p\text{-}1$ obtained from the F-table at α% level of significance; where p is the lag order, T is the sample size and α% is either *1% or 5%*.

An asymptotically equivalent test is given by

$$F = \frac{(RSS_0 - RSS_1)/p}{RSS_1/(T-2p-1)} \sim X^2_{(p)}$$

which implies that F-test statistic is asymptotically Chi-square distributed at p degree(s) of freedom.

Table 1. Analysis of Variance (ANOVA) Table for the Granger Causality Test

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)
Null Model	RSS_0		
Model Difference	RSS_0 - RSS_1	p	$(RSS_0 - RSS_1)/p$
Full Model	RSS_1	*T-2p-1*	$RSS_1/(T-2p-1)$

3.5.5. Decision Rule

If $F_{test\ statistic} > F_{critical\ value}$ at either 1% or 5% level of significance (with p-value<0.01 or p-value<0.05), then the null hypothesis can be rejected in favour of the alternative hypothesis that X_t Granger cause or significantly predict Y_t. Whereas if $F_{test\ statistic} < F_{critical\ value}$ at 1% or 5% level of significance (with p-value>0.05), then the null hypothesis cannot be rejected, and hence, it can be concluded that X_t does not Granger cause or does not significantly predict Y_t [27,38].

3.6. Augmented Dickey-Fuller (ADF) Regression and Unit Root Test

The Augmented Dicky-Fuller (ADF) regression is used to investigate unit root stationarity or non-stationarity of a time series model. The ADF test is based on the regression model

$$\Delta y_t = \alpha y_{t-1} + \beta + \lambda t + \sum_{i=1}^{p} \phi_i \Delta y_{t-i} + \varepsilon_t \qquad (12)$$

where Δ is a difference operator; $\Delta y_t = y_t - y_{t-1}$; t is a trend variable; β is a constant; α, λ, φ are unknown coefficients; ε_t is the error term; p is the lagged order chosen to ensure that the residuals follow a pure random process for serially uncorrelated u_t [28,29,34,42].

3.6.1. Statement of Hypothesis and Test Statistic for the Augmented Dicky-Fuller

The null and the alternative hypothesis for the ADF test are:

H_0: $\alpha = 0$ (the time series y_t is not stationary, i.e. y_t has a unit root)

versus

H_A: $\alpha < 0$ (the time series y_t is stationary, i.e. y_t has no unit root)

The ADF test statistic is based on the t-ratio for the coefficient α, given by

$$DF_\alpha = \frac{\alpha}{std\ error(\alpha)} \sim \text{Critical Value (t-distributed at 1\%}$$

or 5% level of significance)

where $\boldsymbol{\alpha}$ is the estimated coefficient of y_{t-1}; **std error ($\boldsymbol{\alpha}$)** is the corresponding standard error of $\boldsymbol{\alpha}$.

3.6.2. The Decision Rule

If the test statistic (t-ratio) is less than the critical value, then the null hypothesis of a unit root (α=0) is rejected in favour of the alternative hypothesis that the time series y_t has no unit root (α<0), and hence it is stationary.

Whereas if the test statistic is greater than the critical value, then the null hypothesis of a unit root is accepted against the alternative hypothesis, and hence it can be concluded that the time series y_t is not stationary; it has a unit root.

A time series y_t is *I(0)*, meaning y_t is in its standard form if it does not require differencing to become stationary. If y_t is not stationary, then its first difference $\Delta y_t = y_t - y_{t-1}$ is taken, and it is said to be integrated of order one, denoted by *I(1)*. If its first difference Δy_t is still not stationary, then the differencing process continues for $\Delta^2 y_t, \Delta^3 y_t, \ldots, \Delta^d y_t$ which implies that the time series y_t required differencing $d>0$ times to become stationary. In this case, some error correction terms are imposed (included) in the model, and the resulting model is termed vector error correction model (VECM).

3.6.3. Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (kpss) Tests

The Phillips-Perron (PP) test is built on the Dickey-Fuller test based on the null hypothesis of a unit root. The test makes a non-parametric correction to the t-test statistic (t-ratio) of the ADF test, and it is robust with respect to unspecified autocorrelation and heteroscedasticity in the disturbance process test model; but it performs worse than the ADF test in finite samples [43,44]. Thus, the PP test is a confirmative test for the ADF test since both investigate unit root (stationarity or non-stationarity) of a given time series.

The PP test involves fitting the Dickey-Fuller (DF) regression

$$\Delta y_t = \alpha y_{t-1} + (constant,\ time\ trend) + \varepsilon_t \quad (12.1)$$

and estimating the model

$$y_t = \pi y_{t-1} + (constant,\ time\ trend) + \varepsilon_t \quad (12.2)$$

and using the result of model (12.2) to compute the test statistic.

The Kwiatkowski-Phillips-Schmidt-Shin (kpss) tests are used for testing a null hypothesis that an observable time series is stationary around a deterministic trend or level. The series y_t is expressed as the sum of deterministic trend, random walk, and stationary error. The test is the Lagrange Multiplier (LM) test of the null hypothesis that the random walk has zero variance. The kpss test aimed at complementing the PP and ADF unit root tests.

The kpss time series model is of the form

$$y_t = \lambda t + (x_t + \beta) + \varepsilon_t \quad (12.3)$$

where $x_t = x_{t-1} + u_t$ is a random walk, with initial value x_0=β serving as intercept; t is the time index; $u_t \sim$ i.i.d N(0, σ_u^2).

The simplified version of the kpss model without the time trend component is used to test level stationarity [31].

The null and the alternative hypotheses are as follows:

H_0: $\sigma_u^2 = 0$ (the time series y_t is trend or level stationary) versus

H_A: $\sigma_u^2 \neq 0$ (the time series y_t is neither trend nor level stationary).

Thus, testing both the unit root hypothesis and the (trend & level) stationarity hypothesis, it becomes easier to distinguish series that appear to be stationary, series that appear to have a unit root, and series for which the dataset or tests are not sufficiently informative to be sure whether they are stationary or integrated [31,33,42,43].

3.7. Lag Length and Model Selection Criteria

The choice of lag length is determined by the model selection criteria. A major underlying approach is that if the number of parameters in the VAR model increases with the square of the number of variables, then it is desirable to impose some restrictions on the parameter matrices, which eliminates some lagged variables in some of the equations of the model [29,30].

The standard model election criteria is used to choose the best order in the VAR model which minimizes them over a set of possible orders p=0,1,2,..,p_{max} .

The general form of the criteria is

$$IC(p) = ln|\Omega(p)| + C_r \delta(k, p) \quad (13)$$

where $(p)=\frac{1}{T}\sum_{t=1}^{T} \epsilon_t \epsilon_t'$ is the residual covariance matrix without the degrees of freedom correction from the VAR(p) model; C_T is a sequence indexed by the sample size T; δ(k, p) is a penalty function which penalizes large VAR(p) models; $\ln|\Omega(p)|$ is a non-decreasing function of order p such that δ(k, p) increases as p increases (prediction error); p is the lag order or lag length; k is the number of variables; T is the sample size.

Thus, the lag length which optimally balances the two forces is then chosen.

In a time series involving k variables, T sample size, a constant term, and a maximum p lag length, the use of an information criterion may be plausible. The main information criteria are: 1. Akaike Information Criterion (AIC), 2. Schwartz-Bayesian Information Criterion (SBIC), 3. Hannan-Quinn Information Criterion (HQIC), and 4. Final Prediction Error (FPE). Their expressions are as follows:

$$AIC(p) = \ln|\Omega(p)| + \frac{2}{T} pk^2 \quad (13.1)$$

$$SBIC(p) = \ln|\Omega(p)| + \frac{lnT}{T} pk^2 \quad (13.2)$$

$$HQIC(p) = \ln\left|\Omega(p)\right| + \frac{2\ln(lnT)}{T} pk^2 \qquad (13.3)$$

$$FPE(p) = \ln\left|\Omega(p)\right| + \left(\frac{T+kp+1}{T-kp-1}\right)^k \qquad (13.4)$$

where $|\Omega(p)|$ is the determinant of the variance-covariance matrix of the estimated residuals [33,41,42].

Another important method that has been shown to have good properties is to choose the value of the lag length p that minimizes the modified Akaike Information Criterion (MAIC), and it is defined as

$$MAIC(p) = \ln\left|\Omega(p)\right| + \frac{2(\tau_p + p)}{T - p_{\max}} \qquad (13.5)$$

where $\tau_p = \frac{\alpha^2}{\left|\Omega(p)\right|} \sum_{t=p_{\max}+1}^{T} (\epsilon_{t-1}^2)$, which satisfies the limiting condition p→∞ as T→∞; p=argmin$_p$ $IC(p)$; α is the coefficient of y_{t-1} in model (12).

The AIC and SBIC are the most widely used information criteria, but the SBIC penalizes larger model orders than the AIC. The AIC asymptotically overestimates the lag length with a high precision; but under a small sample size, the AIC and FPE may outperform the SBIC and HQIC. Interestingly, they are all consistent estimators of a model lagged order in distinct situations despite their differences in performance [32,34,38,39].

4. Results and Interpretation

This section focuses mainly on the presentation of results and interpretation of the data output used to achieve the desirable objective of the study.

4.1 The Descriptive Statistics for the Economic Indicators

Table 2 gives the summary description of each economic indicator, showing the main statistical features of the data set used in the research for easy comparison. The descriptive statistics result shows that each economic indicator is positively skewed to the right of its arithmetic mean. This implies that any future value of each economic indicator is more likely to be greater than the value of its mean. The kurtosis which describes the sharpness of the peak of each economic indicator's frequency-distribution curve is appreciable, with Federal Government Revenue having the least while Net Domestic Investment attains the highest. The standard deviation quantifies the amount of variability or extent to which each indicator's series dispersed around its mean. The Nominal GDP has the highest standard deviation while the Net Foreign Investment has the lowest. The quartiles partitioned the values of each economic indicator into four equal parts for easy identification of the lower quartile, the median and the upper quartile respectively. The quartile-based result shows that although the Non-Oil producing sector begins with minimum revenue greater than the minimum revenue of the Oil producing sector (zero), but the Oil producing sector speedily dominates the Non-Oil producing sector from the lower to the upper quartiles, and resulting to the highest contributor of the country's Federal Government Revenue and Economic Growth as shown in Table 2 above. It is caused by negligence on the part of the government to boost both sectors significantly, instead of promoting a single booming sector in lieu of the initial dominant sector without considering the long-run economic implication in the country.

4.2. Result of the Granger Causality Tests

The result of the Granger causality tests provides a strong statistically significant evidence (*F-test>F-critical, with p-value<0.01*) that Federal Government Revenue significantly predict Economic Growth *at 1% level of significance* and Economic Growth significantly predict Federal Government Revenue at any time *at 5% level of significance*, given their historical monetary values. The causality is in two directions since both indicators significantly predict each other, and hence, they Granger cause each other. However, the result in Table 3 shows clearly that Oil Revenue and Net Domestic Investment do not significantly predict Economic Growth since there is no statistically significant evidence to reject the null hypothesis (*F-test<F-critical, with p-value>0.05*) at 5% significant level. Consequently, the Oil Revenue and Net Domestic Investment do not Granger cause Economic Growth. In the same vein, the Net Domestic Investment does not significantly predict Federal Government Revenue, since it does not provide a statistically significant evident to reject the null hypothesis at 1% or 5% level of significance. Interestingly, the Granger causality tests based on the dataset in this study provide statistically significant evident that Federal Government Revenue, Non-Oil Revenue, Total Expenditure and Net Foreign Investment significantly predict the country's Economic Growth, and hence, they Granger cause Economic Growth. Similarly, the Economic Growth, Oil Revenue, Total Expenditure and Net Foreign Investment significantly predict the country's Federal Government Revenue, and hence, they Granger cause Federal Government Revenue in this direction.

Therefore, the annual Economic Growth of Nigeria is predictable at any time using its historical monetary values together with the historical monetary values of the Federal Government Revenue, Non-Oil Revenue, Total Expenditure and Net Foreign Investment at a suitable optimal lag length. Similarly, the annual Federal Government Revenue of Nigeria is also predictable at any time using its historical monetary values together with the historical monetary values of the Economic Growth, Oil Revenue, Total Expenditure and Net Foreign Investment at a suitable optimal lag length. Even though the Oil Revenue does not significantly predict Economic Growth directly, it significantly predicts the Federal Government Revenue, and the Federal Government Revenue significantly predicts the Economic Growth. The empirical finding in this study reveals that the Oil Revenue is a key contributor to Federal Government Revenue but does not reflect the country's Economic Growth. This justifies the fact that the Oil Revenue certainly boosts Federal Government Revenue in its

contribution but does not consistently determine or stabilize the country's Economic Growth on a long-run. The Net Domestic Investment neither predicts Economic Growth nor Federal Government Revenue, and hence, the addition of Net Domestic Investment time series does not significantly improve the predictive task of the multivariate vector autoregressive model. On the other hand, there is a strong statistically significant evident that the Total Expenditure and Net Foreign Investment significantly predict both Economic Growth and Federal Government Revenue. Thus, the addition of the time series' of Total Expenditure and Net Foreign Investment has significantly improved the predictive task of the multivariate vector autoregressive model.

4.3. The Ordinary Least Squares (OLS) Estimates of Parameters in the VAR Model

The analysis in Table 4 reveals that the coefficient of determination is 51.77% (moderate goodness of fit), which implies that the explanatory variables account for about 52% of variation in the response variable (Federal Government Revenue). The F-statistic result confirmed the significance of the entire model at 1% significant level, and the intercept is also significant. There is statistically significant evident that the previous values of Economic Growth, Oil Revenue and Non-Oil Revenue have positive impact on future Federal Government Revenue, as displayed by the VAR model; and hence, they are significant contributors to the country's Federal Government Revenue. From the analysis in Table 5, it was discovered that the explanatory variables account for about 97% and 83% of variation in the response variable, as given by the coefficient of determination and its adjusted value respectively. The F-statistic result confirmed that the entire model is statistically significant at 1% level of significance, with a significant intercept. The analysis reveals that the historical values of the Federal Government Revenue, Oil Revenue, Non-Oil Revenue, Total Expenditure, Net Foreign Investment and Net Domestic Investment have significant impact on Economic Growth, and hence, they are significant contributors to the country's Economic Growth.

Table 2. Descriptive Statistics Table for the Seven Economic Indicators in Nigeria (1961-2010)

Variable	Minimum	Maximum	Lower Quartile	Upper Quartile	Median	Mean	Stand. Dev.	Skewness	Kurtosis
NOMGDP	2,361.20	29,108,020.00	8,630.50	2,801,973.00	68,527.77	3,704,657.00	7,397,532.00	2.187	6.601
FEDREV	223.65	7,866,590.00	1,695.30	582,811.10	15,141.95	1,072,419.00	2,099,142.00	2.018	5.786
OILREV	0.00	6,530,630.00	1,016.00	416,811.10	11,638.50	852,142.40	1,689,681.00	2.062	5.993
NOILREV	223.65	1,907,581.00	755.96	166,000.00	4,607.30	226,826.90	451,088.60	2.296	7.535
TEXP	163.90	4,194,218.00	1,529.20	487,113.40	15,596.10	514,703.90	984,924.30	2.268	7.465
NFI	-11,859.60	75,027.20	8.00	1,918.70	49.34	5,645.10	14,912.39	3.334	14.552
NDI	-5,797.80	1,110,660.00	227.40	46,716.70	3,165.10	66,178.03	178,968.30	4.585	25.595

Table 3. Summary Result of the Granger Causality Tests

Causality	F-test	df	F-critical	Pr(>F)	Decision
FEDREV "predict" NOMGDP	2.4971	(6,37)	2.3359	0.0452*	Reject H_0 (Significant)
NOMGDP "predict" FEDREV	11.752	(1,47)	7.0771	0.001291**	Reject H_0 (Significant)
OILREV "predict" NOMGDP	1.0176	(2,45)	3.1504	0.37	Do Not Reject H_0
NOMGDP "predict" OILREV	2.4016	(6,37)	1.9269	0.05062	Do Not Reject H_0
NOILREV "predict" NOMGDP	9.2641	(15,19)	2.2341	0.0221*	Reject H_0 (Significant)
NOMGDP "predict" NOILREV	2.8554	(1,47)	2.8100	0.09783	Do Not Reject H_0
OILREV "predict" FEDREV	2.9662	(7,35)	2.2490	0.01858*	Reject H_0 (Significant)
FEDREV "predict" OILREV	3.0349	(12,25)	2.1649	0.02888*	Reject H_0 (Significant)
NOILREV "predict" FEDREV	3.0937	(2,45)	2.3932	0.05556	Do Not Reject H_0
FEDREV "predict" NOILREV	2.0059	(6,37)	1.9269	0.09496	Do Not Reject H_0
NOILREV "predict" OILREV	3.0612	(1,47)	2.8100	0.08685	Do Not Reject H_0
OILREV "predict" NOILREV	2.6733	(3,43)	2.1774	0.06023	Do Not Reject H_0
TEXP "predict" NOMGDP	10.348	(2,45)	7.7678	0.0002144***	Reject H_0 (Significant)
NFI "predict" NOMGDP	2.6369	(4,41)	2.6060	0.04929*	Reject H_0 (Significant)
NDI "predict" NOMGDP	0.3485	(2,45)	3.1504	0.7077	Do Not Reject H_0
TEXP "predict" FEDREV	4.2301	(2,45)	3.1504	0.02104*	Reject H_0 (Significant)
NFI "predict" FEDREV	3.236	(13,23)	2.1282	0.03495*	Reject H_0 (Significant)
NDI "predict" FEDREV	0.9509	(8,33)	2.1807	0.4945	Do Not Reject H_0
N/B: '', '**' and '*' indicate the rejection of the null hypothesis at 0.1%, 1% and 5% significant level respectively***.					

Table 4. Estimates of Parameters in the VAR Model

Response Variable: FEDREV						
Predictor Variable	Parameter Estimate	Standard Error	t-value	Critical Value	Pr(>t)	Decision
Lag(NOMGDP)	0.40929	0.12576	3.255	2.7012	0.00228**	Reject H_0
Lag(OILREV)	0.37178	0.13322	2.791	2.7012	0.00795**	Reject H_0
Lag(NOILREV)	0.29400	0.13115	2.242	2.0195	0.03046*	Reject H_0
Lag(TEXP)	-0.10075	0.12668	-0.795	2.0195	0.43099	Do Not Reject H_0
Lag(NFI)	0.07059	0.12305	0.574	2.0195	0.56932	Do Not Reject H_0
Lag(NDI)	0.20771	0.11367	1.827	1.6829	0.0767	Do Not Reject H_0
Constant	47.18635	9.11787	5.175	3.496	6.37e-06***	Reject H_0
Included Observations (Sample Size) = 49; Log Likelihood = -1299; Residual Standard Error = 10.88 on 41 degrees of freedom; Multiple $\mathbf{R^2}$ = 0.5177 and Adjusted $\mathbf{R^2}$ = 0.4354; F-statistic = 6.287 on 7 and 41 degrees of freedom; F-critical, F(7,41;0.01) = 3.02; p-value = 4.859e-05. *N/B: '***', '**' and '*' indicate the rejection of the null hypothesis at 0.1%, 1% and 5% significant level respectively.*						

Table 5. Estimates of Parameters in the VAR Model

Response Variable: NOMGDP						
Predictor Variable	Parameter Estimate	Standard Error	t-value	Critical Value	Pr(>t)	Decision
Lag(FEDREV)	0.62681	0.22716	2.759	2.2622	0.022143*	Reject H_0
Lag(OILREV)	0.74829	0.14640	5.111	4.781	0.000635***	Reject H_0
Lag(NOILREV)	0.65691	0.24279	2.706	2.2622	0.024167*	Reject H_0
Lag(TEXP)	-0.6516	0.21068	-3.015	2.2622	0.014602*	Reject H_0
Lag(NFI)	-0.84967	0.20014	-4.245	3.2498	0.002157**	Reject H_0
Lag(NDI)	0.43948	0.12620	3.482	3.2498	0.006913**	Reject H_0
Constant	106.53669	36.06230	2.954	2.2622	0.016110*	Reject H_0
Included Observations (Sample Size) = 45; Log Likelihood = -894.168; Residual Standard Error = 5.988 on 9 degrees of freedom; Multiple $\boldsymbol{R^2}$ = 0.9662 and Adjusted $\boldsymbol{R^2}$ = 0.8347; F-statistic = 7.348 on 35 and 9 degrees of freedom; F-critical, F(9,35;0.01) = 4.60; p-value = 0.00173. *N/B: '***', '**' and '*' indicate the rejection of the null hypothesis at 0.1%, 1% and 5% significant level respectively.*						

Moving on to the optimal lag length chosen by each information criterion: the Akaike Information Criterion (AIC), Hannan-Quin Information Criterion (HQIC) and the Final Prediction Error (FPE) chose an optimal lag length of 5 while the Schwartz-Bayesian Information Criteria (SBIC) chose an optimal lag length of 1. Thus, any lag length greater than 5 will affect the entire result of the multivariate vector autoregressive model. The optimal lag length of the VAR model for Federal Government Revenue (as response variable) was based on the SBIC while the optimal lag length of the VAR model for Economic Growth (as response variable) was based on the AIC, HQIC and FPE. However, the optimal lag length for the Granger causality tests lies between 1 and 16 ($1 \leq p \leq 16$), depending on the most significant strength of the causal variable in the predictive model. Thus, these information criteria highly optimized the task in the study.

4.4. Augmented Dickey-Fuller (ADF) and Phillips-Perron Unit Root Tests

The outcome of the ADF and PP stationarity tests necessitated an investigation of the existence or non-existence of a conventional long-run relationship between the response variable and the set of independent variables, mainly for the avoidance of spurious OLS regression, specifying the order of integration of the response and explanatory variables in the VAR model. The analysis of the ADF and PP unit root tests revealed that the time series of some economic indicators are in standard form while others required differencing once to become stationary. In particular, the Economic Growth, Federal Government Revenue and Total Expenditure are in their standard form, and are said to be integrated of order zero, denoted by *I(0)*; which implies that they are stationary (no unit root) without differencing. Whereas the Oil Revenue, Non-Oil Revenue, Net Foreign Investment and Domestic Investment were all differenced once before they became stationary, and they are said to be integrated of order one, denoted by *I(1)*. The PP test confirmed the analysis of the ADF test and justified the decision as shown in Table 6. Therefore, the multivariate VAR satisfies the stability condition since all the roots of the characteristic polynomial lied outside the unit circle, where the matrix polynomial has a full rank and non-singular.

4.5. Analysis of the Kwiatkowski-Phillips-Schmidt-Shin (kpss) Tests

The empirical analysis of the kpss tests reveals that the observable time series of Oil Revenue is not level stationary at 5% significant level while the time series of Economic Growth, Federal Government Revenue, Non-Oil Revenue, Total Expenditure, Net Foreign Investment and Net Domestic Investment are all stationary in levels. The analysis further reveals that there is stationarity around a deterministic trend for Economic Growth, Federal Government Revenue, Non-Oil Revenue, Total Expenditure and Net Foreign Investment respectively; since the data do not provide statistically significant evident to reject the null hypothesis

at 5% level of significance, and hence, they can be detrended. Whereas there is a strong statistically significant evident of no stationarity around the deterministic trend of Oil Revenue and Net Domestic Investment respectively at 1% level of significance; and hence, Oil Revenue and Net Domestic Investment are not trend stationary. Thus, the analysis of the ADF, PP and kpss tests have justified the fact that a given time series could be trend stationary or level stationary or have a unit root.

Table 6. Result of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Unit Root Tests

Variable	ADF Statistic	Critical Value	p-value	PP(DFz_α) Statistic	p-value	Order of Integration	Decision
NOMGDP	-4.4668	-4.15	<0.01**	-24.0808	0.01684*	I(0)	Reject H_0
FEDREV	-3.7476	-3.50	0.02983*	-26.7152	<0.01**	I(0)	Reject H_0
ΔOILREV	-6.2692	-4.15	<0.01**	-36.0408	<0.01**	I(1)	Reject H_0
ΔNOILREV	-4.3821	-4.15	<0.01**	-22.9653	0.02195*	I(1)	Reject H_0
TEXP	-3.9303	-3.50	0.01972*	-21.9654	0.02825*	I(0)	Reject H_0
ΔNFI	-4.946	-4.15	<0.01**	-34.9591	<0.01**	I(1)	Reject H_0
ΔNDI	-6.217	-4.15	<0.01**	-50.8122	<0.01**	I(1)	Reject H_0

N/B: '**', '*' indicate the rejection of the null hypothesis at 1% and 5% significant level respectively. Unlike the t-ratios in a VAR model, the negative signs are not ignored in the case of ADF and PP tests.

Table 7. Analysis of the kpss Level and kpss Trend Stationarity Tests

Variable	kpss Level	p-value	Remarks	kpss Trend	p-value	Remarks
NOMGDP	0.139	>0.1	Do Not Reject H_0	0.1297	0.08019	Do Not Reject H_0
FEDREV	0.1428	>0.1	Do Not Reject H_0	0.1362	0.06821	Do Not Reject H_0
OILREV	0.5222	0.03667*	Reject H_0	0.2831	<0.01**	Reject H_0
NOILREV	0.3558	0.09622	Do Not Reject H_0	0.0927	>0.1	Do Not Reject H_0
TEXP	0.1394	>0.1	Do Not Reject H_0	0.0805	>0.1	Do Not Reject H_0
NFI	0.2997	>0.1	Do Not Reject H_0	0.0557	>0.1	Do Not Reject H_0
NDI	0.2774	>0.1	Do Not Reject H_0	0.2178	<0.01**	Reject H_0

N/B: '**' and '*' indicate the rejection of the null hypothesis at 1% and 5% significant level respectively.

4.6. Graphical Representation of the Percentage Contribution of Oil Revenue and Non-Oil Revenue to Federal Government Revenue and Economic Growth

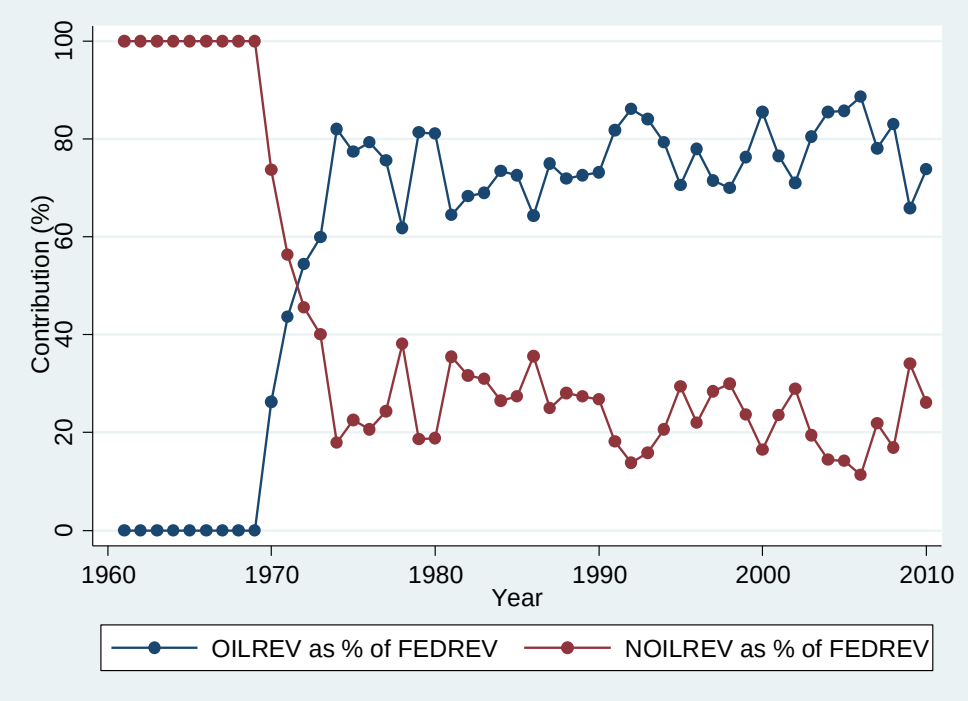

Figure 1. Line Graph showing the Percentage Contribution of Oil Revenue & Non-Oil Revenue to Federal Government Revenue in Nigeria (1961-2010)

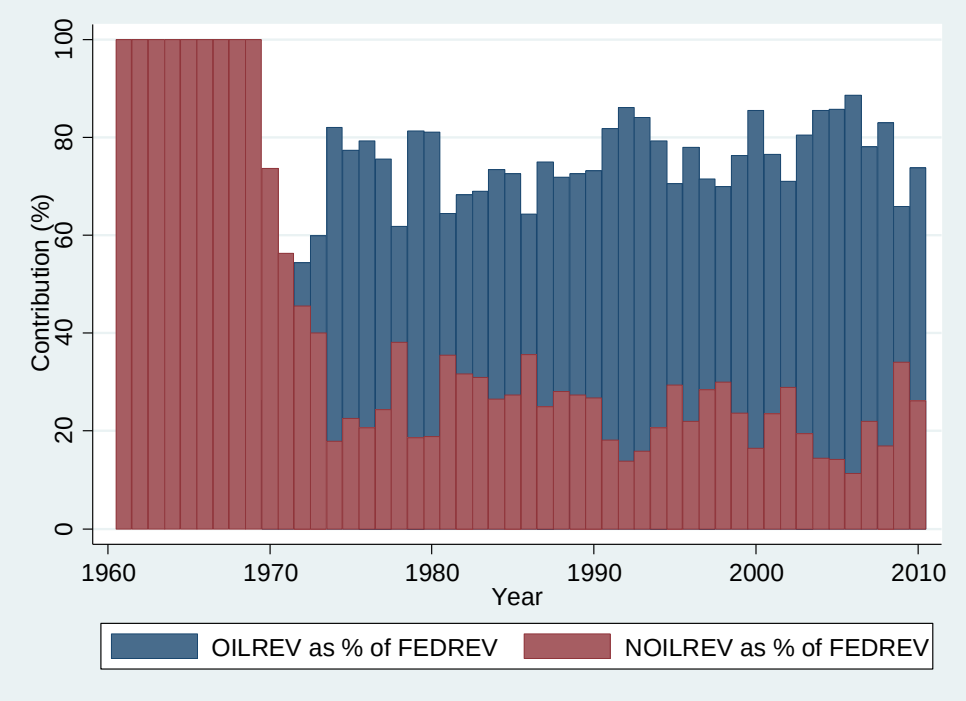

Figure 2. Bar Graph showing the Percentage Contribution of Oil Revenue & Non-Oil Revenue to Federal Government Revenue in Nigeria (1961-2010)

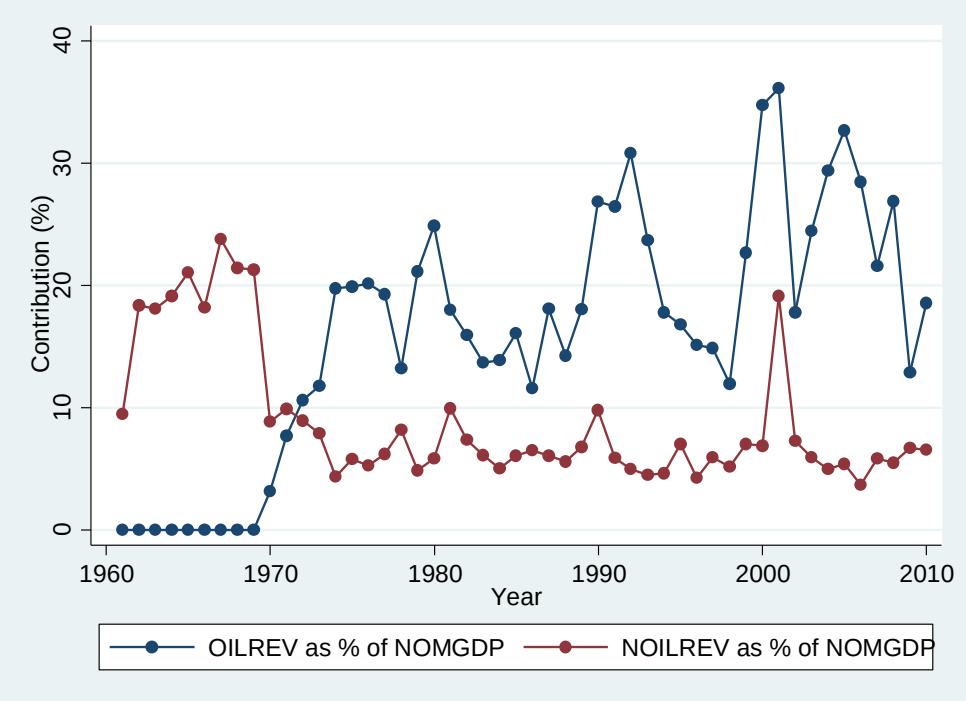

Figure 3. Line Graph showing the Percentage Contribution of Oil Revenue & Non-Oil Revenue to Economic Growth (Nominal GDP) in Nigeria (1961-2010)

Figure 1 and Figure 2 described the percentage contribution of the Oil and Non-Oil producing sectors to Federal Government Revenue generation while Figure 3 and Figure 4 displayed the percentage contribution of the Oil and Non-Oil producing sectors to Economic Growth in Nigeria. From the analysis of the graphs, the Non-Oil producing sector was the principal source of Federal Government Revenue as well as the key sector to the country's Economic Growth until early 1970s when the Oil producing sector dominated the Non-Oil producing sector, and became the highest source of Federal Government Revenue in the country (see Figure 1 and Figure 2). It is noticeable that inspite of the government's negligence on the Non-Oil producing sector, the two sectors exhibit significant contribution pattern of growth as a percentage of Federal Government Revenue over the years irrespective of their marginal proportionate contribution, primarily caused by the replacement rather than using an optimal ratio to boost both sectors significantly.

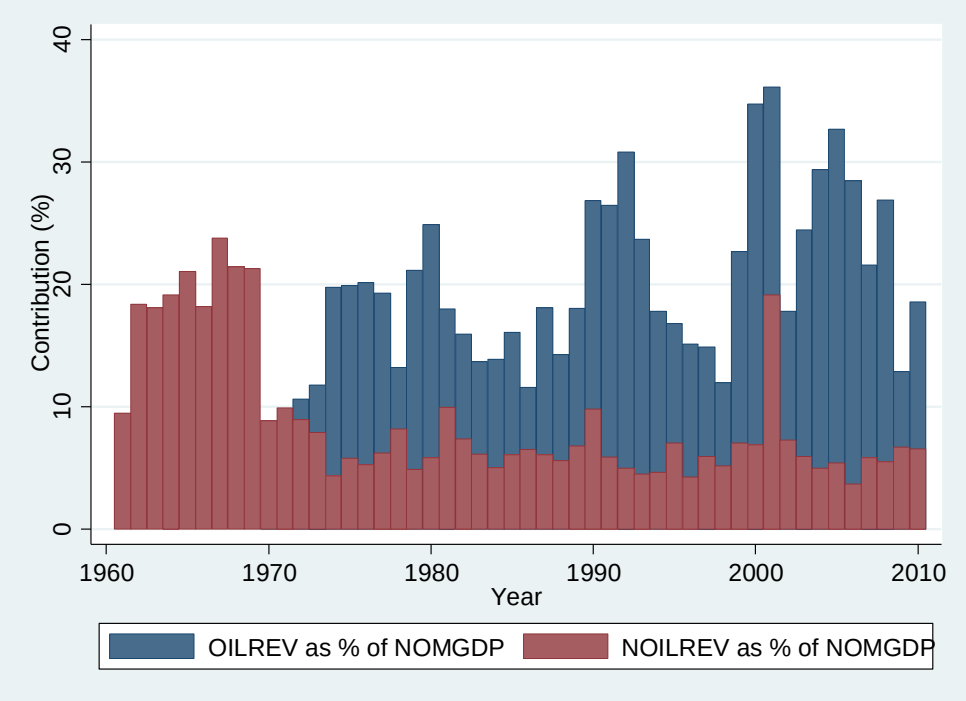

Figure 4. Bar Graph showing the Percentage Contribution of Oil Revenue & Non-Oil Revenue to Economic Growth (Nominal GDP) in Nigeria (1961-2010)

The empirical analysis of Figure 3 and Figure 4 revealed that the Non-Oil producing sector was also the key contributor to Nominal GDP until early 1970s when the booming Oil producing sector replaced the Non-Oil producing sector. Although the Oil sector has dominated the Non-Oil sector in terms of Federal Government Revenue generation and Economic Growth, but the Non-Oil sector is still a significant contributor to Federal Government Revenue generation and Economic Growth in the country. It is noticeable that the Oil contribution alone does not significantly reflect the country's highest or maximum Economic Growth status, while the significant contribution of both sectors especially in the year 2001 reflects the maximum Economic Growth status (see Figure 4). Thus, the Oil producing sector is the most reliable sector for Federal Government Revenue generation; but any attempt to boost both sectors without further negligence will significantly promote and stabilize the growth of the country's economy.

4.7. Percentage and Actual Growth Rates of Major Economic Indicators

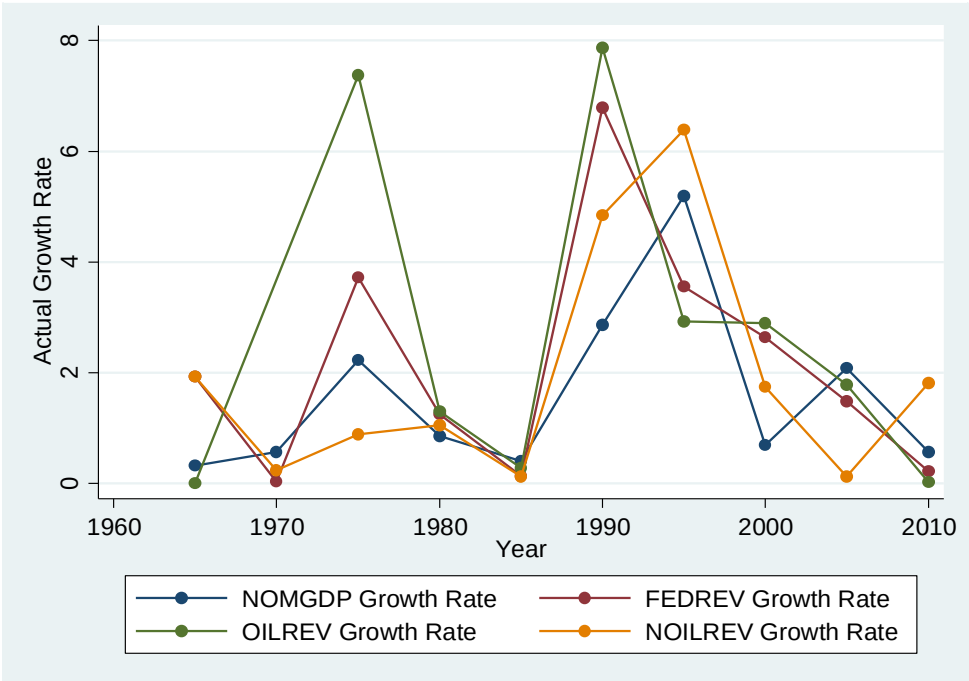

Figure 5(a). Line Graph showing the Actual Growth Rates of Major Economic Indicators

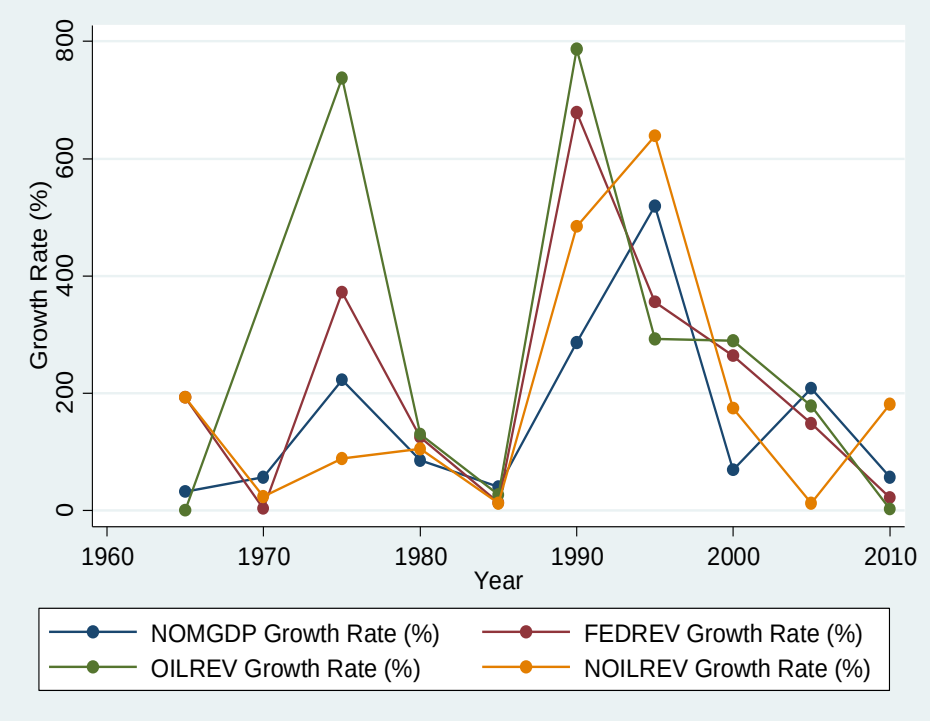

Figure 5(b). Line Graph showing the Percentage Growth Rates of Major Economic Indicators

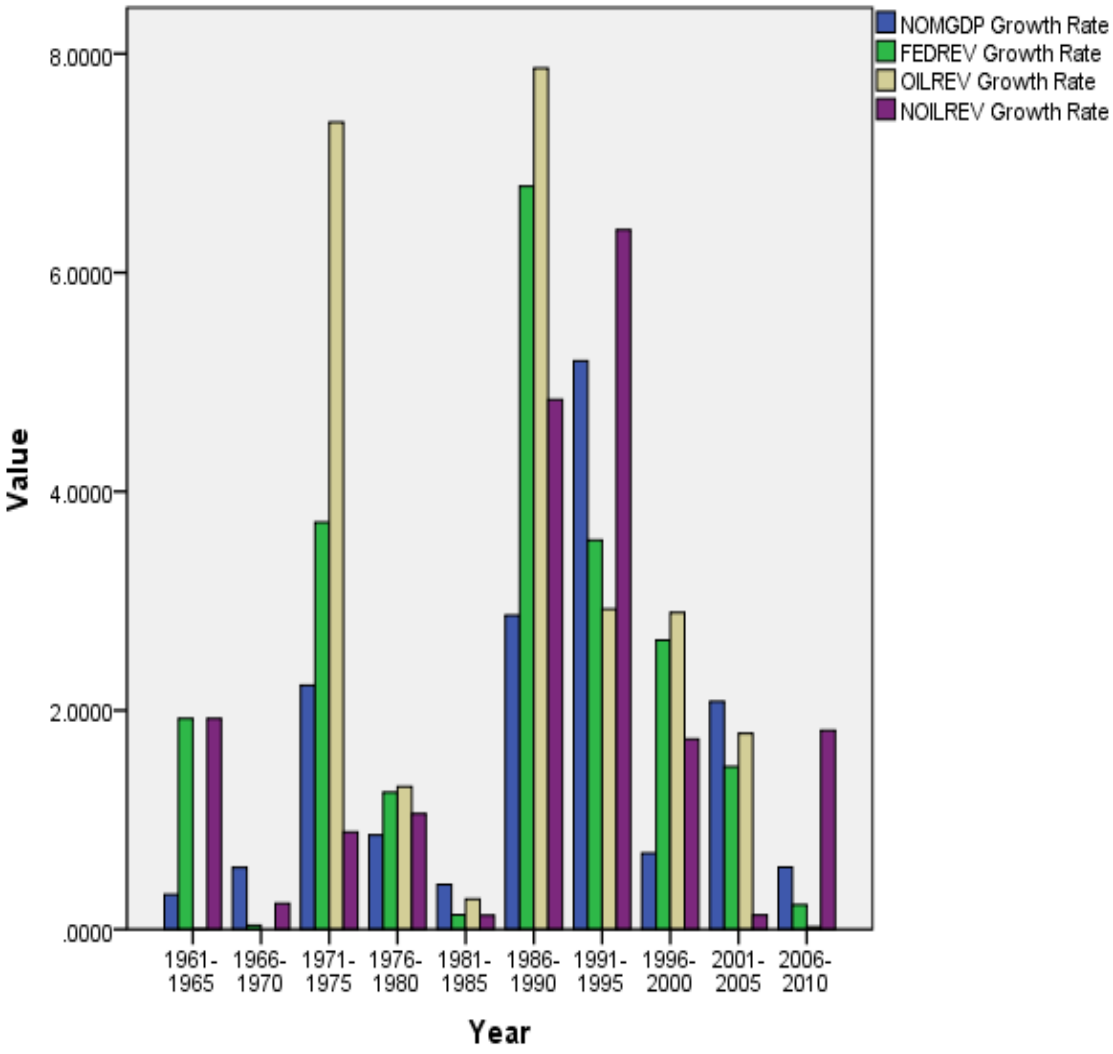

Figure 6(a). Bar Graph showing the Actual Growth Rates of Major Economic Indicators

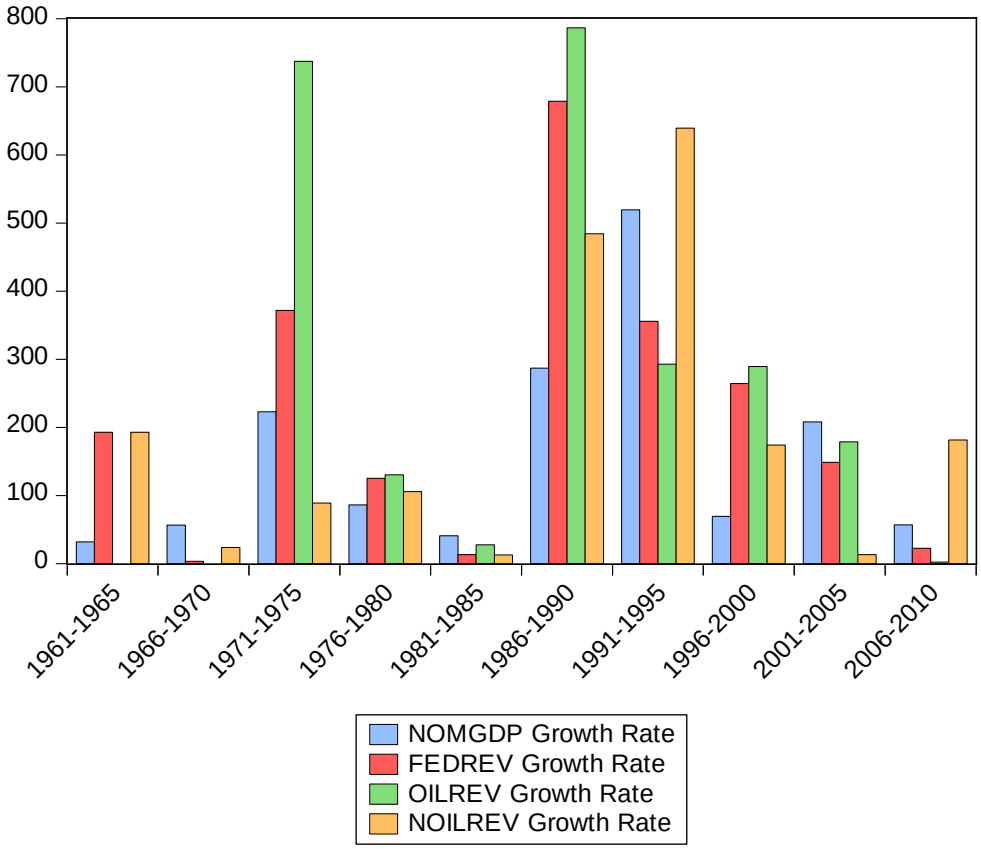

Figure 6(b). Bar Graph showing the Percentage (%) Growth Rates of Major Economic Indicators

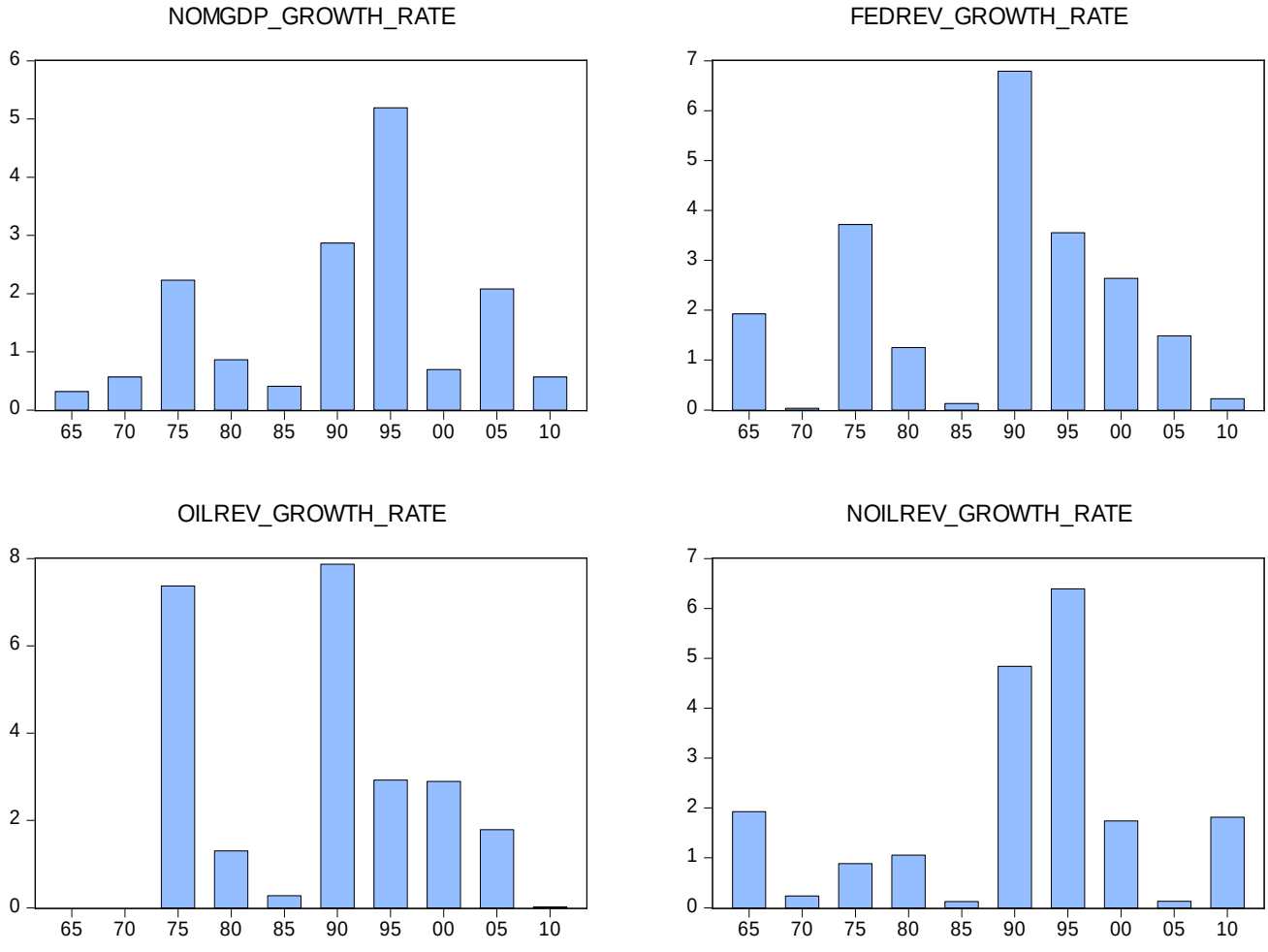

Figure 6(c). Bar Graphs Showing Individual Actual Growth Rates of Major Economic Indicators

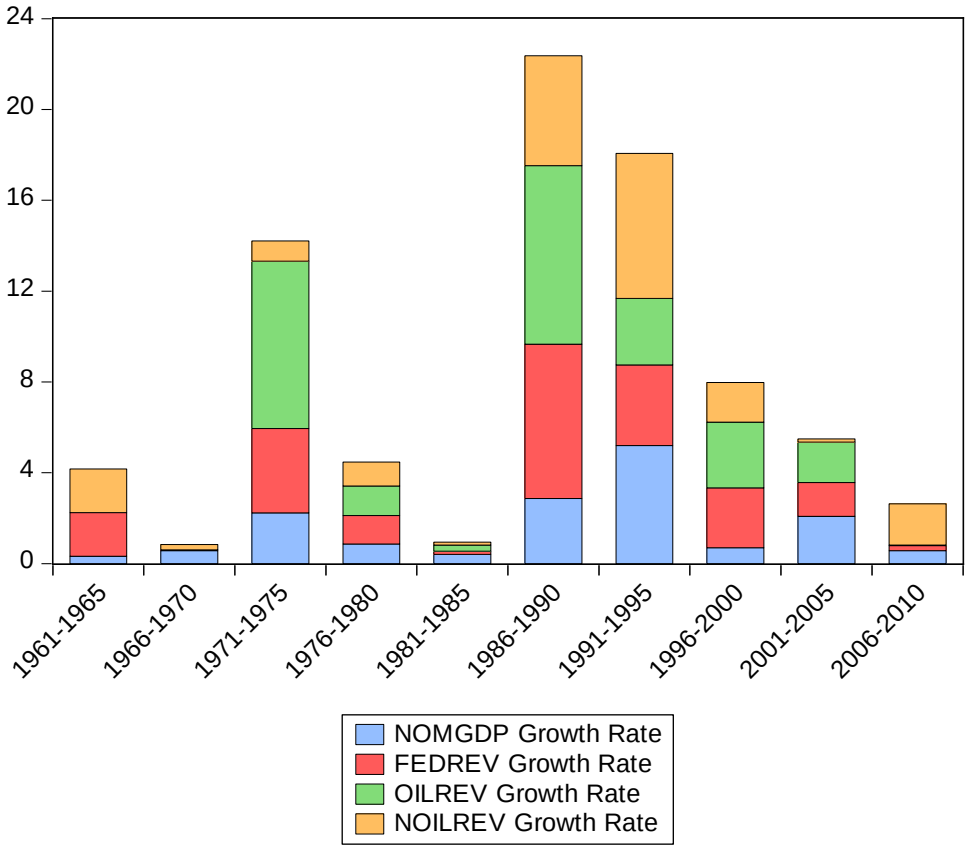

Figure 6(d). Actual Growth Rates of Major Economic Indicators Stack in a Single Graph

There is observable similar growth rate pattern (proportion and structure) between Federal Government Revenue and Oil Revenue; Nominal GDP and Non-Oil Revenue respectively (see Figure 6(c)). The Non-Oil producing sector seems to be more consistent for the country's economic growth rate, especially on a long-run to the next decades as compared to the Oil producing sector (see Figure 5). Again, the maximum economic growth rate was attained when the growth rate of the Non-Oil sector increases significantly, resulting to an optimal level of 5.192 from the year 1991 to 1995 (see Figure 5 and Figure 6). This is not the highest growth rate for the Non-Oil sector, but it is the most appreciable growth rate level at which both sectors jointly yield the maximum growth rate level of the country's economy. Therefore, it is imperative for the Federal Government of Nigeria to diversify the economy and boost both sectors significantly using an optimal ratio in order to boost Federal Government Revenue generation and a long-run sustainable economic growth in the country, rather than boosting a single seasonal booming sector in lieu of another significant sector. This will significantly rectify the problem of yielding seasonal maximum revenue without correspondingly reflecting maximum economic growth status on the long-run.

5. Conclusion and Recommendation

The analysis in this study proved that both the Oil and Non-Oil producing sectors are significant contributors to Federal Government Revenue generation and Economic Growth in Nigeria; and thus have positive significant impact in the country's economy. It is noticeable that as correlation does not imply causation, the ability of any of these economic indicators to significantly "predict" the other is based on the result of the Granger causality test. The result of the Granger causality test shows that the Federal Government Revenue significantly predict Economic Growth at 5% level of significance and Economic Growth significantly predict Federal Government Revenue at 1% significant level, at any time, given their historical monetary values. The causality is in two directions since both significantly predict each other. In a quest to develop suitable predictive models for both Federal Government Revenue and Economic Growth, the predictive ability of the other economic indicators (Oil Revenue, Non-Oil Revenue, Total Expenditure, Net Foreign Investment and Net Domestic Investment) was also investigated using the Granger causality test. The analysis shows that the Non-Oil Revenue, Total Expenditure and Net Foreign Investment are significant predictors of Economic Growth, and are said to Granger cause Economic Growth. Similarly, the Oil Revenue, Non-Oil Revenue, Total Expenditure and Net Foreign Investment are significant predictors of Federal Government Revenue, and hence, they Granger cause Federal Government Revenue. Therefore, the country's annual Economic Growth is predictable at any time using its historical monetary values together with the historical monetary values of the Federal Government Revenue, Non-Oil Revenue, Total Expenditure and Net Foreign Investment at an optimal lag length. The annual Federal Government Revenue is also predictable at any time using its historical monetary values together with the historical monetary values of the Economic Growth, Oil Revenue, Non-Oil Revenue, Total Expenditure and

Net Foreign Investment. The findings revealed that the Oil Revenue and Net Domestic Investment do not significantly predict Economic Growth, and hence, they do not Granger cause Economic Growth. Again, the Net Domestic Investment does not significantly predict Federal Government Revenue. Thus the addition of Total Expenditure and Net Foreign Investment has significantly improved the predictive task of the multivariate vector autoregressive (VAR) model. On the other hand, the addition of Net Domestic Investment does not significantly improve the predictive task of the multivariate vector autoregressive (VAR) model. The analysis of the descriptive statistics shows that the future value of any economic indicator is most likely to be greater than its mean since every economic indicator is positively skewed to the right. The Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC) and Final Prediction Error (FPE) chose a an optimal lag length of 5 while the Schwartz-Bayesian Information Criterion (SBIC) chose an optimal lag length of 1 for the multivariate VAR model. The predictive model for Federal Government Revenue was based on SBIC while the predictive model for Economic Growth was based on AIC, HQIC and FPE. The analysis of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests revealed that Economic Growth, Federal Government Revenue and Total Expenditure are in standard stationary VAR, and are said to be integrated of order zero, denoted by *I(0)*; while the Oil Revenue, Non-Oil Revenue, Net Foreign Investment and Net Domestic Investment are integrated of order one, denoted by *I(1)*, which implies that they were differenced once before they became stationary. The kpss tests revealed that the Oil Revenue and Net Domestic Investment are non-stationary around a deterministic trend while the Economic Growth, Federal Government Revenue, Non-Oil Revenue, Total Expenditure and Net Domestic Investment are all stationary around a deterministic trend, and they are referred to as detrended series. The kpss tests further revealed that only the Oil Revenue is not level stationary at 5% significance level while the other economic indicators are level stationary. Thus the results of the ADF, PP and kpss have justified the stationarity status of each time series variable. The line and bar graphs showing the sectoral percentage contribution of the Oil and Non-Oil producing sectors revealed that the Oil producing sector has dominated the Non-Oil producing sector in terms of its huge Federal Government Revenue generation, but does not single-handedly accelerate to stabilize the long-run Economic Growth of the country. Although the Oil producing sector is a reliable source of Federal Government Revenue generation but it does not alone reflect a corresponding optimal Economic Growth status (Oil shocks, unemployment, abject poverty, low standard of living among others). The Non-Oil sector seems to be more reliable in terms of a long-run sustainable economic growth and stability. It was observed from the line and bar graphs showing the percentage contribution of both sectors to Economic Growth that the country's maximum Economic Growth was at the point where both sectors increases moderately in a certain share ratio. Again, the maximum Economic Growth Rate was at the point where the Non-Oil sector accelerates moderately, which suggests a diversification of the country's economy rather than depending on a single booming sector and neglecting the other significant sectors needed to maintain a long-run economic growth and stability. Therefore, it is imperative for the Federal Government of Nigeria to diversify the country's economy, invest proportionately in all significantly contributing sectors in order to maintain consistency in Federal Government Revenue generation and attain an optimal long-run Economic Growth and stability status.

As part of developmental measures or strategies to maintain consistency in Federal Government Revenue generation and to accelerate a long-run sustainable Economic Growth and stability, alleviate poverty, reduce massive unemployment status and achieve a good standard of living among the teeming population with annual growth rate of approximately 3% in the country, it is imperative for the Federal Government of Nigeria to consider the following recommendations:

- There is need for the Federal Government to judiciously channel Oil Revenue to the development of the Non-Oil producing sector of the economy (especially the agricultural, industrial and manufacturing sub-sectors) in order to boost the Non-Oil producing sector and accelerate a long-run sustainable economic growth and stability.
- Diversification of the country's economy will re-awaken other significantly neglected sectors, capable of boosting the Federal Government Revenue and Economic Growth alongside with the booming Oil producing sector which is mainly known for seasonal wealth accumulation.
- A re-visitation to the agricultural sector will enhance the overall achievement of the goals behind the establishment of Federal Colleges and Universities of Agriculture, and a number of agricultural programmes that are drastically non-functional in the country due to government's negligence. This will hopefully provide massive employment opportunities especially to young school leavers, boost food production, alleviate poverty and ensure a good standard of living for the citizenry.
- Diversifying the country's economy will also enhance less exposure to external shocks, an increase in trade and investment, higher productivity of capital and labour as well as a better regional and national economic integration.
- Implementation of legal and administrative economic policies will minimize corruption and favouritism on the part of public office holders, and thus ensure efficient allocation and utilization of Oil and Non-Oil generating Revenues for the development of all states of the federation.
- The Federal Government of Nigeria should embark on training high level human resource manpower (technical know-how) in order to sufficiently harness her agricultural and natural resources (especially the petroleum), and save the country from the cost of international dependency on exploration.

Hopefully, Nigeria will achieve the internationally agreed Millennium Development Goals (MDGs) within

the next decade if these measures are effectively put in place.

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