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Article

The effects of oil shocks on government expenditures and government revenues nexus in Nigeria (with exogeneity restrictions)

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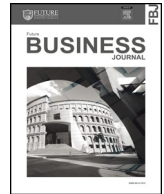


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The effects of oil shocks on government expenditures and government revenues nexus in Nigeria (with exogeneity restrictions)

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ABSTRACT

The study employed data from 1981 to 2014 to investigate the effects of oil shocks (price and revenue) on the dynamic relationship between government revenues and government expenditures in Nigeria and how it transmits effects on major macroeconomic variables using structural VAR (SVAR) on key variables, and also employed unrestricted VAR and Vector Error Correction (VEC) Models on expanded number of variables. The results of SVAR show that oil price shocks could not predict the variation in government expenditure in the short-run, while the predictive power of oil revenue shocks is very strong both in the short-run and in the long-run. The VAR and VECM also substantiate the results of SVAR and provide further insight which shows that short-run fiscal synchronization hypothesis is evidenced between the oil revenues and total government expenditures, while spend-tax hypothesis exists in the long-run between total expenditures and total revenues. It is also evidenced that oil shocks highly affect policy variables in the short-run and transfer the effects on the other macroeconomic variables in the long run. Thus, the study suggests expedient government actions to redirect the economy from oil revenue dependency towards diversifications along other less volatile sources of revenues so as to prevent long-run transmission of effects of oil shocks on broader macroeconomic variables.

Introduction

The oil rich developing economies are hard hit recently by the burst of the crude oil price bubble at the international market. This has created agitation on how the countries who are key players would respond economically to the shocks in the short and long-run. Nigeria is one of the countries heavily affected by the sharp decline in the revenue vis-à-vis the fall in the price of crude oil. It is recalled that, over the years, oil revenues are the main source of financing government expenditures and for importation of products to the country. Specifically, on average, 75% of government revenues come from oil export (Nweze and Edame, 2016). As such, the budget is usually affected by sudden negative or positive shocks to the oil prices. For instance, in about 20 months, the oil price has dropped rapidly from as high as about 130 dollars per barrel to as low as 28 dollars in the earlier months of 2016.

The crisis has drained the Nigeria's excess crude account (ECA), which ought to serve as a buffer and countercyclical reserve against any unexpected shocks. The country is nowhere to be found within the World Bank's minimum reserve requirements. Unfortunately, Nigeria is an import dependent economy, depending heavily on the foreign exchange through the crude oil export to finance its enormous importation. This has created serious dip in the foreign reserves, which now stands as the time of this study at \$27.14bn (Business News, 2016). The persistent crisis is perceived to continue impacting negatively on all macroeconomic indicators

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of an emerging economy like Nigeria.

Given these, Nigeria has lost track in meeting spending commitments in many areas, it has put upward pressures on government borrowing (both local and foreign) as the government seeks to fund additional deficit positions. Could it be that, the effect would depend on how prolonged the current downtrend persists, bearing in mind that the country's ability to withstand shocks is fizzling out as the ECA dries up. The revenue trap accounts for heavy borrowing plan to finance 2016 budget of the government. An imminent danger is a ripple effect that can stifle economic growth; given the heavy reliance of the economy on Government spending to stimulate growth. In short, the effect could be heavier on all the macroeconomic indicators, including exchange rate, interest rates, and inflation among others. This study is a step ahead in examining the roles of oil shocks (price and revenue) on the nature of interaction between government revenue and expenditure, having potential to guide in the nature of recommendable strategies for policy review and the crisis amelioration.

There are four possible relationships as entrenched in the literature between revenue and expenditure (Yinusa and Adedokun, 2017). The first is tax-spend hypothesis which assumed revenue as the determinant of expenditure where it exists. In this circumstance, deficit could be easily avoided by stimulating government revenue. The second possibility is the spend-tax hypothesis, which places expenditure as the determinant of revenue. This can be scary if proper policy is not devised because it has potential to escalate the level of deficit in the economy, while the payment is shifted on the future tax payers. In such scenario, recession could be aggravated through the investors' speculation on the possible tax increase in the future, thus drives away investment. However, if the third scenario which is fiscal synchronization is valid, the duo of revenue and expenditure determine each other and the government has better chances of choosing among the various policy thrust to manage the crises. But if there exist no fiscal synchronization otherwise referred as fiscal separations, it implies the revenue and expenditure decisions are made independently. This could be dangerous for the economy as deficit escalates if expenditure rises faster than revenue.

Studies on the relationships between the revenue and expenditure is well documented in literature, but more is required in the economies where crude oil and associated shocks are major challenges. Dizaji (2014) gave special attention to studying the impact of oil shock in the relationship between expenditure and income in Iran, where he brought country specific variables into the relationship. The study revealed that, a proper understanding of the relationship between expenditure and revenue is sensitive to roles of critical macroeconomic variables that are much relevant in each economy. Like Dizaji (2014), this study focuses specifically on Nigeria fiscal dynamics, as it responds to the shocks that are associate with crude oil prices and revenues. But unlike the previous study, the oil shocks appear to have transmitted stronger effects on government total revenues and expenditures through oil revenue, foreign exchange, foreign reserve, inflation and interest rate in case of Nigeria. Table 1 present the overview of the changes as reflected concurrently in the key variables.

As shown in Table 1, oil price changes transmit effects on oil revenues and foreign reserves. The differences in the prices and revenues in some cases are compensated or aggravated by changes in the exchange rate and volume of oil produced.

The roles of the variables were much appreciated in early 2015 when economic recess was formerly declared in the country. Foreign exchange of Naira became difficult to manage vis-à-vis the heavily depleted foreign reserve. Consequently, the import dependent economy could not revert from the free flow of rising inflation which was consequential on the high cost of import. In its entirety, the economy still finds it difficult to devise way-out of the recess. Meanwhile, it is expected that the policy direction of the government could be better enlightened through proper understanding of the relationship between its expenditure and revenue, given the roles of key macroeconomic variables in the relationships. The main purpose of this study is to examine how oil price shocks influence Nigeria oil revenue and how shocks in oil revenue affect government expenditures and consequently, how the effects are transmitted to other macroeconomic variables.

The study employs three econometric techniques to avoid the limitations inherent in the use of single approach which tends to produce conflicting results over the same time horizon. For instance, a reliable result must be consistent and valid when subjected to robustness check which is provided by alternative techniques. Structural VAR is employed on three key variables; oil price, oil revenue and total government expenditures. This provides initial understanding of the dynamic interaction and how shocks to oil (price and revenue) affect government expenditure. By building structures into the interaction in this case corrects for theoretical waivers that are associated with unrestricted vector autoregressive (VAR) models. In other words, by the structural imposition, it is easier to align the estimation procedures with theory. The second model accommodate more variables that are relevant to understanding how revenues and expenditures transfer the effects of oil shocks to other macroeconomic variables. Dual econometric procedures and variable mix allowed in this study correct for the dichotomy and sensitivities of previous studies to numbers of variables and econometric techniques.

Literature review

Many approaches were adopted in the literature on the analysis of revenue expenditure nexus, but the most prominent ones examined it within the framework of tax-spend and fiscal synchronization frameworks. Diversities are inherent in the studies depending on each country, time horizon and methodology adopted. In general, all the possible scenarios are well documented. Theoretically, tax-spending hypothesis supports unidirectional causality which runs from revenues to expenditures. It was originally promoted by Buchanan and Wagner (1977). In their opinion, taxes encourage growth in government expenditure. Meanwhile, tax-spend hypothesis was motivated by Peacock and Wiseman (1979), they argued for unidirectional causality running from government expenditures to government revenues. Fiscal synchronization is the case of bidirectional causality which indicate concurrent rise in the revenue and expenditure. Baghestani and McNown (1994) argues for fiscal separation in which government expenditure and revenues are independently determined by long run economic growth.

Table 1
Changes in the Values of Key Macroeconomic Variables in Nigeria (1981–2014).
Source: Data from Statistical Bulletin of Central Bank of Nigeria and Statista Database

	1981–1986 (Changes)		1986–1990 (Changes)		1990–1995 (Changes)		1995–2000 (Changes)		2000–2005 (Changes)		2005–2011 (Changes)		2011–2014 (Changes)	
	Actual	%	Actual	%	Actual	%	Actual	%	Actual	%	Actual	%	Actual	%
oil Price (\$)	-16.27	-47.9	8.73	65.52	-5.4	-29	10.74	63.7	22.99	83.3	56.87	112.4	-11.46	-10.7
Oil Volume (Barel/day)	34	2.37	343	23.38	183	11.11	172	8.63	462	21.34	-77	-2.93	-127	-4.96
Oil Revenue (NMillion)	-0.45	-5.26	63.78	786.44	252.66	351.45	1267.13	390.43	3170.7	199.21	4116.6	86.44	-2085	-23.5
Oil Revenue (\$Million)	-10.02	-71.4	4.93	122.84	5.89	65.8	0.76	5.12	23.08	148.09	19.04	49.23	-14.86	-25.8
Foreign Reserve (\$Million)	395	16.18	1704.8	60.1	-2930	-64.52	7775	483.59	18,893	201.28	4360.7	15.42	1601.7	4.91
Exchange Rate	1.41	231.3	6.02	297.79	13.85	172.29	80.22	366.55	21.04	20.61	30.71	24.94	4.69	3.05

The empirical evidences are diverse across countries. [Narayan \(2005\)](#) investigate causality between government revenue and government expenditure in nine Asian countries using bounds testing and conventional F-test to examine granger causality. The result showed that for Indonesia, Singapore, Sri Lanka in the short-run and for Nepal in both the short and long-run found support for the tax-and-spend hypothesis; Indonesia and Sri Lanka conform with spend-and-tax hypothesis in the long-run and for other countries there is neutrality. In a refined revenue variable, in which oil revenues are extracted from total revenues, [Reyes-Loya and Blanco \(2008\)](#) conducted time-series analysis using monthly data from 1990 to 2005 to examine three different specifications of how international oil price fluctuations and government income generated from oil exports influence fiscal policy in Mexico. The study shows that, the behavior of government spending and taxation is consistent with the spend-tax hypothesis. It further shows that there is an inverse relationship between oil-related revenues and tax revenue from non-oil sources.

In examining possible effects of vital macroeconomic variables on the relationships between the expenditure and revenue, some studies allow other variables peculiar to the economic reality of each country. [Hamdi and Sbia \(2013\)](#) examine the dynamic relationships between oil revenues, government spending and economic growth in the Kingdom of Bahrain, using a multivariate cointegration analysis and error-correction model. The result shows that oil revenues remain the principal source for growth and the main channel for financing government spending in the country. In the same way, [Farzanegan \(2011\)](#) analyzed dynamic effects of oil shocks on different categories of Iranian government expenditures using impulse response functions and variance decomposition analysis techniques. The study shows that Iran's military and security expenditures significantly respond to shock in oil revenues and oil prices, while social spending components do not show significant reactions to such shocks. Meanwhile, in a dynamic analysis of macroeconomic variable of the same economy, [Dizaji \(2014\)](#) investigate dynamic relationship between government revenues and government expenditures in Iran as a developing oil export based economy, considering how oil price and oil revenue shocks could affect the relationship. His results show that the contribution of oil revenue shocks in explaining the government expenditures is stronger than the contribution of oil price shocks. More so, strong causality runs from government revenues to government expenditures while the reverse causality is very weak, consequently, the results support the revenue-spending hypothesis in Iran.

[Mehrra \(2008\)](#) examines the nonlinear or asymmetric relationship between oil revenues and output growth in oil-exporting countries, applying a dynamic panel framework and two different measures of oil shocks. The results confirm that in heavily oil-dependent countries that lack the institutional mechanisms, an act of de-linking fiscal expenditure from current revenue and oil revenue shocks tend to affect the output in asymmetric and nonlinear ways. The study thus suggests that output growth is adversely affected by the negative oil shocks, while oil booms or the positive oil shocks play limited role in stimulating economic growth. In another study, [Nusair \(2016\)](#) examines the effects of oil price shocks on the real GDP of the Gulf Cooperation Council (GCC) countries using nonlinear cointegrating autoregressive distributed lag. The results suggest evidence of asymmetries in all the cases. A significant positive oil price changes in all the cases are found with the expected positive sign, implying that increases in oil price lead to increases in real GDP. Conversely, negative oil price changes are significant for only Kuwait and Qatar with positive sign, suggesting that decreases in oil price lead to decreases in their real GDP. However, in panel framework, there is evidence that positive oil prices changes increase real GDP and negative changes decrease real GDP. In all, the study suggest that positive oil price changes have a considerably larger impact on real GDP than negative changes.

It is evidenced that, beyond the revenue expenditure nexus, oil price shock is accorded importance in the interaction among various macroeconomic variables. [Chen, Liu, Wang and Zhu \(2016\)](#) investigate the impacts of oil price shocks on the bilateral exchange rates of the U.S. dollar against currencies in 16 OECD countries. The result shows that the responses of dollar exchange rates to oil price shocks differ greatly depending on whether changes in oil prices are driven by supply or aggregate demand. The study argues that Oil price shocks could explain about 10% to 20% of long-term variations in exchange rates. Also, [Liu, Lin, Xia, Fan, and Wu \(2015\)](#) using CGE models on Chinese economy found that in a scenario where world oil price increases by one hundred percent and the inflation rate is to be targeted at below two percent, the monetary authority should raise the interest rate and reserve ratio two and half percentage points and three percentage points, respectively.

Methodology

Structural Vector Autoregressive (SVAR) and Vector Error Correction(VEC) Models are employed in the study. Economic theories in many instances are inadequate to determine the relationship between certain variables, in such cases it usually appears more logical to allow data to define the relationship. In such situation, (VAR) model as published by [Sims \(1980\)](#) underplay the role of theory in the nature of relationship among variables in the model. It thus assists researcher to understand pertinent relationship among macroeconomic variables beyond limit.

VAR model is specified as;

$$x_t = B_1x_{t-1} + B_2x_{t-2} + \dots + B_px_{t-p} + Cy_t + \varepsilon_t \quad (1)$$

Where x_t is a k vector of endogenous variables, y_t represents vector of exogenous variables, B_1, B_2, \dots, B_p and C are matrices of coefficients to be estimated, ε_t is a vector of innovations that may be contemporaneously correlated but are not correlated with own lagged values and also do not correlate with all of the right-hand side variables in the model. In this model, simultaneity is not an issue given that the lagged values of the endogenous variables appear on the right-hand side of the equations, thus ordinary least square yields consistent estimates. Even then, though the innovations may be contemporaneously correlated, the resulting ordinary least square estimation is efficient and equivalent of generalized least square, since the equations have identical regressors.

Meanwhile, building structure into VAR model assist in accounting for salient features that could be inferred from theory within the model. By definition, Structural Vector Autoregression (SVAR) is a multivariate, linear representation of a vector of observables

on its own lags and in some instances other variables as a trend or a constant. SVAR makes explicit identifying assumptions to isolate estimates of policy behavior and its effects on the economy while keeping the model free of many additional restrictive assumptions needed to give every parameter a behavioral interpretation. In this study, the SVAR is employed to analyse the relationship among some selected variables to allow appropriate restrictions where necessary, so as to conform with economic theory. However, VEC model is a robustness check allowing broader variables in the analysis, and in some cases, it may be more superior to SVAR, given that in some instances, SVAR may be mis-specified, [Tijerina-Guajardo and Pagán \(2003\)](#). The comparative involvement of the two model helps in ensuring robustness check on each other.

It should be noted that, VEC is basically a VAR system that builds on Johansen's test for cointegration. Indeed it is a restricted VAR designed for non-stationary data that are tested to be cointegrated. The VEC has cointegration relations built into its specification to allow long-run restriction of behavior of the endogenous variables so as to converge to their cointegrating relationships while it is allowed for short-run adjustment dynamics [Dizaji \(2014\)](#).

The parameters of SVAR and VAR or VEC model are in no way interpreted like OLS parameters, rather they are forecast tools that make use of impulse response functions (IRFs) and the variance decomposition analyses (VDC). The former allows for identification of dynamic effects of shocks to one variable on another. The process ensures the magnitude and reveals significance of a one standard deviation increase in the shock variable on the response variable, Stock and Watson (2001). The latter, that is VDC takes microscopic look into the entire system. It assigns variance of forecast errors in a variable to its shock, as it also does to other variables.

The SVAR modelling

This study adapts the procedures in [Dizaji \(2014\)](#) as defined for the structure of oil dependent Iranian economy. The condition for the modelling the oil dependent Iran is identical to the current circumstances in the Nigerian economy. In Nigeria, oil revenue and government spending respond to oil price shocks, while government expenditure equally responds to oil revenue shocks.

The trend of oil revenues and government expenditures in [Fig. 1](#) shows strong identical pattern, inconspicuous in the early 1980s but began to rise unprecedentedly over the years after. The government expenditure trend followed suit with the revenue from oil which unarguably justifies the strong pairwise correlation of 0.99 between the two variables.

In the analysis therefore, oil prices, government expenditures and oil revenues are the three variables in the specifications. Consequently, three structural shocks are; oil price shocks ε_t^{OP} , oil revenue shocks ε_t^{OR} , and government expenditure shocks ε_t^{GE} .

The SVAR model is thus presented as follows;

$$\begin{bmatrix} \Delta(OP) \\ \Delta(OR) \\ \Delta(GE) \end{bmatrix} = \begin{bmatrix} b_{11}(L) & b_{12}(L) & b_{13}(L) \\ b_{21}(L) & b_{22}(L) & b_{23}(L) \\ b_{31}(L) & b_{32}(L) & b_{33}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_t^{OP} \\ \varepsilon_t^{OR} \\ \varepsilon_t^{GE} \end{bmatrix} \quad (2)$$

Where B_i are matrices in the lag operator L , such that $L^k x_t = x_{t-k}$; b_{ij} are the estimated coefficient; $B_{ij}(L) = \sum_k B_{ij} L^k$ which denotes the sum of moving average coefficient for $k = 1, 2, \dots, \rho$, where ρ is the degree of the polynomial $B_{ij}(L)$, in other words, it is the optimal lag order of the VAR model; ε_t^{OP} , ε_t^{OR} , and ε_t^{GE} are the structural shocks. In the specification, changes in the variables are the functions of present and past values of the structural shocks.

The structure of the shocks as reflected in the residuals after conducting appropriate stationarity test assist in identifying nine elements. Meanwhile, variance-covariance matrix of residuals provides six equations to solve for the nine unknowns, thus three restrictions are to be imposed. The following long-run restrictions are therefore employed.

Oil revenue and government expenditure in Nigeria have no impact on oil price, since oil price is determined in the world market. Thus, two restrictions could be inferred;

1. $b_{12} = 0$, implies that oil revenue shocks have no effect on oil prices,

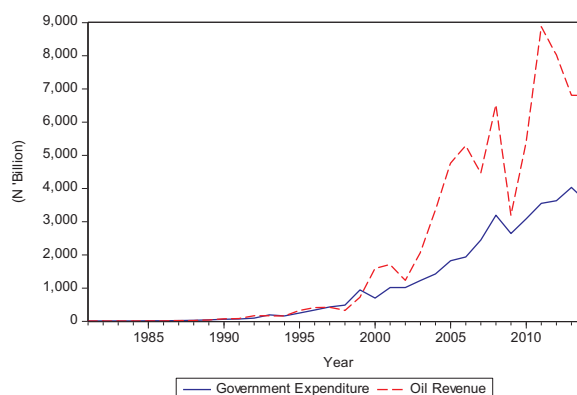


Fig. 1. Oil Revenue and government total expenditure in Nigeria (2081-2014).

2. $b_{13} = 0$, implies that government expenditure shocks have no effect on oil prices.
Oil revenues are determined exogenously, on one hand Nigeria has no control over the oil prices and to an extent must keep its production volume within the quotas assigned her by the organization of petroleum exporting countries (OPEC). This implies that, government expenditures could not influence or determine oil revenues. The third restriction is inferred;
3. $b_{23} = 0$, implies that government expenditures have no effect on oil revenues.

Given the identified restrictions, Eq. (2) is redefined as follows;

$$\begin{bmatrix} \Delta(OP) \\ \Delta(OR) \\ \Delta(GE) \end{bmatrix} = \begin{bmatrix} b_{11}(L) & 0 & 0 \\ b_{21}(L) & b_{22}(L) & 0 \\ b_{31}(L) & b_{32}(L) & b_{33}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_t^{OP} \\ \varepsilon_t^{OR} \\ \varepsilon_t^{GE} \end{bmatrix} \quad (3)$$

Model (3) is depicted in terms of a lower triangle matrix. It helps in examining how oil price shocks influences oil revenue and government expenditures, so also, how shocks to oil revenue affect government expenditures.

Analysis of SVAR Model

Data collection and variable specification

Annual time series data on Oil Revenue (OR) and Government Expenditure (GE) at current prices, over the period from 1981 to 2014 were collected from Central Bank of Nigeria's Statistical Bulletin. The oil price (OP) data is collected from Statista database on the OPEC crude oil prices.

Unit root test

The choice of the analysis at level or first difference depends on the nature of the data. Unit root tests are used to determine if trending data should be first differenced or be differenced at higher order to make it stationary. In this study, [Phillips and Perron \(1988\)](#) and Augmented Dickey–Fuller (ADF) unit root tests are employed. The two methods are used for robustness check. They differ on how each deal with serial correlation and heteroscedasticity in errors. While the ADF tests use a parametric autoregression to approximate the structure of errors, Philips-Perron (PP) tests ignore any serial correlation in the test regression using non-parametric method. Usually, it is important to use multiple unit root test approaches to serve as robustness check and ensure that the limitations inherent in the use of a single approach do not lead to wrong conclusion about the nature of the data being analysed, specifically, ADF is too sensitive to relatively short data point the limitation of which is not inherent in PP.

ADF and Philip Perron (PP) support stationarity of the variables at first difference $I(1)$ as presented in [Table 2](#). According to [Fuller \(1976\)](#), if all the variables in the system are not stationery, it is better to use VAR in levels, see [Dizaji \(2014\)](#). Consequently, SVAR is conducted at level.

However, the choice of lag length plays critical roles in VAR analysis, which engender a subjection of the VAR model to various lag length selection criteria and found lag 2 selected by all the criteria.

Variance decomposition (VD)

Variance decomposition gives information about the roles or the relative importance of shocks to variables in the model, in other words, it shows how shocks to a variable affect other variables of the SVAR model. [Table 3](#) presents the percentage of the forecast error variance that are assigned to each shock. As presented, about 91% of variation in oil prices are explained by the variable itself after the tenth year, while none of the variation in other variables could be explained by themselves in the same magnitude. The

Table 2

ADF & Philip Perron unit root tests on crude oil prices, government expenditure and crude oil revenue.

Variable	Unit Root Tests			
	ADF Level	1st diff.	PP Level	1st diff.
With intercept only				
LOR	-0.6475	-2.5444	-0.1963	-7.5567*
LEXPEN	-2.2201	-1.3887*	-1.171	-6.8868*
LOP	-0.3916	-4.4763*	-0.23	-6.1292*
With Intercept and Trend				
LOR	-2.6184	-3.225	-2.6184	-15.7496*
LEXPEN	0.2983	-4.6448*	-0.6133	-7.2112*
LOP	-2.1661	-5.1403*	-2.0873	-7.1067*

ADF is the Augmented Dickey-Fuller test and PP is the Phillips-Perron test. *Indicate rejection of the null hypothesis of non-stationary at 1%

Table 3
Variance decomposition.

Period	LOP	LOR	LGE
Variance decomposition of LOP:			
Year 1	100.0000	0.0000	0.0000
Year 2	99.6860	0.0033	0.3107
Year 3	98.2604	0.0288	1.7108
Year 4	97.1609	0.0343	2.8047
Year 6	95.5647	0.2557	4.1796
Year 8	93.7957	0.8047	5.3996
Year 10	91.8145	1.7107	6.4748
Variance decomposition of LOR:			
Year 1	69.0041	30.9959	0.0000
Year 2	58.9677	41.0271	0.0052
Year 3	52.1581	42.0873	5.7546
Year 4	48.5223	42.9159	8.5618
Year 6	44.6088	45.4954	9.8958
Year 8	45.0860	45.2564	9.6576
Year 10	47.7758	43.4573	8.7669
Variance decomposition of LGE:			
Year 1	3.1047	13.1375	83.7579
Year 2	4.6092	39.4291	55.9617
Year 3	3.6551	46.0999	50.2451
Year 4	6.6590	48.9978	44.3432
Year 6	14.5575	50.4711	34.9714
Year 8	23.5068	48.7240	27.7692
Year 10	32.0458	45.5881	22.3661

variation in government expenditure could only explain 50% of the variable itself in the third year before it lost the substantial predictive power to oil revenue shocks throughout the periods. Oil revenue lost such predictive power to Oil Price shocks throughout the periods. In other words, for government expenditures in the first three years and for oil prices in all years the biggest portion of variations is explained by the historical trend of the variables themselves. In the contrary, the lion share of variation in the oil revenue is explained by the shocks to the oil price in all the years.

Oil price shocks is the principal variable that explain the variation in oil revenue with 69% and about 48% in the first and tenth year respectively, which implies it has strong explanatory power, both in the short and long run. So also, oil price shocks play important roles in explaining variations in government expenditures with 40% in the tenth year, supporting explanatory capacity in the long-run. By implication, behavior of government expenditure in Nigeria is heavily dependent on the oil price shocks, signifying that strong long-run causality runs from oil price to government expenditure. However, it does not have such explanatory capacity in the short-run. The short-run predictive capacity of oil revenue shocks is higher, explaining 39% of variations in government expenditures in the second year and steadily increases to 45% in the tenth year. It thus, support strong short-run and long-run causality running from oil revenue to government expenditure.

Impulse response function

Impulse response functions trace out the response of a variable in the short and long-run to a one standard deviation increase in current value of another variable. The relevant variables after the provisions have been made on restrictions are government expenditure responses to a one standard deviation increase in the oil prices and oil revenue. The horizontal line within the impulse response function (IRF) is the symbol of statistical significance. When it falls within the confidence bands, the IRF is not statistically significance. Fig. 2 shows that the innovations to oil revenues are statistically significance and exert positive effects on the government expenditures throughout the periods after the shock. However, shock to oil prices is only marginally significant in the long-run after seventh year.

The findings substantially align with studies such as Cunado and de Garcia (2004) who argues against the use of oil price as an impulse variable in the study of nexus between the oil price shocks and macroeconomic variables. It is evidenced as earlier discussed under the variance decomposition that, oil revenue is the major predictor of government expenditures in Nigeria and not the crude oil prices.

The VAR/VEC model for the expanded number of variables

Limited number of variables in the previous model stands the risk of omission of vital variables that are relevant to understanding the nature of relationship between the expenditure and revenue, vis-à-vis oil shocks. The choice of additional variable for the VAR model draws from related studies. Hamilton (1996), Cunado and de Garcia (2004) and Dizaji (2014) argued in favour of disaggregating government expenditures into recurrent and capital expenditures, consumer price index, and money supply. However,

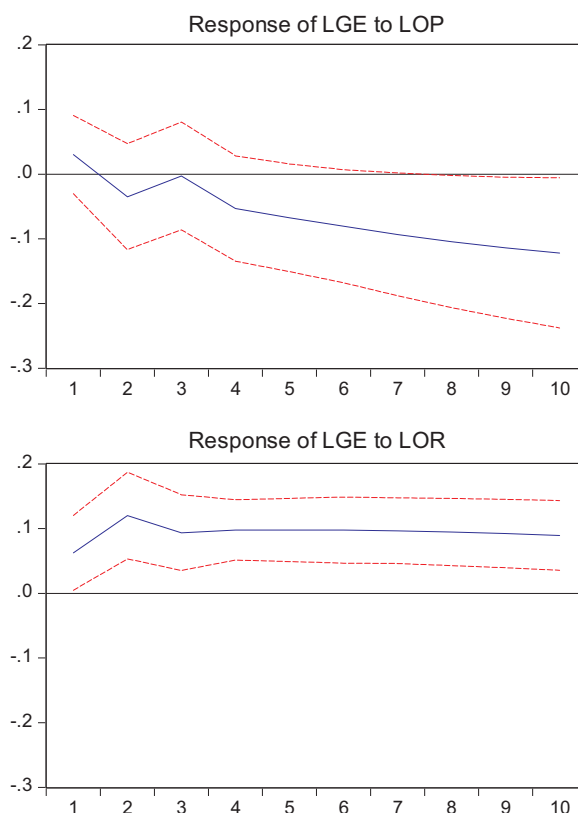


Fig. 2. Response to Cholesky One S.D. Innovations in oil revenue.

the choice of a variable depends on the characteristics of the economy under study. In case of Nigeria, inflation is more of exogenously determined variable through excessive demand for foreign made products which drives up exchange rate. In spite of the entrance channel of the inflation, the monetary authority must respond to the rising price through monetary policy, especially money supply (M2). Thus, money supply is more relevant to this study than the use of consumer price index. More so, annual time series with limited number of data points disallow the luxury of many variables, thus preventing the engagement of disaggregated government expenditures. Consequently, the model includes one external shock, oil revenues (OR), two policy variables, money supply (M2) and government expenditures (GE) and one key macroeconomic variable, government total revenues (TR).

To align with the cholesky ordering which is employed in the VAR specification, the variables are ordered in line with the degree of their evidence for exogeneity. Oil revenue (OR) is exogenous and least affected by other variables in the model, but influences total revenues (TR) through which it affects other variables. The study assumes tax-spend hypothesis in the ordering, reflecting government expenditures are determined by government revenue. Money supply (M2) is determined by the volume of transactions in the economy as promoted by government expenditure policy.

unrestricted VAR and restricted VAR otherwise referred as Vector Error Correction Model (VECM) are employed to bridge the gap of argument between the two prominent school of thoughts. In the first instance, [Fuller \(1976\)](#) argued that, if all the variables in the system are nonstationary, it is better to use a VAR in levels. [Farzanegan and Markwardt \(2009\)](#) further argued that evidences through Monte Carlo simulations show that short run forecasting performance of unrestricted VAR models are better than VECM performance. However, [Naka and Tufte \(1997\)](#) argued that VECM would yield more efficient result if the variables are cointegrated. This study therefore threads in line with [Dizaji \(2014\)](#) in which both VAR and VECM were employed for robustness check. However unlike VAR, the impulse-response results are not interpreted for VECM.

Annual data in logarithmic form are used to reduce the scale of the variables. This is desirable when analyzing time-series properties of variables with large values. All data are from Central Bank of Nigeria's Statistical Bulletin.

Unit root test

As presented in [Table 4](#), all the variables are not stationary at level but are at first difference judging from the result of Philip-Perron (PP) test. However, the Augmented Dickey Fuller (ADF) test on oil revenue is only stationary at second difference I(2).

VAR analysis is sensitive to lag order on which the analysis is based. Thus, to ensure lag validity, the variables are subjected to various lag order selection criteria, in which all criteria support lag 1. So also, VECM is premised on the cointegration of the variables under study. The cointegration technique adopted is based on Johansen technique proposed by [Johansen \(1991\)](#) and the result

Table 4

ADF & Philip Perron unit root tests on crude oil revenue, total revenue, government expenditure and money supply.

Variable	Unit Root Tests		PP	
	ADF Level	1st diff.	Level	1st diff.
With intercept only				
LOR	-0.6475	-2.5444	-0.1963	-7.5567*
LTR	-2.0732	-6.2766*	-0.8292	-6.4672*
LGE	-2.2201	-1.3887*	-1.171	-6.8868*
LOP	0.1286	-3.7222*	0.0306	-3.7222*
With Intercept and Trend				
LOR	-2.6184	-3.225	-2.6184	-15.7496*
LTR	-1.6193	-3.475	-1.6256	-6.8202*
LGE	0.2983	-4.6448*	-0.6133	-7.2112*
LOP	-2.9087	-3.6440**	-2.4877	-3.6440**

ADF is the Augmented Dickey-Fuller test and PP is the Phillips-Perron test. *Indicate rejection of the null hypothesis of non-stationary at 1%, and **indicates stationary at 5% critical values.

supports the existence of cointegration among the variables, as presented in Table 5.

The variance decomposition (VAR Model)

Table 5 presents the variance decomposition for ten years' forecasts in unrestricted VAR model. The table shows that for three of the four variables in the model, the biggest portion of variations is explained by the variables' own trend in the first year. Meanwhile, government total revenues (LTR) shows clear exemption, given that, about 97% of its variations in the first year are explained by oil revenue shocks. This is a demonstration of high dependency of government revenues on income from oil. The precedence is retained throughout the ten years, explaining about 61% of the variations in the government revenues. The substantial variations in the oil revenue is explained by its own trend with 100% in the first year and 61% in the tenth year to justify the assigned exogenous position in the variable ordering. However, in the long-run about 32% variations in the oil revenues are explained by the government expenditure shocks, supporting its strong explanatory power. The predictive power could partly be attributed to expenditure effects on government investment in oil exploration that allow for ease of adjustment in the volume of barrel produced within the limit allowed by the OPEC. It could also imply that increased expenditures enhance oil exploration within the permitted limits to help government offset its deficits. Meanwhile, as expected total revenue and money supply do not have predictive power on oil revenue in the short and long-run.

The trend of total revenues has no predictive power on the variable itself with just 3% in the first year and 5% in the tenth year. Instead, both the oil revenue shocks and total expenditure shocks jointly predict 97% of variations on the total revenue in the first year and 95% in the tenth year. Individually, total expenditure shocks explain about 33% of variation in the total revenue, meanwhile, in the reverse order and the same period, total revenue shock could only explain 6% of variation in government expenditure. This substantiate the spend-tax hypothesis earlier confirmed under the structural VAR modelling. Money supply shocks have no explanatory power over the total revenue.

Oil revenue shocks have the largest explanatory power for the variations in government expenditures in the long run with 51%, compare to 43% explained by the trend of the variable itself, although the explanatory power of oil revenues is weaker in the short-run. The variance decomposition supports strong bi-directional predictive power for the two variables. Thus, fiscal synchronization hypothesis is supported when oil revenue component of total revenue is extracted and tested alongside total expenditure.

Forecast errors in money supply aside its own variations are mostly due to variations in oil revenue and total expenditures. The implication of this is that money supply is influenced by expenditure policy which is also influenced by the size of revenue from crude oil (Table 6).

Table 5

Trace and maximum eigen value cointegration test among the oil revenue, total revenue, total expenditure and money supply.

	Ho: No of CE	Eigen Value	Trace Test Statistic	**Prob.	Max. Eigen Value Test	
					Statistic	**Prob.
LOR, LTR, LTE & LM2	0	0.61575	55.38966	0.0084*	30.60676	0.0198*
	1	0.353155	24.7829	0.1693	13.94078	0.3699

Trace test & Max. Eigen Value Test indicates 1 cointegrating eqn(s) at the 0.05 level.

* Rejection of the hypothesis at 5% significance level for both the Trace and Maximum Eigen Value Tests.

** MacKinnon-Haug-Michelis (1999) *p*-values.

Table 6
Variance Decomposition (VAR).

Period	LOR	LTR	LTE	LM2
Variance Decomposition of LOR:				
Year 1	100.0000	0.0000	0.0000	0.0000
Year 2	90.8337	0.4329	8.7253	0.0082
Year 3	82.6595	1.2122	16.0790	0.0493
Year 4	76.8082	1.9630	21.1143	0.1145
Year 6	69.5611	3.1215	27.0400	0.2775
Year 8	65.3566	3.9388	30.2527	0.4519
Year 10	62.6165	4.5508	32.2121	0.6207
Variance decomposition of LTR:				
Year 1	97.4769	2.5231	0.0000	0.0000
Year 2	87.4977	2.2428	10.2551	0.0044
Year 3	79.5683	2.4647	17.9585	0.0085
Year 4	74.1989	2.8300	22.9342	0.0368
Year 6	67.6945	3.5650	28.5883	0.1522
Year 8	63.9127	4.1907	31.5896	0.3069
Year 10	61.4181	4.7103	33.4001	0.4714
Variance Decomposition of LTE:				
Year 1	30.1221	8.0142	61.8638	0.0000
Year 2	39.8753	6.6575	53.4496	0.0177
Year 3	44.8355	5.9937	49.1128	0.0580
Year 4	47.4740	5.7114	46.6971	0.1175
Year 6	49.7721	5.6505	44.3061	0.2714
Year 8	50.5050	5.8326	43.2195	0.4429
Year 10	50.6757	6.0741	42.6381	0.6122
Variance Decomposition of LM2:				
Year 1	9.8068	7.1018	1.0484	82.0431
Year 2	25.8227	9.6867	5.1211	59.3695
Year 3	38.6282	7.7863	9.7970	43.7886
Year 4	47.4352	5.4966	14.6257	32.4426
Year 6	56.0966	2.8460	22.7320	18.3254
Year 8	58.5282	2.2315	28.0981	11.1423
Year 10	58.6364	2.4718	31.4630	7.4288

Variance Decomposition (VECM)

The results in Table 7 is purely for comparison purposes, prepared to weigh the validity of results presented under the un-structured VAR model. The variables ordering is the same as in unrestricted VAR. As evidenced, the roles of shocks to the oil revenues in explaining itself and shocks to total revenues become stronger in the long run, producing 81 and 77% under VEC compared with 63 and 61% under VAR respectively in the tenth year. Meanwhile, the explanatory power becomes weaker for total expenditures and money supply with 20 and 23% under VEC compared with 51 and 59% under VAR respectively. The shocks to total revenues have been marginally weak across board for all the variables under VEC compared to VAR. Predictive power of total expenditure is weaker across board for every other variable in the model under VEC compared with VAR. For instance, shocks to total expenditures in the tenth year explains 8, 15 and 19% under VEC compared with 32, 33 and 31% under VAR for oil revenue, total revenue and money supply respectively.

The results produced two ways effects, demonstrating that variation in oil revenue is weakly explained by the total expenditure shocks and vice versa. It thus supports a weak fiscal synchronization hypothesis between the oil revenues and total expenditures. However, the spend-tax hypothesis remains valid between the total revenue and total expenditure, although with proportionate reduction in their corresponding predictive power. More specifically, oil revenues shocks have stronger short-run predictive power for policy variables in Nigeria than it could do in the long-run, while reverse is the case for other macroeconomic variables.

Impulse response function

The impulse response function in Fig. 3 presents statistically significant and positive effects of innovations to oil revenues on itself, total revenues and government expenditures up to the seventh year, thereafter it dies out. The response of money supplies to shocks in oil revenue is positive and permanent. The positive response of the variables to the oil shocks, justify the reality of recession upon negative shocks to oil revenue, such as the current experience in the country. A dominant effect of oil revenue in Nigeria therefore, could not be overemphasized, for strong ability to explain the behaviour of all critical macroeconomic variables.

Fig. 4 shows that a one standard deviation increasing shocks in total revenue are found to have statistically significant and positive effects on oil revenues, total revenues and total expenditures only in the first quarter but in the long run the effects are insignificant. The responses of money supply to shocks in total revenues are not statistically significant at all levels. This supports the

Table 7
Variance decomposition (VEC).

Period	LOR	LTR	LTE	LM2
Variance decomposition of LOR:				
Year 1	100.0000	0.0000	0.0000	0.0000
Year 2	90.0186	1.8197	0.8089	7.3529
Year 3	83.2813	4.1159	4.4127	8.1902
Year 4	82.6163	4.2087	5.9726	7.2023
Year 6	82.2409	4.4218	6.7534	6.5839
Year 8	81.6894	4.6067	7.4888	6.2151
Year 10	81.4052	4.7124	7.8802	6.0023
Variance decomposition of LTR:				
Year 1	97.8355	2.1645	0.0000	0.0000
Year 2	87.7424	2.4428	1.4245	8.3903
Year 3	79.0315	4.0301	8.5903	8.3481
Year 4	78.3314	3.6507	11.2543	6.7637
Year 6	78.1322	3.4652	12.8397	5.5629
Year 8	77.5165	3.4318	14.1701	4.8815
Year 10	77.2187	3.4106	14.8812	4.4895
Variance decomposition of LTE:				
Year 1	17.0575	8.8370	74.1055	0.0000
Year 2	20.4903	8.9156	70.5432	0.0510
Year 3	19.8570	5.8642	74.1434	0.1354
Year 4	19.4556	4.7349	75.6568	0.1527
Year 6	20.1710	3.7505	75.8984	0.1801
Year 8	20.3087	3.1908	76.3113	0.1891
Year 10	20.4408	2.8754	76.4873	0.1965
Variance decomposition of LM2:				
Year 1	11.7257	0.8930	3.9360	83.4454
Year 2	19.2754	0.8283	10.6567	69.2397
Year 3	21.3275	1.0188	13.3034	64.3504
Year 4	22.0083	1.2804	15.5291	61.1822
Year 6	22.5381	1.4155	17.5584	58.4880
Year 8	22.8150	1.4908	18.4916	57.2025
Year 10	22.9604	1.5291	19.0092	56.5014

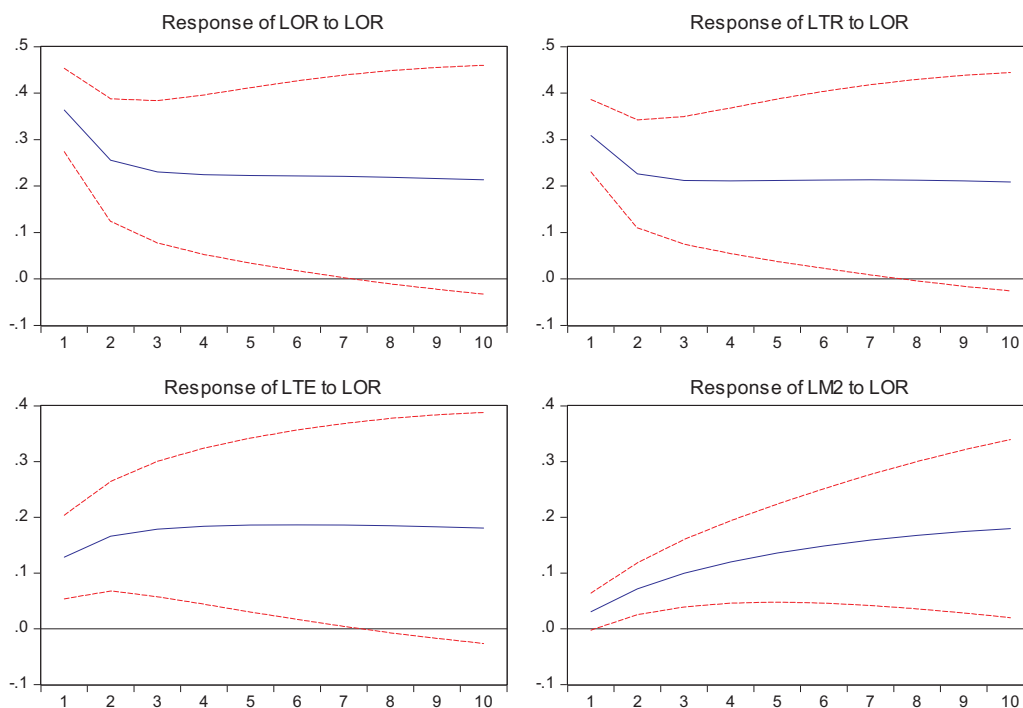


Fig. 3. Response to Cholesky One S.D. innovations in oil revenue.

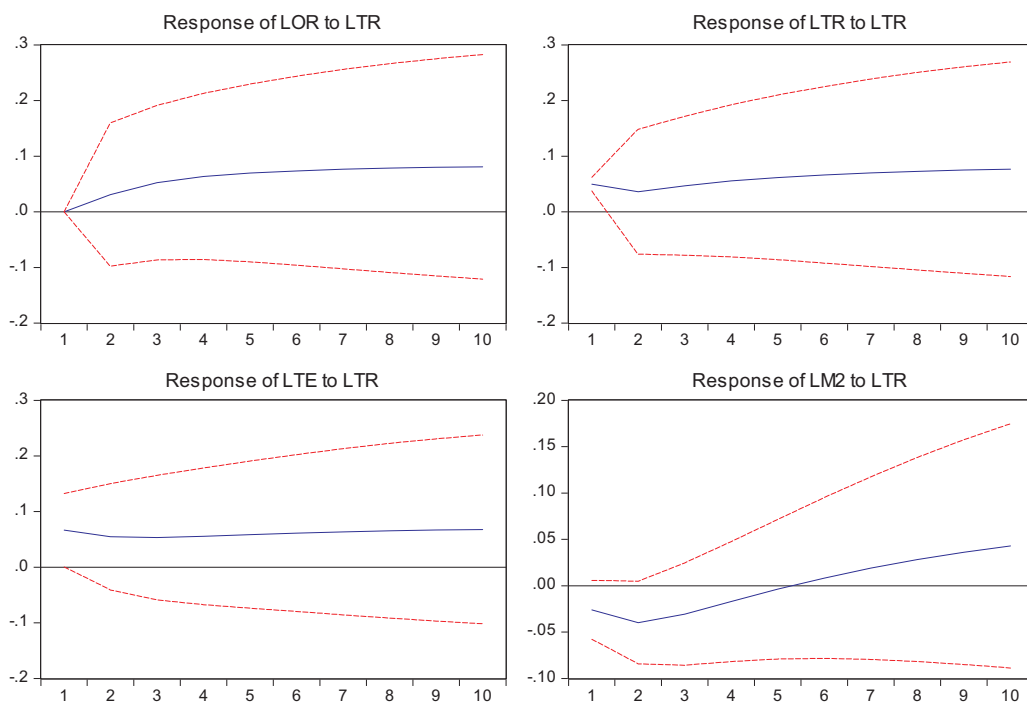


Fig. 4. Response to Cholesky One S.D. innovations in total revenue.

argument that macroeconomic variables in Nigeria responds to oil revenue shocks and not the total revenues. In other words, the pattern of total revenue is less sensitive as much as does the oil revenues.

Unlike [Dizaji \(2014\)](#) on Iran, where it was found that it is not the oil revenue shocks themselves but the response of government total revenues to them that cause fluctuations in aggregate economic activities. In Nigeria, taking inference from [Figs. 3 and 4](#), it is oil revenue shocks and not the total revenues that cause macroeconomic fluctuations.

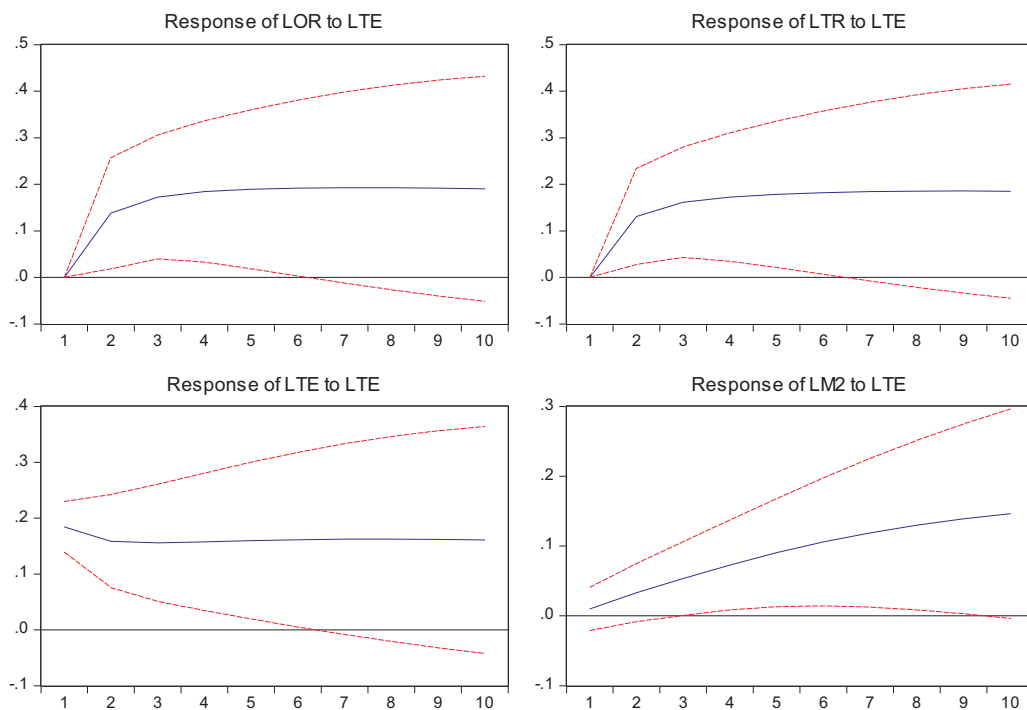


Fig. 5. Response to Cholesky One S.D. innovations in total expenditure.

Fig. 5 demonstrate that innovations to total expenditures have positive and significant effect on oil revenues and total revenues up to seventh year before it dies out. This is plausible because total revenue submerged the oil revenues, thus total expenditures affect them significantly. Meanwhile the reverse is only the case for oil revenue. More also, the results indicate that money supply responds positively and significantly to the innovations in total expenditures after the first year and remain steady till ninth year before it disappears. It implies that total expenditures are important in determining money supply and also it enhances government desire to expand its revenue vis-à-vis increase in crude oil exploration to obtain increase in revenue. However, the expansion in exploration could only be varied within the quotas assigned by the OPEC.

The impulse response functions imply that the innovations in oil revenues significantly affect the government expenditures in Nigeria, and vice versa, justifying fiscal synchronization hypothesis in two-way causality. Meanwhile, the innovations in the total revenues could not significantly affect the total expenditure. Thus, spend-tax hypothesis is confirmed. In summary, the results of the impulse response functions confirm the earlier results of the variance decomposition which indicate there are differences in the relative effects of oil revenues and total revenues on macroeconomic variables in Nigeria.

Policy implications on Nigeria economy

Nigeria economy is hard hit by the global oil crash, leaving the country in disarray and near economic comatose. The current hit is the largest on the economy after the oil crises of early 1980s. of course, the short term effects is stronger within the reality of current financial and economic globalization, in which Nigeria economy has little or no domestic insulin to immunize the system against external shocks. In the first instance, the heavy dependence on importation in exchange for scarce foreign currencies raised exchange rate of Naira against major global currencies. This created serious dip in the foreign reserves with free fall, now standing below thirty thousand US dollars. The inability to manage foreign exchange market due to depleted reserve culminated into rising inflation driven by exchange rate crises. It however took only few months to became clear that the economy has been plunked into economic recession.

The onus of economic revitalization lies partly on the researchers to provide policy antidote, a fundamental reason for this study. It is evidenced, the crises have two sides of a coin; the short-run and long-run effects. Present economic experience is a short-run reaction to the oil shocks, which has strong explanatory power for behavior of policy variables in the short-run, but weakens over the years. Therefore, oil shocks transmit strong effects on foreign exchange, money supply, inflation and interest rate within a year of the price crash. Secondly, the study suggests a stronger and much permanent effects on the macroeconomic variables in the long-run. A solution to the long-run problems depends on how the short-run crises are managed. Any realistic process must follow holistic approach to macroeconomic management. This is because fiscal synchronization hypothesis is evidenced in the short-run. It is recalled that, if fiscal synchronization is valid in an economy, the duo of revenue and expenditure determine each other and the government has better chances of choosing among the various policy thrust to manage the crises. However, in the current case, revenue generation approach vis-à-vis alternative means of generating foreign exchange such as export promotions would provide better magic to resuscitate the economy.

The origin of the crises is the shortage inflow of foreign exchange, motivated by poor pricing of crude oil in the international market. Consequently, immediate solution revolves around the ability of the economy to fill the short-fall, through other media, aside the crude oil exports. As it stands, Nigeria must underplay the importance of crude oil in favour of less volatile alternatives, such as agricultural cash crops. In the committee of global agricultural produce, Nigeria is a leading actor. It remains the largest producer of cassava, cowpeas, kola nuts, yam and sorghum; second largest producer of cashew after Vietnam and second largest producer of millet and okra after India; third largest producer of palm oil after India and Malaysia; third largest producer of palm kernel after Indonesia and Malaysia; fourth largest producer of cocoa beans after Cote d'Ivoire, Indonesia and Ghana; fourth largest producer of Ginger after India, China Mainland and Nepal; and fourth largest producer of groundnut after China Mainland, India and United States of America among several other farm products.

Nigeria economy did not start out as oil dependent economy. Fact finding shows that, non-oil export dominated the sources of foreign exchange, accounting for about 97.4% as against 2.6% oil export in 1960. The position was gradually lost to oil exports as the percentage declined to 41.84% in 1970, subsequently to 3.1% in 1980 and 0.37% in 2000. Meanwhile, despite the marginalisation of the non-oil export, especially the agricultural sector, the sector (agriculture) contributed over 40% of GDP before the 2014 GDP rebasing, but with the rebase, the sector accounts for about 22%, not because of lower productivity, but because other emerging sectors have broadened the GDP sectoral contributions. Raw agricultural Commodities contribute about 39% of total non-oil exports, while the semi-manufactured goods that are essentially value-added products from agricultural produce, comprising of leather and processed skin, cocoa products and others also accounts for 31%. However, it is unfortunate that agricultural produce, which constitute less than 5% of foreign exchange now was the Nigeria's main source of foreign exchange in the post-independence period of about 97%.

Effective repositioning of the economy in line with non-oil exports and efficient management of the income proceeds will ease the long-run effects of oil shocks which may aggravate the problems associated with an economy characterized with spend-tax hypothesis. Spend-tax hypothesis places expenditures ahead of revenues. The effects could be scary if proper policies are not devised to cushion the escalation of budget deficit with consequence of shifting repayment burden on the future tax payers. The final consequence would be a prolonged recession and its high potential to scare investors who might speculate possible tax increase in the future, thus drive away investment.

Summary and conclusion

The study examines the role of oil shocks on nexus between government expenditures and government revenues in Nigeria using structural VAR. Overall, the results support fiscal synchronization between oil revenue and total expenditure in the short-run, but spend-tax hypothesis between total revenue and total expenditure in the long-run. It suggests government should enhance the effectiveness of policy variables by underplay the role of oil revenue in favour of alternatives. It is obvious that government should reduce its dependence on oil revenues by financing its projects and programmes through nonoil sources such as agricultural export promotion.

The study employed three econometric techniques. The first technique is SVAR which allows imposition of three long run restrictions to examine the dynamic relationship among the choice variables. Result of the variance decomposition analysis indicate that oil revenue shocks have considerable contributions in explaining the shocks to government expenditures both in the short-run and long-run, while oil price shocks have predictive power on government expenditure only in the long-run. However, the predictive power of oil revenue in explaining the shocks to the government expenditures is much stronger than that of oil price shocks even in the long-run. The impulse response functions show that the shocks to oil revenues is statistically significant and has positive effects on government expenditures both in the short-run and long-run, while the shocks to oil price is only significant marginally on the government expenditure in the long-run. The restrictions support causality that runs from oil revenues to government expenditures.

VAR and VECM are applied to the expanded number of variables which include, oil revenue, total revenue, total expenditure and money supply. Two methods are allowed for robustness check to bridge the gap between the short-run efficiency of unrestricted VAR and long-run efficiency of cointegrated variables within the vector error correction model (VECM).

The results of VAR model show that the variations in government expenditures is sensitive to the shocks to oil revenues and vice versa, the same is established for VECM but in much weaker magnitudes to support a unidirectional causality between oil revenue and government expenditure. VAR is argued to have short-run predictive ability than VECM, thus, the study concludes on short-run fiscal synchronization between oil revenue and government expenditure. However, the VECM establishes strong predictive power for government expenditure on total revenue in a unidirectional causality. Consequently, a long-run spend-tax hypothesis is confirmed.

Finally, the results show that oil shocks affects policy variables much more in the short-run and transfer the effects on the other macroeconomic variables in the long run. Thus, suggests expedient government actions to dowse the immediate effects of oil shocks so as to prevent the transmission of the effects to broader macroeconomic variables in the long-run. Principal among the possible strategies is to redirect the economy from oil revenue dependent country to a much diversified economy along other less volatile sources of revenues.

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