How has the oil industry affected macroeconomic activities in Nigeria?

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Keywords: Oil resource, Nigerian economy, vector autoregression model

Abstract: Oil is one of the most essential natural resources in the world. Analysing the impact of the oil industry on economic development is, therefore, a particular focus of scholarly interest. This paper attempts to highlight and critically analyse the changes that occurred in the economy of Nigeria between 1986 and 2015. A vector autoregression model and a linear regression analysis are employed on some macroeconomic variables from 1986 to 2015. The econometric findings showed in the first study demonstrate that oil price shocks have not played a vital role on GDP, government expenditure, net export, and the real exchange rate in the last three decades. In addition, the linear regression analysis has shown that there is a significant negative relationship between the growth rate of the oil revenue and the GDP in Nigeria from 1986 to 2015, so the resource curse phenomenon can be seen to occur in Nigeria to a certain extent.

1. Introduction

Oil exports gradually became the primary source of income in Nigeria after they joined the OPEC. The development of the oil industry in Nigeria attracts a huge amount of Foreign Direct Investment, with many western countries taking part in exploring and producing oil. The period of 1958 to 1981 could be regarded as the golden years for Nigeria, lasting until the crude oil price crash in 1982. The fall of oil prices brought significant challenges to Nigerian oil industry. Whether oil price slump caused the economic downturn in Nigeria is a question that has sparked vigorous debate. Several pieces of research have been carried out during the last few decades that probed the causes and consequences of the oil price shocks [1]. The aim of this paper is using empirical studies to investigate how oil industry has affected the Nigerian economy in the last few decades.

2. Methodology

The main purpose of this study is to investigate how oil industry has impacted on the Nigerian economy through different macroeconomic variables, to test which, two hypotheses have been developed: Hypothesis 1: Oil price shocks did not change macroeconomic indicator variables in Nigeria from 1986 to 2015. Hypothesis 2: There is no statistically significant relationship between oil revenue and economic growth in Nigeria.

Burbidge and Harrison originally used the vector autoregression methodology to explore the impact of oil price shocks on the oil-importing economies [2]. The VAR model provides a structure for testing the effects of one variable on others given that all variables are considered to be endogenous [3]. Therefore, in this section, a vector autoregressive (VAR) methodology will also be used in examining how oil price shocks have affected the macroeconomic variables in Nigeria. The second part of the analysis is to investigate the relationship between oil revenue and GDP in Nigeria. The linear regression model will be utilised to test the relationship between different variables. In this section, oil revenue will be regarded as an independent variable, and GDP will be considered as dependent variables.

The study in this paper depends on secondary data was collected from the database of the World Bank, where statistics and data for over 200 countries and 1,200 indicators were available. In the first section, the vector autoregressive model is based on five variables, which are oil price, GDP, the exchange rate, net export, and government expenditure. Each selected variable performs the different aspects of economic performance in Nigeria. All the data above were collected for the

  DOI: 10.25236/ermbfe.2019.106

years 1986 to 2015. Data used to conduct the linear regression analysis model consists of oil revenue. The data for independent variable oil revenue is measured by the oil rents (% of GDP) from 1986 to 2015. The dependent variable GDP will use the same data in the first test. The complete data analysis will be presented in chapter 3.

3. Data Analysis and Discussion

3.1 Testing for stationarity in time series variables

In order to construct these variables as a VAR model, we first generate the time series variables that are whether these variables were stationary or non-stationary. In this paper, we employed the Augmented Dickey-Fuller (ADF) unit root test to test whether these variables were stationary or non-stationary. The results of the unit root test are presented in Table 1 below.

Table 1 Unit root test

Variables	Type (C,T,K)	ADF t-Statistic	5% Critical Value	Prob.	Conclusion
LGDP	(C,T,2)	-1.878	-4.362	0.666	unit root
LOil	(C,T,2)	-1.305	-4.362	0.8868	unit root
expenditure	(C,0,2)	-2.232	-3.743	0.1948	unit root
Netexport	(C,0,2)	-1.767	-3.743	0.397	unit root
realexchange	(C,0,1)	-2.513	-3.73	0.1124	unit root
△LGDP	(C,0,1)	-1.14	-4.371	0.9221	unit root
$△^2$LGDP	(C,0,1)	-3.768	-4.38	0.0182	stationary
△LOil	(C,0,1)	-3.781	-3.75	0.0031	stationary
$△^2$LOil	(C,0,1)	-3.415	-3.75	0.0105	stationary
△ expenditure	(C,0,1)	-3.377	-3.75	0.0118	stationary
△Netexport	(C,0,1)	-4.578	-3.75	0.0001	stationary
△ realexchange	(C,0,1)	-3.177	-3.743	0.0214	stationary

Note: C, T and K respectively represent for constant, liner trend and lag length, △ represents the first order difference, $△^2$ represents second order difference, stationary is based on a 5% significance level

As we can see from the results of the ADF unit root test, the ADF values of all variables are higher than the critical values, so they are non-stationary series. But the first difference sequences △expenditure, △Netexport, and △realexchange are stationary series, so they are I(1). In addition, LGDP and LOil are non-stationary series, their first difference sequence △ LGDP and △LOil are also non- stationary series. However, their second-order difference sequence △2LGDP and △ 2LOil are both stationary series, so they are I (2). So cointegration technique is taken to model these long-term relationships.

We are going to select the order of the VAR model and determine the optimal lag length first before doing the cointegration test, and then a reasonable VAR model can be established. In this paper, they are used to choose a lag length for the unrestricted VAR model. The calculating results of log-likelihood values (LL), likelihood ratio (LR), and P values will show in table 2 below.

Table 2 VAR lag length Selection

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-362.636				1.30E+06	28.2797	28.3494	28.5216
1	-292.519	140.23	25	0	42704.8	24.8091	25.2271	26.2608*
2	-269.512	46.012	25	0.006	63365.7	24.9625	25.7289	27.6239
3	-225.281	88.462*	25	0	30193.1*	23.4832*	24.5979*	27.3542

Note: The lag length is determined by the value of the minimum information criteria.

This test selects the maximum lag length set the max lag length from 0 to 3, which can ensure sufficient freedom. From the table above, SBIC gets the minimum value when the lag length is 1, but the FPE, AIC, HQIC get the minimum values when the lag length is 3. So the optimal lag length of the unrestricted VAR model is 3. In the following step, the trace test for the cointegration test is conducted using this lag length.

Johansen cointegration is an important property in contemporary time series analysis and it will be brought to test whether the presence of oil prices and other four macroeconomic variables

Cointegration. If there is no more than one cointegration relationship between these variables, the VAR model can be established. The results of the trace test statistics for Johansen cointegration are presented in Table 3 below.

Table 3 Johansen Cointegration Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.792339	82.24351	69.81889	0.0037
At most 1	0.571477	39.80355	47.85613	0.2296
At most 2	0.282312	16.92343	29.79707	0.6457
At most 3	0.228211	7.966968	15.49471	0.4689
At most 4	0.035388	0.972781	3.841466	0.324
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

The test statistics indicate that the hypothesis of no cointegration among the variables can be rejected (statistic = 82.24 > 69.81). However, the hypothesis of at most one cointegration among the variables can be accepted (statistic = 39.80 < 47.86). In addition, the hypothesis of at most 2, 3, and 4 also involve statistics that are less than the critical value (16.92343 < 29.79707; 7.966968 < 15.49471; 0.972781 < 3.841466). Thus, the result of Johansen Cointegration Test shows that there is only one cointegration relationship between LOIL, LGDP, government expenditure, net export, and the real exchange. Therefore, the VAR model can be established.

3.2 Establishing the VAR model

Table 4 VAR (3) regression model

Equation	Parms	RMSE	R-sq	chi2	P>chi2
LGDP	16	0.141708	0.9895	2439.968	0
LOil	16	0.169907	0.9746	997.3667	0
expenditure	16	3.72588	0.4674	22.81743	0.0881
Netexport	16	101.907	0.7012	61.02391	0
realexchange	16	40.6211	0.7827	93.66461	0

First, we will build the VAR (3) regression model. As it can be seen from VAR (3) model in Table 4, the fitting effects of five equations are very good (the goodness of fit values, or R2, are 0.9895, 0.9746, 0.4674, 0.7012 and 0.7827).

3.3 Granger Causality Test

Table 5 Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LGDP does not Granger Cause LOIL	28	0.96504	0.3959
LOIL does not Granger Cause LGDP		0.27252	0.7639
NETEXPORT does not Granger Cause LOIL	27	0.37218	0.6935
LOIL does not Granger Cause NETEXPORT		3.30058	0.0558
REALEXCHANGE does not Granger Cause LOIL	28	0.38655	0.6837
LOIL does not Granger Cause REALEXCHANGE		0.65739	0.5277
EXPENDITURE does not Granger Cause LOIL	27	0.72156	0.4971
LOIL does not Granger Cause EXPENDITURE		0.36045	0.7014
NETEXPORT does not Granger Cause LGDP	27	0.62216	0.546
LGDP does not Granger Cause NETEXPORT		3.74118	0.0399
REALEXCHANGE does not Granger Cause LGDP	28	0.90055	0.4202
LGDP does not Granger Cause REALEXCHANGE		0.36287	0.6996
REALEXCHANGE does not Granger Cause LGDP	28	0.90055	0.4202
LGDP does not Granger Cause REALEXCHANGE		0.36287	0.6996
EXPENDITURE does not Granger Cause LGDP	27	0.618	0.5481
LGDP does not Granger Cause EXPENDITURE		0.01707	0.9831
REALEXCHANGE does not Granger Cause NETEXPORT	27	0.3329	0.7204
NETEXPORT does not Granger Cause REALEXCHANGE		0.05135	0.9501
EXPENDITURE does not Granger Cause NETEXPORT	27	0.27929	0.759
NETEXPORT does not Granger Cause EXPENDITURE		0.19555	0.8238
EXPENDITURE does not Granger Cause REALEXCHANGE	27	1.04292	0.3692
REALEXCHANGE does not Granger Cause EXPENDITURE		0.00203	0.998

According to the results of the Granger-causality tests, for GDP, the real exchange rate and the government expenditure, the null hypothesis that oil price shocks do not Granger-cause macroeconomic variables cannot be rejected. The finding shows that oil shocks Granger-cause net exports can be explained that oil accounted for over 90% of Nigeria’s export revenue. In order to realize the response of one variable to another variable in a system, the next step is to use impulse response test to study the impulse response relationship between two different variables in a higher dimensional system.

3.4 Impulse response functions

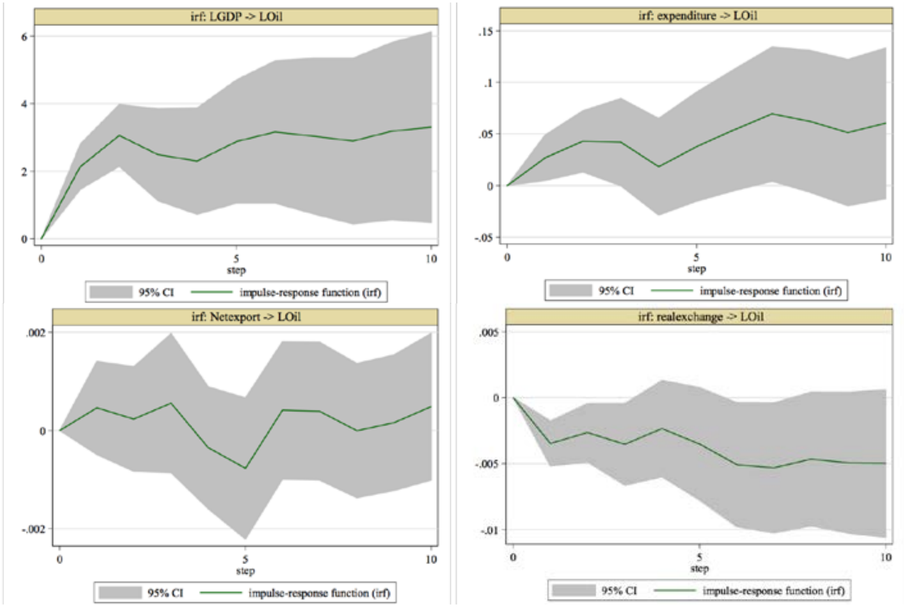

Fig.1 Impulse response functions of shocks to linear measure

All graphs show that the impact of a one-time shock to the measures of oil shocks on the current and future values of each of the macroeconomic variables [4]. For GDP and government expenditure, the oil shock has resulted in a positive response from the first three periods, thenceforth there is a sustained negative reaction. After the initial positive response of net export to oil prices, a remarkable negative reaction then followed. And then the reaction decreased slowly. The response of the real exchange rate to the oil price shocks measure is negative throughout the 10 periods after the shock to the oil price, so oil price shocks have a slightly negative effect on the real exchange rate.

Through the several tests above, we conclude that oil price shocks have no significant effects on macroeconomic variables, so we have to accept the hypothesis made in methodology chapter that oil price shocks did not change macroeconomic indicator variables in Nigeria from 1986 to 2015. Next, a linear regression analysis will be brought to test the other hypothesis that if there was a significant relationship between oil revenue and GDP in Nigeria from 1986 to 2015.

3.5 A linear regression analysis of oil revenue and GDP in Nigeria

This section is going to do the liner regression test, two variables will be brought, which are the independent variable oil rent and the dependent variable GDP. The regression result of the relationship between the growth rate of oil revenue and the GDP will be presented below. Here I create null hypothesis H0: There is no significant relationship between growth rate in oil revenue and Gross Domestic Product from in Nigeria 1986 to 2015. Whereas the alternative hypothesis H1: There is significant relationship between growth rate in oil revenue and Gross Domestic Product in Nigeria from 1986 to 2015.

Table 6 Variables Entered/Removeda

Model	Variables Entered	Variables Removed	Method
1	OILRENT[b]	.	Enter

a. Dependent Variable: GDP

b. All requested variables entered.

Table 7 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.705[a]	.497	.479	115.19022

a. Predictors: (Constant), OILRENT

Table 8 ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	354165.254	1	354165.254	26.692	.000[b]
	Residual	358257.256	27	13268.787		
	Total	712422.510	28			

a. Dependent Variable: GDP

b. Predictors: (Constant), OILRENT

Table 9 Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	490.318	65.506		7.485	.000
	OILRENT	-10.125	1.960	-.705	-5.166	.000

According to the tables above, the coefficient of correlation R gave a value of .705 implying that the strength of the relationship between growth rate in Oil Revenue and growth rate in GDP is weak at 70.5%. Also, the coefficient of determination R Square of 0.497 indicates that the growth rate in oil revenue can explain 49.7% of the variations in GDP growth.

From the ANOVA table, we can see a relatively high F value (26.692) and a low Sig. value < 0.05 (.000), so we reject H0 and in favor of H1 that there is a significant relationship between growth rate in oil revenue and Gross Domestic Product in Nigeria from 1986 to 2015.

Finally, the coefficients of regression indicate that the relationship between the growth rate in oil revenue and the GDP is negative at 10.125. The result of this evidence shown that the dependent variable gross domestic product is negatively influenced by the growth rate in oil revenue, implying that for every unit increase in oil revenue, GDP is also predicted to decrease by 10.125 units. This table provides the elements of the regression equation we have estimated, which can be written: Y = 490.318 - 10.125X. Among it, Y is the growth rate in oil revenue, X is Gross Domestic Product.

As we can see from the four tables above, oil revenue has a significant negative on GDP in Nigeria from 1986 to 2015. This also shows that GDP and oil revenue have a negative correlation, so the resource curse phenomenon happens in Nigeria to a certain extent.

4. Conclusion

From the study above, we can see that oil exports rather than oil price shocks play an essential role in the Nigerian economy and that this may have a significant positive impact on macroeconomic activities in Nigeria. However, we are surprised by the finding of the linear regression test that showed that oil revenue and GDP have a strong negative relationship; that when oil revenue increases, the GDP in Nigeria will have a remarkable decline. This result has shown that the resource curse phenomenon does take place in Nigeria to some degree.

The proposal presented in this paper for Nigeria could also apply to other countries that are dependent on oil or minerals. The Nigerian experience provides telling confirmation of a resource-rich country has slow economic growth. However, it must be acknowledged that there are many limitations in this paper. First, the variables used in the two studies are not entirely adequate; more macroeconomic variables such as FDI, net imports, consumer price and so on could be used in the test, which can investigate if oil industry has improved the people’s living standards in Nigeria. In addition, due to the limited space, the second study only used one dependent variable, other variables like net export, FDI and consumer price could also be used to test the relationship between them and oil revenue. Second, this paper did not explain in depth the reasons for the resource curse phenomenon. Third, due to the limited ideas from other articles, some parts of the literature review are not sufficiently critical.

References

[1] Olomola, P. A., & Adejumo, A. V. (2006). Oil price shock and macroeconomic activities in Nigeria. *International Research Journal of Finance and Economics*, *3*(1), 28-34.

[2] Burbidge, J., & Harrison, A. (1984). Testing for the Effects of Oil-Price Rises using Vector Autoregressions. *International Economic Review*, 459-484.

[3] Farzanegan, M. R., & Markwardt, G. (2009). The Effects of Oil Price Shocks on the Iranian Economy. *Energy Economics*, *31*(1), 134-151.

[4] Nalin, H. (2013). Impact of Oil Price Shocks on Macroeconomic Variables: Evidence from an Emerging Market. *Global Review of Business and Economic Research*, *9*(2), 103-115.