

CRUDE OIL PRICE SHOCKS AND MACROECONOMIC BEHAVIOR IN NIGERIA

Emmanuel Olusegun STOBER^a

Abstract

Milton Friedman's permanent income hypothesis suggests that frictionless open economies with depletable natural resources should increase its external reserves with most of the resource windfalls. Nigeria like any other country endowed with natural resources such as crude oil and liquefied natural gas are often faced by the Dutch disease. The evolution of the Nigeria's foreign exchange market has been influenced by the changing pattern of international trade, institutional changes in the economy and structural shifts in production. The increased export of crude oil followed by the sharp fall in its prices, and enhanced official foreign exchange receipts should give the government a wakeup call. This study focuses on macroeconomic behavior in the presence of crude oil price volatility. The dataset covered the period of 1970-2014, using OLS model. Given the high degree of dependency and contribution crude oil has on Nigeria's revenue generation, this analysis reveals crude oil price to be having a positive impact on Nigeria's economic wellbeing. A 1% increase in its price has an impact of 0.67% increase in GDP. Adding-up all other analyzed variable, crude oil still stand as the mean influential factor to the Nigerian economic development. Therefore, it is of optimum important to quickly diversify the economy, to prevent the repercussion of crude oil price shock, and also heavily invest in the development of infrastructural facilities to create the enabling environment for a non-oil economy.

Keywords: Exchange rate, External reserves, Nigerian economic development, Vector Error Correction Model (VECM)

JEL Classification: C54, C55, C22, E37, E52

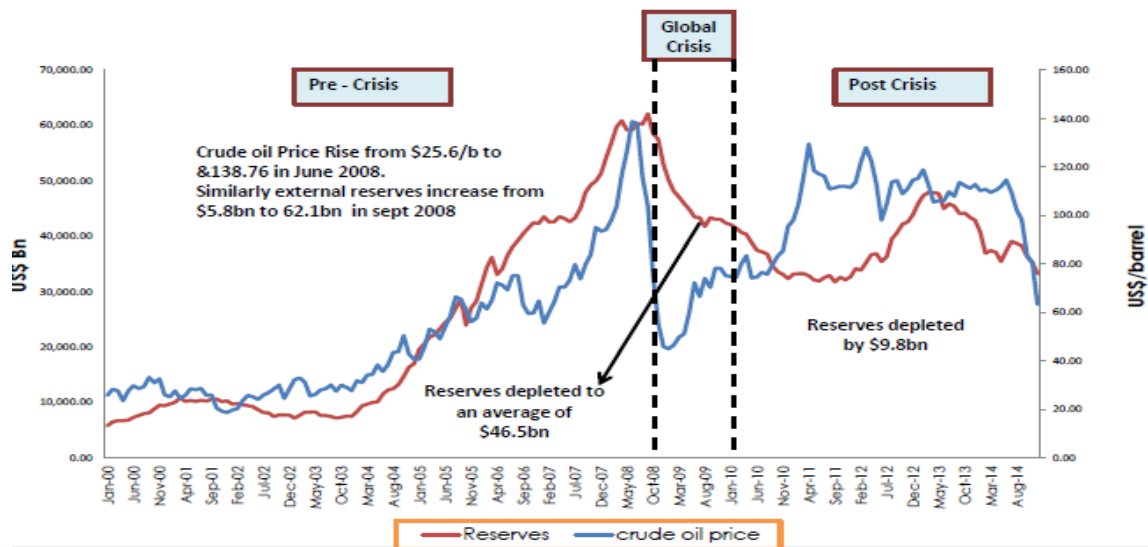
Author's Affiliation

^a - Bucharest University of Economic Studies, Romania. Email: stober.emmanuel@gmail.com (corresponding author).

1. Introduction

Central Bank of Nigeria (CBN) has been depleting the external reserves in a bid to defend the local currency (Naira). Analysts also add that the recent movements in the external reserves meant that the naira is beginning to come under fresh pressure. In order to cushion the effect of the pressures, the CNB was forced to place a banned on forty one categories of goods ranging from private jets to rice, wheelbarrows, toothpick and Indian incense. It also stopped Nigerians from using the interbank market to buy Eurobonds and foreign shares. Importers or investors purchasing the listed items shall do so using their own funds. The defending of the naira is in a bid to reposition it to its steady state. Director of the central bank’s trade and exchange department said: “The implementation of the policy will help conserve foreign reserves as well as facilitate the resuscitation of domestic industries and improve employment generation”. Figure 1 illustrates the external reserves and crude oil price movement.

Figure 1: The correlation between Nigeria’s External reserves and Crude oil price



Source: Adapted from (Emefiele, 2015)

The above figure reveals the volatility of the foreign exchange reserves as a result of the impact of crude oil price shock. As a result of volatility in the foreign exchange market, the CBN is forced to step in to rescue the naira from free fall. In October 2015, the naira declined versus every international convertible currency. It declined by 0.37% against the US dollar, 0.26% versus the euro, 0.31% against the pound sterling, 0.35% versus the yen, 0.67%

against the Chinese yuan and 0.73% compared to the Swiss franc (Oando, 2015). The major development in the foreign exchange market in October 2015 was the surprise adjustment of the Chinese yuan; it is also notable that it fell by 0.38% in September 2015 on average compared to the Nigerian naira. While this is considered a relatively minor adjustment, this development will need further close monitoring.

Amid a weakening economy, the Nigerian interest rate declined by 0.27% point from 17.29% in August to 17.02% in September 2015 after a 0.01% point month-on-month decrease in August. However, the interest rate is relatively stable at 0.12% Compound Annual Growth Rate (CAGR) from 16.86% in January to 17.02% in September (CBN, 2015). Meanwhile, the US dollar is currently kept from rising due to the uncertainty about an interest rate hike. At least in the short-term, the US dollar is forecast to remain well sustained by the Federal Reserve due to the unprecedented stimulus program in China, Japan and the Euro-zone as a result of low inflation/deflation.

Nigeria's economy depend on crude oil proceed to a very large extend. However, the downward sliding price has become a wakeup call. In nominal terms, the price of the OPEC Reference Basket (ORB) declined by a monthly average of \$0.19%, or 0.42%, from \$45.02 per barrel in September to \$45.02 per barrel in October. Meanwhile the September average price also fell by \$0.63, or 1.4%, from \$44.83 per barrel in August. In real terms, after accounting for inflation and currency fluctuations, the ORB declined by 1.8%, or \$0.55, to \$30.22/b from \$30.76/b (base June 2001=100). Over the same period, the US dollar fell by 0.5% against the import-weighted modified Geneva I + US dollar basket* while inflation declined by 0.1%. (OPEC, 2015).

The next section reviews some relevant litratures, while section 3 contain the methodology and detail analysis of this study, while the research is concluded in the 4th section .

2. Literature Review

Previous studies have focused on regional and sub-regional level in examining the relationship between the foreign exchange regime and macroeconomic performance. Stotsky, Ghazanchyan, Adedeji, & Maehle (2012) focus on seven Eastern Africa countries, five of

* The 'modified Geneva I+US\$ basket' includes the euro, the Japanese yen, the US dollar, the pound sterling and the Swiss franc, weighted according to the merchandise imports of OPEC Member Countries from the countries in the basket.

which decisively liberalized their foreign exchange regimes. Their study find that for the determinants of growth, investment and the real exchange rate are significant determinants but not the exchange regime or liberalization; and for inflation, the lagged inflation rate, nominal exchange rate, and the de facto regime are significant, however, exchange rate pass-through is limited. Araujo, Li, Poplawski-Ribeiro, & Zanna (2013) develops a neoclassical model with private and public investment and several frictions that capture pervasive features in Resource-rich developing countries, including absorptive capacity constraints, inefficiencies in investment, and borrowing constraints that can be relaxed when natural resources lower the country risk premium.

Their model was applied to the Economic and Monetary Community of Central Africa and discusses how our results can be used to inform the current account norm analysis pursued at the International Monetary Fund. Still on African study, Martinez & Mlachila (2013) explores the quality of the recent high-growth episode in sub-Saharan Africa.

They found that the quality of growth in sub-Saharan Africa over the past 15 years has unambiguously improved, although progress in social indicators has been uneven. Other authors study Pacific island countries to test within a relatively homogeneous group of small states what differentiates their growth performance from their peers (Yang, Chen, Singh, & Singh, 2013).

The macroeconomic effects of natural resource extraction in Papua New Guinea was also studied by (Basu, Gottschalk, Schule, Vellodi, & Shu-Chun, 2013), they found that macroeconomic effects from a resource boom typically associated with Dutch Disease effects such as a real appreciation and a fall in tradable sector production stem largely from the non-tradable component of government spending.

They recommended that a sovereign wealth fund, combined with a smooth capital spending path, will entails the best means of dealing with the macroeconomic volatility and maintaining a stable fiscal regime.

The Global economic meltdown coupled with the recent downward slide of the crude oil price has called for a new model of managing and controlling monetary instruments in crude oil exporting countries. The next section will investigate the interactions among macroeconomic variables and the role played by crude oil price.

3. Research Methodology

This paper uses Ordinary Least Square (OLS) regression to identify the relationship between economic growths, leading rate, inflation, crude oil price, exchange rate and external reserves. The empirical investigation is based on sample covering the period of 1970 to 2014.

3.1. Model Specification

This paper explores a linear relationship between variables. Following the standard literature, the model is based on the following equation:

$$GDP = f(COP, INF, ER, FX, LR) \quad (1)$$

In an explicit and econometric form, equation (1) can be stated as:

$$GDP_t = \beta_0 + \beta_1 COP_t + \beta_2 INF_t + \beta_3 ER_t + \beta_4 FX_t + \beta_5 LR_t + \varepsilon_t \quad (2)$$

where; GDP_t is the Gross Domestic Product, LR_t is Leading rate, INF_t is Inflation rate, COP_t is the average annual Crude Oil Price, FX_t is the average annual Foreign Exchange rate, ER_t is the External reserves, β_0 is the constant term called the intercept and, β_1 , β_2 , β_3 , β_4 , and β_5 are the coefficients of the regression equation. “t” is the time trend, and “ ε_t ” is the stochastic random term. Data used for this analysis is for 44 years from 1970 to 2014 for Nigeria from World Development indicators (2015), World Bank website and the crude oil price from (OPEC, 2015).

Estimation Equation:

$$LGDP = \beta_0 + \beta_1 * LCOP + \beta_2 * LER + \beta_3 * LFX + \beta_4 * LINF + \beta_5 * LLR + e$$

3.2. Empirical Results

We investigated the time series characteristics of the data to test whether the variables are integrated. In order to test the analyzed stationary variables, Augmented Dickey-Fuller (hereafter as ADF) test and Philip and Perron (hereafter as P-P) will be applied.

Table 1: Unit Root at Level

Variables	Critical Value at 5% level	ADF t-statistic	P-P t-statistic
LCOP	-2.93	-2.631	-2.631
LER	-2.93	-1.935	-1.905
LFX	-2.93	-0.291	-0.387
LGDP	-2.93	0.464	0.464
LLR	-2.93	-1.433	-1.462
LINF	-2.93	-3.752	-3.538

Table 1 reveals that all the variables (with the exception of LINF) to be non-stationary at levels, in both ADF and PP test statistics with the critical values at the 5% level of significance. Notice here that the critical values for LGDP, LCOP, LER, LLR and LFX are greater than the statistic t_{α} value so that we can reject the null at conventional test sizes. As a consequence of the non-stationarity of the time series data, which is unanticipated and is likely to result in a spurious finding when modeled or forecasted. For consistent reliable results, the above situation will require us to transform the data so that it becomes stationary. Table 2 reveals a first difference result of the variables.

Table 2: Unit Root at 1st Difference

Variables	Critical Value at 5% level	ADF t-statistic	P-P t-statistic
LCOP	-2.931	-6.277	-6.278
LER	-2.933	-5.555	-6.318
LFx	-2.931	-5.296	-5.299
LGDP	-2.931	-6.28	-6.296
LLR	-2.931	-6.277	-6.293
LINF	-2.933	-7.156	-15.473

All the variables in both ADF and P-P unit root test at 1st difference have been transformed. As a result, we can reject the null hypothesis of unit root and we can safely conclude that the variables are stationary. The next step after testing the variables are stationary is OLS estimation as presented in table 3.

Table 3: Ordinary Least Squares

Dependent Variable: GDP(-1)
 Method: Least Squares
 Date: 01/07/16 Time: 10:22
 Sample (adjusted): 1971 2014
 Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.30239	2.117098	11.95145	0.0000
COP(-1)	0.671731	0.095554	7.029888	0.0000
ER(-1)	0.009911	0.089395	0.110863	0.9123
FX(-1)	0.337100	0.061332	5.496335	0.0000
INF(-1)	-0.030040	0.070399	-0.426714	0.6720
LR(-1)	-1.401700	0.238010	-5.889245	0.0000

R-squared	0.929614	Mean dependent var	24.66155
Adjusted R-squared	0.920353	S.D. dependent var	1.042085
S.E. of regression	0.294096	Akaike info criterion	0.516302
Sum squared resid	3.286711	Schwarz criterion	0.759601
Log likelihood	-5.358645	Hannan-Quinn criter.	0.606529
F-statistic	100.3759	Durbin-Watson stat	0.822369
Prob(F-statistic)	0.000000		

Source: Author's Estimation using Eviews 7.1.

Each point on the regression line gives an estimate of the expected value of the dependent variable corresponding to the chosen independent values. The value of β_1 , β_2 , β_3 , β_4 and β_5 which measure the slopes of the lines are 0.671731, 0.009911, 0.3371, -0.03004, and -1.4017 respectively. As COP increases by 1%, the estimated increase in GDP amounts to about 0.67%. When FX increases by 1%, GDP is expected to increase by 0.34% and as a result of 0.01% increase in ER; GDP is expected to increase by 1% during the same period. Meanwhile, GDP and all the other analyzed independent variables share inverse relationship. The low positive influence of ER is due to the action of the Central bank of Nigeria. The monetary authority uses the external reserves to implement an expansionary monetary policy through the purchasing of government bonds on the open market, to put downward pressure on interest rates and promote investment in order to increase employment. Through the expansionary monetary policy, the decrease of 1.4% in lending rate will increase the GDP by 1%. Unfortunately, buying government debt does not always transformed into job creation. As suggested by this analysis, a decrease of 0.03% in the inflation rate will increase the GDP by 1%.

3.3. Testing the hypothesis

The R-squared (R^2) at 0.9296 shows that approximately 93% of the dependent variance (GDP) can be explained by the independent variables (COP, ER, FX, INF and LR). The associated F-probability is 0.0000 and coefficients are significantly differing from zero. The t-statistics are greater than 2 in absolute value; therefore, we can conclude that the model is valid.

The Durbin-Watson statistic at 0.822 falls below 2 but not that near to zero, therefore, it will be appropriate to analyze if there exist a possibility of positive serial correlation (first order). Serial correlation of the errors violates the OLS assumption that the error terms are uncorrelated, denoting that the Gauss Markov theorem does not apply and that OLS estimators are no longer the Best Linear Unbiased Estimators (BLUE). Since Durbin-Watson

statistic is only valid for nonstochastic regressors and for testing the possibility of a first-order autoregressive model for the regression errors, The Breusch–Godfrey test which has none of these restrictions, and is statistically more powerful than Durbin's h statistic, will be more appropriate test for the parameters. There are two advantages for using the Breusch–Godfrey test instead of a possible Durbin–Watson test, one advantage is that the classical Durbin–Watson test relies heavily upon the assumption that the residuals are normally distributed and the Breusch–Godfrey test is less sensitive to that assumption. The other thing is that the Breusch–Godfrey test allows us to test for serial correlation through a number of lags besides just one lag. So that is to say the Durbin–Watson test focuses on the correlation between residual at time t and a residual at time $t-1$, whereas the Breusch–Godfrey test uses all of the correlations between the residuals between time t and and time $t-k$, where k is the number of lag that you specify. If k is chosen to be equal to one, then the Breusch–Godfrey test with one lag is very similar to Durbin–Watson test. But for varieties of reasons, so many Econometrician and Statisticians prefer the Breusch–Godfrey test. Therefore, we will proceed with the Breusch–Godfrey test as presented in table.

Table 4: Breusch-Godfrey Serial Correlation LM Test

F-statistic	4.483516	Prob. F(3,35)	0.0091	
Obs*R-squared	12.21501	Prob. Chi-Square(3)	0.0067	
Test Equation:				
Dependent Variable: RESID				
Method: Least Squares				
Date: 01/07/16 Time: 11:12				
Sample: 1971 2014				
Included observations: 44				
Presample missing value lagged residuals set to zero.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.294352	1.889524	-0.155781	0.8771
COP(-1)	-0.018491	0.085084	-0.217320	0.8292
ER(-1)	0.013365	0.079775	0.167532	0.8679
FX(-1)	0.004429	0.054358	0.081470	0.9355
INF(-1)	0.020399	0.063620	0.320637	0.7504
LR(-1)	-0.001803	0.211758	-0.008516	0.9933
RESID(-1)	0.529639	0.172513	3.070139	0.0041
RESID(-2)	0.096653	0.197655	0.488997	0.6279
RESID(-3)	-0.075421	0.186979	-0.403366	0.6891
R-squared	0.277614	Mean dependent var	5.19E-15	
Adjusted R-squared	0.112497	S.D. dependent var	0.276469	
S.E. of regression	0.260454	Akaike info criterion	0.327470	
Sum squared resid	2.374274	Schwarz criterion	0.692418	

Log likelihood	1.795658	Hannan-Quinn criter.	0.462810
F-statistic	1.681319	Durbin-Watson stat	1.884119
Prob(F-statistic)	0.137916		

Source: Author’s Estimation using Eviews 7.1.

The autocorrelation of the error terms in each regression is checked by using the Breusch–Godfrey test statistic. It reveals that the error terms are statistically significant from lag 2, where the p-value is greater than 0.05. This implies that the regression residuals does not have autocorrelation problem. Having satisfied the autocorrelation of the error terms, we can process to testing of a linear restriction as presented in table 5.

Table 5: Wald Joint Test of Coefficient

Test Statistic	Value	df	Probability
F-statistic	90.82985	(5, 38)	0.0000
Chi-square	454.1493	5	0.0000
Null Hypothesis: C(2)=C(3)=C(4)=C(5)=C(6)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(2)	0.671731	0.095554	
C(3)	0.009911	0.089395	
C(4)	0.337100	0.061332	
C(5)	-0.030040	0.070399	
C(6)	-1.401700	0.238010	

Restrictions are linear in coefficients.

Source: Author’s Estimation using Eviews 7.1.

Since the P-value is equal to 0.000, we can reject the null hypothesis. In other words, we can conclude that the model has some predictive variables that help to predict the GDP. Normality test also shows the residual is normally distributed with p-value (0.371).

4. Conclusion

This Paper focuses on the relationship between crude oil price shocks and other macroeconomic behaviors in the Nigerian economy. It covered the period from 1970-2014,

using OLS to determine the effect of independent variables on the dependent variable, the unit root result indicated the variables are integrated of order one I(1).

Each point on the regression line gives an estimate of the expected value of the dependent variable corresponding to the chosen independent values. The R-squared (R²) at 0.9296 shows that approximately 93% of the dependent variance (GDP) can be explained by the independent variables. Given the high degree of dependency and contribution crude oil has on Nigeria's revenue generation, this analysis reveals crude oil price to be having a positive impact on Nigeria's economic wellbeing. A 1% increase in the price of crude oil has an impact of 0.67% increase in GDP. Adding-up all other analyzed variable, crude oil still stand as the mean influential factor to the Nigerian economic development. Among other studied variables, exchange rate with a 1% increase, revealed to have 0.34% positive influence on GDP. Due to recent economic realities, external reserves seem to be buffer, as a monetary policy tool to sustain the economic performance against external shocks and budget deficit. This research has shown a 1% increase in foreign exchange reserves to increase the GDP by 0.01%. One percent increase in lending rate will decrease GDP by 1.4%. Meanwhile a 1% increase in inflation is revealed to lead to 0.03% decrease in GDP.

Since Nigeria cannot determine the crude oil price, it is of optimum important to quickly diversify the economy, to prevent the repercussion of crude oil price shock, and also heavily invest in the development of infrastructural facilities to create the enabling environment for a non-oil economy, such as mineral sources, agriculture, manufacturing, tourism, and the entertainment industry. Meanwhile, exchange rate policy that aims at reviving the value of Naira should be adopted.

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