Forecasting the Causal Relationship between Oil Prices and Exchange Rate in Nigeria: 1970 - 2014

Uguru. Leonard C. Ph.D

Department Of Accountancy, Ebonyi State University, Abakaliki

Abstract: This study empirically forecasted the causal relationship between oil prices and exchange rate in Nigeria using data for 45 years (1970 - 2014). The data which is purely secondary data was sourced through the Central Bank of Nigeria Statistical Bulletin for various years. The study modified the Sibanda and Mlambo (2014)'s model to estimate the relationship and long-run effect of oil prices and exchange rates in Nigeria. With the Durbin-Watson statistic value that there is no autocorrelation in the model, t-test statistic was used to test the hypothesis that "there is no significant relationship between oil prices and exchange rate in Nigeria", using the e-view statistical software. The empirical findings indicate that a unit increase in oil price will lead to 44.91% increases in exchange rate in Nigeria. This implies that oil prices significantly influence exchange rate in Nigeria, with the t-statistic P-value (0.0000) and table value (1.671) at 5% level of significance. The study then recommended that exchange rate management policy makers should ensure that the oil price changes are included in exchange rate management in Nigeria.

Keywords: Oil prices, exchange rate, Nigeria, interest rate, inflation rate.

I. Introduction

From the historical perspective, the Nigerian economy has been anchored on dual sectors – Agriculture and Petroleum industry, with each playing vital role at different period as the mainstay of the economy. The dominance of the petroleum sector as the economic hub of foreign exchange has made Nigeria an endangered open mono – cultural economy whose fate is extremely tied to the development in the oil sector (Mustapha and Ohiaeri, 2014). This over-dependence on the crude oil has led to Nigeria suffering from Dutch Disease (Edun, 2012). The petroleum export sector led to the creation of a dual economy by giving rise to a new enclave that was only loosely tied into the rest of the economy but created a very large financial surplus. This means that the entire economy will be at a standstill if anything negative happens with the crude oil money.

Edun (2012) asserts that Nigeria started to develop a current account balance of payment deficit in 1982 because of too many imports and almost a single export item – crude oil. To make good the current account deficit, import controls were established which led to black market economy as there was a fixed exchange rate system at the time. Englama, *et al.* (2010) are of the opinion that countries choose fixed exchange rates in attempt to ameliorate volatility and stimulate international trade and investment. Exchange rates are prices at which country currencies are exchanged for each other. It can be categorized in two broad categories namely nominal and real exchange rates. Nominal exchange rate is the measurement of relative price of two currencies while real exchange rate serves double role of sustaining competitiveness in international arena and also as a nominal fulcrum for domestic prices.

Real exchange rate may appreciate or depreciate. The appreciation in the real exchange rate has led to Nigeria being an importer of food commodities, where it had previously been self sufficient (Edun, 2012). Examples of such food commodities are rice, wheat, maize, vegetable oil, and so on. The previous self sufficiency on staple food gave way to the dependence on externally produced ones in Nigeria since 1972 when the oil price and the highly valued currency is engendered. In fact, it was more profitable to source for staple food externally than to grow it because the high valued currency was consumer biased.

In a brief overview of potential transmission channels which could generate co-movement between oil prices and the US dollar, Grisse (2010) suggests that changes in the US dollar exchange rate could have an effect on oil prices because of their effect on the global demand for oil and also their impact of oil exporter's price setting behavior. He maintains that in as much as crude oil price is denominated in dollar on international financial markets, any depreciation in the US dollar leads to decrease in price of the crude oil as it concerns the domestic currency for consumers in non-dollar countries. With the hindsight of the law of demand and supply, when the crude oil price becomes less expensive, it is expected that the demand will rise which will consequently lead to higher oil prices.

In Nigeria in particular, decline in crude oil prices as a result of factors like low demand, seasonality factors, excess supply and exchange rate appreciation lead to the economy experiencing significant decline in the level of foreign exchange inflows that often result in budget deficit and or slower growth (Englama, *et al.*)

2010). A typical example is the oil price surge between 2014 and 2015 that lead to the National Assembly having a disagreement with the Executive on the oil price benchmark in the 2015 budget. Also, Englama, *et al.* (2010) observe that the price of oil decline from \$147 per barrel in July 2008 to \$41.4 at the end of December 2008. Before the global financial crises, the price of crude oil was high, exchange rate was stable but the emergence of the crisis saw a crash in the crude oil price and the exchange rate fall by more than 20 percent.

From the foregoing therefore, the objective of this study is to ascertain the correlation between the crude oil prices and exchange rate in Nigeria between 1970 and 2014. The paper is organized as follows: This introduction is followed by Section 2 that reviews the relevant literature, Section 3 reviews empirical studies, Section 4 explains the methodology and develops the empirical model, and the result was presented and discussed in Section 5 while Section 6 discussed the conclusion and policy implications.

II. Review Of Relevant Literature

Crude oil came to limelight as a foreign exchange earner for Nigeria in 1958 as a result of the discovery of the first oil well in Oloibiri in 1956. Before then, agricultural products were the mainstay of Nigeria economy. The discovery of crude oil in the country led to what is today called the "Dutch Disease" (Edun, 2012). This means that the focus of the economy tilted towards crude oil to the detriment of manufacturing and agricultural sectors that had hitherto been sustaining the developmental stride in the country.

The overthrow of tradable commodities (agricultural produce) by the non-tradable commodities poses great challenge for monetary and fiscal policy coordination and for exchange rate management (Mustapha and Ohiaeri, 2014). For instance, as a monolithic economy, Nigeria remains a prey in the hands of the unsteady international crude oil prices.

The fluctuations in the crude oil prices have different effects on different countries depending on whether the country is an oil producer or otherwise. For instance, higher oil prices imply higher revenues for oil producers and lower savings in oil-importing countries (Grisse, 2010). On that note, Kilian, Rebucci and Spatafora (2009) regress the external balances of crude oil producing countries and oil importing countries on oil price shocks. Their findings indicate that crude oil price shocks goes together in the same direction with a deterioration in the crude oil trade deficit of some sampled oil importing countries like the United States, Japan and Euro Area; even though that the intensity of the effect depends on the kind of oil price shock considered such as shocks to oil supply, aggregate demand and oil-specific demand (Grisse, 2010). Higgins, Klitgaard and Lerman (2006) argue that not minding the fact that dearth availability of relevant data makes it inherently difficult to know for sure where crude oil exporters' savings are invested, greater percentage of the profits of oil exporters during the oil boom directly or indirectly ended up financing the United States current account deficit.

The reason for the above may be attributed to the backdrop that as the price of oil is mostly denominated in dollar and as the price of oil increases, more US dollars will be demanded oil importers to facilitate their payments.

The effect of crude oil prices on exchange rate can be seen from two points of view namely – demand and supply viewpoints. From the supply viewpoint, Nikbakht (2009) opines that the rise in oil prices impact negatively on production activities. And crude oil being one of the major raw materials in production is at a position that any increase in its price will consequently increase the cost of production of non-tradable goods.

The final outcome then will be an appreciation of exchange rate as a result of the consequential rise in the prices of non-tradable goods (Sibanda and Mlambo, 2014). On the other hand, from the demand viewpoint, the exchange rate is affected indirectly as a result of its association with disposable income (Nikbakht, 2009). Therefore, the disposable income of consumers of the crude oil will definitely decrease when the oil price increases. Sibanda and Mlambo (2014) aver that this scenario will reduce the demand for non-tradable goods resulting in the fall in their prices and finally depreciating the exchange rate.

For Grisse (2010), oil prices and exchange rates seem to have been negatively associated in recent years (2003-2008). Within this period, the world experiences oil price boom and financial crisis and dollar appreciation (depreciating) was related with lower (higher) oil prices. Honohan and Lane (2003) observe that depreciation of exchange rate had led to the dramatic increase in the naira price of imports, which should have discouraged imports. Meanwhile, a more flexible exchange rate was once more introduced to the economy in Nigeria in 1999.

III. Review Of Empirical Studies

Plethora of literature abounds on the crude oil price and exchange rate behavior in the developing economies and also in the oil producing and oil importing countries. Some of them are reviewed in this section of the study in chronological order.

Dawson (2004) examines the effect of oil prices on exchange rate using Dominican Republic as a case study. The study uses a multiple regressions model to test the hypothesis formulated. Unique data was generated from the Central Bank of the Dominican Republic. The result indicates that as the price of oil that the country

imports increases, the exchange rate also increases. It was recommended that the Dominican Republic should consider decreasing its dependency on imports. This, the study suggested could be achieved through sourcing for alternative energy source and reducing its dependence on oil and oil products.

Rautava (2004) assess the link between oil prices and real exchange rate in Russia. Using vector autoregressive (VAR) model and co-integration techniques, the study reveals that there was a significant influence of oil price and exchange rate fluctuation on the Russian economy both at the long-run and short-run conditions.

Olomola (2006) examine the effect of the oil price shock and aggregate economic activity in Nigeria. The variables used were domestic money supply, real oil price, inflation rate, real exchange rate, and real GDP, proxied by industrial production index. Using a VAR model with quarterly data for the period 1970 - 2003, the findings indicate that oil price do significantly influence real exchange rate but not on inflation and output in Nigeria. The study concludes that a rise in crude oil price leads to wealth effects with attendant real exchange rate appreciation and increases the demand for non-tradable goods, a situation that would result in "Dutch Disease".

Habib and Kalamova (2007) examined the impact of real oil price on real exchange rate of oil producing countries using Norway, Russia and Saudi Arabia as sample. The findings show that while there are no significant impact of real oil price on the real exchange rates in Norway and Saudi Arabia, that in Russia, the long-run impact exists.

Harri, Nalley and Hudson (2009) examine the price relationship through time of the primary agricultural commodities, exchange rates, and oil prices. Using overlapping time periods, the co-integration technique was employed to ascertain the relationship between prices and fluctuations in the strength of the link between markets over time. The result shows that exchange rates do not contribute in the linkage of prices through time. The paper then recommends that policy action that result in fostering or altering the current renewable fuel standard mandates is expected to consider their effect on these on these markets.

Aliyu (2009) investigated the effect of oil price shock and real exchange rate volatility on the real gross domestic product (GDP) in Nigeria. The study employed the Johansen VAR – based co-integration technique on a quarterly data for the period of 1986 to 2007. The result showed both long-run and short-run effect. Therefore, diversification of the economy and infrastructural diversification were recommended.

In a study by Englama, Duke, Ogunleye and Isma'il (2010), attempt was made to examine the effects of oil price volatility, demand for foreign exchange, and external reserves on exchange rate volatility in Nigeria using monthly data for the period 1999-2009. The study reaffirms the direct nexus between oil price changes and exchange rate fluctuations, and then recommends that the demand for foreign exchange should move in consonance with the volatility in crude oil prices bearing in mind that Nigeria's economy is oil dependent.

Grisse (2010) investigates the relationship between oil prices and the US dollar nominal effective exchange rate using a structural model that is fully identified by exploiting the heteroskedasticity in the data, following Rigobon (2003). The findings revealed that higher crude oil prices depreciate the dollar both in the short run and over longer horizons. Also, US short term interest rates explain much of the long run variation in oil prices and dollar exchange rate.

Ferraro, Rogoff and Rossi (2011) investigate whether oil prices have a reliable and stand out-of-sample relationship with the Canadian/US dollar nominal exchange rate. The findings suggest that oil prices can predict the Canadian – US dollar nominal exchange rate at a daily frequency, in the sense of having a stable out-of-sample relationship. However, the predictive ability is not evident at quarterly and monthly frequencies. With the Kilian and Vigfusson (2009) as the base to consider two models aimed at modeling potentially important non-linearities in the oil price – exchange rate relationship. The study further suggests that a study should be carried out to find whether the Canadian – US dollar exchange rate respond to demand or supply shocks to oil prices.

Adelowokan (2012) made analytical attempts to determine the precise channel of exchange rate passthrough in Nigeria. The study employed the interest rate and inflation rate channels and used a distributed lag model that incorporates the first order lag of exchange rate. The results indicate that it is only previous exchange rate of naira in relation to the U.S dollar that pass-through interest rate in Nigeria between 1970 and 2010, while neither current exchange rate of naira nor previous exchange rate of naira vis-a-vis U.S dollar pass-through inflation rate in Nigeria between 1970 and 2010. The paper then recommends that the concerned monetary authority should at all time guide the fluctuation of exchange rate volatility in the economy considering its transitory shock effects on macroeconomic prices in Nigeria.

Ugwuanyi and Onyeka (2012) examined the impact of exchange rate volatility on economic growth in Nigeria, using a 25-year data (1987 - 2011). The findings show that exchange rate volatility had positive and non-significant impact on Nigeria's gross domestic product growth rate. They then recommends re-thinking of exchange rate management in Nigeria and re-diversification of the Nigeria economy which is presently oil dependent to sectors that will attract foreign exchange earnings.

Edun (2012) used a case study of Dutch Disease to assess the impact of expanding oil revenues on non-oil sectors of the Nigeria economy, taking the agricultural sector as the non-tradable sector. The study employed annual time series data from 1960 to 2010. The findings revealed variations in agricultural output explained majorly by own shock followed by a quantity of oil in the short run while the real exchange rate explained more than own shock in the long run. This confirms that real exchange rate and quantity of oil are an important source of variation in agricultural production in Nigeria. The study recommends that the government of Nigeria should prioritize agricultural sector again with more sense of responsibility and strong effort in reducing the impact of corruption on the implementation of policies.

Mustapha and Ohiaeri (2014) explain the impact of selected macroeconomic variables (money supply, interest rate differentials and external reserves) on exchange rate dynamics by employing econometric models of Vector Error Correction Model. The findings reveal that an increase in oil price leads to real appreciation of the naira, while money supply (M_2) growth and rise in real interest rate differentials undermine real naira/dollar rate. The paper recommends the diversification of the Nigerian economy.

Ani, *et al.* (2014) investigates the causal relationship between oil prices and key macroeconomics variables in Nigeria in a multivariate framework using time series data from 1980 to 2010. The study adopted Granger causality and ordinary least square to test the hypothesis. The findings indicate that there is a positive but insignificant relationship between oil price and the Nigerian GDP.

Shafi, *et al.* (2015) examine the impact of exchange rate volatility and oil prices fluctuations on economic growth in France based on annual data for forty years. Engle Granger results indicate that relationship is significant in the long run in France. Also, foreign direct investment and import of the country has significant positively related to the exchange rate while the exports and other factors has negatively related to the real effective exchange rate.

IV. Methods And Model Specification

This study investigated the causal relationship between exchange rate and other explanatory variables like oil prices, interest rates and inflation rates. The study adopted a time series research design hence times series data from 1970 to 2014 was employed. The data which is purely secondary data was sourced through the Central Bank of Nigeria Statistical Bulletin for various years. The annual data of the variable were denominated in US dollar.

The study is going to follow Sibanda and Mlambo (2014) to estimate the causal relationship between exchange rate and oil prices in Nigeria. Sibanda and Mlambo (2014) used the modified model of Aziz (2009) to estimate the long run effects of nominal exchange rate and oil prices using monthly data at levels as follows: NEXC = f(OP, INT) ... 1

NEXC = f(OP, INT) ... 1 Where, the nominal exchange rate (NEXC) is a function of oil prices (OP) and interest rates (INT). This study modifies the Sibanda and Mlambo (2014)'s model hence the following model:

REXR = f(OPR, INTR, INFR) ... 2 Where, REXR is the real exchange rate, OPR is the oil prices in US dollar, INTR is the interest rate while INFR is the inflation rate for the various years. So, the econometric model is given below as:

REXR = $\beta_0 + \beta_1 OPR + \beta_2 INTR + \beta_3 INFR + \mu$... 3 Where β is a constant and μ is the stochastic error term. Using annual data, this model tried to ascertain the causal relationship between real exchange rate and other selected variables (oil prices, interest rates and inflation rates) in Nigeria.

V. Result And Discussions

The annual data for the selected variables for the study were analyzed using the e-views statistical package and the result was as shown in the table below.

Table 1: Regression ResultDependent Variable: REXRMethod: Least SquaresDate: 08/07/15Time: 16:49Sample(adjusted): 1971- 2012Included observations: 42 after adjusting endpoints							
 Variable	Coefficient	Std. Error	t-Statistic	Prob.			
 С	-167.2685	30.14643	-5.548535	0.0000			
LOG(OPR)	44.90876	8.692377	5.166454	0.0000			
LOG(INTR)	29.53725	12.87997	2.293270	0.0275			
 DLOG(INFR)	3.078782	4.332146	0.710683	0.4816			
 R-squared	0.606797	Mean dependent var		48.66857			

Forecasting the Causal Relationship between Oil Prices and Exchange Rate in Nigeria: 1970 - 2014

Adjusted R-squared	0.575755	S.D. dependent var	61.58357
Sum squared resid	61140.71	Schwarz criterion	10.31102
Log likelihood	-212.5440	F-statistic	19.54740
Durbin-Watson stat	0.274209	Prob(F-statistic)	0.000000

Source: Author's E-view Output

The Table above shows that the P-value for the oil prices (OPR) and interest rate (INTR) are significant while that of the inflation rate (INFR) is insignificant. Also, the Durbin-Watson statistic value (0.27) shows that there is no autocorrelation in the model. The acceptable value for the Durbin Watson Statistic is 2 but it permits a range of \pm 0.2. The Durbin-Watson Statistic of 0.27 falls within the acceptable range, the model is thus, free from autocorrelation and is reliable. The constant or intercept is -167.2685. This implies that when all the model parameters are zero, there will still be a negative effect of -167.2685 on the exchange rate. The coefficient of oil prices (44.90876), was positively signed. This shows that a unit increase in oil prices will lead to 44.90876% increases in exchange rate. The coefficient of interest rate (29.53725), implies that a unit increase in interest rate will exert a corresponding influence of 29.53725% on exchange rate. The coefficient of determination (R²) is 0.606797. This indicates that the independent variables specified in the model sufficiently explained about 60.7% variations in the exchange rate.

Test of Hypothesis

Ho: There is no significant relationship between oil prices and exchange rate in Nigeria.

To test this hypothesis, we considered the value obtained from the estimation of the model with the table value. The P-value for oil price is 0.0000, which is less than 0.05 and is therefore significant. The t-statistic for the oil price obtained from the estimation is 5.166454. The table value is 1.671 at 5% level of significance. This implies that the oil price significantly influence exchange rate in Nigeria. Therefore at the 5% level of significance, the alternate hypothesis is accepted while the null hypothesis is rejected.

For the F-Statistic, which apart from the R^2 also tells about the overall significance of the model, the value obtained through estimation is 0.000000, while the table value is 2.76. Since the estimated value is lesser than the table value, we reject the null hypothesis and accept the alternate hypothesis that there is a significant relationship between oil prices and exchange rate in Nigeria.

The above findings of the study are collaborated by similar findings of studies conducted by other researchers and scholars before now. For instance, Dawson (2004) finds that as the price of oil that the country imports increases, the exchange rate also increases. The findings of other studies like Englama, Duke, Ogunleye and Isma'il (2010), and Ani, *et al.* (2014) also supported our result that there is a significant relationship between oil prices and exchange rate in Nigeria.

VI. Conclusion And Policy Implications

Oil prices and exchange rates in Nigeria seem to associate closely, and tend to have been positively related for some years now. This study empirically forecasted the causal relationship between oil prices and exchange rate in Nigeria using data for 45 years (1970 - 2014). The study modified the Sibanda and Mlambo (2014)'s model to estimate the relationship and long-run effect of oil prices and exchange rates in Nigeria. With the Durbin-Watson statistic value that there is no autocorrelation in the model, t-test statistic was used to test the hypothesis that "there is no significant relationship between oil prices and exchange rate in Nigeria", using the e-view statistical software.

The empirical findings indicate that a unit increase in oil price will lead to 44.91% increases in exchange rate in Nigeria. This implies that oil prices significantly influence exchange rate in Nigeria, with the t-statistic P-value (0.0000) and table value (1.671) at 5% level of significance.

The above result has tremendous implication for the Nigeria economy because the country, even though is a producer of crude oil, imports the refined petroleum products (PMS, DPK, AGO, etc). The excessive dependence on crude oil as the main source of foreign exchange earner has made the economic structure of Nigeria to be prone to inelastic mono-product. Exchange rate management policy makers should make effort to include the oil price changes into exchange rate management in Nigeria. The diversification of the economy is expedient with regards to the global search for alternative greener energy sources.

References

 Abiola, A. G. and Abraham, T. W. (2015). Benchmarking Nigeria's Crude Oil Price in a Climate of Falling Prices. Journal of Research Economics and International Finance, 4(2):34-38

- [3]. Aliyu , S.U.R (2009). Oil Price Shocks and the Macro-Economy in Nigeria: A Nonlinear
- [4]. Approach, MPRA Paper No. 18726. <u>http://mpra.ub.unimuenchen.de/18726/</u>

 ^{[2].} Adelowokan, O. A. (2012). Exchange rate Pass-Through in Nigeria: A Dynamic Evidence. European Journal of Humanities and Social Sciences, 16(1), 785 – 801.

- [5]. Ani, W.; Ugwunta, D.; Inyiama, O. and Eneje, B. (2014). Oil Price Volatility and Economic development: Stylized Evidence in Nigeria. Journal of Economics and International Finance, 6(6), 125 – 133.
- [6]. Aziz, M. I. A. (2009). Oil Price and Exchange Rate: A Comparative Study between Net Oil Exporting and Net Oil Importing Countries. ESDS International Annual Conference 30th November 2009, Institute of Materials, London.
- [7]. Dawson, C. (2004). The Effect of Oil Prices on Exchange Rates: A Case Study of the Dominican Republic. The Park Place Economist 14(1): 23-30.
- [8]. Edun, A. T. (2012). A Vector Autoregressive Analysis of Oil and Exchange Rate in Nigeria: A Case of Dutch Disease. British Journal of Arts and Social Sciences, 11(1), 1 – 21.
- [9]. Englama, A.; Duke, O.; Ogunleye, T, and Isma'il, U. (2010). Oil Prices and Exchange Rate Volatility in Nigeria: An Empirical Investigation. Central Bank of Nigeria Economic and Financial Review 48(3):31-48.
- [10]. Ferraro, D.; Rogoff, K. and Rossi, B. (2011). Can Oil Prices forecast Exchange Rates? Working Papers, Federal Reserve Bank of Philadelphia. Available at www.philadelphia.org/research-and-data/publications/working-papers/
- [11]. Grisse, C. (2010). What drives the Oil Dollar Correlation? International Reserve Function, Federal Reserve Bank of New York.
- [12]. Habib, M. M. and Kalamova, M. M. (2007). Are There Oil Currencies? The Real Exchange Rate of Oil Exporting Countries". ECB Working Paper No. 839, <u>http://ssrn.com/abstract=1032834</u>
- [13]. Harri, A.; nalley, L. and Hudson, D. (2009). The relationship between Oil, Exchange Rates and Commodity prices. Journal of Agricultural and Applied Economics, 41(2), 501 510.
- [14]. Higgins, M.; Klitgaard, T. and Lerman, R. (2006). Recycling Petrodollars. Current Issues in Economics and Finance. 12 (9), Federal Reserve Bank of New York.
- [15]. Kilian, L. and Vigfusson, R. (2009). Are the Responses of the U.S. Economy Asymmetric
- [16]. in Energy Price Increases and Decreases? Quantitative Economics.
- [17]. Mustapha, S. A. and Ohiaeri, N. (2014). Systemic Estimation of Monetary Variables, Oil Price and Naira Real Exchange Rate Dynamics. European Journal of Business and Management, 6(18), 125 – 139.
- [18]. Nikbakht, L. (2009). Oil Prices and Exchange Rates: The Case of OPEC. Business Intelligence Journal, 3(1), 83–92.
- [19]. Olomola, A. (2006). Oil Price Shock and Aggregate Economic Activity in Nigeria. African Economic and Business Review, 4(2), www.theaebr.com/V4N2Fa2007Bimola.pdf
- [20]. Rautava, J. (2004). The Role of Oil Prices and the Real Exchange Rate in Russia's Economy A Cointegration Approach. Journal of Comparative Economics 32: 315-327
- [21]. Rigobon, R. (2003). Identification through Heteroskedasticity. Review of Economics and Statistics. 85(4), 777 792.
- [22]. Shafi, K; Liu, H; Zahra, I; Satti, J. A. and Nazeer, A. (2015). Exchange Rate Volatility and Oil prices Shocks. International Journal of Academic Research in Business and Social Sciences, 5(1), 249 – 256.
- [23]. Sibanda, K. and Mlambo, C. (2014). The Impact of Oil Prices on the Exchange Rate in South Africa. Journal of Economics, 5(2), 193 – 199.
- [24]. Ugwuanyi, B. U. and Onyeka, V. N. (2012). Foreign Exchange Volatility and Economic Growth in Nigeria. ESUT Journal of Accountancy, 3(1), 118 – 124.