Oil Prices and Exchange Rate Volatility in Nigeria: An Empirical Investigation

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As a mono-product economy, where the main export commodity is crude oil, volatility in oil prices has implications for the Nigerian economy and, in particular, exchange rate movements. The latter is particularly important due to the twin dilemma of being an oil-exporting and oil-importing country, a situation that emerged in the last decade. The study examined 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 1999:1 to 2009:12. Drawing from the works of Jin (2008), the authors utilized cointegration technique and vector error correction model (VECM) for the long-run and the short-run analysis, respectively. The results showed that a 1.0 per cent permanent increase in oil price at the international market increases exchange rate volatility by 0.54 per cent in the long-run, while in the short-run by 0.02 per cent. Also a permanent 1.0 per cent increase in demand for foreign exchange increases exchange rate volatility by 14.8 per cent in the long-run. The study reaffirms the direct link of demand for foreign exchange and oil price volatility with exchange rate movements and, therefore, recommends that demand for foreign exchange should be closely monitored and exchange rate should move in tandem with the volatility in crude oil prices bearing in mind that Nigeria remains an oil-dependent economy.

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I. Introduction

Volatility in exchange rate and oil prices can be defined as the rate of change in price over a given period. It is expressed as a percentage and computed as the annualized standard deviation of the percentage change in the daily price. The larger the magnitude of the change, or the more quickly it changes over time, the higher the volatility. Volatile exchange rates make international trade and investment decisions more difficult because it increases exchange rate risk. On the face of it, floating exchange rates would appear to be riskier than fixed rates since it is free to change regularly. For this reason, countries may choose fixed exchange rates in order to reduce volatility and encourage international trade and investment.

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The volatility in oil prices have varying consequences for different countries; while oil-producing countries reap the benefit of high oil prices, oil-importing countries experience unfavourable terms-of-trade in their external sector that can transfer into their economies in the long run. Several empirical studies have been undertaken to investigate the effect of oil price volatility on exchange rate movement in different economies. Although the literature are mixed on the causality between the two variables, most empirical studies show that oil price directly impact on exchange rate (Amano and Norden (1995);Jin 2008; Coudert, et al., 2008). Exchange rate volatility, however, tends to increase the risk and the uncertainty of external transactions and predisposes a country to exchange rate-related risks (Celasun 2003; Setser 2007; Jin 2008).

Crude oil became an export commodity in Nigeria in 1958 following the discovery of the first producible well in 1956. Prior to that, exports were mainly primary agricultural commodities that comprised groundnuts, cocoa beans, palm oil, cotton and rubber. Palm oil was the leading export from 1946-1958, followed by cocoa beans while groundnut/oil ranked third. From a production level of 1.9 million barrels per day in 1958, crude oil exports rose to 2.35 million barrels per day in the early 2000s. However, it had fluctuated between 1.26 and 1.8 million barrels per day between 2007 and 2010 which was far below the OPEC quota due to the socio-political instability in the oil-producing areas of the country. In terms of its contribution to total revenue, receipts from oil that constituted 26.3 per cent of the federally collected-revenue in 1970, rose to 82.1 per cent in 1974 and 83.0 per cent in 2008 largely on account of a rise in crude oil prices at the international market.

Non-oil exports on the other hand, as a percentage of total exports, declined from 7.0 per cent between 1970-1985 to 4.0 per cent between 1970 and 1986 (CBN, 2000). The discovery of crude oil in Nigeria led to what is commonly referred to as the "Dutch disease". Thus, the performance of the manufacturing sector remained less impressive and that of agriculture declined. In the early 1960s, manufacturing activities consisted of partial processing of agricultural commodities, textiles, breweries, cement, rubber processing, plastic products, and brick making. The economy gradually became dependent on crude oil as productivity declined in other sectors.

As a mono-product economy, Nigeria remains susceptible to the movements in international crude oil prices. During periods of favourable oil price shocks triggered by conflicts in oil-producing areas of the world, the surge in the demand for the commodity by consuming nations, seasonality factors, trading positions, etc; the country experiences favourable terms-of-trade quantified in terms of a robust current account surplus and exchange rate appreciation. On the converse, when crude oil prices are low, occasioned by factors such as low demand, seasonality factors, excess supply and exchange rate appreciation, the Nigerian economy experiences significant drop in the level of foreign exchange inflows that often result in budget deficit and or slower growth. A recent example was the dramatic drop in the price of crude oil in the wake of the global financial and economic crises. The price of oil fell by about two thirds from its peak of $147.0 per barrel in July 2008 to $41.4 at end-December 2008. Prior to the crises, oil price was high, exchange rate was stable but with the advent of the global financial crisis (GFC) oil price crashed and the exchange rate caved-in, depreciating by more than 20 per cent. Since oil price volatility directly affects the inflow of foreign exchange into the country, there is a need to investigate if it has direct impact on the Naira exchange rate volatility.

The objective of this paper, therefore, is to examine empirically the relationship between oil prices and exchange rate volatility in the Nigerian economy. Specifically this study intends to investigate the dynamic relationship between oil prices and exchange rate volatility using monthly data from 1999 to 2009 for the analysis. Following this introduction, Section 2 reviews empirical studies on the volatility of oil prices and its effects on exchange rate volatility. The methodology adopted for the empirical study is discussed in Section 3. The empirical findings are analysed in Section 4. Section 5 summaries and concludes the paper.

II. Literature Review

Vast literature exists on the causal relationship between exchange rate and other variables in the developed and developing economies. Other distinguishing category is the position of the countries as either oil-exporting or importing country.

Following the study on the determination of the relationship between oil prices and the US dollar, Coudert, et al. (2008) highlighted the importance of the US dollar as a reserve currency and currency of choice for payment of oil transaction. This implies that the rate of exchange of the dollar to domestic currencies would affect the demand for oil. They posited that dollar depreciation reduces the oil price in a domestic currency with floating exchange rate, while the effect is neutral in countries that are pegged to the US Dollar. They concluded that the dollar depreciation has a priori positive impact on oil demand and oil price. On the supply side, a depreciation in the dollar would cause a decline in supply as the movement in the dollar would affect the cost of production that are priced in dollar through the rate of exchange of the domestic currency to the dollar. On the impact of oil price on the dollar effective exchange rate, they stated that a surge in oil prices tend to boost producer countries wealth and demand for dollar assets. In addition, based on the behavioural equilibrium exchange rate, oil prices influence terms-of-trade, net foreign assets and, implicitly, impact on the exchange rate. Coudert, et al. (2008) found that the relationship between the two variables were unclear and seem to depend on the period investigated. In addition, the oil price variable tends to lead the exchange rate variable, thus, the causality runs from the oil price to the exchange rate. They concluded that speculation on oil price would lead to a speculation on the dollar.

Olomola (2006) in his empirical study on the oil price shock and aggregate economic activity in Nigeria, used a VAR model with quarterly data from 1970 to 2003. Volatility was measured as the conditional variance of the percentage change of the nominal oil price. The five variables used for the empirical study were gross domestic product (real GDP), proxied by industrial production index (y), domestic money supply, the real effective exchange rate (reer), the inflation rate (CPI), and real oil price (Poil). The specification used for the model is the scaled specification, a non-linear transformation of oil price that takes volatility into account. The findings showed that while oil prices significantly influence exchange rate, it does not have significant effect on output and inflation in Nigeria. He concluded that an increase in the price of oil results in wealth effects which appreciates the exchange rate and increases the demand for non-tradable, a situation that would result in "Dutch disease".

Ricken (2009) extended the literature on the subject by testing for the role of good governance on oil price and the exchange rates of oil-exporting countries. He derived a simple theoretical model based on the effect of oil price movements on the real exchange rates of oil-exporting countries that depends on the degree of government spending as well as the size of the oil sector compared to the domestic economy. He utilizes a panel of 33 oil-exporting countries with data from 1985 to 2005 to evaluate seven indicators and computed the average partial derivatives of real exchange rates with respect to the oil price. He found that higher oil prices triggers appreciation proportional to the size of oil in an economy and for oil-dependent economy, the covariance was more than in countries that were less dependent on oil. He also added that the characteristic of the political and institutional development was also associated with the covariance of the two variables. He concluded that oil-exporting countries with credible governance can avoid the resource curse associated with volatile real exchange rate.

Gounder and Bartleet (2007) used a multivariate framework to measure the short-run impact of oil shocks on economic growth, inflation, real wages and exchange rate. Short-run impacts were examined using linear and non-linear oil price transformation. The Likelihood Ratios tests of Granger non-causality result indicated that linear price changer, asymmetric price increase and the net oil price variables impacted significantly on the economy unlike the asymmetric price decrease. The generalized impulse responses and error variance decomposition results confirm the direct link between net oil price shock and growth and its indirect linkages through inflation and the real exchange rate. The paper, thus, concluded that oil prices exhibit substantial effects on inflation and exchange rate in New Zealand.

Aliyu (2009), assessed the impact of oil price shock and real exchange rate volatility on the real gross domestic product in Nigeria using quarterly data that span the period 1986-2007. He used the Johansen VAR-based cointegration technique to examine the sensitivity of real GDP to change in oil prices and real exchange rate volatility in the long-run while the vector error correction model was used in the short-run. The result of the long-run analysis indicated that a 10.0 per cent permanent increase in crude oil prices increases the real GDP by 7.72 per cent, similarly a 10.0 per cent appreciation in exchange rate increases GDP by 0.35 per cent. The short-run dynamics was found to be influenced by the long-run equilibrium condition. He recommended the diversification of the economy and infrastructural diversification.

Jin (2008) employed a vector autoregressive model VAR to compare the effects of oil price and real effective exchange rate on the real economic activity in Russia, Japan and China. He first applied a Lag Augmented VAR (LA-VAR) approach causality test to investigate whether the oil price shock and exchange rate volatility granger-cause the economic growth in Russia, Japan and China. In addition, cointegration technique was used to examine how the real GDP of Russian, Japan and China are affected by changes in oil prices and the exchange rate in the long-run. To get the short-run of the model, a vector error correction model (VECM) was employed to analyze the short-run dynamics of the real GDP for the three countries. His findings indicated that oil price increases impact negatively on economic growth in Japan and China, and positively on economic growth of Russia. Specifically, a 10 per cent permanent increase in international oil prices is associated with a 1.67 per cent growth in Russian GDP and a similar decline in Japanese GDP. On the one hand, an appreciation of the real exchange rate leads to a positive GDP growth in Russia and a negative GDP growth in Japan and China.

The debate on the influence of oil prices on the real exchange rate motivated Rautava (2004) to examine the relationship that exists between oil prices and real exchange rate in Russia. The study employed vector autoregressive (VAR) modeling and cointegration techniques to examine the impact of international oil prices and the real exchange rate on the Russian economy and its fiscal policy. The findings from the study indicate that the Russian economy was influenced significantly by fluctuations in oil prices and the real exchange rate through both long-run equilibrium conditions and short-run direct impacts. However, because of growth trends in the Russian economy which improved in the recent times, the role of oil prices have greatly reduced.

Sosunov and Zamulin (2007) supported the findings of Rautava (2004); they used a calibrated general equilibrium model to examine whether the 80 per cent real appreciation of the Russian ruble in 1998-2005 can be explained by the increase in oil revenues. The result indicated that the oil price alone is insufficient to explain the appreciation of the Russian ruble without assuming permanent increase in oil price. The study, therefore, concludes that accounting for the increase in the volume of oil exports could only be significant if oil prices are assumed permanent.

Korhonen and Juurikkala (2007) used basic data from OPEC countries for the period 1975 to 2005 to examine the determinants of equilibrium real exchange rates in some selected oil-dependent countries. The authors included three oil-producing Commonwealth of Independent States (CIS) countries in the analysis. They utilized different estimation techniques that included pooled-mean group and mean-group estimators. The result indicated that oil price had significant effect on real exchange rates in the group of oil-producing countries. It showed that higher oil price cause real exchange rate appreciation. The elasticity of the real exchange rate with respect to the oil price ranges from 0.4 and 0.5, but may be larger depending on the specification.

Habib and Kalamova (2007) examined whether real oil price had an impact on the real exchange rates of three oil-exporting countries namely, Norway, Russia and Saudi Arabia. The authors developed a measure of the real effective exchange rates for Norway and Saudi Arabia (1980-2006) and for Russia (1995-2006). They tested if real oil prices and productivity differentials against 15 OECD countries influence exchange rates. The results showed that in Russia, there was a positive relationship between real oil price and real exchange rate in the long-run. In case of Norway and Saudi Arabia, the results indicated that there were no significant impacts of real oil price on the real exchange rates. The results further indicated that different exchange rate regimes for these countries could not explain why the impact of oil prices differs across countries but adduce the development to other policy responses, such as the accumulation of net foreign assets and sterilisation, as well as specific institutional characteristics.

Conflicting findings on the relationship between crude oil prices and exchange rates motivated Akram (2004) to explore the possibility of a non-linear relationship between oil prices and the Norwegian exchange rates. The non-linearity of the model improved its predictive power when compared with other similar linear and random walk models. The result from the model indicated that oil price was negatively related to the value of the Norwegian exchange rate when oil price was below US$14.0, contrary to other findings from other studies. Also, from the existing literature, Koranchelian (2005) estimated a long-run equilibrium real exchange rate path for Algeria. The result showed that the Balassa-Samuelson effect and real oil prices explained the long-run evolution of the equilibrium real exchange rate in Algeria.

Golub (1983) used a discrete model to test the effect of oil price on macroeconomic variables such as incomes, current-account balances, and saving. According to him, these have different influence on asset stocks and their distribution in oil-importing and oil-exporting countries, and thereby disturb asset-market equilibrium. He found that a rise in the price of oil generates a current-account surplus for OPEC and current-account deficits in the oil-importing countries. The resulting reallocation of wealth also influences exchange rates because of differential portfolio preferences. He found that if the OPEC countries' increased demand for dollars falls short of the reduction in the demand for dollars by the oil-importing countries, there will be an excess supply of dollars in the foreign-exchange market and the dollar will tend to depreciate (Golub, 1983).

III. Methodological Framework and Sources of Data

The paper employs monthly data for the period 1999:1 to 2009:12 sourced from the Central Bank of Nigeria.. The variables are oil price volatility (VOL_OPR), foreign reserves (LRE), demand for foreign exchange (LDD) and exchange rate volatility (VOL_EX). Both oil price volatility and exchange rate volatility were computed from their actual series as the annualized standard deviation of the percentage change in the daily price

Drawing from the works of Jin (2008), the paper adopted a VAR model and cointegration technique to get new insights into relationships that exist among oil price volatility (VOL_OPR), foreign reserves (LRE), demand for foreign exchange (LDD) and exchange rate volatility (VOL_EX). The vector autoregression model of order p (VAR (p)) is constructed as stated in Jin (2008).

In order to check the time series properties of the variables used in the model, we apply the unit root tests. We utilize the Augmented Dickey-fuller (ADF) and Philips Perron (PP) unit root tests to investigate the order of integration of the variabes in the model. The following equation (1) which include a constant and trend term is applied.

$$\Delta y_t = \propto 0 + \propto 1 y_t - 1 + \propto 2trend + \sum_{i=1}^{p} \beta j \quad \Delta y_{t-j} + \mu_t \tag{1}$$

where Δy_t denotes the first difference of y_t comprised of either real GDP, real exchange rate or real oil prices and p is the lag length of the augmented terms for y_t . Equation (1) permits the test to determine if the variable y_t is a stationary series. The null hypothesis in the ADF/PP tests is that y_t is non-stationary or has a unit root.

Table 1: ADF and PP Unit Root Test Results

Variables	Levels				First Differences			
	ADF1	PP1	ADF2	PP2	ADF1	PP1	ADF2	PP2
VOL_EX	-7.3331*	-7.0459*	-7.3302*	-7.0339*	-	-	-	-
VOL_OPR	-6.7119*	-6.7788*	-6.6876*	-6.7551*	-	-	-	-
LDD	-2.8354	-2.6185	-4.4337*	-4.3746*	-13.5972*	-13.7527*	-13.5156*	-13.6988*
LRE	-1.0628	-1.4889	-2.4860	-3.7022*	-19.8520*	-19.5845*	-19.7787*	-19.5141*

Notes: ADF1 and PP1 = Unit root tests with constant, and ADF2 and PP2 = Unit root tests with constant and trend.
*, **, and *** indicate statistical significance at the 1%, 5% and 10% level, respectively.
With constant only: McKinnon (1996) critical values are: -3.4812(1%), -2.8838(5%), and -2.5787(10%).
With constant and trend: MacKinnon (1996) critical values are: -4.0307(1%), -3.4450(5%) and -3.1474(10%).

The results of both the ADF and PP unit root tests are presented in table 1 which suggests that two variables VOL_EX and VOL_OPR in each of the test were stationary in levels, while the LDD is stationary in level with trend, but not stationary with constant only, and the LRE indicates non-stationary at levels. We, therefore, proceed to test for actual number of cointegration equations that exist among the variables.

IV. Empirical Analysis

IV.1 Long-run Analysis: VAR and Cointegration Test

The results allow the possibility of long-run relationship (cointegrating relations) among these variables. We are to determine how the exchange rate volatility reacts in the long run to volatility in oil prices, foreign reserves and demand for foreign exchange in Nigeria. A vector autoregression model of order p (VAR (p)) was constructed for this test in equation 2 (Jin 2008).

$$y_t = \Phi_0 + \sum_{i=1}^{p} \Phi_i y_{t-i} + \varepsilon_t \tag{2}$$

This VAR can be re-written in the VECM form as:

$$\Delta\gamma_t = \Phi_0 + \sum_{i=1}^{p-1} \Gamma_i' \Delta\gamma_{t-1} + \prod y_{t-i} + \varepsilon_t \tag{3}$$

$$\text{where, } \prod = \sum_{i=1}^{p} \Phi_i - 1 \text{ and } \Gamma_i' = -\sum_{j=i+1}^{p} \Phi_j \tag{4}$$

Where y_t a (4x1) matrix of foreign exchange demand (LDD), exchange rate volatility (VOL_EX), oil price volatility (VOL_OPR) and foreign reserves (LRE). is the (4x1) intercept vector and εt is a vector of white noise process. denotes an (4x4) matrix of coefficients and contains information regarding the short-run relationships among the variables. The matrix Π conveys the long-run information contained in the data. It is the rank of Π = αβ, β the matrix of cointegrating vectors; the elements of a are known as the adjustment parameters in the vector error correction model. The table below presents the test results for the number of cointegrating relations.

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.3681	117.3773	63.8761	0.0000
At most 1 *	0.2304	58.1618	42.9153	0.0008
At most 2	0.1254	24.3830	25.8721	0.0757
At most 3	0.0535	7.0984	12.5180	0.3344

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.3681	59.2155	32.1183	0.0000
At most 1 *	0.2304	33.7787	25.8232	0.0036
At most 2	0.1254	17.2846	19.3870	0.0984
At most 3	0.0535	7.0984	12.5180	0.3344

From Table 2 above both the maximum eigenvalue test and the trace test indicate that there are two cointegrating equations at the 5 per cent significance level among the volatility of oil price, foreign reserves, demand for foreign exchange and exchange rate volatility. Since the long-run cointegrating relation is found among the variables, an estimation of cointegrating vectors was employed. The value of the cointegrating vectors (β) is presented below:

To determine the optimum lag length, we test for statistics which include Sequential Modified Likelihood Ratio (LR) test, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan Quin Information Criterion (HQ) are diverse. The LR, FPE, AIC and HQ indicate lag length of two, while SC shows lag length of one. We therefore choose lag length of two.

Table 3: Var Lag Length Selection Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1231.143	NA	5271.923	19.92166	20.01263	19.95861
1	-993.959	455.2397	148.8359	16.35418	16.80906*	16.53896
2	-962.9463	57.52355*	116.9273*	16.11204*	16.93083	16.44465*
3	-954.04	15.94514	131.3725	16.22645	17.40915	16.70689
4	-944.0733	17.20058	145.3588	16.32376	17.87037	16.95203
5	-935.5808	14.10857	165.0954	16.44485	18.35536	17.22095
6	-920.9552	23.35376	170.36	16.46702	18.74144	17.39094
7	-913.7391	11.05689	198.8327	16.6087	19.24702	17.68045
8	-907.4908	9.170933	236.7454	16.76598	19.76822	17.98556

* indicates lag order selected by the criterion

To ensure the reliability of the coefficients of the Normalized Cointegrating model for the long-run and Vector Error Correction Model for the short-run, we employed AR root stability test. The estimated VAR is stable if all roots have modulus less than one and lie inside the unit circle. The result of AR root stability test satisfies the stability condition of the model in table 4.

Tabe 4: Stability Test

Root	Modulus
0.98099	0.98099
0.842447	0.842447
-0.502025	0.502025
0.287164 - 0.360442i	0.460849
0.287164 + 0.360442i	0.460849
0.442617	0.442617
-0.21477	0.21477
-0.148237	0.148237

No root lies outside the unit circle.

VAR satisfies the stability condition.

Table 5: Long-Run Models

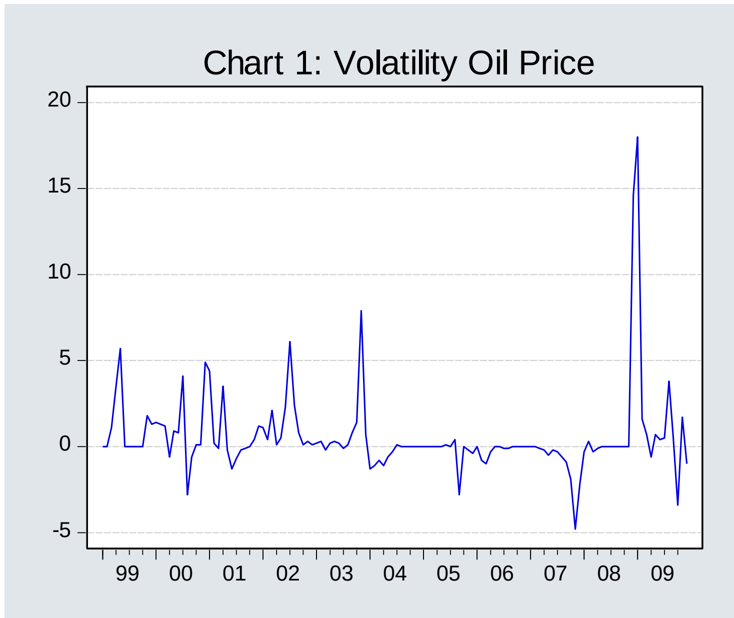
Cointegrating coefficients				
CointEq1				
VOL_EX(-1)	VOL_OPR(-1)	LDD(-1)	LRE(-1)	C
1.0000	0.493832	11.75946	-4.79562	9.454034
CointEq2				
VOL_EX(-1)	VOL_OPR(-1)	LDD(-1)	LRE(-1)	C
1.0000	-0.542072	-14.751	6.152268	-13.894

From Table 5 above, we derive a cointegrating equations among the exchange rate, oil price, foreign reserves and demand for foreign exchange. The normalized equations become: The value of the cointegrating vectors (β) is presented below:

$$VOL\_EX = -0.49\ VOL\_OPR + 4.80LRE - 11.76LDD \quad (5)$$

$$VOL\_EX = +0.54VOL\_OPR - 6.15LRE + 14.75LDD \quad (6)$$

Analysis is focused on equation 6 because it reflects theoretical expectation. The cointegrating vector indicates a stationary long-run relationship in which the level of exchange rate volatility (VOL_EX) depend on the oil price volatility, foreign reserves and demand for foreign exchange. From equation 6, a 1.0 per cent permanent increase in the level of international oil prices volatility causes the exchange rate volatility to increase by 0.54 per cent in Nigeria. This conforms to expectation, as an increase in oil price volatility should increase exchange rate volatility in the Nigerian economy. Also a permanent 1.0 per cent increase in demand for foreign exchange increases exchange rate volatility by 14.8 per cent, while the co-efficient of foreign reserves is negative. It implies that increase in reserve accumulation would decrease exchange rate volatility. The result also showed that foreign exchange demand has much devastative effect on exchange rate volatility than oil volatility This result confirms the general belief that volatility in exchange rate is greatly influenced by the foreign exchange demand and the volatility in oil price in the international market. Thus it can be concluded that there is a net transfer income from oil importing countries to Nigeria when oil prices rise at the international market. In addition, in spite of foreign reserves level of about US$51.0 billion in October 2008, exchange rate instability was experienced in Nigeria, because of the drastic fall in crude oil prices at the international market.



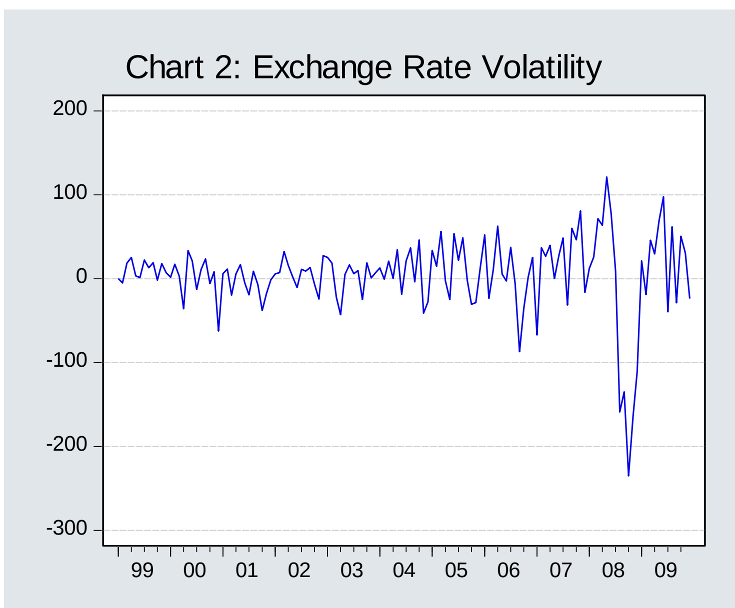


Chart 1 and 2 show the volatility in oil prices and the Naira exchange rates in Nigeria from 1999:1-2009:12. As indicated in the VAR model, the a priori expectation is for an increase in oil price volatility to lead to an increase in exchange rate volatility. The effect of sharp reduction in oil price in the last quarter of 2008 was reflected in sharp depreciation in exchange rate during the period. The movements of the two variables in the graph are in line with a priori expectation.

IV.2 Short-run Analysis: A Vector Error-Correction Model (VECM)

In econometric analysis, a cointegrated set of time series variables must have an error-correction representation, which reflects the short-run adjustment mechanism. The focus of this section is to examine the influence of the estimated long-run equilibrium on the short-run dynamics, i.e. the cointegrating vectors. Thus the parameters of the error-correction term implied by cointegrating vectors for exchange rate is investigated to determine if they are appropriately signed and significant. After specifying with two lags, we examined the effects of oil prices, foreign reserves, and demand for foreign exchange on the exchange rate in the short-run by using a vector error-correction model (VECM) as follows:

$$\Delta \gamma_t = \emptyset_0 + \sum_{i=1}^{p-1} \emptyset_i \, \Delta \gamma_{t-1} + EC_{t-1} + \varepsilon t \text{ ----------------------- } (7)$$

where

EC_{t-1} indicates the error-correction term. = -

Table 6: Short-Run Model

	Error Correction:	D(VOL_EX(-1))	D(VOL_OPR (-1))	D(LDD(-1))	D(LRE(-))
CointEq2	-0.3591	0.1995	0.0219	0.0708	-0.3053
	-0.0549	-0.0937	-0.0059	-0.5948	-0.5156
	[-6.54399]	[2.12842]	[3.72600]	[0.11906]	[-0.59221]

The sign of the error-correction parameter in the equation of interest is as expected and statistically significant.

The sign of the coefficient of error-correction terms for the exchange rate is negative and statistically significant. A value of −0.36 for the coefficient of error-correction term suggests that the exchange rate will converge towards its long-run equilibrium level within 36 days after the shock of oil price. In the short-run the coefficients of the demand for exchange rate and external reserves were not statistically significant and, therefore, these variables do not exact any influence on exchange rate volatility in the short-run.

V. Summary and Policy Implications

The study empirically examined the relationship between oil price volatility and exchange rate volatility in Nigeria. Vector Autoregressive model (VAR) and cointegration technique were used to examine the long-run relationship, while vector error correction model (VECM) was used for the short-run analysis. The empirical results showed that exchange rate volatility is greatly influence by the swings or volatility in oil prices at the international market both in the long-run and short-run. In the long-run a 1.0 per cent permanent increase in the level of international oil prices volatility causes exchange rate volatility to increase by 0.54 per cent. Also a permanent 1.0 per cent increase in demand for foreign exchange is likely to increase exchange rate volatility by 14.8 per cent. However, the main drivers of volatility in exchange rate in the long-run are demand for foreign exchange and oil price volatility. From the results obtained, exchange rate management policies should focus on foreign exchange demand strategies and in addition, incorporating the movement of international oil prices into exchange rate management, as Nigeria remains an oil dependent economy. The consequences of oil price shocks on the economy are real since oil remains the major foreign exchange earner for the country. As the world move in search for greener energy, the diversification of the economy to increase supply of foreign exchange from other commodities is critical to avoid damage to the economy of an oil exporting country like Nigeria that could result from the higher outward transfer of wealth during prolonged oil price shocks.

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