Impact of Oil Price Shock and Exchange Rate Volatility on Economic Growth in Nigeria: An Empirical Investigation

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Abstract

This paper seeks to assess the impact of oil price shock and real exchange rate volatility on real economic growth in Nigeria on the basis of quarterly data from 1986Q1 to 2007Q4. The empirical analysis starts by analyzing the time series properties of the data which is followed by examining the nature of causality among the variables. Furthermore, the Johansen VAR-based cointegration technique is applied to examine the sensitivity of real economic growth to changes in oil prices and real exchange rate volatility in the long-run while the short run dynamics was checked using a vector error correction model. Results from ADF and PP tests show evidence of unit root in the data and Granger pairwise causality test revealed unidirectional causality from oil prices to real GDP and bidirectional causality from real exchange rate to real GDP and vice versa. Findings further show that oil price shock and appreciation in the level of exchange rate exert positive impact on real economic growth in Nigeria. The paper recommends greater diversification of the economy through investment in key productive sectors of the economy to guard against the vicissitude of oil price shock and exchange rate volatility.

Keywords: Cointegration, Granger Causality, Oil price shock, Exchange Rate Volatility, VECM

JEC Classification Codes: F40; F41, F43

I. Introduction

Analysis of the impact of asymmetric shocks occasioned by exchange rate and oil price variability on economic growth has been a major preoccupation of both academics and policy makers for some decades now. On the one hand, it has been recognized in the literature that depreciation of exchange rate tends to expand exports and reduce imports, while the appreciation of exchange rate would discourage exports and encourage imports. Thus, exchange rate depreciation leads to income transfer from importing countries to exporting countries through a shift in the terms of trade, and this affects the economic growth of both importing and exporting nations. On the other hand, the perception that oil price spikes have a serious negative effect on the economies is based largely on the close correlation in the timing of oil price spikes and

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economic downturns[2]. While Greenspan (2004) noted that the impact of oil prices alone in modern market-based economies is difficult to infer in a way in which policy is automatically obvious, McKillop (2004) argued that higher oil prices reduce economic growth, generate stock exchange panics and produce inflation, which eventually lead to monetary and financial instability. It will also lead to higher interest rates and even a plunge into recession. Jin (2008) argued that sharp increase in the international oil prices and violent fluctuation of the exchange rate are generally regarded as factors discouraging economic growth.

Previous research on the impact of exchange stability on growth has tended to find weak evidence in favor of a positive impact of exchange rate stability on growth. For large country samples; Ghosh, Gulde and Wolf (2003) discovered weak evidence that exchange rate stability affects growth in a positive or negative way. Schnabl (2007) builds on De Grauwe and Schnabl (2005) using both GLS (Generalized Least Squares) and GMM (Generalized Method of Moment) panel estimations for 41 countries in the EMU (European Monetary Union) periphery. The results provide evidence in favor of a robust negative relationship between exchange rate volatility and growth. Also, the issue of which regime of exchange rate is susceptible to macroeconomic stability and growth has been extensively discussed in the literature[3]. Proponents of flexible exchange rates emphasized the need for macroeconomic flexibility in the face of real asymmetric shocks while in contrast; proponents of fixed exchange rates have stressed the (microeconomic) benefits of low transaction costs for international trade, Frankel and Rose (2002).

An oil price increase, all things being equal, should be considered positive in oil exporting countries and negative in oil importing countries, while the reverse should be expected when the oil price decreases. The challenge, however, of the combined effect of hikes in oil prices and exchange rate instabilities on macroeconomic economic stability and economic growth for oil

[2]Hamilton (1983) discovered the existence of a negative relationship between oil prices and macroeconomic activity indicating that oil price increases reduced US output growth from 1948 to 1980.

[3] For a detailed review on the issue see: Friedman (1953), Mundell (1995), Fischer (2001), Gosh, *et al.* (2003), Edward and Levy-Yeyati (2003) and Kawai (2006). McKinnon (1963), for instance, emphasized the benefits of fixed exchange rate regimes for small open economies in the face of nominal shocks arguing that since the international price level is given and traded goods make up a high share of the domestically consumed goods in these economies, exchange rate stability ensures domestic price stability.

producing nations like Nigeria is really enormous. Huge inflow of oil revenues in Nigeria are more often associated with expansion in the level of Government spending while periods of dwindling oil revenues are usually accompanied by budget deficits. There is no gain saying that Nigeria relies so much on revenue from oil exports, but, it equally massively imports refined petroleum and other related products. Evidence, for instance, shows that Government spending, which hitherto, before 1999 remained well below N0.5 trillion, hit N1.02 trillion mark in 2001 and N1.5 trillion in 2004. The figures for 2006 and 2007 stood at N2.04 and N2.45 trillion respectively. Furthermore, total imports by the oil sub sector – fuel imports being one of the major components, accounts for an average of 22.4 percent between 2000 and 2007 in the Nigeria's total visible trade. Specifically, the sub sector which accounts for 17.5 percent in 2001 and rose to 28.5 percent in 2005. The figures, however, stood at 27.3 percent and 21.2 percent in 2006 and 2007 respectively.

Although the naira exchange rate has witnessed some period of relative calm since the implementation of the structural adjustment programme (SAP) in July, 1986, its continued depreciation, however, scored an indelible mark in the level of real sector activities in the country. The naira which traded at N0.935 = $1.00 (United States) in 1985 depreciated to N2.413 = $1.00 and further to N7.901 against the US dollar in 1990. To stem the trend, the policy of guided deregulation pegged the naira at N21.886 against the dollar in 1994. Further deregulation of the foreign exchange market in 1999, however, pushed the exchange rate to N86.322 = $1.00. With huge inflow of oil revenue due to hike in the oil price, the end-period rate stood at N117.97 in December, 2007. This remained stable until towards the end of 2008 when the global financial crisis took its toll and the naira exchange rate depreciated from N116.20in November, 2008 to N131.5 in December, 2008 or a decline in value by 12.95% and further to N142.00 or a decline by 7.98% in February 2009. In spite of these developments, the national income accounts, for the country revealed an impressive performance. Real GDP grew at an average of 5.01 percent between 2000 and 2008 with the highest of 9.6 percent in 2003. Against this background, the paper seeks to assess the impact of spikes in oil prices and exchange rate volatility on economic growth in Nigeria between 1986 and 2007. The rest of the paper, beside the introduction, which occupies section one, is organized in the following way. Section two dwells on literature review and theoretical issues. Section three presents the research methodology of the paper, section four

contains empirical results and discussion, and finally, summary and recommendations are drawn in section five.

II. Literature Review and Theoretical Issues

There is consensus in the literature on the impact of exchange rate stability neither on economic growth nor on the mechanism through which oil price fluctuations affect growth. While Macro- and microeconomic analysis of exchange rate system are relied upon in the former, supply and demand analysis of the impact of changes in oil price is used in the latter. From the macroeconomic perspective, Schnabl (2007) argued that theoretically, flexible exchange rates allow an easier adjustment in response to asymmetric country specific real shocks. The microeconomic effects of low exchange rate volatility under the fixed exchange rate system are associated with lower transaction costs for international trade and capital flows thereby contributing to higher growth. Indirectly, fixed exchange rates enhance international price transparency as consumers can compare prices in different countries more easily. If exchange rate volatility is eliminated, international arbitrage enhances efficiency, productivity and welfare. Earlier, Mundell (1973a, 1973b) opined that monetary and exchange rate policies are the chief source of uncertainty and volatility in small open economies and economic growth is enhanced when exchange rate fluctuations are smoothed. Schnabl (2007) argued that even large, comparatively closed economies such as the Euro area and Japan are sensitive to large exchange rate swings, in particular in the case of appreciation.

The transmission mechanisms, according to Jin (2008) through which oil prices affect real economic activity include both supply and demand channels. The supply side effects are related to the fact that crude oil is a basic input to production, and an increase in oil price leads to a rise in production costs that induces firms' lower output. The demand side effect is derived from the fact that oil prices changes affect both consumption and investment decisions. Consumption is adversely affected because increase in oil price affects disposable income and the domestic price of tradables. Investment is adversely affected because such increase in oil price also affects firms' input prices and thereby increasing their costs.

Empirical evidences have shown strong effect of short run and long run adverse effect of exchange rate swings on economic growth performance through the trade channel. The nature of the effect, however, runs in either positive or negative direction. According to IMF (1984) and European Commission (1990) empirical evidence in favor of a systematic positive (or negative) effect of exchange rate stability on trade (and thereby growth) in small open economies has remained mixed. Bacchetta and van Wincoop (2000) found based on a general equilibrium framework that exchange rate stability is not necessarily associated with more trade. Gravity models have been used as frameworks to quantify the impact of exchange rate stability on trade and growth, in particular in the context of a monetary union. Using panel estimations for more than 180 countries, Edwards and Levy-Yeyati (2003) found evidence that countries with more flexible exchange rates grow faster. Eichengreen and Leblang (2003) found strong negative relationship between exchange rate stability and growth for 12 countries over a period of 120 years. They conclude that the results of such estimations strongly depend on the time period and the sample. Schnabl (2007) found robust evidence that exchange rate stability is associated with more growth in the EMU periphery. The evidence, according to him, is strong for Emerging Europe which has moved from an environment of high macroeconomic instability to macroeconomic stability during the observation period. Other empirical studies examined the role of capital market in ensuring exchange stability and economic growth[4].

Equally, a number of empirical studies have explored the relationship between economic growth and oil price fluctuations. The existence of a negative relationship between oil prices and macroeconomic activity was discovered by Hamilton (1983) in the United States. Hooker (1994) confirmed Hamilton's results and demonstrated that between 1948 and 1972, oil price variability exert influence on GDP growth. His results show that an increase of 10% in oil prices led to a lower GDP growth of roughly 0.6 % in the third and fourth quarters after the shock. Later, Mork (1989), Lee *et al.,* (1995) and Hamilton (1996) introduced non-linear transformations into the models and Granger causality tests. Results confirmed incidence of negative relationship

[4] See: Frankel and Rose (2002), McKinnon and Schnabl (2004a, 2004b) and Chmelarova and Schnabl (2006). Aghion *et al.,* (2006), for instance, found that countries with underdeveloped capital markets are particularly vulnerable to exchange rate fluctuations, because they lack the instruments to hedge foreign exchange risk – for instance, depreciations inflate the value of international liabilities in terms of domestic currencies because foreign debt are denominated in international currencies an there is little or virtually no instruments that could contain these.

between oil prices fluctuations and economic downturns as well as Granger causation from oil prices to growth before 1973 but no Granger causation from 1973 to 1994. Other studies include: Mork (1989), Hoover and Perez (1994), Federer (1996), Hamilton (1997), Lee and Ni (2002) and Balke *et al.,* (2002).

Recently, Gounder and Barleet (2007) using both linear and nonlinear oil price transformation discovered a direct link between net oil price shock and economic growth in New Zealand. In addition, oil price shock was discovered to have substantial effect on inflation and exchange rate. In a comparative study of the impact of oil price shock and exchange rate volatility on economic growth, Jin (2008) discovered that the oil price increases exerts a negative impact on economic growth in Japan and China and a positive impact on economic growth of Russia. Specifically, a 10% permanent increase in international oil prices is associated with a 5.16% growth in Russian GDP and a 1.07% decrease 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.

Nigeria is regarded as the largest oil producing nation in Africa and the tenth largest in the world in terms of oil reserves. With a production level of close to 2 million barrels per day – though this level has been seriously affected due to crisis in the oil production region, Nigeria benefited, handsomely from hikes in the oil since the beginning of second Gulf war. The balance of payment position of the country remains highly favorable with over 20 months of imports, which translates to over $55 billion of reserves. Exchange rate was moderately stable between 2000 and 2008, while real GDP growth averaged 5.01 percent within the same period.

However, oil consumption in the country heavily relies on the import of refined petroleum and products since the collapse of local refineries in the late 1980's. Thus, over 80% of the country's domestic requirements of oil are sourced from imports. The near collapse of the power generation and distribution industry in the country further accentuates the acute shortage of energy. The burden on the government to provide energy resources at subsidized rate became very unwieldy and between 1999 and 2008, the federal government of Nigeria has reduced its subsidy approximately 9 times. This seriously affects production, consumption and investment decisions. Figure 1, presented in the appendix, charts the level of oil production and consumption

in the country between 1986Q1 and 2007Q4, while figures 2, 3 and 4, all in the appendix, present the trends in the variables in natural log.

III. Research Methodology

There is a large number of macroeconomic variables which affects economic growth and may equally be considered, beside oil price shock and exchange rate volatility, as one of the control variables; investment, consumption and government spending, trade, foreign direct investment, etc. Including these variables into the specification increases the fit of the model, but also decreases the degrees of freedom. For this reason the model is restricted to only the chosen variables. Real GDP is, therefore, regressed against the international oil price and the naira exchange rate vis-à-vis the US dollar.

Quarterly data from the first quarter of 1986Q1 to the last quarter of 2007Q4 is used for all variables in country. Data of nominal GDP was obtained from the CBN (Central Bank of Nigeria) Statistical Bulletin and the consumer price index (CPI) from the same source is used as a deflator to compute the real GDP figures. Exchange rate variability was measured using the CPI-based real exchange rate, which is derived from the nominal exchange rate using both the US producer and the Nigerian price indexes. We deduced oil price shock as the average quarterly price of internationally traded variety of crude (UK Brent) in US dollars. The analysis converts all variables into logarithmic form and their trends shown in Figures 2, 3 and 4 suggest the existence of strong links among them. Using the specification provided in equation 3.1 we tested for stationarity of the series using Augmented Dickey Fuller (ADF) and Phillips and Perron tests.

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_1 trend + \sum_{j=1}^{p} \beta_j \Delta y_{t-j} + \mu_t \qquad 3.1$$

where Δy indicates the first difference of y_t and p is the lag length of the augmented terms for y_t. Equation (3.1) allows us to test whether the variable y_t is a stationary series. The null hypothesis in the ADF tests is that y_t is non-stationary or has a unit root.

Furthermore, we carried out the Granger causality test where Granger (1969) proposed a time-series data based approach in order to determine causality. The Granger test suggests that x is a cause of y if it is useful in forecasting y. In this framework "useful" means that x is able to

increase the accuracy of the prediction of y with respect to a forecast, considering only past values of y. Because the Granger-causality test is very sensitive to the number of lags included in the regression, both the Akaike (AIC) and Schwarz Information Criteria have been used in order to find an appropriate number of lags.

Since the main objective of this paper is to assess not only the pairwise nature of causality among the variables, but, also the short run and long run dynamic impact as well, we tested for cointegration using two well known approaches: the one developed by Engle and Granger (1987) and the other one by Johansen (1988) and Johansen and Juselius (1990). In addition, vector error correction methodology (VECM) was applied. Economically speaking, cointegration of two variables indicates a long-term or equilibrium relationship between them, given by their stationary linear combination (called the cointegrating equation). The Engle–Granger test is a procedure that involves an OLS estimation of a pre-specified cointegrating regression between the variables. This was followed by a unit root test performed on the regression residuals previously identified. We applied the Engle-Granger two-step procedure by estimating equation (3.2) using OLS and then testing the level of stationarity of the residual term.

$$lrgdp_t = \alpha_0 + \beta_1\, loil\_shock_t + \beta_2\, lrer\_vol_t + \varepsilon_t \qquad (3.2)$$

Equation (3.2) says that $lrgdp_t$, which is the log of real GDP is a linear function of $loil\_shock_t$, that is, log of oil price shock and $lrer\_vol_t$, that is, log of real exchange rate volatility. ε_t is the error term. The null hypothesis of no cointegration is rejected if it is found that the regression residuals are stationary at level. This procedure has some weaknesses, as the test is sensitive to which variable is used as a conditioning left-hand-side variable, which is problematic in the case of more than two variables.

On the other hand, Johansen and Juselius (1990) developed the maximum likelihood estimator for cointegration analysis. Johansen's cointegration test is used as a starting point in the vector autoregression (VAR) model. The vector autoregression model of order p (VAR (p)) is constructed as a following equation.

$$\Delta y_t = \Phi_0 + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \varepsilon_t \qquad 3.2$$

where y_t is a (3×1) vector of the log of real GDP (*lrgdp*), the log of oil price shock (*loil_shock*) and the log of exchange rate volatility (*lrer_vol*). Φ_0 is the (3×1) intercept vector and ε_t is a vector white noise process. Γ_i denotes an (3×3) 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. If the rank of Π is *r*, where $r \leq n - 1$, then Π can be decomposed into two *nxr* matrices α and β such that $\Pi = \alpha\beta'$ and β is the matrix of cointegrating vectors; the elements of α are known as the adjustment parameters in the vector error correction model. The Johansen-Juselius procedure is based on the maximum likelihood estimation in a VAR model, and calculates two statistics – the trace statistic and the maximum Eigenvalue – in order to test for the presence of *r* cointegrating vectors. While the null hypothesis of no cointegration is rejected in the Engle and Granger test if the regression residuals are found to be stationary at levels, the trace statistic in the Johansen procedure tests the null hypothesis that there are at most *r* cointegrating vectors against the hypothesis of *r* or more cointegrating vectors. The maximum Eigenvalue statistic also tests for *r* cointegrating vectors against the hypothesis of *r+1* cointegrating vectors. Results are reported in the next section.

IV Results and Discussion

A. Unit Root and Granger Causality Tests

It has often been argued that macroeconomic data is characterized by a stochastic trend, and if untreated, the statistical behavior of the estimators is influenced by such trend. The treatment, which involves differencing the data to determine the level of cointegration, is carried out in this section using the ADF and PP tests outlined in the previous section. The estimation of equation (3.1) with constant and trend yields the results presented in Table 1. The results show that all the series are nonstationary at level, except *lrgdp*, which is stationary at level at 5 percent under the PP test. Taking the variables in their first difference, results show that all are I(1) at 1 percent level of significance. For consistency, therefore, all the series were considered as I(1) and taken at their first difference in the analysis.

Table 1: Unit Root Test

	Level		*First Difference*	
Variable	ADF	PP	ADF	PP
lrgdp	-0.74	-3.68**	-10.4*	-22.4*
loil_shock	-0.84	-0.84	-10.6*	-10.6*
lrer_var	-1.81	-2.01	-13.4*	-14.2*

(**)* denotes rejection of null hypothesis at the (5%) 1% levels

Table 2 presents the results of pairwise Granger causality among the real GDP, oil price shock and exchange rate volatility. The results show that the two null hypotheses that oil price shock and real exchange rate volatility do not Granger cause real GDP could be safely rejected at 1 percent level – a unidirectional causality emanates from oil prices to real GDP while a bidirectional causality runs from exchange rate to real GDP and vice versa. This is consistent with the expectation and with the realities in the Nigerian economy, that is, just as exchange rate appreciation could result in improvements in the real GDP, a rise in the real GDP could also leads to an appreciation in the level of the exchange rate.

Table 2: Pairwise Granger Causality Test

Date: 03/09/09 Time: 10:55
Sample: 1986Q1 2007Q4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
oil_shock does not Granger Cause *rgdp*	82	14.1307	5.9E-06
rgdp does not Granger Cause *oil_shock*		2.08047	0.13184
rer_vol does not Granger Cause *rgdp*	82	12.0148	2.9E-05
rgdp does not Granger Cause *rer_vol*		5.49041	0.00590
rer_vol does not Granger Cause *oil_shock*	82	6.75439	0.00198
oil_shock does not Granger Cause *rer_vol*		2.46989	0.09127

Source: Researcher's computations

What, however, is counterintuitive from the result is the realization that *lrer_vol* Granger causes *loil_shock*. It could be noted that although Nigeria is one of the leading oil countries, yet, the result is not tenable because oil is an international commodity whose price is dictated by developments in the global economy and through Cartel pricing policy of organization of petroleum exporting countries (OPEC). The results further showed that the null hypothesis that real GDP does not Granger cause *lrer_vol* could reasonably be rejected.

B. Cointegration Test and Vector Error Correction Model

Having established the order of integration of our series in the preceding section, the next task is to determine the number of long run equilibrium relationships or cointegrating vectors among the variables. Note that when series are found to be integrated of the same order, such as I(1) as in this case, it implies that an equilibrium relationship exists among the variables. Therefore, since the main focus of the paper is to assess how real GDP in the long run reacts to changes in oil price shock and real exchange volatility, we conduct a cointegration test in line with the Johansen test specified in equation (3.2). Table 3 presents the test results for the number of cointegrating vectors. The results show that both the maximum eigenvalue and the trace statistic suggest the presence of one cointegrating equation among the three variables in the Nigerian economy at 1 percent level in line with the Osterwald-Lenum critical values. This unveils the existence of a long run equilibrium relationship between real GDP and the variables used in the model.

Table 3: Cointegrating Relations

Hypothesized No. of CE(s)	Max-Eigen Statistic	Critical Value [Eigen] at 1%	Trace Statistic	Critical Value [Trace] at 1%
None *	35.07530	25.52	44.97886	35.65
At most 1	8.800888	18.63	9.903556	20.04
At most 2	1.102668	6.65	1.102668	6.65

Max-Eigen and Trace Statistic tests indicate 1 cointegrating equation(s) at 1% level.
* denotes rejection of the hypothesis at the 1% level.

Next we apply the Johansen procedure to obtain the long run coefficients of the model. Table 4 presents the normalized *(β)* of the variables in the model. All the coefficients were correctly signed and statistically significant at 1 percent level. Both variables depict positive relationship with the log of real GDP. This is consistent with the expectation for an oil producing country like Nigeria. Similar findings were reported by Jin (2008) for the Russian economy, which is a net oil exporter. Theoretically, negative sign is, however, expected for net oil importing countries like New Zealand and Japan as reported by Grounder and Barleet (2007) and Jin (2008) respectively.

Table 4: Normalized Cointegrating Eigenvector (β')

One cointegrating Equation	**Log likelihood**	**140.0380**
Lrgdp	*loil_shock*	*lrer_vol*
1.0000	0.7721	0.0348
(0.000)	(0.048)	(0.0078)

Extracted from regression output using Eviews, standard errors in parenthesis

Thus, we can derive the cointegrating equation from the above results – with log of real GDP as the regressand while log of oil price shock and log of real exchange rate volatility as regressors, as follows:

$$lrgdp_t = 6.65 + 0.772*loil\_shock_t + 0.035*lrer\_vol_t \qquad (6.1)$$

Looking critically at the numerical values of the coefficients and their respective signs, Equation (6.1) is saying that a 10 percent permanent increase in crude oil price internationally will cause the real GDP to increase by 7.72 percent, while the same 10 percent appreciation in the level of real exchange rate only increases real GDP by 0.35 percent. This shows that Nigeria's GDP increases more by oil price increase than by exchange rate appreciation and this is consistent with the expectation.

From the point of view of income and output effect of oil price increase, higher oil price transfers income from oil importing countries to oil exporting countries and this results in improvements in the terms of trade and Balance of payments position and hence accretion to foreign reserve[5].

[5] Nigeria, for instance, recorded positive current account balance consistently since 1999 and its number of months of import equivalent dramatically rose from 6.17 in 2003 to 18.9 in 2004, while the figures for 2006 and 2007 slightly dropped to 16.74 and 16.4 percent respectively. Equally, the level of Nigeria's foreign reserves stood at $51.3 billion in 2007 as against $42.3 billion in 2006. The Global financial crisis which surfaced towards the end of

Hence the positive sign of the oil price variable is as expected. The output effect, all things being equal, is also expected to be positive for oil exporting countries largely because the scale of income transfer is enormous. Thus, although the Nigerian economy relies so much on importation of refined petroleum products and the fact that its industries are highly import dependent, yet the two coefficients bear positive sign.

From the perspective of exchange rate depreciation, it is generally recognized that such would encourage exports and reduce imports. Therefore, the positive sign of the coefficient of real exchange rate volatility of the naira reported in equation (6.1) seems unreasonable. This is because Nigeria's oil exports like it was noted by Jin (2008) in the case of Russia are to a large extent invoiced in US dollars and the demand for oil, globally, is price-inelastic. Alternatively, a plausible explanation on the likely channel of influence of the real exchange rate appreciation could be through imports. Strong naira could provide means of cheap imports from abroad of the needed capital and technological inputs and this could have positive effect on real GDP growth.

C. Short-Run Analysis: An Error-Correction Model

The analysis in this section seeks to examine the short run effects of oil price shock and the real exchange rate volatility on real GDP in Nigeria. The two-step Engle and Granger model suggests that any set of cointegrated time series has an error-correction representation, which reflects the short-run adjustment mechanism. The motive of the analysis is to discover whether the short-run dynamics are influenced by the estimated long-run equilibrium conditions, that is, the cointegrating vectors.

Table 5: Short run Vector Error Correction Model (VECM)

Variable	Coefficient	Standard error	t-ratio	Probability
ecm(-1)	-0.287*	0.107	-2.688	0.009
dloil_shock(-1)	-10.68	4.911	-2.175	0.033

2008 in the country caused a significant dip in the level of foreign reserves due to persistent fall in the level of oil prices.

dlrer_vol(-1)	-0.61**	0.207	-2.931	0.005
dloil_shock(-2)	10.32*	4.650	2.217	0.029
dlrer_vol(-2)	0.147	0.178	0.822	0.414
R^2	0.63	*D.W Statistic*	1.87	
Adjusted R^2	0.61	*F-Statistic*	23.9	0.000

(**)* indicate significance at 1 and 5 percent respectively.

A crucial parameter in the estimation of the short-run dynamic model is the coefficient of the error-correction term which measures the speed of adjustment of real GDP to its equilibrium level. The estimation of equation 3.2 using a two-lag specification and by incorporating the error term – *(ecm)*, yields the results presented in Table 5. The results show that the parameter of the error-correction terms in the model is statistically significant and correctly signed. This confirms that real GDP in Nigeria has an automatic adjustment mechanism and that the economy responds to deviations from equilibrium in a balancing manner. A value of −0.287 for the coefficient of error correction term suggests that the Nigerian economy will converge towards its long run equilibrium level in a moderate speed after an oil price shock or a fluctuation in the level of the exchange rate[6]. Eliminating, for instance, 95% of a shock to the oil price or real exchange rate would take a little less than two years or precisely 7.13 quarters.

V. Conclusion and Recommendations

This paper employs an empirical analysis to examine the effects of oil price shock and real exchange rate volatility on the level of real economic activity in Nigeria using a sample of observations from 1986Q1 to 2007Q4. The first step in the empirical analysis involves testing the time series characteristics of the data series using ADF and PP tests and running the pairwise Granger causality test. This was followed by applying the Johansen cointegration test and the estimation of the long run cointegrating vectors. The analysis was capped with the estimation of short run vector error correction model.

We found that the variables were characterized by a unit root at level, but, the hypothesis of nonstationarity was rejected at first difference. This is consistent with strand of empirical studies

[6] The time required to dissipate *x*% of a shock is determined according to: $(1-\alpha)^t=(1-x)$, where t is the number of years and α is the absolute value of the speed of adjustment parameter.

on characteristic of time series data, which according to Engle-Granger require differencing before they could attain stationarity. The Granger pairwise causality test showed that the null hypotheses that oil price shock and real exchange rate volatility each do not Granger cause real GDP could be safely rejected at the 1 percent level. In other words, oil price shock and real exchange rate volatility each Granger cause real GDP in Nigeria within the period of the study. These findings expose the fact that international oil prices and real exchange rate volatility are two key variables that influence economic growth in Nigeria within the sample period. A number of empirical studies earlier cited in the paper have reported similar findings, namely, Mork (1989), Hamilton (1996 and 1997), Balke *et al.,* (2002) and Jin (2008).

Next, the Johansen cointegration test revealed one cointegrating equation at 1 percent level using both the trace statistic and the maximum eigenvalue. Using the long run vector coefficients, we examined the sensitivity of real GDP in Nigeria to shock in international oil prices and the real exchange rate volatility. The results of the long run analysis, for instance, indicated a 10 percent permanent increase in crude oil price internationally will cause the real GDP to increase by 7.72 percent while the same 10 percent appreciation in the level of real exchange rate only increases real GDP by 0.35 percent. This shows that Nigeria's GDP increases more by oil price increase than by exchange rate appreciation and this is consistent with the expectation. Finally, the results from the short run vector error correction model showed the coefficient is correctly signed and statistically significant. This implies that long run equilibrium condition influences the short run dynamics. Real GDP in Nigeria has an automatic adjustment mechanism and that the economy responds to deviations from equilibrium in a balancing manner.

Lastly, theory and evidence have shown that oil price shock has both income and output effect on the Nigerian economy, while exchange rate instability, beside its direct effect on foreign trade, was also found to have significant effect on output via investment. Given the importance of crude oil to the Nigerian economy, therefore, the paper recommends greater diversification of the economy through judicious investment in the productive sectors of the economy using the crude oil money. Also it is a known fact that exchange rate in Nigeria is primarily anchored by the country's level of excess reserves. Exchange rate stability could, therefore, be achieved even

in the face of dwindling oil revenue through a conscious effort aimed at infrastructural development and diversification of the export-base of the economy.

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Appendix 1: Figures

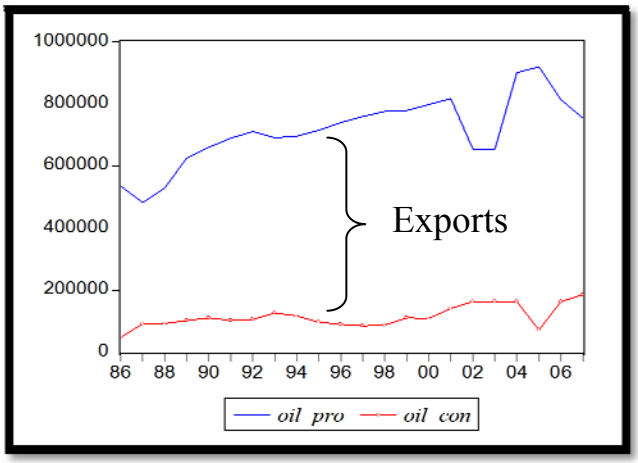

Figure 3

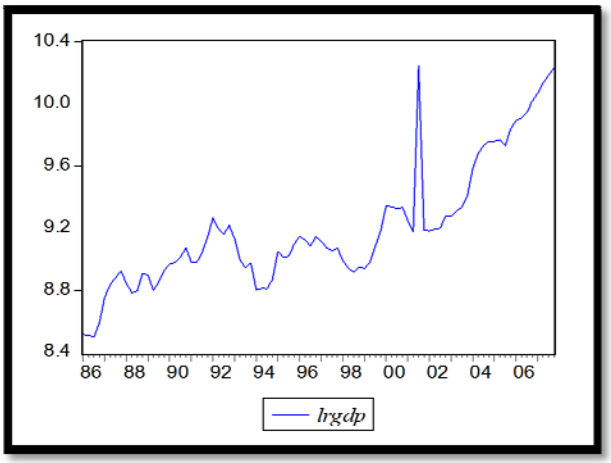

Figure 4