Analysis of the relationship between Oil price, Exchange rate and Stock market in Nigeria

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THE RELATIONSHIP BETWEEN OIL PRICE, EXCHANGE RATE AND STOCK MARKET IN NIGERIA

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Abstract

The objective of this paper is to analyze the dynamic effects of oil price shock and exchange rate on the Nigeria stock market using monthly data from June 1999 to December 2014, applying Vector Autoregression (VAR) Model. Granger Causality Test, Impulse Response Functions (IRFs) and Variance Decomposition (VDC) were also used to aid in the analysis of the results. The findings showed that oil price, exchange rate and stock market are not co-integrated. Granger Causality Test result indicate that there is bidirectional causality between stock price and exchange rate, also there is bidirectional causality between oil price and exchange rate but unidirectional causality from oil proceed to exchange rate.

Keywords: Causality, Exchange rate, Oil price and Stock market

1.0 Introduction

Oil, one of the most traded commodities in the world, has observed numerous price fluctuations which have not only been associated with major world development but also believed as a trigger for economic inflation or recession. The rise in oil prices may affect the economy in a various ways particularly in the rise in the cost of production of goods and services, which in turn may affect the rate of inflation, consumer confidence, as well as financial markets, (Mohd Yahya,et.al,2012). In relation to this matter, an earlier study conducted by Hamilton (1983) shows that higher oil prices contributed to the U.S recessions particularly after World War II. Recently there has been a fall in the price of oil globally which has affected the economy of oil producing countries especially mono-product economy

which Nigeria is one of them. In Nigeria for instance, inflation level has increased, unemployment is also on the increase which made the government to announce the adoption of floating exchange rate regime as panacea for the current economy downturn. Recently, it was announced that Nigeria economy is in recession simply because the earnings from oil has fallen dramatically.

According to Muhamed,et.al(2008), establishing the relationship between stock prices and exchange rates is important for a few reasons. First, the link between those two markets may be used to predict the path of the exchange rate. This can have implications for the ability of multinational corporations to manage their exposure to foreign contracts and the exchange rate they face. Second, currency is more often being included as an asset in investment funds' portfolio. Knowledge about the link between currency rates and other assets in a portfolio is vital for the performance of the fund. The mean-variance approach to portfolio analysis suggests that the expected return depends on the variance of the portfolio. Therefore, an accurate estimate of the variability of a given portfolio is needed. This, in turn, requires estimates of the correlation between stock prices and exchange rates. Third, the understanding of the stock price- exchange rate relationship may prove helpful to foresee a crisis.

Khalid and Kawai (2003) as well as Ito and Yuko (2004) among others, claim that the link between the stock and currency markets contributed in the propagation of the 1997 Asian financial crisis. It is believed that the sharp depreciation of the Thai baht triggered depreciation of the other currencies in the region, which led to the collapse of the stock market as well.

The traditional models of the open economy have established the existence of a relationship between the stock market performance and the exchange rate behavior. The models show that changes in exchange rates affect the competitiveness of firms as variations in exchange rate affect the value of the earnings as well as the cost of its funds because many companies borrow in foreign currencies to finance their operations and hence its stock price (Dornbusch and Fischer, 1980). An appreciation of the local currency, for example, makes exporting goods unattractive and leads to a decrease in foreign demand and hence revenue for the firm and its value would fall. This would also lead to a fall in the stock prices (Gavin, 1989).

Alternative approach to the study of the relationship between exchange rates and stock prices is provided by the portfolio balance models where the role of capital account transactions is stressed. For instance, a vibrant stock market would attract capital inflows from foreign investors, which increase the demand for its currency. The opposite would be the case

with falling stock prices where the investors try to sell their stocks to avoid further losses and convert their money into foreign currency to move out of the country. Consequently, the local currency will depreciate. In the same vein, foreign investment in domestic equities could increase over time arising from the benefits of international diversification accruing to foreign investors. Thus, movements in stock prices may affect exchange rates and money demand because investors' wealth and liquidity demand could be a function of the performance of the stock market (Mishra, 2004).

Few empirical studies have been conducted on the oil-stock price relationship (Hassan and Mahdibo;2013, Asaolu and Ilo;2012, Akinlo,2014, Yahya,et.al;2013, Anthony,2012, Itoteenaan,et.al;2013, Sheevun;2015, Samane and Amir;2014, Samuel Imarhiagbe;2010). Also, the existing literature typically utilizes a two-variable framework to investigate the relationship between exchange rate and stock market (Abdulrasheed.2013; Anthony,2012; Nadeem and Zakir,2009; Tran,2016). However, there are few research work which have examined the relationship between oil price, exchange rate and stock market in Nigeria. This paper therefore aims to fill this gap, examines the dynamic relationships between the price of oil, exchange rate and stock market in Nigeria using monthly data.

2.0 Literature Review

Previous research has worked on the relationship between oil and stock market price for many countries around the world. Several empirical studies have also established the relationship between exchange rate and stock market price. The goal of those studies is to establish the relationship between oil price and stock price as well as the effect of exchange rate on stock prices. The results of those works differ either as a result of the methodology employed or geographical factors.

Anthony, (2012) examined the long-run and short-run dynamic effects of oil price on stock returns in Nigeria over 1985:1–2009:4 by using the Johansen co-integration tests. A bi-variate model was specified and empirical results show a significant positive stock return to oil price shock in the short-run and a significant negative stock return to oil price shock in the long-run.

Itotenaan,et.al (2013) investigated the relationship between oil prices and stock market performance in Nigeria. Different empirical methods including the Johansen's co-integration model, the augmented Dickey-Fuller test, the Vector error correction (VEC) model, as well as the Vector auto regression (VAR) estimation model, were used in the study.

Sheevun, (2015), in his own study examined the dynamic relationship between the inflation adjusted Philippine Stock Exchange index (PSEi) prices and real oil prices in

Philippine peso using monthly data from January 1996 to December 2014 applying the Vector Autoregression (VAR) Model. Granger Causality Test, Impulse Response Functions (IRFs) and forecast Error Variance Decomposition (FEVD) were used in the analyses of the results which suggest that there is no significant relationship between the monthly inflation adjusted stock prices of the PSEi.

Akinlo, (2014), examined the relationship between changes in oil prices and stock market growth over the period 1981-2011 using vector error correction modeling approach which suggest a long run relationship between oil price, exchange rate and stock market growth.

Abdulrasheed, (2013), in his own study used Johansen's co-integration to test for the possibility of co-integration and Granger-causality between stock market index and monetary indicators (exchange rate and M2) before and during the global financial crisis for Nigeria, using monthly data for the period 2001–2011. Results suggest absence of long-run relationship before and during the crisis.

Samuel, (2010), analyzed the impact of oil prices on stock prices of selected major oil producing and consuming countries with nominal exchange rate as additional determinant. Daily stock prices, oil prices, and exchange rates for six countries (Mexico, Russia, Saudi Arabia, India, China, and the US.) from January 26, 2000 to January 22, 2010, are modeled as a co-integrated system in Vector Autoregressive analysis. Variance decompositions and impulse responses are also estimated. Their results support unit root in all variables (except Saudi Arabia and the US exchange rates that are stationary in levels and first difference). Evidence of one long-run relationship (Mexico inconclusive) in Saudi Arabia, India, China and the US is supported, while Russia exhibits two long-run relationships. The results from the long-run exclusion test suggest all three variables cannot be eliminated from co-integrating space in all countries (except Mexico), while the weak exogeneity test reveals all variables to be responsive to deviation from long-run relationships (except China).

Asaolu and Ilo, (2012), investigated the relationship between the Nigerian stock market return and the world crude oil price which was analysed under the co-integration and vector error correction (VECM) framework from 1984 to 2007. The study found that the Nigerian stock market return and oil price are tied together in the long –run as anticipated given the dominance of the oil sector on the Nigerian economy.

Tran, (2016), researched the causal relationship between exchange rates and stock prices during pre and post financial crisis in Viet Nam, based on the collected daily data from 2005 to 2015. It investigated the long-run and short run relationship between above-mentioned two variables using Johansen and Juselius (1990) co-integration test and causal relationships by

using Toda and Yamamoto (1995) procedure. Variance decompositions (VDCs) analysis expresses the predictable portion of exchange rates (stock prices) changes on the forecast error variance in stock prices (exchange rates). The causal relationship between the two variables using Granger Causality test found a unidirectional causal relationship from stock prices to exchange rates, but also supports the traditional approach in post crisis case.

David and Mike (2013), examined the dynamic interaction between stock prices and the Naira-US$ exchange rate in Nigeria using co-integration and the Granger-Sim causality methodology. It was revealed that whenever there is a change in the Naira-US$ exchange rate, stock prices react in tandem. The empirical analysis thus provides evidence of a positive co-integrating relationship between the Naira-US$ exchange rate movement and the Nigerian stock market prices with bi-directional Granger causality found to exist between stock prices and exchange rate in Nigeria during the period researched.

Samane and Amir (2014), aimed to examine the relationship among oil prices, exchange rates, inflation rate, and stock price index in Tehran Stock Exchange. The relationship between the variables for the 12-month period: 1391-1: 1376 was analyzed by Model (VAR) and the method of variance analysis. The causality relationship between variables was studied using Granger causality test (1987) and Wald test. The results showed that in the long term and short term, all variables except the oil shocks had a significant relationship with the Stock Exchange index.

Yahya,et.al (2012), analyzed the dynamic effects of oil price and macroeconomic variables changes on Islamic stock market in Malaysia using an estimation of Vector Auto Regression (VAR) method between January 2007 - December 2011, the study applies the co-integration analysis, multivariate Granger causality test, Impulse Response Function (IRF) and Variance Decomposition (VDC) analysis. It was found that Islamic stock prices are co-integrated with oil price and exchange rate variables and that the Islamic stock price is positively and significantly related to the oil price variable but inversely and not significantly related to the exchange rate variable. Using Granger causality test, only oil price variable is Granger-caused by the Islamic stock return in Malaysia. Therefore, oil price shock will affect the Islamic stock return in the short and long run in Malaysia.

Yahya,et.al (2013), analyzed the dynamic effects of oil price and gold price changes on the Islamic stock market in Malaysia using an estimation of the Vector Auto Regression (VAR) method by using data covering the period from January 2007 to December 2011, the study applies the co-integration analysis, Granger causality test, Impulse Response Function (IRF) and Variance Decomposition (VDC) analysis. The findings show that Islamic stock

returns were not co-integrated with strategic commodities in the long run. From the Granger causality viewpoint, it was observed that there was a bi-directional causality relationship between Islamic stock returns with oil prices. On the other hand, the FBMES was not affected by the gold prices or vice versa.

3.0 Data and Methodology

The paper uses monthly data from June 1999 until December 2014 on oil price, all share index and exchange rate. The oil price adopted is US $ per barrel and stock market price is proxied as all share index. Exchange rate is the Nigerian Naira exchange rates against US Dollars. The data were sourced from the Central bank of Nigeria Statistical Bulletin and Independent Statistics and analysis, US Energy Information Administration. The study adopts vector Autoregressive (VAR) technique. The basic model employed in the study can be expressed as:

$$ASI_t = \alpha_0 + \alpha_1 OILP_t + \alpha_2 EXCR_t + \mu_t \quad \text{.....(1)}$$

Where ASI_t is the stock market index, $OILP_t$ is the oil price and $EXCR_t$ is the Nigerian naira/US Dollar exchange rate.

4.0 Empirical Results

Table 1: Descriptive Statistics

	ASI	EXCR	OILP
Mean	25133.08	133.8380	65.33640
Median	23365.97	132.7746	62.69000
Maximum	65652.38	169.6800	132.7200
Minimum	4890.800	94.88000	15.86000
Std. Dev.	13562.20	18.98618	34.21188
Skewness	0.710940	-0.241755	0.218803
Kurtosis	3.151482	2.014038	1.632115
Jarque-Bera	15.84632	9.345750	15.98523
Probability	0.000362	0.009345	0.000338
Sum	4674753.	24893.87	12152.57
Sum Sq. De	3.40E+10	66687.87	216533.7
Observation	186	186	186

From the table above, all the series display a high level of consistency as their mean and median values are within the maximum and minimum values of the series. It can be deduced from the table that none of the variables is normally distributed. This is evident from our probability for Jarque-Bera which rejected our null hypothesis and supported by Skewness and Kurtosis for the series.

Unit Root Test

It has now become a standard practice to consider unit root when modeling economic relationship with time series because it helps to evaluate the behavior of the series over time if it is stationary or non-stationary. It is also used to determine how series respond to shocks and to test for market efficiency. For this purpose, Augmented Dickey-Fuller (ADF) and Phillip Perron (PP) estimators will be employed to check the stationarity process of the data series.

Table 2A: Unit Root Test Results

LEVEL						
	Augmented Dickey-Fuller			Phillip Perron		
	Constant	Constant and Trend	None	Constant	Constant and Trend	None
ASI	-2.291424	-2.501380	-0.678506	-1.792553	-1.981054	-0.339310
EXCR	-1.025029	-2.600796	1.708749	-1.092134	-2.248894	1.981522
OILP	-1.979411	-2.853573	-0.683600	-1.877963	-2.549604	-0.476063
FIRST DIFFERNCE						
ASI	-4.759959***	-4.769028***	-4.750017***	-12.20997***	-12.20127***	-12.20659***
EXCR	-8.442552***	-8.399424***	-8.184848***	-8.253794***	-8.209253***	-8.132725***
OILP	-8.663989***	-8.693832***	-8.687049***	-8.672403***	-8.703692***	-8.694610***

Table 2B: Summary of Unit Root Test Results

	Augmented Dickey-Fuller (ADF)			Phillip-Perron (PP)		
	Level	First Difference	I(d)	Level	First Difference	I(d)
ASI	-2.501380[b]	-4.769028[b***]	I(1)	-1.981054[b]	12.20997[a***]	I(1)
EXCR	-2.600796[b]	-8.442552[a***]	I(1)	-2.248894[b]	-8.253794[a***]	I(1)
OILP	-2.853573[b]	-8.693832[b***]	I(1)	-2.549604[b]	-8.703692[b***]	I(1)

Note: *** imply statistical significance at1% . Also, '*a*' denotes model with constant, '*b*' is for model with constant and trend

From table 2 above, the result of ADF and PP tests shows that all the variables are integrated of order one which justify the use Johansen Co-integration Test.

Co-integration Test

Based on the result of our unit root, this paper made use of the Johansen Co-integration test to examine whether a long-run association between variables exists and to examine the presence of co-integrating relationships in the data. The null hypothesis in the Johansen test states that there is no co-integration among variables and the alternative hypothesis states that there is co-integration.

Table 3: Johansen-Juselius Cointegration Test

Null	Alternative r	Max-Eigen	Critical value	Trace	Critical vaslue
r≤0	1	8.14992	21.13162	13.67246	29.79707
sr≤1	2	3.49304	14.26460	5.522531	15.49471
r≤2	3	2.02948	3.841466	2.029488	3.841466

Source: Computed by the author

Table 3 presents the result of the Johansen co-integration test for the variables under study. Both the maximum Eigen-value statistics and trace statistics suggest absence of co-integration among the variables.

After testing for the long run co-integration relationship between the variables within the period under study and found out the absence of long run relationship, the study proceeds with the estimation of unristricted VAR and test for Granger causality. Though, from literature we know that most I(1) series are co-integrated but it did not rule out the possibility of non-cointegration. Therefore, this result could be plausible, that the series are driven by other exogenous variables in the case of Nigeria just like many other countries as shown in empirical literature (Abdulrasheed,2013). Absence of co-integration between All Share Index, Exchange rate and Oil price implies that the appropriate model to be used will be the unrestricted VAR and also test for causality between the variables. Unrestricted VAR and Causality between the variables can be tested based on the following Trivariate auto-regression models.

$$ASI_t = \alpha_0 + \sum_{i=1}^{4} \alpha_{1t} ASI_{t-i} + \sum_{i=1}^{4} \alpha_{2t} OILP_{t-i} + \sum_{i=1}^{4} \alpha_{3t} EXCR_{t-i} + \varepsilon_{1t} \text{.....(2)}$$

$$OILP_t = \beta_0 + \sum_{i=1}^{4} \beta_{1t} ASI_{t-i} + \sum_{i=1}^{4} \beta_{2t} OILP_{t-i} + \sum_{i=1}^{4} \beta_{3t} EXCR_{t-i} + \varepsilon_{2t} \text{.....(3)}$$

$$EXCR_t = \delta_0 + \sum_{i=1}^{4} \delta_{1t} ASI_{t-i} + \sum_{i=1}^{4} \delta_{2t} OILP_{t-i} + \sum_{i=1}^{4} \delta_{3t} EXCR_{t-i} + \varepsilon_{3t} \text{.....(4)}$$

The above equations were tested based on four lags. This was arrived at after testing for optimal lag based on different criteria such as Schwarz information criteria, Hannan Queen Information criteria, generalized Dickey Fuller, and final prediction error criteria.

Table 4: Causality Test result

VAR Granger Causality/Block Exogeneity Wald Tests

Null Hypothesis	**Obs**	**Chi-sq**	**Prob**
DEXCR does not Granger Cause DASI	176	11.57533	0.0208
DASI does not Granger Cause DEXCR		7.839025	0.0977
DOILP does not Granger Cause DASI	176	8.370366	0.0789
DASI does not Granger Cause DOILP		15.89523	0.0032
DEXCR does not Granger Cause DOILP	176	3.202507	0.5245
DOILP does not Granger DEXCR		28.68985	0.0000

Source: Computed by the Author

The table 4 above present Granger-causality test results which shows that, there is a bi-directional causal relationship between exchange rate and stock market index, there is a bi-directional causal relationship between stock market index and oil price. Also there is a unidirectional causal relationship from oil price to exchange rate.

The result of our VAR were tested for serial correlation by using VAR residual serial Correlation LM test which signify that there is no serial correlation at Lag 4. Also, Roots of Characteristic Polynomial were used to test for stability condition which was satisfied.

Impulse Response Function

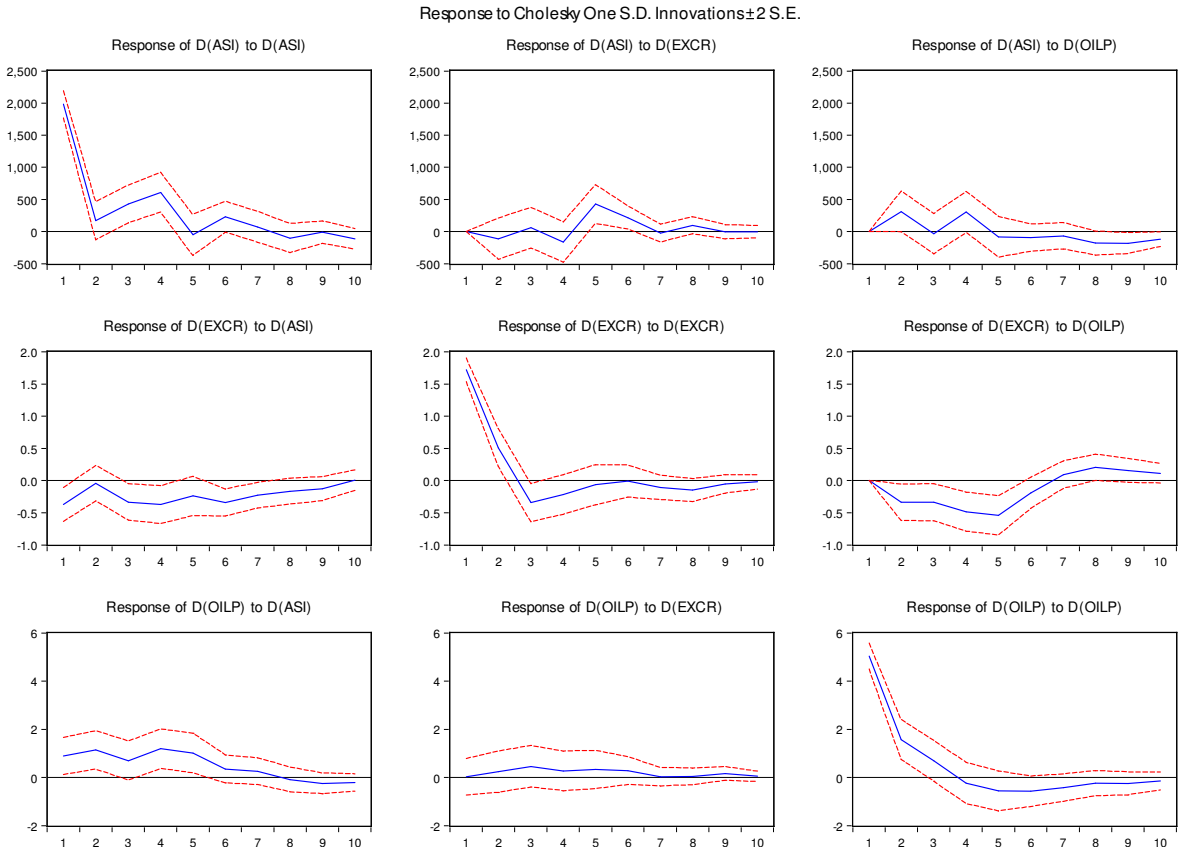

Fig. 1:

The first diagram shows the effect of one standard deviation shock from the stock price on itself. The effect of this variable on itself was positive up to seventh month with the first two months has the highest effect but became negative after the seventh periods with little impact.

The second diagram shows the effect of one standard deviation shock from exchange rate on stock market index. The effect of exchange rate was fluctuating up to fourth months before it settled down to be positive. The third diagram explained the effect of one standard deviation shock from oil price on stock market index. The effect of oil price was positive up to fifth months before becoming negative but the negative impact was minute. The fourth diagram described the effect of one standard deviation shock from stock market index on exchange rate. The effect was negative throughout the ten months except tenth month where it was zero. The fifth diagram explained the effect of one standard deviation shock from exchange rate on itself. The effect was positive for the first three months, after which it became negative and fluctuating around zero.

The sixth diagram shows the effect of one standard deviation shock from oil price on exchange rate. The effect was negative up to seventh months before becoming positive which was very small. The seventh diagram shows the effect of one standard deviation shock from stock market index on oil price. The effect was positive up to eight months before becoming negative The eighth diagram described the effect of one standard deviation shock from exchange rate on oil price. The effects were positive but very low and eventually disappear at the end of the tenth months. The last diagram shows the effect of one standard deviation shock from oil price on itself. The effect was positive up to fourth period before becoming negative.

Table 5A: Variance Decomposition of D(ASI)

Period (Months)	**S.E**	**D(ASI)**	**D(EXCR)**	**D(OILP)**
1	1980.850	100.0000	0.000000	0.000000
2	2015.428	97.28866	0.306871	2.404472
3	2062.170	97.29506	0.382345	2.322599
4	2178.654	95.05787	0.901626	4.040503
5	2222.249	91.41638	4.570412	4.013205
6	2246.529	90.49979	5.398651	4.101556
7	2248.749	90.42243	5.400395	4.177172
8	2260.176	89.70960	5.534287	4.756117
9	2267.290	89.14946	5.499801	5.350736
10	2273.119	88.94051	5.471744	5.587742

Source: Computed by the Author

Table 5B: Variance Decomposition of D(EXCR)

Period (Months)	**S.E**	**D(ASI)**	**D(EXCR)**	**D(OILP)**
1	1.7661428	4.430392	95.56961	0.000000
2	1.865502	3.999649	92.69749	3.302856
3	1.955692	6.569422	87.43480	5.995777
4	2.061177	9.224528	79.84738	10.92809
5	2.146030	9.767465	73.75230	16.48023

6	2.181641	11.91304	71.36722	16.71974
7	2.198109	12.81167	70.54241	16.64592
8	2.219024	13.13817	69.67728	17.18455
9	2.228805	13.34949	69.12435	17.52616
10	2.231699	13.31523	68.95422	17.73055

Source: Computed by the Author

Table 5C: Variance Decomposition of D(OILP)

Period (Months)	**S.E**	**D(ASI)**	**D(EXCR)**	**D(OILP)**
1	5.115497	3.041596	0.004116	96.95429
2	5.477002	6.989965	0.200712	92.80932
3	5.583247	8.297356	0.873871	90.82877
4	5.719514	12.22153	1.060906	86.71756
5	5.845240	14.71835	1.340481	83.94117
6	5.890519	14.85708	1.547422	83.59550
7	5.911489	14.94925	1.539482	83.51127
8	5.917057	14.94111	1.542296	83.51659
9	5.929466	15.05081	1.611674	83.33752
10	5.934987	15.14368	1.614658	83.24167

Source: Computed by the Author

The table above presented the result of VDC for all the variables. The result are reported for a 10-month horizon. The ordering of the variables is based on the Cholesky decomposition method which suggests the following order of the variables: DASI,DEXCHR and DOILP.

According to Table 5A, it can be seen that 11.1 percent of stock market variations are contributed by other factors where both oil price and exchange rate contributed almost the same percentage. This is in line with our causality result which indicates that both oil price and exchange rate has causal effect on stock market.

Also, Table 5B presented the result of variation in exchange rate where 31.0 percent of variation in exchange rate is contributed by other factors. Among the variations, oil price is the most significant variable explaining about 18 percent of variation in exchange rate. This result, corroborate the result of our Granger causality which signify that causality run from both stock market and oil price to exchange rate.

Lastly, Table 5C explained the result of variation in oil price where 16.7 percent of variation in oil price is contributed by other factors with stock market responsible for 15 percent. This indicates that stock market has significant effect on oil price but exchange rate does not which is in line with our causality result.

Conclusions

The main objective of this study is to investigate the relationship between oil price, exchange rate and stock market in Nigeria using vector autoregressive model (VAR). All the variables were tested based on generalized Dickey-Fuller test and Phillip Perron test to confirm the Dickey-Fuller test result which shows that all the variables are I(1). Johansen Co-integration test were employed to test for co-integration among the variables, the results show that oil price, exchange rate and stock market index are not co-integrated. The results of Granger Causality test show that there is bidirectional causality between exchange rate and stock market. Also, there is bidirectional causality between stock market and oil price but unidirectional causality run from oil price to exchange rate.

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