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Article

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Energy Prices and the Nigerian Stock Market

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ABSTRACT

This paper analysed the relation between the stock market indices and the developments in the international energy market using historical monthly data from January 1985 to December 2017. Energy prices as applied in the study are composed of changes in the prices of crude oil, natural gas (*NGS*) and liquefied NGS (*LNGS*). We employed the traditional vector autoregressive techniques in estimating the linkages between the variables of interest. Our findings showed that changes in energy prices did not have significant influence on the stock market. Although there was evidence of a long-run relationship between the two variables, no causal relationship was found to exist between them; this entails that past values of the prices of crude oil, NGS and LNGS were not vital in predicting the developments in the stock market. Likewise, lagged values of the stock market indices were not instrumental in forecasting the movements in energy prices. Thus, we conclude that the stock market could be more responsiveness to other macroeconomic indicators other than the energy prices.

Keywords: Energy Price, Stock Market, Granger Causality, Vector Autoregressive, Nigeria
JEL Classifications: C25, Q47, F4

1. INTRODUCTION

Although fluctuations in the energy prices are often considered a key factor for understanding changes in stock prices, there is no consensus about the relation between stock prices and the prices of energy among researchers (Kilian and Park, 2009). Basher and Sadorsky (2006), for example, concluded that oil price risk impacts stock price returns in emerging markets. El-Sharif et al. (2005) posit that the relationship between oil price uncertainties and changes in stock market returns is always positive, often highly significant and reflects the direct impact of volatility in the price of crude oil on share values within the sector.

Reboredo and Rivera-Castro (2014), however, observed that oil price changes had no effect on stock market returns. Kilian and Park (2009) contends that the reaction of U.S. real stock returns to an oil price shock differs greatly depending on whether the change in the price of oil is driven by demand or supply shocks in the oil market. Thus, Caporale et al. (2015) maintain that while some sectors of the U.S. economy are found to exhibit a negative response to oil price uncertainty during periods with supply-side shocks, oil price volatility affects stock returns positively during periods characterised by demand-side shocks in other sectors. Henriques and Sadorsky (2008) which observed that technology stock price and oil prices each individually Granger cause the stock prices of alternative energy companies. It was also found that a shock to technology stock prices has a larger impact on alternative energy stock prices than does a shock to oil prices.

Similary, in the Australian case, Faff and Brailsford (1999) employed an augmented market model to investigate the sensitivity of Australian industry equity returns to an oil price factor over the period 1983-1996. The key findings indicate that a degree of pervasiveness of an oil price factor, beyond the influence of the market, is detected across some Australian industries. The results further revealed significant positive oil price sensitivity in the Oil and Gas and Diversified Resources industries. In contrast, the study found significant negative oil price sensitivity in the Paper and Packaging, and Transport industries. In what appears to be a confirmation of the findings in U.S. and Australia, Sadorsky (2001) used a multifactor market model to estimate the expected returns to Canadian oil and gas industry stock prices. Results presented showed that an increase in the market or oil price factor increases the return to Canadian oil and gas stock prices.

2. LITERATURE REVIEW

The influence of movements in energy price on stock returns has continued to attract considerable attention, and has come under empirical examination in the recent literature. Oil price uncertainties do not only have effect at country-level (Alom, 2015) but also at firm-level (Wattanatorn and Kanchanapoom, 2012) and some specific non-manufacturing sectors like the trucking sector (Winebrake et al., 2015).

Gupta (2016) suggests that oil price shocks impacts positively on firm-level returns. Caporale et al. (2015) give a more telling insight and contend that even as the linkage between oil price shocks and aggregate stock returns has significant implications for portfolio management strategies in general, understanding of the response of sectoral indicators to oil price volatility provides vital information to agents regarding the sectors of the stock market in which to invest during times of uncertainty with the aim of minimizing risk and maximizing returns. Unexpected movements of oil price can be linked with increased uncertainty about future oil prices which prompts firms to delay or postpone investments decisions. Thus, not only oil price increases but also high oil price volatility is inimical to growth with complication for monetary policy.

According to Gupta (2016), oil price fluctuations have strong impact both on the macroeconomy and the stock market, with important implications on the economic activities of a country. A number of studies have attempted to specifically determine the degree and magnitude of the perceived response of the stock market and other macroeconomic variables to oil price uncertainties (Ratti and Vespignani, 2016). For instance, Ulussever (2017) assessed the effect of crude oil prices (*COP*) on the behavior of traders among investors in the Gulf Cooperation Council (GCC) stock markets. The study used firm level data from Qatar, Bahrain, Saudi Arabia, Oman, Kuwait, Abu Dhabi and Dubai stock exchanges. The findings revealed significant evidence supporting herd behaviour in all GCC equity markets with the exception of Qatar and Oman, especially during periods of market losses. The findings further suggested that investors' tendency to act as a herd in the GCC equity markets is significantly affected by the developments in the oil market. Hamma et al. (2014) add that in the context of Tunisia, stock sector market returns is not only affected by the volatility in the oil market but also the volatilities in the stock market.

Tian (2016) asserts that the Chinese economy is quite responsive to oil price volatilities. Qianqian (2011) applied the cointegration and error correction model to specifically measure the impact of oil price on the Chinese economy. The results revealed that there exists a long-run equilibrium association between the oil price and the China's output, the total amount of net exports, the consumer price index, and the monetary policy. Rising international oil price would lead to decline in the total amount of net exports and the real output while pushing the prices up.

Sadorsky (1999) employed a VAR to examine the oil price and stock market return relation. The results show that oil prices and oil price volatility both play significant roles in affecting real stock returns. There was also evidence that oil price shocks have asymmetric effects on the economy. Kang et al. (2015) find that oil prices uncertainties have strong positive impact on stock market return in the presence of structural break.

Reboredo and Rivera-Castro (2014) posit that crude oil is an influential commodity with extraordinary ramifications for the real economy and the financial markets. Both academicians and energy market participants have been concerned with forecasting and modeling oil prices by quantifying and managing the inherent risks in their frequent volatilities (Hamma et al., 2014).

Investors and other market participants are faced with uncertainties associated with volatility spill over via oil price or stock returns. In view of this, it remains a general agreement that investors, within a given time period, require a larger expected return from a security that is riskier (Glosten et al., 1993).

Chang et al. (2010) also presented evidence of volatility spillovers in the case of Dubai while suggesting that the forecast conditional correlations between pairs of crude oil returns has both positive and negative trends. The study argues that the optimal hedge ratios and optimal portfolio weights of crude oil across different assets and market portfolios has to be evaluated in order to provide important policy implications for risk management in crude oil markets.

Kumar (2014) found similar evidence in the Indian industrial sector with respect to gold market and produced evidence of volatility spillover. Using generalised vector autoregressive (VAR)-ADCC-BVGARCH model, unidirectional significant return spillover from gold to stock sectors. The study further estimate optimal weights, hedge ratios, and hedging effectiveness for the stock-gold portfolios and found that stock-gold portfolio provides better diversification benefits than stock portfolios.

3. DATA AND METHODOLOGY

We analyse the energy price and stock market dynamics using monthly data obtained from the World Bank and the Central Bank of Nigeria statistical Bulletins (issue 2016) spanning the period, 1981-2016. The energy component of our analysis is disintegrated into monthly change in *COP*, natural gas (*NGS*) and liquefied *NGS* (*LNGS*). Our response variable is the stock market returns. The VAR Granger causality approach was employed to ascertain the direction of causality among the variables.

Model for this study is a general VAR model, which is employed to analyse the direction of causality energy prices and stock market returns. Our multivariate time series can be explained in a VAR of order P thus:

$$y_t = w+\delta_1 y_{t-1}+\delta_2 y_{t-2}+\ldots+\delta_p y_{t-p}+\mu_t \qquad (1)$$

Table 1: Results of unit root test with breakpoint

Variables	ADF-statistic	5% critical values	Order of integration	P-value	Break dates
INASI	−18.18924	−4.443649***	I (0)	<0.01	2009M01
COP	−16.89289	−4.443649***	I (0)	<0.01	1990M08
NGS	−18.39671	−4.443649***	I (0)	<0.01	2000M12
LNGS	−9.882048	−4.443649***	I (0)	<0.01	2009M02

***Significance at 1%, ADF: Augmented Dickey-Fuller, *INASI*: Natural logarithm of all share index, *COP*: Crude oil prices, *NGS*: Natural gas, *LNGS*: Liquefied natural gas

Where μ_t is an error vector of random variables with zero mean and covariance matrix Σ expressed as,

$$w = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_k \end{bmatrix} \bullet\bullet \delta_i = \begin{bmatrix} \delta_{11i} & \delta_{21i} & \cdots & \delta_{k1i} \\ \delta_{12i} & \delta_{22i} & \cdots & \delta_{k2i} \\ \delta_{13i} & \delta_{23i} & \cdots & \delta_{k3i} \\ \vdots & \vdots & \ddots & \vdots \\ \delta_{1ki} & \delta_{2ki} & \cdots & \delta_{kki} \end{bmatrix}$$

Moreover, our variables *COP*, *NGS* price, *LNGS* price and stock market index represented by the all share index (ASI) enter the models endogenously, and we rewrite the covariance matrix as a general VAR (P) model thus,

$$\omega_t = \mu + \sum_{i=1}^{p} \gamma_i \omega_{t-i} + \varepsilon_t \quad (2)$$

Where ω_t = *a* vector of jointly determined variables, μ = *a* vector of constants, γ_i = *a* matrix of coefficients to be estimated, and ε_t = *a* vector of error terms. To determine the direction of causality, Granger causality test uses past value of a variable X_t to forecast second variable Y_t and shows result in a form X_t "Granger cause" Y_t (Stolbov, 2015). Thus, X_t Granger causes Y_t if X_t is instrumental in predicting Y_t at some time in the future. Usually, we may have that X_t is Granger causal for Y_t, which at the same time Granger causes X_t. Under such an outcome, we say there exists a feedback system (Sørensen, 2005). It is also important to emphasised that Granger causality association is not necessarily reciprocal, for instance, Y_t may be Granger causal for X_t, without any implication that X_t Granger causes Y_t.

We now expand equation (2) to incorporate causal links among our variables. The following models were therefore developed,

$$INASI = \beta_0 + \sum_{i=1}^{n} \beta_1 COP_{t-1} + \sum_{j=1}^{n} \beta_2 NGS_{2t-j} + \sum_{j=1}^{n} \beta_3 LNGS_{2t-j} + \varepsilon_{1it} \quad (3)$$

$$COP = \beta_0 + \sum_{i=1}^{n} \beta_1 INASI_{t-1} + \sum_{j=1}^{n} \beta_2 NGS_{2t-j} + \sum_{j=1}^{n} \beta_3 LNGS_{2t-j} + \varepsilon_{2it} \quad (4)$$

$$NGS = \beta_0 + \sum_{i=1}^{n} \beta_1 INASI_{t-1} + \sum_{j=1}^{n} \beta_2 COP_{2t-j} + \sum_{j=1}^{n} \beta_3 LNGS_{2t-j} + \varepsilon_{3it} \quad (5)$$

$$LNGS = \beta_0 + \sum_{i=1}^{n} \beta_1 INASI_{t-1} + \sum_{j=1}^{n} \beta_2 COP_{2t-j} + \sum_{j=1}^{n} \beta_3 NGS_{2t-j} + \varepsilon_{4it} \quad (6)$$

Table 2: Descriptive statistics

Statistic	Mean	Median	Maximum	Minimum	Obs.
INASI	1.644361	1.611894	38.19779	−30.64159	393
COP	0.643935	0.591976	54.13105	−31.84466	395
NGS	0.809154	−0.344363	61.26126	−33.33333	395
LNGS	0.210714	0	12.31527	−21.60612	395

INASI: Natural logarithm of all share index, *COP*: Crude oil prices, *NGS*: Natural gas, *LNGS*: Liquefied natural gas

Where,
β_0 = Intercept, β_1-β_3 = Parameter estimates, inclusive of lag lengths, ε_1-ε_4 = Error terms, and *i* and *j* = Lag lengths. *INASI* = Natural logarithm of ASI, *COP* = Changes in *COP*, *NGS* = Changes in *NGS* prices, and *LNGS* = Changes in *LNGS* price.

4. RESULTS AND DISCUSSIONS

Augmented Dickey-Fuller unit root test is conducted to ascertain the stationarity of our monthly dataset. The results are presented in Table 1 and indicate that all the variables do not have unit root and are stationary at level. Since we have no evidence of cointegration, we analyse the causal influence using the VAR Granger causality test. Descriptive Statistics are presented in Table 2. Since our series are all integrated of order zero [i.e. I(0)], it could be more appropriate to choose the unrestricted VAR cointegration rank test approach to cointegration over the Johansen technique in estimating the long-run association between our variables. The breakpoint test showed that stock market returns has structural break in January 2009 while the break date for changes in *COP* was August 1990. Moreover, Changes in *NGS* and the *LNGS* were in December 2000 and February 2009, respectively. All the series demonstrated strong sings of volatilities over the sample period as shown in Figure 1.

In Table 3, we analysed the influence of changes in energy prices on the stock market. The VAR estimate showed that energy prices have not had significant effect on the Nigeria stock market. Both changes in prices of crude oil, *NGS* and *LNGS*, at different lags, were found to have exerted little influence on the stock market during the sample period.

The cointegration test results in Table 4 identified minimum of 4 cointegrating equations which appear to suggest that there is a long-run association between response variable and energy prices. However, there was no evidence of a causal relationship between our response variable and energy prices as presented in Table 5. In other words, changes in the prices of crude oil, *NGS* and *LNGS* were not critical in forecasting the stock market. In the same vein, the stock market was not instrumental in projecting changes in energy prices during the period. VAR confirmed the

Figure 1: Graphical representation of variable proxies

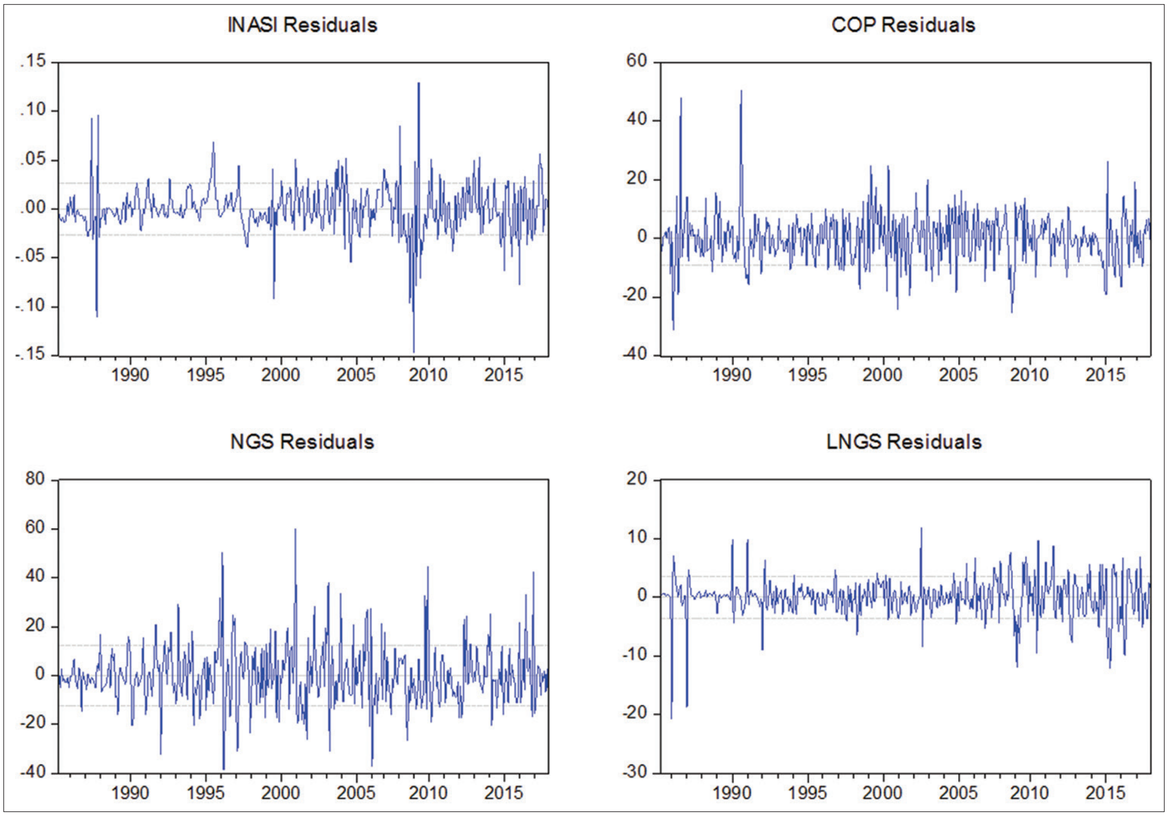


Table 3: Results of vector autoregressive estimate

Sample: 1985M01-2017M12									
Included observations: 390 after adjustments									
Variable	*INASI (−1)*	*INASI (−2)*	*COP (−1)*	*COP (−2)*	*NGS (−1)*	*NGS (−2)*	*LNGS (−1)*	*LNGS (−2)*	Intercept
Coefficient	1.115732	−0.12018	0.000233	0.000195	8.82E-05	7.14E-06	−2.78E-05	−0.00015	0.021877
Stander error	0.051054	0.050831	0.000149	0.000152	0.000105	0.000105	0.00037	0.000362	0.006267
t-statistic	21.85414	−2.36431	1.563043	1.287857	0.837338	0.068281	−0.07497	−0.39904	3.490777
Probability	0.000000	0.0186	0.1189	0.1986	0.4029	0.9456	0.9403	0.6901	0.0005
Adj. R^2:		0.998988		Prob (F-stat.):		0.000000		DW:	2.036273

INASI: Natural logarithm of all share index, *COP*: Crude oil prices, *NGS*: Natural gas, *LNGS*: Liquefied natural gas

Table 4: Unrestricted (VAR) cointegration rank test results

Included observations: 388 after adjustments				
Series: *INASI COP NGS LNGS*				
Unrestricted (VAR) cointegration rank test (Trace)				
Hypothesized No. of CE (s)	Eigenvalue	Trace statistic	0.05 critical value	Probability**
None*	0.328010	333.4463	47.85613	0.0001
At most 1*	0.256896	179.2117	29.79707	0.0001
At most 2*	0.140109	64.00689	15.49471	0.0000
At most 3*	0.013918	5.438281	3.841466	0.0197
Unrestricted (VAR) cointegration rank test (Maximum Eigenvalue)				
Hypothesized No. of CE (s)	Eigenvalue	Max-eigen statistic	0.05 critical value	Probability**
None*	0.328010	154.2345	27.58434	0.0001
At most 1*	0.256896	115.2049	21.13162	0.0001
At most 2*	0.140109	58.56861	14.26460	0.0000
At most 3*	0.013918	5.438281	3.841466	0.0197

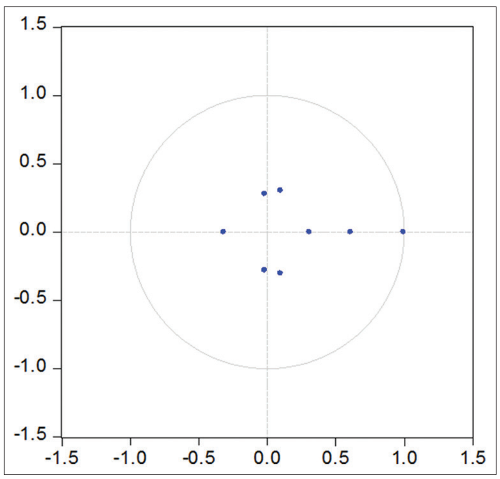
Trace test and Max-eigenvalue tests indicate 4 cointegrating eqns at the 0.05 level. *denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) *P* values. VAR: Vector autoregressive. *INASI*: Natural logarithm of all share index, *COP*: Crude oil prices, *NGS*: Natural gas, *LNGS*: Liquefied natural gas

Table 5: VAR granger causality result

Sample: 1985M01-2017M12			
Included observations: 390			
Dependent variable: *INASI*			
Excluded	**Chi-square**	**df**	**Probability**
COP	5.248819	2	0.0725
NGS	0.721040	2	0.6973
LNGS	0.222587	2	0.8947
Dependent variable: *COP*			
INASI	5.002590	2	0.0820
Dependent variable: *NGS*			
INASI	0.126777	2	0.9386
Dependent variable: *LNGS*			
INASI	1.521961	2	0.4672

INASI: Natural logarithm of all share index, *COP*: Crude oil prices, *NGS*: Natural gas, *LNGS*: Liquefied natural gas, *VAR*: Vector autoregressive

Figure 2: Roots of characteristic polynomial



stability condition of our model as shown in Figure 2 where no root lies outside the unit circle.

5. CONCLUSION

This study examined the relation between the Nigerian stock market and the developments in the international energy market. Previous studies have broadly analysed this relationship but mostly focusing on the *COPs*. For a broader representation of the energy market, this paper included the *NGS* and *LNGS* prices into the existing models using historical monthly data from January 1985 to December 2017.

Our findings showed that changes in energy prices did not have significant influence on the stock market. Although there was evidence of a long-run relationship between the two variables, no causal relationship was found to exist between them. We may, therefore, conclude that past values of the prices of crude oil, *NGS* and *LNGS* were not vital in predicting the developments in the stock market. Likewise, lagged values of the stock market indices were not instrumental in forecasting the movements in energy prices. Thus, it can be inferred that the stock market could be more responsiveness to other macroeconomic indicators other than the energy prices.

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