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.

Similarly, 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 investment 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 Vespiagnani, 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 behavior 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.

Rebredo 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 liquified NGS (LNPS). 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:

\[ y_t = \mu_t + \sum_{i=1}^{P} \delta_i y_{t-i} + \sum_{i=1}^{P} \delta_i y_{t-i+1} + \sum_{i=1}^{P} \delta_i y_{t-i+2} + \ldots + \sum_{i=1}^{P} \delta_i y_{t-i+P} + \epsilon_t \]

(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 $\mu$ is an error vector of random variables with zero mean and covariance matrix $\Sigma$ expressed as,

$$ w = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} $$

Where $w_i = \sum_{j=1}^{p} \gamma_j w_{i-j} + \epsilon_j$

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,

$$ \omega_t = \mu + \sum_{j=1}^{p} \gamma_j \omega_{t-j} + \epsilon_t $$

Where $\omega_t = a$ vector of jointly determined variables, $\mu = a$ vector of constants, $\gamma_j = a$ matrix of coefficients to be estimated, and $\epsilon_t = a$ 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 $X_t \rightarrow \text{Granger cause} \rightarrow Y_t$ (Stolbov, 2015). Thus, $X_t \rightarrow \text{Granger cause} \rightarrow Y_t$ 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,

$$ \text{INASI} = \beta_0 + \sum_{j=1}^{n} \beta_j \text{COP}_{t-j} + \sum_{j=1}^{n} \beta_j \text{NGS}_{2t-j} + \sum_{j=1}^{n} \beta_j \text{LNGS}_{3t-j} + \epsilon_{1t} $$

$$ \text{COP} = \beta_0 + \sum_{j=1}^{n} \beta_j \text{INASI}_{t-j} + \sum_{j=1}^{n} \beta_j \text{NGS}_{2t-j} + \sum_{j=1}^{n} \beta_j \text{LNGS}_{3t-j} + \epsilon_{2t} $$

$$ \text{NGS} = \beta_0 + \sum_{j=1}^{n} \beta_j \text{INASI}_{t-j} + \sum_{j=1}^{n} \beta_j \text{COP}_{2t-j} + \sum_{j=1}^{n} \beta_j \text{LNGS}_{3t-j} + \epsilon_{3t} $$

$$ \text{LNGS} = \beta_0 + \sum_{j=1}^{n} \beta_j \text{INASI}_{t-j} + \sum_{j=1}^{n} \beta_j \text{COP}_{2t-j} + \sum_{j=1}^{n} \beta_j \text{NGS}_{3t-j} + \epsilon_{4t} $$

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 signs 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
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 |
| Standard 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 | 0.998988 | 0.998988 | 0.998988 | 0.998988 | 0.998988 | 0.998988 | 0.998988 | 0.998988 |
| DW: | 2.036273 | 2.036273 | 2.036273 | 2.036273 | 2.036273 | 2.036273 | 2.036273 | 2.036273 | 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

| 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 (Trace)

| 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 equations 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.
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 responsive to other macroeconomic indicators other than the energy prices.

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 responsive to other macroeconomic indicators other than the energy prices.

Table 5: VAR granger causality result

| Dependent variable | Excluded | Chi-square | df | Probability |
|--------------------|----------|------------|----|-------------|
| INASI              | 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.

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