

The Effects of Oil Price Volatility on Selected Banking Stock Prices in Nigeria

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1. Introduction

The stock market has been viewed as a market where most elements that feed into the development of a nation's economy operate. In Nigeria, the Nigerian Stock Exchange (NSE), which is one of the fastest growing stock markets in Africa and among the emerging stock markets in the world, has recorded phenomenal growth. As at 2002, of the eight sub-Saharan markets analyzed, only Nigeria, South Africa and Zimbabwe were considered 'frontier markets' and are thus, included in the IFC Global Composite Index (Magnusson and Wydick, 2002). Moreover, the recent global financial crisis led to a downward movement of stock prices and also posed a great threat to an emerging economy like Nigeria.

Nigeria's financial sector has witnessed major transformations in recent years. In the past decade, the banking sector has gone through major consolidation, which resulted in the reduction in the number of banks from 89 to 24 and significantly increased bank capitalization. Because of consolidation, financial intermediation levels increased significantly: the number of bank branches almost doubled to about 5,800 in 2011, (Sanusi, 2011; CBN, 2012) and banks engaged in a range of new activities, including the financing of infrastructure and oil projects, activities that were previously beyond their capacity. In addition, Nigerian banks have extended into considerable cross-border activities with subsidiaries and branches in the Economic Community of West African States (ECOWAS) region, Southern Africa, Central Africa, Europe and North America (NSE, 2015).

However, the banking reform efforts were threatened by the global financial crisis, which posed devastating challenges. While the initial effects were contained due to low levels of exposure to complex financial instruments, the large swings in oil prices, combined with the resulting depreciation of the naira and drop in investor confidence led to growing pressures. Market speculation about the quality of some bank balance sheets was evident in the breakdown of the naira interbank market as well as perceptions that some banks were using the Central Bank discount window as an ongoing source of funding. In addition, some banks had high exposure to importers of fuel products, who had high foreign currency obligations owing to the high fuel prices in 2008 and were subsequently hit by falling oil prices and devaluations of naira.

There are a number of different factors that affect financial markets, however many researchers believe there is a direct relationship between oil price and Stock market performance (see Salisu and Oloko, 2015; Babatunde, et al, 2013, Fowowe 2013). From the foregoing, this study contributes to the existing literature in the following ways. Is reckoning with the existing literature that aggregate stock market indices may mask the individual characteristics of the activity sectors in relation to oil price? To the best of our

knowledge, there are no existing studies on Nigeria that examined the effect of oil price on banking stock performance. Therefore, this study examines the relationship between oil price fluctuations and banking stock prices using disaggregate data on the banking sector which is by far the dominant in the Nigerian securities market in terms of market capitalization and trading volume. This is the unique gap that this study fills.

The paper is organized into six sections. Following the introductory section is section 2 which discusses the findings of selected previous works on the relationship between oil price and stock markets. The theoretical framework, empirical methodology and data issues are treated in Section 3. Section 4 presents the empirical results and discussion of findings. Section 5 provides concluding remarks and policy implications.

2. Review of Literature

Bjornland (2009) and Jimenez-Rodriguez and Sanchez (2005) offer some arguments on the linkage between the oil prices and stock markets performance. In their view, an oil price increase is expected to have a positive effect in an oil-exporting country as the country's income would increase. The consequence of the income increase is expected to be a rise in expenditure and investments, which in turn creates greater productivity and lower unemployment. Stock markets tend to respond positively to this sequence of events. Several other researchers have found similar positive and significant effects (Adam et al (2014) and Fariz et al.(2016) for Indonesia; Salisu and Oloko (2015), and Vo (2011) for US; Uwubanmwe and Omorokunwa (2015), Akinlo (2014), Okany (2014), Gil-Alana and Yaya (2014), Chaudary et al (2014), Ogiri et al (2013), Asaolu and Ilo (2012), and Tajudeen and Terfa (2010) for Nigeria; Wajdi et al (2014) for Tunisia; Hussin et al (2012) for Malaysia; Narayan and Narayan (2009) for Vietnam; and Amin and Amin (2014)).

Elyasiani et al (2011) find that oil price fluctuations constitute a systematic asset price risk at the industry level as nine of the thirteen sectors analyzed showed statistically significant relationships between oil-futures return distribution and industry excess return. Also, Papapetrou (2001) found that oil price is an important factor in explaining the stock price movements in Greece with positive oil price shocks depressing real stock returns. Fariz et. al. (2016), in a sectoral study for Indonesia showed that the strength and the sensitivity of this association vary across sectors, and the effects are positive for all sectors. They found strong significance of asymmetric reactions for Agriculture and Consumer Goods sectors stock returns due to changes in crude oil prices.

Some authors however have found a negative relationship between oil market and stock markets. For instance, investigating the relationship between oil prices and returns on the Nigerian Stock Exchange, Fowowe (2013) reported a negative but insignificant effect of oil prices on stock returns in Nigeria. Such negative and statistically insignificant relationship has also been confirmed in Kang et al (2014) for US; Effiong (2014) for Nigeria; Al-Qudah (2014) for Jordan; Fatima and Bashir (2014) for China and Pakistan.

Adebiyi et al (2012) in a study for Nigeria found an immediate and significant negative real stock returns response to oil price volatility in Nigeria.

Beyond the foregoing there is equally, a categorization of the oil price-stock returns relationship that is predicated on methodological disparities. Hence, the results of empirical studies on the effect of oil prices on stock markets have also yielded divergent views, resulting in three main positions. Among the first group of studies, it is believed that the direction of the impact of oil prices on stock markets is determined based on the data frequency, sector and country/region being investigated. For instance, Faff and Brailsford (1999) find significant positive Sensitivity of stock prices to oil price fluctuation and diversified resources industries, while they also find A negative relationship in the Paper and Packaging, and Transport industries. Thus, according to the results of Okoro (2014), Antonakakis et al (2014), Wang et al (2013), Gencer and Demiralay (2013), Mollick and Assefa (2013), Babatunde et. al. (2012), Adaramola (2012), Balcilar and Ozdemir (2012), Cretiet. al. (2012b), Musihet. al. (2010), the co-movements between oil and stock markets can be either positive or negative.

Kilian and Park (2009) find that the response of aggregate US real stock returns may differ greatly depending on whether the increase in the price of crude oil is driven by demand or supply shocks. Basher and Sadorsky (2006) find strong evidence that oil price risk impacts stock price returns in emerging markets although the exact relationship depends somewhat on the data frequency being used. For daily and monthly data, oil price increases have a positive impact on stock market returns in emerging markets. For weekly and monthly data, oil price decreases have positive and significant impacts on emerging market returns.

Among the second group, Park and Ratti (2008), Narayan and Narayan (2009), and Imarhiagbe (2010), show that oil price does influence stock markets. While finding a positive effect, Babatunde et al (2012), Fatima and Basher (2014), Cunado and Gracia (2014), Jouini and Harrathi (2014), Reboredo and Rivera-Castro (2014), Ding et al. (2016), Reboredo and Ugolini (2016), and Bampinas and Panagiotidis (2017), Salisu and Isah (2017), among others, propose asymmetries in the relationship.

However, for the third group Maghyereh (2004) studied the relationship between oil prices changes and stock returns in 22 emerging markets, working within a VAR model framework from 1998 to 2004, without finding any significant evidence that oil prices had an impact on stock returns in these countries. Cong et al. (2008) applied multivariate vector autoregression methodology to analyze the interactive relationship between oil price shocks and Chinese stock market activity. The authors found evidence that oil price shocks had no significant effect on stock returns except for the manufacturing index and some oil companies. Again, Fowowe (2017) finds weak interdependence for returns and volatilities between the South African and Nigerian stock and oil markets. Guliman (2015) and Aydogan and Berk (2015) find no relationship at all or find inconclusive evidence of any correlation between stock market and oil prices.

Furthermore, different studies have employed different methodological approaches such as vector autoregressive (VAR) model, vector error-correction model (VECM), univariate and multivariate GARCH-type models including the BEKK (Baba, Engle, Kraft and Kroner over parameterization), CCC (Constant Conditional Correlation) and DCC (Dynamic Conditional Correlation) with different country or regional case studies. For instance, Fowowe (2013) applies the GARCH-Jump models to investigate the relationship between All Share Index and crude oil prices (Brent and WTI) in Nigeria. Agren (2006) uses an asymmetric version of the BEKK–GARCH(1,1) for stock markets in five major developed countries (Japan, Norway, Sweden, the U.K., and the US); Malik and Hammoudeh (2007) use the same model for US and Gulf equity markets. Malik and Ewing (2009) similarly employ bivariate BEKK–GARCH(1,1) for five US sector indices. Overall, their empirical results seem to support the existence of significant transmission of shocks from world crude oil prices to the different stock markets. Similar conclusions are reached in the studies by Jouini and Harrathi (2014), Wadji et al (2014), Arouri et al. (2011), Arouri et al. (2012), Wang et al. (2013) and Salisu and Oloko (2015).

On the whole, the empirical findings from the various studies indicate that the relationship between oil price and stock market depends the choice of econometric method adopted, measurement of variables and the peculiar features of the country under consideration. Compared to the previous literature, our investigation builds on the recently developed VAR-GARCH model, and moves from the market-level and sector-level analyses to an individual bank-level analysis by taking the stock prices of six (6) banks in the *Banking* sector in Nigeria. Following the work of Gupta (2016), Soyemi et. al. (2017) examined the impact of oil price shocks on energy sector-firms for Nigeria. Our study deviates from this by investigating the effects of oil price changes on selected firms in the *Banking* sector in Nigeria due to the overwhelming share of this sector in the NSE. This paper adds to the literature since, to the best of our knowledge, it is a pioneer attempt on Nigeria in this direction.

3. Theoretical Framework, Methodology and Data issues

3.1. Theoretical framework

The Arbitrage Pricing Theory (APT) and Capital Asset Pricing Model (CAPM) remain the major theoretical models used to validate the effect of shocks and other risks on stock market returns (Salisu and Isah, 2017). Specifically, APT assumes that asset returns are generated with the following linear equation:

$$r_i = \delta_i + \phi_i \zeta + \mu_i \tag{1}$$

where r_i denotes the return on asset i , the unconditional expected return is denoted by δ , ζ is a vector of different risk factors, ϕ_i is a vector measuring the influence that each risk factor has on the return on asset i , and μ_i an error term for the residual effect of the returns.

Nevertheless, in the framework of our study, the effect of oil price shock is secluded among other risk factors. Given the above reason, we present a reduced version of the above APT as follows:

$$r_i = \delta_i + \phi_i oilp + \mu_i \quad (2)$$

where r_i is as defined previously while $oilp$ represents oil price shock which indicates expected risk from an unexpected change in oil price. Meanwhile, oil price shock may be expected to have different effects on stock returns of companies (for disaggregate stock returns) as well as countries (for aggregate stock returns), depending on the anticipated effect of the shock on the future cash flow of the potential company or country (Huang et al., 2017).

3.2. Methodology

This study adopted bivariate VAR-GARCH model to investigate the effect of oil price volatility on stock prices of six Banking sector firms listed on the NSE. As earlier noted, the choice of the newly developed VAR-GARCH model is to capture the probable interactions in the conditional returns as well as correlations between stock price returns and oil price returns is emphasized by its simplicity in dealing with both cross-market spillover effects and statistical complications. In addition, with the increasing integration of markets, the use of this model becomes relevant particularly in measuring the extent of integration as well as inter-linkages in these markets. A number of computational merits of VAR-GARCH model have been provided in Arouri et al. (2011a).

The VAR-GARCH model essentially incorporates the multivariate CCC-GARCH model of Bollerslev (1990) as a special case where correlations between system shocks are assumed to be constant to simplify the estimation and inference procedure (see Arouri et al., 2011a). In addition, it allows for the possibility of interdependencies between/among markets. Since we are dealing with two variables namely; banking stock prices (SPR) and oil price (OPR), we adopt the bivariate form of this model. The conditional mean equation for a modified bivariate VAR(1)-GARCH(1,1) model can be specified as:

$$R_t = \varphi + \Pi R_{t-1} + \xi_t \quad (3)$$

$$\xi_t = \sum_t v_t \quad (4)$$

Where:

$R_t = (SPR_t, OPR_t)'$ represents the returns on stock prices and oil price at time t ; φ is a (2 X 1) vector of constants of the form $\varphi = \begin{pmatrix} \varphi^{SPR} \\ \varphi^{OPR} \end{pmatrix}$; Π is a (2 X 2) matrix of the coefficients

of the form $\Pi = \begin{pmatrix} \Pi_{11} & \Pi_{12} \\ \Pi_{21} & \Pi_{22} \end{pmatrix}$; $\xi_t = (\xi_t^{SPR}, \xi_t^{OPR})'$ is a vector of disturbance terms for the mean equations of SPR and OPR respectively; $v_t = (v_t^{SPR}, v_t^{OPR})'$ is a vector of independently and identically distributed errors; $\Sigma_t = \text{diag}(\sqrt{h_t^{SPR}}, \sqrt{h_t^{OPR}})$ with h_t^{SPR} and h_t^{OPR} being the conditional variances of SPR and OPR respectively.

The volatility spillover effects are computed from the conditional variances specified in Equations (5) and (6):

$$h_t^{SPR} = \mu_0^{SPR} + \mu_1^{SPR} (h_{t-1}^{SPR}) + \zeta_1^{SPR} (\xi_{t-1}^{SPR})^2 + \mu_2^{SPR} (h_{t-1}^{OPR}) + \zeta_2^{SPR} (\xi_{t-1}^{OPR})^2 \quad (5)$$

$$h_t^{OPR} = \mu_0^{OPR} + \mu_1^{OPR} (h_{t-1}^{OPR}) + \zeta_1^{OPR} (\xi_{t-1}^{OPR})^2 + \mu_2^{OPR} (h_{t-1}^{SPR}) + \zeta_2^{OPR} (\xi_{t-1}^{SPR})^2 \quad (6)$$

Both equations show that conditional variance of each market does not only depend on its immediate past values and innovations but also on those of the other market. The equations also show how volatility is transmitted over time and across the two markets under investigation. The cross values of error terms, $(\xi_{t-1}^{OPR})^2$ and $(\xi_{t-1}^{SPR})^2$, represent the return innovations in the oil market and to the corresponding stock rate at time $(t-1)$, and thus capture the direct effects of shocks transmission. The transfer of risk between the two markets is accounted for by the lagged conditional volatilities, h_{t-1}^{OPR} and h_{t-1}^{SPR} .

To guarantee stationarity, the roots of the equation $|I_2 - AL - BL| = 0$ must be outside the unit circle where the expressions $(I_2 - AL)$ and BL satisfy some other identifiability conditions as proposed by Jeantheau (1998). L is a lag polynomial, I_2 is a (2×2) identity matrix, and A and B are defined as:

$$A = \begin{pmatrix} \alpha_{s1}^2 & \alpha_{s2}^2 \\ \alpha_{o2}^2 & \alpha_{o1}^2 \end{pmatrix} \text{ and } B = \begin{pmatrix} \beta_{s1}^2 & \beta_{s2}^2 \\ \beta_{o2}^2 & \beta_{o1}^2 \end{pmatrix}$$

The conditional covariance can be expressed as:

$$h_t^{SPR,OPR} = \rho^{SO} \sqrt{h_t^{SPR}} \sqrt{h_t^{OPR}} \quad (7)$$

Where ρ^{SO} is the conditional constant correlation. The structural and statistical properties of the model have been well documented in Ling and McAleer (2003). These properties cover the necessary and sufficient conditions for stationary and ergodicity, sufficient conditions for the existence of moments of ξ_t , and sufficient conditions for consistency

and asymptotic normality of the Quasi-Maximum Likelihood Estimator in the absence of normality of v_t .

3.3. Data and data issues

The study employs daily observations on crude oil price (Brent) and the closing prices of the individual banks listed on the NSE. Both series span from January 01, 2000 to December 31, 2015. Daily frequency is used because it affords an opportunity to capture the intensity of the dynamics of the relationship between the key variables. Crude oil price expressed in USD per barrel for Brent spot prices is used to represent the international crude oil market given that this serves as pricing benchmark for two thirds of the world's internationally traded crude oil supplies (see Alloui et al., 2013; Maghyereh, 2004).

Data on crude oil prices was extracted from the US Energy Information Administration (EIA) database, OPEC database, IMF, and Bloomberg. The data for the banking stock prices are obtained from the NSE database and CashCraft Assets Management. Daily returns on the two variables were computed by taking the difference in the logarithm of two successive prices as follows:

It is imperative to note that while preparing the data for analyses, we encountered the problem of non-synchronous trading days. In order to deal with this issue, we carefully traced and removed the asynchronous trading days using Brent (oil market) trading days as the gauge. At the end of this exercise, we had 3633 usable observations. Finally, it is noteworthy that due to the potential sensitivity of the subject under scrutiny we have ascribed the pseudonyms Bank I, Bank II, Bank III, Bank IV, Bank V and Bank VI to the six banks in our sample².

4. Empirical results and Discussion

4.1. Descriptive Statistics of Stock Market and Crude Oil Prices

In this section, we examine the statistical properties of the returns series and confirm relevant stylized facts about financial time series variables. In essence, we present descriptive statistics and conduct appropriate tests for serial correlation and time-varying autoregressive conditional heteroskedasticity i.e. ARCH effects. Table 1 shows the descriptive statistics augmented with the results for serial correlation using Ljung–Box Q-statistics test and for ARCH effects using ARCH–LM test by Engle (1982). Also included is the result for unconditional correlation between Brent returns and banks' stock returns.

Average daily returns on stock prices are negative for Bank II, Bank IV, Bank V, and Bank VI and *Brent* are positive over our sample period. The stock price of Bank II realized the worst performance (-0.044), followed by Bank IV, Bank V and Bank VI. Conversely, *Brent*,

²We are grateful to the journal's Editorial Team for pointing out this useful direction.

Bank I and Bank III experienced positive average returns, with Bank III having the highest average stock price return.

From Table 1 also, all the returns series show wide margins between minimum and maximum values, which suggests the presence of large variance. Meanwhile, as indicated by the standard deviation statistic, Bank II stock appears to be the most volatile of the return series followed by Bank V, while *Brent* appears to be the least volatile return series. In addition, the skewness statistic shows that the return series for *Brent*, *Bank II* and *Bank III* are negatively skewed while it is positively skewed for Bank I, Bank IV, Bank V and Bank VI.

Moreover, Kurtosis coefficients are important in size and highly significant, indicating that outliers may occur with a probability higher than that of a normal distribution. The kurtosis statistic which compares the peakedness and tailedness of the probability distribution with that of a normally distributed series shows that all the return series were found to have a leptokurtic behavior (i.e., their distributions have fatter tails than corresponding normal distributions). This suggests that each of the mean equations should be tested for the existence of conditional heteroskedasticity. Meanwhile, the Jarque–Bera statistic, which measures normality of the distribution using both the skewness and kurtosis statistics shows that we can reject the null hypothesis for normality for all the return series at all conventional significance levels.

We further carried out stochastic test for autocorrelation and conditional heteroskedasticity to verify stylized facts on financial time series variables. ARCH–LM test by Engle (1982) was adopted for testing the significance of time-varying conditional variance (ARCH effects) while Ljung–Box Q -statistic test was employed for testing the significance of autocorrelation. The results for these tests are also presented in Table 1 and show that we can reject the null hypothesis of no ARCH effects for all the return series at 1% level of significance. In addition, Q -statistic results show that there is statistically significant autocorrelation in the return series for all the stock returns. While, return series for *Brent* are found to exhibit insignificant autocorrelations. We also computed the unconditional correlations between *Banking* Sector stock returns and oil returns. These correlations are weak on average and positive for Bank II, Bank III, Bank IV and Bank V, while negative for *Bank I* and *Bank VI*, suggesting that oil price increases over the period were seen as indicative of higher expected corporate earnings for Bank II, *Bank III*, *Bank IV* and *Bank V*, and negative earnings for *Bank I* and *Bank VI*. *Bank III* has the highest positive correlation with oil (0.032), while the lowest positive correlation is observed between *Bank V* and oil market (0.013). *Bank I* and *Bank VI* had respectively negative correlations of -0.014 and -0.003 with the oil market.

Table 1: Descriptive statistics and statistical properties of return series for the Banking Sector and Brent

	RBR	RBI	RBII	RBIII	RBIV	RBV	RBVI
Mean	0.0123	0.0340	-0.0436	0.0405	-0.0401	-0.0376	-0.0166
Median	0.0365	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	18.1297	68.9808	368.888	228.278	199.243	167.428	90.016
Minimum	-19.891	-31.916	-368.888	-228.278	-193.152	-155.256	-85.866
Std. Dev.	2.269	3.122	11.525	6.168	5.787	6.476	3.736
Skew.	-0.252	2.628	-0.448	-0.200	0.738	5.111	0.222
Kurt.	9.020	75.422	822.280	1035.75	734.032	356.825	173.617
J-B	5525.305	798131.7	1.02E+08	1.61E+08	80896252	18966752	4406558.
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ARCH	32.66	4.14	64.20	532.99	786.32	279.98	870.15

	RBR	RBI	RBII	RBIII	RBIV	RBV	RBVI
LB(Q)	2.59	55.27	426.21	493.15	276.68	258.74	22.48
Corr. with oil	1.000	-0.014	0.022	0.032	0.017	0.013	-0.003
Observations	3633	3633	3633	3633	3633	3633	3633

Notes: The table reports statistics of return series, including mean (Mean), standard deviation (Std. Dev.), skewness (Skew.), kurtosis (Kurt.), ARCH refers to the empirical statistics of the statistical test for conditional heteroskedasticity, LB (Q) is the empirical statistics of the Ljung-Box tests for autocorrelations applied to the series. J-B is the empirical statistics of the Jarque-Berra test for normality based on skewness and excess kurtosis. Corr. Denotes correlation coefficients. RBR, RBI, RBII, RBIII, RBIV, RBV, and RBVI stand for prices of Brent crude and the stocks of BANK I, BANK II, BANK III, BANK IV, BANK V and BANK VI respectively.

4.2 Empirical Results

This model estimated using maximum likelihood method under the assumption of bivariate normal distributed error terms. The log likelihood function is maximized using Marquardt's numerical iterative algorithm to search for optimal parameters.

The empirical findings from our VAR (1)-GARCH (1, 1) estimation results are reported in Table 2 for a pair of oil price and six banking stock prices. One-period lagged values of stock price returns appears to have a significant explanatory power in explaining their current values in all the series considered in the *Banking* sector. With respect to the interdependence of returns in the mean equations, the findings showed that lagged oil price volatility significantly influenced stock prices in all the cases considered, except for *Bank II* and *Bank IV*. This could be as a result of the concentration of about one-thirds of total banking sector credit to the oil sector in Nigeria. . Thus, similar to results obtained for Nigeria by Fowowe (2013); Kuwait by Mohanty et al. (2011); Kuwait, Saudi Arabia, U.A.E. by Arouri et al. (2011); UK by Jammazi(2012); and Bahrain, Kuwait, Oman, Saudi Arabia, and UAE by Hammoudeh and Choi (2006). The effect of oil on stock prices is positive for five out of six companies in the *Banking* sector with *Bank VI* being negatively impacted.

Turning to the conditional variance equations, the estimates of ARCH and GARCH coefficients are statistically significant based on generally accepted levels in most cases. We can observe in the stock market that the sensitivity to past own conditional volatility (h_{t-1}^{SPR}) appears to be significant for *Bank II*, *Bank IV*, *Bank V* and *Bank VI*, while it is insignificant for *Bank I* and *Bank III* at the 1% level. From the results, it can also be seen that the present value of conditional volatility of stock returns in the *Banking* sector also rely on past unexpected shocks (ξ_{t-1}^{SPR})² affecting returns dynamics since the associated coefficients are highly significant in all cases except for *Bank III*. However, the relatively large size of ARCH coefficients suggests that conditional volatility changes very rapidly under the influence of returns innovations, and it tends to fluctuate gradually over time as evident from the large magnitude of GARCH coefficients. Furthermore, the past unexpected shocks of stock market (ξ_{t-1}^{SPR})² is not significant to the oil market for all the models. The past conditional volatility is negative for *Bank II*, *Bank I*, *Bank III*, *Bank IV* and *Bank VI*; and positive for *Bank V*. The stock market past conditional volatility (h_{t-1}^{SPR}) for *Bank II*, *Bank I*, *Bank IV* and *Bank VI* are significant for oil market while *Bank III* and *Bank VI* are insignificant. In addition, the past conditional volatility of oil market h_{t-1}^O is significant in *Bank II*, *Bank I*, *Bank IV* and *Bank VI* and insignificant in *Bank III* and *Bank V*. The cross-market unexpected past shocks (ξ_{t-1}^{OPR})² from oil to stock is significant in all the cases except in *Bank I*.

Next, we consider the volatility spillover effect between oil and stock markets in Nigeria. We first observed that there is direct transmission of volatility h_{t-1}^{OPR} from oil market to stock market in *Bank II*, *Bank I*, *Bank IV*, and *Bank VI*, but not in *Bank III* and *Bank V*. The cross-volatility coefficients are mostly significant at conventional levels. More

specifically, past oil shocks $\left(\xi_{t-1}^{OPR}\right)^2$ have significant effects on stock market returns for *Bank II*, *Bank III*, *Bank IV*, *Bank V* and *Bank VI* except in *Bank I*. Past oil returns strongly affects stock returns in *Bank II*, *Bank I*, *Bank IV*, *Bank VI*, but not in *Bank III* and *Bank V*. Therefore, our results suggest an intensification of spillovers from oil to the *Banking sector* stocks.

Summing the *Banking* sector as a whole, the observed spillover effects from oil market to the stock market are significant at the 1% level. This relationship is not unexpected because oil price increases tend to have a serious effect on consumer and investor confidence and demand for financial products, while rising financial stock prices are often indicative of oil consumption due to increasing productive activity.

The estimates for the constant conditional correlation (*CCC*) between oil and individual bank (*Banking* sector) stock price are found to be positive for all but *Bank I* stock returns. This is not surprising, as there existed a negative cross-volatility between oil market and *Bank I* stock returns. Moreover, on a general note the *CCC* are somewhat low and weak. The positive outcome for *CCC* is in favour of plausible gains from investing in both stock and oil markets. It is seen that past conditional volatility of stock (*Banking* sector) returns significantly affected the current value of the oil market volatility and vice versa, in all the firms. Oil market unexpected past shocks in all the firms except one (i.e. *Bank I*) exerted significant influences on stock market returns, while oil prices are unaffected by past stock market shocks. It is equally imperative to note that the *Banking* sector may be subject to indirect impacts of oil price changes. For instance, increases in oil price are likely to exert influence on this sector through their effects on monetary policy, interest rates, employment and consumer confidence. Consequently, therefore, to better forecast stock market volatility and make appropriate investments decisions, investors need to closely watch events in the oil markets.

Table 2: Estimate of Bivariate VAR (1)-GARCH (1, 1) Model for Six Banking Sector Firms and Brent

Variables	BankI		BankII		BankIII		BankIV		Bank V		BankVI	
	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil
Mean Equation												
Constant	-1.9111*** (0.0021)	0.0399*** (0.0116)	-0.0422 (0.0411)	0.0387 (0.0264)	-0.0497* (0.0272)	0.0330*** (0.0008)	-0.4289*** (0.0397)	0.0516** (0.0250)	-0.0278*** (0.0011)	0.0360* (0.0196)	-0.0187*** (0.0026)	-0.0012 (0.0232)
Stock(1)	-0.5262*** (0.0019)	0.0034** (0.0006)	0.1013*** (0.0169)	0.0123 (0.0098)	0.1464*** (0.0001)	-0.0002*** (0.0000)	-0.1768*** (0.0166)	0.0107*** (0.0006)	0.2687*** (0.0041)	-0.0022 (0.0018)	0.1992*** (0.0179)	0.0010 (0.0049)
Oil(1)	0.7466*** (0.0012)	0.0033*** (0.0072)	0.0749*** (0.0217)	0.0417*** (0.0100)	0.0529*** (0.0014)	0.0209** (0.0104)	0.1131*** (0.0210)	0.0036 (0.0155)	0.0213*** (0.0014)	0.0160*** (0.0001)	-0.0277*** (0.0009)	0.0863*** (0.0125)
Variance Equation												
Constant	1.2215*** (0.0674)	0.0050 (0.0020)	2.5369*** (0.0148)	-0.0164*** (0.0015)	22.6227*** (0.0195)	0.0135*** (0.0025)	1.5316*** (0.1491)	-0.0016 (0.0049)	0.7191*** (0.0021)	0.0173*** (0.0026)	0.0011 (0.0008)	0.0595*** (0.0100)
$(\xi_{t-1}^{SPR})^2$	5.4212*** (0.0069)	- (0.0079*** (0.0006)	0.2738*** (0.0095)	-0.0230*** (0.0023)	0.0992*** (0.0070)	-0.0014 (0.0025)	0.4189*** (0.0144)	-0.0063*** (0.0002)	0.2692*** (0.0009)	0.0103*** (0.0029)	0.3054*** (0.0029)	-0.0129*** (0.0037)
$(\xi_{t-1}^{OPR})^2$	-1.5661*** (0.0179)	0.0492*** (0.0007)	0.0099 (0.0275)	0.0507*** (0.0003)	0.3459*** (0.0059)	0.0511*** (0.0009)	-0.3173*** (0.0165)	0.0472*** (0.0043)	0.3668*** (0.0001)	0.0533*** (0.0009)	-0.1109*** (0.0045)	0.0754*** (0.0033)
h_{t-1}^{SPR}	0.1146*** (0.0007)	0.8429*** (0.0555)	-0.0451*** (0.0019)	-1.4107*** (0.0158)	-0.0170*** (0.0000)	0.0072 (0.3411)	0.7538*** (0.0075)	0.2889** (0.0382)	0.8228*** (0.0001)	-0.0498 (0.0835)	0.7641*** (0.0019)	-0.5972*** (0.2037)
h_{t-1}^{OPR}	236.3689*** (2.4683)	0.9464*** (0.0006)	-48.3745*** (0.1317)	0.9233*** (0.0003)	-0.0273 (0.2689)	0.9483*** (0.0008)	-4.8130** (1.9275)	0.9420*** (0.0038)	-0.0992 (0.0656)	0.9455*** (0.0009)	5.1848*** (0.0554)	0.9202*** (0.0020)
CCC between oil and stocks		0.0017*** (0.0000)		-0.0164*** (0.0000)		-0.0002 (0.0018)		0.0228*** (0.0025)		0.0030*** (0.0002)		0.0058*** (0.0003)
Log-likelihood		- 20096.908 9		-16793.6567		- 18590.6015		-17870.7924		-17909.3707		- 15477.873 0

Notes: The bivariate VAR (1)-GARCH (1, 1) model is estimated for each firm over the period January 2, 2001 to December 31, 2015. The optimal lag order for the VAR model is selected using the AIC and SBC information criteria. Standard errors are given in

AIC	11.076	9.257	10.246	9.850	9.871	8.532	parenthesis. Oil, Stock and CCC are oil price , firm stock prices and constant conditional correlation respectively. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.
SBC	11.105	9.286	10.275	9.879	9.900	8.561	
No. of Observations	3632	3632	3632	3632	3632	3632	

5. Conclusion and Policy Implications

This study examined the empirical relationship between oil price volatility and the stock prices of selected firms on the Nigerian banking sector for the period January 2, 2001 to December 31, 2015. The study employed a bivariate VAR-GARCH model to achieve this objective. Empirical results of the conditional mean equations showed that there is evidence of short-run predictability on banks' stock prices and also revealed that crude oil prices had a significant impact on the *Banking* sector movements only in two banks (*Bank II and Bank IV*). Additionally, the study also investigated volatility transmission between the two markets (*Brent and Banking sector*).

Based on the conditional variance equations, our empirical findings indicated that the conditional volatility of the prices on the individual firms in the *Banking* sector are affected not only by own volatility, but also by innovations in the oil market. Our results also showed the existence of significant volatility transmission between oil and *Banking* stocks in Nigeria, with the spillover effects being more apparent from oil to the *Banking* stocks. Following the findings of this study, a number of policy implications can be contemplated. Due to the volatility of international oil prices, which affects stock market and the empirical evidence of its short-term predictability on banks stock returns, banks in Nigeria are encouraged to hedge their investments and diversify their investment activities to non-oil sectors. In addition, the volatility transmission results showed that innovations in the oil market affected banking stocks in Nigeria. Therefore, due to the exposure of the balance sheet of banks to such oil price risk, bank lending to the oil and gas sector may require the exercise of caution in terms of credit expansion. This way the proliferation of non-performing loans especially during weak global oil price regimes can be avoided. Finally, oversight structures such as the regulatory role of the Securities and Exchange Commission (SEC) should be given additional attention.

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