

Sectoral Stock Pricing in the Nigerian Stock Exchange: Symmetric and Asymmetric Approaches

Journal of Management and
Social Sciences
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Abstract

Each sector has a symbolic pattern that predicts the likelihood of returns. This study investigates sectoral stock price volatility at the Nigerian Exchange Group. The volatility dynamics of sectoral stock returns under symmetric and asymmetric conditions using the data on selected exogenous variables such as consumer price index, Treasury bill rate, and market price of stocks and monthly firm stock price categorised into each sector were investigated using the Traditional GARCH, Threshold GARCH, and Exponential GARCH models. Apart from GARCH models, it was used to establish the relationships among the determinants of expected returns. Arising from the pricing purpose, some sectors were overvalued (Agriculture, Conglomerate, Construction, Consumer goods, Health, Oil & Gas, and Services) while others (Financial Services and Natural Resources) were undervalued. However, volatility in most sectoral stock returns is not permanent but rather mean-reverting, and they perform much better under the leverage effect, implying that negative news (shocks) has more influence on stock price volatility than positive news. Meanwhile, it remains a fact that volatility is not relevant in determining expected returns after estimating and applying asset pricing models. Hence, the study provides evidence in favour of a portfolio of sectoral stocks as a more beneficial investment strategy than aggregate stock market indices, thereby supporting portfolio theory. The study then recommends that the government, through its agencies, should mobilise adequate funds into the market to stabilise it during periods of high volatility, as well as improve stock market education to mitigate the effects of negative news, while investors should improve their knowledge of each sector for portfolio management.

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Keywords

Stock returns, volatilities, asset pricing, GARCH, TGARCH, EGARCH, ARDL, Nigerian Stock Exchange

Introduction

The importance of pricing mechanisms to optimal investment decisions and resource allocation can always be emphasised. The optimal allocation of capital depends on the efficient performance of stock market pricing and pricing methods. It also serves as a driving force for moving excess funds for investment management, which implies that an appropriate price mechanism reveals sustainable investment opportunities to both actual and potential investors. As supported by fundamental analysis with common theory that present stock prices are equal to the sum of discounted values of expected future cash flows irrespective of investment horizons (Brealey, Myers, & Allen, 2011). Investor within stock exchange need to identify factors affecting these returns to support their decision making and in most cases, such expected returns are often deduce from the asset pricing models: Capital Asset Pricing Model (CAPM) - Sharpe (1964) and Lintner (1965), Asset Pricing Theory (APT) - Ross (1976), Intertemporal CAPM - Merton (1973), Consumption based CAPM - Breeden (1979), Conditional Capital Asset pricing model – (1983), International Capital Asset Pricing Model - Merton (1973), Production Based Asset Pricing Model – Cochrane (1991).

It is of importance for the rational investor by nature to be regarded as risk averse and the need to understand the volatility of such expected returns is paramount to them (Oke, 2013). The direction on the measurement of such uncertainty returns is volatile even though the past prices of stock reflect in the future stock price as in the case of Nigerian Stock exchange (Olowe, Matthew, & Fasiina, 2011). In line with the portfolio theory, proper investment management depends on efficient portfolios and each investor will select one of the efficient portfolios based on the degree of his risk-aversion (Treynor, 1961; Sharp, 1964, & Lintner, 1965).

However, the theory has also shown that different investors are prone to different kinds of sentiment with special preferences for the particular sector(s). In fact investors would demand stocks that have the bundle of salient characteristics compatible with their sentiment (Baker & Wurgler, 2006; Chen, Marcin, & Hernn 2013) argued that sectoral returns react in different ways to market returns viz a viz global market returns which implies that movements of aggregate stock market volatility could be different from sectoral perspective with the focus on developed economies like the US and the

European stock markets as demonstrated in (Sadorsky, 2001; Boyer & Filion, 2007). Even few that considered developed countries focused on the aggregate economy whereas some intrinsic information about the stock behavior could be lost due to masking effects. Hence, understanding the movement of expected returns of each sector through volatility is crucial for policy planning, portfolio diversification and risk management and such other issues.

Finally, as the input and output patterns of each sector is important which spur deep understanding of returns and its volatility dynamics among sectors within Nigerian Stock exchange market to enable policy focus closely on smoothening out the effects of shocks on the transmission channel (Kpughur, Yila, & Chidozie, 2017).

The degree of volatility of stock price of any given sector depends upon input and output of that sector which might not be generalised since the entire stock market has different factors that affect each sector differently. It is necessary for investors to understand each sector index before the stock price transmission mechanism from different sectors in order to take decision that is optimal in nature since unanticipated changes in stock price may be caused by the behaviour of other macroeconomic aggregates such as inflation, money supply, exchange rate, real Gross Domestic Product. The application of sectoral based investment strategy contributes independent movement to stock returns and hence assist in controlling stock risk and returns (Elyasiani, Mansur, & Odusami, 2011).

Theoretically, selection of financial assets depend on the information readily available and asset allocation decision is the choice among broad assets classes known as sectors, while the security selection decision is the choice of which particular securities to hold within the portfolio. The important characteristics of each sector may interest investors in the persistence, endogeneity and conditional heteroscedasticity effects in the investment process, which may have implications on the forecast results (Dutta et al., 2017). The change in economic variables that affected stock returns may react to sectoral sensitivity which mean, the performance and correlations of sectors for portfolio diversification need to be discovered.

Literature Review

The issue of stock market volatility seems not to be a new phenomenon, as the literature has witnessed quite a number of studies that have been conducted on the concept. In fact, empirical findings abound for different countries while varying techniques have been innovatively employed by different authors. What is, however, relatively new is the sectoral analysis of the stock market prices to give room for distinctive treatment of each sector and circumvent aggregation bias. While, it was observed that in terms of scope, proxy for returns, the methodology and findings limited to relevant past studies the inquiry by taking the comparative relationship between assets pricing model for stock returns either to direct, indirect or monotonic view.

The stock market of any country is an important sector in the analysis of economy performance from time to time which huge empirical research had established. Just many had considered relationship between Oil price and stock markets returns (Ghosh et al., 2016; Lean et al., 2017; Salisu et al., 2017; Sharma, 2017; Tursol et al., 2017; Wel et al., 2017) analysed country by country with different form of data especially on aggregate stock market index agreed on the linkages between the changes in oil price and stock price.

However, Dutta et al. (2017) and Khalifa et al. (2017) also examined the causes and consequences of oil price on the individual firm prices using GARCH (Generalized Autoregressive Conditional Heteroskedasticity) - jump model and Spillover Asymmetric Multiplicative Error Model (SAMEM) respectively provide empirical evidence of impact of change in oil price on the individual firm stock price despite global financial crises and geopolitical instability within the Asian countries. Though using daily data reported differential evidence with higher dependency from oil exporting countries and low impact from non-exporting countries (Kayalar et al., 2017).

In a related study, Huang et al. (2017) examined the response of stock price of the selected sectors in some particular G7 countries using daily frequency which the result revealed that each sector behaves differently to the change in the oil price and that only transportation, consumer goods and utilities services are sectors that lag behind volatility of oil price while other sectors lead in the changes. With the use of Nigerian Stock exchange data, Izunobi et al. (2017) compared to Khadi et al. (2017), using Pakistanian stock market data considered the use of macroeconomic variables on the volatility of stock price in Nigeria alongside government monetary policies implication. Evidence from these studies rejected the hypothesis that there is no volatility clustering within the market, meaning high level of persistent volatility from aggregate view of stock market.

Though Mohite (2015) assessed the volatility dynamics of the stock returns on only Indian banking sector with the focus of determining the influence of risk factor on stock returns. This provide evidence of persistence in banking stock returns and that current year's stock has significant impact on the lagged returns (see also Mallikarjuna et al., 2017). Meanwhile Messis et al. (2006) emphasised the relationship between risk factors and determining factors depending on the state of the stock market, which during boom there is positive association. Also, Benjamn et al. (2007) explored the nexus stock returns and volatility within Brazilian stock exchange with evidence of inverse association between changes in volatility and stock returns that distinguished the fact that there is always positive relationship.

In a comparative study, Uyaebo et al. (2015) compared stock returns from Nigerian stock exchange to other countries, Kenya, USA, Germany, South

Africa and China using all share index (ASI). From the study, there is empirical evidence of volatility clustering and volatility persistence with Nigerian stock performance which was very low to other countries stock returns, but it is not different from what Osudina et al. (2016) studied. It is limited to the manufacturing sector by determining the impact of accounting information on the stock returns volatility. There is evidence from the study that strong and positive significant impact on stock returns volatility, meaning stock returns is not always in isolation attached with many factors that might not be recognized in the theory.

Interestingly, Rolle et al. (2014) in their study focus on impact of stock returns volatility on investment using annual all share index assisted with GARCH, the evidence provided disclose impact and its significant relationship. Meanwhile, Stephen et al. (2015) also did same study but on comparative study between Nigerian Stock exchange and Kenya counterparts. The evidence reflected special response of Nigerian stock returns volatility faster than that of Kenya which is not also different from David et al. (2016).

In a different development, Yuthana & Suthawan (2012) assessed stock returns volatility using daily data reported that the structural variations in returns are more likely to be high due to policy and regulatory differences rather than the economic crisis (Jasmina, 2014). This study is not different from Magnus (2017) except in a selective way, where he examined the sensitivity of stock returns of five selected sectors from Nigerian stock exchange to the changes in oil price from January 2007 to March 2016. This found out that the volatility of stock returns has an impact on the volatility of oil price synonymous to volatility of exchange rate (Fapetu et al., 2017).

Meanwhile, despite the cordial relationship in most study mentioned, most study used conventional framework for their study when it was necessary to examine the equilibrium of stock returns propounded by scholars in form of asset pricing model, which is the theoretical best way of assessing assets of listed firms on the stock exchange. Explicitly, Kashif and Arshad (2016) examine volatility modeling and asset pricing with the extension of macroeconomics variables, value-at-risk and semi-variance for the Karach Stock exchange for the period of January 2000 to December 2015. Evidence provided that other than conventional framework, there is positive and statistical significant relationship between the stock returns and other macroeconomics variables especially interest rate. However, Ismaila et al. (2017) that also examined volatility risk pricing, market regulations and cross section of stock returns in emerging markets in Africa and found that portfolio returns rely not only on the macro and micro market risks that is captured by a risk-augment CAPM model, but also on the type of equity mispricing.

The results of the previous studies are intuitive, however, most of the studies done in Nigeria have not empirically examined the performance of (i) each sectoral stock returns with asset pricing framework, (ii) symmetry and asymmetry effect of sectoral stock returns, which is a major thrust of this study

and, (iii) influence of stock volatility on the expected stock returns. By this, the policy relevance of this research work in Nigeria is carried out. Hence, this study is an unassuming attempt to fill the gap in this regard.

Methodology

The stock price data used for the study were sourced from the Nigerian Stock Exchange which houses data for Nigerian firms across all sectors that are listed on the Exchange, while the data on selected exogenous variables such as consumer price index, treasury bill rate, and market price of stocks were sourced from the Central bank of Nigeria Statistical Bulletin (2019) and the Nigerian Stock Exchange. The data employed are monthly data covering the period before and after the financial crisis of 2008.

Measurement of Variables

The sectoral stock prices are denominated in the domestic currency, naira. However, the consumer price index and market price (which is proxied by the All-Share Index) are in basis points, while the Treasury bill rate is expressed in percentage. Meanwhile, since volatility analysis is usually done on the return’s series, the required returns from the obtained data are computed as follows:

$$r_t = \left[\log \left(\frac{P_t}{P_{t-1}} \right) \right] * 100 \dots\dots\dots(1)$$

Where P_t^i is monthly stock price at the end of the day, while P_{t-1}^i is the one-period lag stock price.

$$sr_t = \left[\log \left(\frac{SP_t}{SP_{t-1}} \right) \right] * 100 \dots\dots\dots(2)$$

Where SP_t is monthly sectoral stock price at the end of the month while SP_{t-1} is the one-period lag sectoral stock price.

The market returns (Rm_t) is calculated thus:

$$R_m = \left[\log \left(\frac{Im_t}{Im_{t-1}} \right) \right] * 100 \dots\dots\dots(3)$$

Where Im_t^i Monthly market index at the end and Im_{t-1}^i is the market index at the last day of operation of each sector.

Empirical Estimation of Sectoral Stock Price Volatility under Symmetric Conditions

Volatility is found by calculating the standard deviation of change in sectoral stock price. The establishment of whether or not volatility exists in a series follows some basic steps through the ARCH-LM test as proposed by Engle (1982): the foremost is estimating equation (1) by OLS to get the fitted residuals. Secondly, the square of the fitted residuals is regressed on constant and lagged values of the squared residuals, as presented in equation (4) below:

$$\hat{\epsilon}_t^2 = \theta_0 + \theta_1 \hat{\epsilon}_{t-1}^2 + \theta_2 \hat{\epsilon}_{t-2}^2 + \dots + \theta_k \hat{\epsilon}_{t-k}^2 + \mu_t \quad (4)$$

The third step is the use of the ARCH-LM test to determine the presence of ARCH effect in the model. The ARCH-LM test has its null hypothesis as: $H_0: \theta_1 = \theta_2 = \dots = \theta_k = 0$

Empirically, the F-test or Chi-square distributed (χ^2) measured by the product of the number of observations (n) and the coefficient of determination (R2) obtained from the regressed equation (4) is used. The number of autoregressive terms in equation (4) is the degree of freedom (k). The result is disclosed in Table 3.

The symmetric volatility model employed in this study is the Generalized Autoregressive Conditional Heteroskedasticity model of the first order, i.e. GARCH (1,1) model. The conventional GARCH (1,1) model is empirically adjudged to be sufficient to assess the volatility of a series (see Salisu et al., 2013; Fasanya et al., 2017; Okonkwo et al., 2019), and has thus been used in notable studies. The major model selection criteria are the Schwartz Information Criterion (SIC) and Akaike Information Criterion (AIC) to judge the fittest model.

Following Anderson et al. (2003), the GARCH (1,1) model proceeds from the mean equation specified as:

$$r_t = \alpha + \beta r_{t-1} + \epsilon_t \dots \dots \dots (5)$$

Where r_t is the return on sectoral stock price shown to depend on its immediate past value (r_{t-1}). It is calculated as in equation (3.4).

Given that $\epsilon_t = \sigma_t e_t$ and $e_t \approx (1,1)$, the variance equation of the GARCH (1,1) model is therefore given thus:

$$\sigma_t^2 = \Delta + \sum_{i=1}^p \Phi \epsilon_{t-i}^2 + \Psi \sigma_{t-1}^2 ; \Delta > 0, \Phi \geq 0, \Psi \geq 0 \dots \dots \dots (6)$$

Presence of volatility in the series in equation (3) will result into the largeness of the variance, and otherwise if volatility is absent. The coefficients of the ARCH and GARCH effects are respectively Φ and Ψ , and their sum must be less than unity for the model to observe a mean reverting variance process.

Empirical Estimation of the Sectoral Stock Price Volatility under Asymmetric Conditions

One of the weaknesses of the symmetric GARCH model is that it produces unreliable results when the effects of shocks are different due to good and bad news in the stock market. Thus, the GARCH (1,1) model is modified to include the asymmetric feature of stock market volatility. The prominent asymmetric GARCH models are the Threshold Generalized Autoregressive Conditional Heteroskedasticity (TGARCH) and the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) models (Osokoo et al., 2011)). The main essence of considering the asymmetric volatility models is therefore to compare their performances with those of the symmetric volatility model in order to establish the one with most reliable results.

The Threshold-GARCH process allows analysis on the effects of good and bad news (negative and positive return shocks) on the volatility. TGARCH (1, 1) model is the standard GARCH (1,1) model while adding up the asymmetric threshold effect. It is specified as:

$$\begin{aligned} \sigma_t^2 &= \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \\ &+ \gamma \varepsilon_{t-1}^2 + I_{t-1} \end{aligned} \tag{7}$$

Where: γ is the asymmetric or leverage effect and I_{t-1} is the dummy variable used to differentiate the good and bad news, i.e. $I_{t-1} = 1$ if $\varepsilon_{t-1}^2 < 0$ indicating bad news, and $I_{t-1} = 0$ if $\varepsilon_{t-1}^2 \geq 0$ indicating good news. The model assumes that unexpected changes in the market returns or ε_t will have different effects on the volatility of stock returns, σ_t^2 . Good news will lead to higher return; hence it is associated with higher variance through γ . According to Ahmed et al., (2011), a non-zero value of γ indicate the asymmetric nature of the returns. However, when γ is zero, we get back to the standard symmetric GARCH model. When γ is positive, then there is a leverage effect.

The EGARCH model with the exponential nature of the conditional variance, in the EGARCH model captures the effect of external unexpected shocks on the predicted volatility. The EGARCH (1, 1) model is formulated as:

$$\begin{aligned} \ln \sigma_t^2 &= \alpha_0 + \alpha_1 \frac{\varepsilon_{t-1}^2}{\sigma_{t-1}^2} + \gamma \frac{\varepsilon_{t-1}^2}{\sigma_{t-1}^2} \\ &+ \beta_{1 \ln \sigma_t^2} \end{aligned} \tag{8}$$

As in the TGARCH model, the presence of γ indicates an asymmetric effect of shocks on volatility and the positive value of this parameter implies the presence of leverage effect (Ahmed & Suliman (2011)).

Estimation Techniques

The study examined the time-series characteristics of the variables to determine their order of integration and the existence of long and short run relationships in some cases. To obtain robust results, this study chooses the Augmented Dickey-Fuller Test with GLS Detrending (ADFGLS) and Phillip-Perron tests procedure for the stationarity tests. Thereafter, the volatility models are considered. The symmetric volatility model considered is the GARCH (1,1), while the asymmetric volatility models are the Exponential GARCH [EGARCH] (1,1) and the Threshold GARCH [TGARCH] (1,1). The essence of the consideration of both the symmetric and asymmetric models is to determine if positive and negative news have different shocks effects on volatility.

Analysis and Results

Descriptive Statistics

This sub-section discusses the statistical properties of the variables. Thus, the univariate statistics of the variables, which include the mean, median, Skewness, Jarque-Bera, Kurtosis, among others are reported. The results of the descriptive statistics for selected variables are presented in Table 1.

Table 1: Summary Statistics for Sectoral Stock Returns Series and other Variables

Variables	Mean	Median	Maxim	Minim	Std. Dev.	Skew	Kurtosis	Jarque-Bera	Prob.
Agriculture	0.0079	0.0084	1.0555	-1.2776	0.1642	-1.5953	38.940	7757.074	0.0000
Conglomerate	-0.0042	-0.0058	0.2671	-0.1916	0.0747	0.5738	4.6852	24.769	0.0000
Consumer goods	0.0076	-0.004	0.1724	-0.1463	0.0590	0.0720	3.4728	1.4558	0.0482
Financial services	-0.0059	-0.0072	0.6401	-0.6971	0.1118	-0.5659	20.116	1753.173	0.0000
Health services	-0.0044	-0.0048	0.2453	-0.3253	0.0782	0.1845	5.5349	39.1004	0.0000
Information & communication	0.0023	-0.0058	0.6497	-0.3231	0.1007	2.7189	18.735	1651.561	0.0000
Industrial goods	0.0018	0.0009	0.2097	-0.2626	0.0638	-0.3825	5.4028	37.8908	0.0000
Natural services	0.0067	-0.0048	0.4925	-0.2447	0.0728	3.0751	19.805	1908.110	0.0000
Oil & gas	-0.0007	-0.0101	0.3615	-0.2779	0.0644	1.0027	11.501	454.5735	0.0000
Service	-0.0107	-0.0176	0.3666	-0.3667	0.0764	0.4376	9.2712	238.896	0.0000
Market returns	0.0009	0.0030	1.0647	-1.2191	0.3618	-0.0746	4.0225	6.3632	0.0041
Market volume	9.8970	9.8818	10.420	9.5497	0.1607	0.5872	3.4185	9.3267	0.0094
Treasury bill	0.0034	-0.002	0.9399	-0.9518	0.2011	0.1935	9.8336	279.1435	0.0000
Consumer Price Index	149.69	141.50	274.57	72.820	56.679	0.5861	2.3189	11.028	0.0040

Source: Compiled by the authors

From Table 1, it is observed that the average stock returns vary across sectors. While some sectors including Agriculture, Consumer goods, Information and Communication, Industrial Goods and Natural Services report positive returns, implying that they suit the demand of all investors, other sectors are found to exhibit unfavourable (negative) returns. However, the positive returns of the five highlighted sectors are relatively small, suggesting that they seem to still be undergoing significant development. Alternatively, the negative returns of

the remaining sectors may not necessarily imply a consistent loss at all periods. It is further seen that the returns series tend to exhibit relative volatility.

The most volatile sector is Agriculture whose standard deviation statistic is 0.1642, followed by the Financial Services sector 0.1118. Consumer Goods sector tends to be the least volatile sector (0.059). It is also essential to consider the distribution properties of these returns series as captured by the skewness and kurtosis statistics, and then the Jarque-Bera test which combines statistical information from the first two to obtain a more accurate conclusion. The skewness statistic shows that they are largely positively skewed, implying a fat tail to the right. The exceptions are Agriculture, Financial Services and Industrial Goods sectors that are negatively skewed. They are all leptokurtic following their kurtosis values being in excess of the threshold of 3. Then, the rejection of the null hypothesis of normal distribution by the Jarque-Bera test is expected following the performances of the previous tests of statistical distribution of the stock returns series. Hence, there is need to study the fluctuation in series, as it happened in reality and greater likelihood of experiencing losses in these markets.

Unit Root Test of the Variables

Table 2 were stationary at level, using augmented dickey fuller and Phillip Perron test, as expected for the unit root test in all the returns series, except the series from treasury bill that are stationary at level to substantiate our actions of using ARDL estimator for the models to establish the relationship between the sectoral stock returns with other variables, since they are different series. Most of the empirical work extensively apply Augmented Dickey-Fuller (ADF) and/or Phillip Perron (PP) test(s) to find the order of integration in variables.

Table 2: Unit Root Test -Augmented Dickey Fuller Test and Phillip-Perron Test

Variable	Augmented Dicky filler	Phillips-Perron	Order of Integration	Variable	Augmented Dicky filler	Phillips Perron	Order of Integration
Agriculture	-16.752 ^{***} , ^b	-17.754 ^{***} , ^b	I(0)	Natural services	-7.564 ^{***} , ^b	-7.455 ^{***} , ^b	I(0)
Conglomerate	-8.449 ^{***} , ^b	-8.467 ^{***} , ^b	I(0)	Oil & gas	8.3592 ^{***} , ^c	-8.300 ^{***} , ^c	I(0)
Construction	-8.9748 ^{***} , ^a	-9.017 ^{***} , ^a	I(0)	Service	-8.853 ^{***} , ^a	-8.805 ^{***} , ^a	I(0)
Consumer goods	-8.823 ^{***} , ^b	-8.752 ^{***} , ^b	I(0)	Market volume	-8.072 ^{***} , ^b	-8.716 ^{***} , ^b	I(0)
Financial services	-10.078 ^{***} , ^c	-10.001 ^{***} , ^b	I(0)	Treasury bill	13.715 ^{***} , ^c	-13.68 ^{***} , ^c	I(0)
Health services	-9.890 ^{***} , ^b	-9.878 ^{***} , ^a	I(0)	Consumer price index	-5.225 ^{***} , ^b	-7.435 ^{***} , ^b	I(1)

Information & communication	-8.886 ^{***,c}	-8.815 ^{***,c}	I(0)	Market returns	-	9.6003 ^{***,c}	-20.0073 ^{***,b}	I(0)
Industrial goods	-9.607 ^{***,c}	-9.690 ^{***,c}	I(0)					

Source: Compiled by the authors

Note: The Null Hypothesis is the presence of unit root. Model 1 includes a constant (a), Model 2 includes a constant (b) and a linear time trend (c) and while *, **, ***, significant level at 10%, 5%, and 1% respectively

Table 3: Results of Sectoral Stock Returns Volatility Under Symmetric and Asymmetric Condition

Sectors	Garch Models	Variance Equations Parameters								Model Selection Criteria	
		C	t-stat	Φ	t-stat	Ψ	t-stat	Θ	t-stat	AIC	SIC
Agriculture	G	0.00	0.86	0.468	3.73	0.754*	17.17			-1.153	-1.049
	T	0.00	1.77	-0.12	-4.12	0.228**	2.84	0.684*	4.06	-1.075	-0.950
	E	-1.76	-3.32	-0.31	-3.00	-0.80*	-8.35	0.504*	3.45	-1.181	-0.956
Conglomerate	G	0.003*	5.06	0.524	3.04	-0.140	-2.33			-2.673	-2.569
	T	0.003*	5.85	0.676	2.49	-0.40	-1.39	-0.13*	-2.38	-2.687	-2.532
	E	-1.66	-1.84	0.41*	2.26	0.11	1.38	0.753*	4.97	-2.594	-2.469
Construction	G	-2.90	-0.23	0.109	3.66	0.901**	34.14			-2.025	-1.971
	T	-1.06	-0.07	0.09	2.05	0.03	0.44	0.898*	32.86	-2.062	-1.937
	E	-0.206	-1.65	0.229	3.70	-0.00	-0.08	0.993*	39.94	-2.064	-1.989
Consumer Goods	G	0.000	1.02	0.1	1.37	0.687**	3.12			-2.908	-2.804
	T	0.000	1.17	0.0	0.21	0.18	1.38	0.779**	5.78	-2.919	-2.794
	E	-10.06	-14.2	0.52	2.55	-0.10	-1.14	0.64*	5.04	-2.926	-2.807
Financial Services	G	0.0019*	2.71	0.286	1.82	0.603*	4.301			-1.747	-1.643
	T	0.00	1.58	0.46	1.58	-0.46	-1.588	0.525	2.01	-1.776	-1.651
	E	-9.353	-30.1	-0.16	-2.55	-0.21**	-6.33	0.96	28.04	-1.869	-1.744
Health Services	G	0.003*	4.30	4.306	3.04	-0.04	-0.312			-2.391	-2.287
	T	0.001	1.74	0.109*	2.52	-0.15**	-3.40	0.594	2.47	-2.410	-2.285
	E	-3.665	-3.49	0.490	2.69	0.304	2.44	0.386	2.02	-2.447	-2.322
Information & Comm.	G	0.001*	6.55	1.108	4.92	0.00	0.04			-2.719	-2.615
	T	0.002	6.22	1.451	3.88	-1.23*	-3.17	-0.05	-1.15	-2.743	-2.618
	E	-3.187	-4.85	0.763	3.62	0.550*	3.66	0.536*	4.58	-2.799	-2.674
Industrial Goods	G	0.0003*	4.79	-0.05	-5.58	0.957*	58.26			-2.848	-2.744
	T	0.0006*	3.51	-0.07	-6.76	0.03	1.25	0.831**	15.51	-2.792	-2.667
	E	-10.54		0.784		0.102*		0.083*		-2.882	-2.757
Natural Goods	G	0.0002	5.13	0.986	5.53	0.167*	2.39			-3.732	-3.628
	T	2.770	3.27	-0.02	-3.11	-0.12**	-2.81	1.015*	5083	-3.877	-3.752
	E	-0.099	-2.05	-0.15	-2.29	0.126*	5.18	0.971**	8744	-3.801	-3.676
Oil and Gas	G	9.700	1.289	0.114	2.623	0.876	31.051			-2.780	-2.676
	T	0.0001	1.624	0.024	0.724	0.159**	1.732	0.875***	23.951	-2.807	-2.682
	E	-0.233*	-2.378	0.274*	3.188	-0.059	-0.8555	0.993***	51.524	-2.836	-2.712
Services	G	0.0014*	2.229	0.793**	4.589	0.086*	0.613			-2.697	-2.593
	T	0.001***	2.610	0.528**	1.990	0.815**	2.335	0.046	0.4542	-2.705	-2.581
	E	-3.719*	-2.792	1.076*	5.544	-0.201	-1.4935	0.489*	2.086	-2.723	-2.598

Source: Computed by the authors

*, ** And *** indicate significant at 10%, 5% and 1% respectively and while “G”, “T” and “E” represents GARCH, TGARCH and EGARCH respectively

The empirical analysis is carried out for sectoral stock returns across the three volatility models considered. The volatility models are partitioned into two: the symmetric model (GARCH (1,1)) and asymmetric models (TGARCH (1,1) and EGARCH (1,1)). Discussing the results, the best model in each group is compared to determine the ‘best from the best’ for each sector. By implication, at the end of the comparisons, a single model is arrived at and adjudged to be the one with the best fit based on the reported information criteria. In other words, the basis of determining the best volatility model is the AIC and SIC,

and the best fitted model is eventually the one with the least values of these criteria.

From the results in Table 4, it is clear that EGARCH (1,1) has the least AIC and SIC values. By further implication, better fit is achieved by the asymmetric model over the symmetric model, and within the class of the former, the TGARCH (1,1) shows less superiority when compared to EGARCH (1,1) model.

It has been a long-term debate that the performance of the stock market can either be dictated or explained by many factors. As earlier pointed out that the EGARCH (1,1c) model has the best fit, the two information criteria employed (AIC and SIC) the most superior model for most of the sectors and the further significance of the asymmetric term. We can conclude that there is evidence of leverage or asymmetric effect for the stock returns of each sector. The significance of the coefficient capturing the leverage effect is so strong that it is largely at 1% for the sectors, with the exemption being only the Health, Information & Communication and Industrial goods sectors at whose significance is at 5%. In addition, the coefficient that measures the asymmetric or leverage effect (Ψ) is seen to be negative for all the sectors except health, ICT and Industrial goods that are positive. For instance, the value is -0.405 for Conglomerate sector while the Construction and Consumer Goods sectors, respectively have -0.0045 and -0.103. For almost all the sectors, it implies that positive shocks in stock returns reduce volatility more than negative shocks having the same magnitude. Bringing this to reality, the occurrence of good news in the stock market with respect to changes in stock prices, volatility tends to reduce than when bad news occurs. By further implications, stock market participants in each sector react more to bad news than they do to good news.

The absence of relative stability in the stock returns of the sectors under consideration as informed by the superiority of the asymmetric model (EGARCH (1,1) over the symmetric model (GARCH (1,1) further indicates that modeling the volatility of the series linearly will produce bias results for which policy recommendations will be misleading. Most stock markets are often faced with many exogenous shocks and external crises that make the stock prices highly unstable. The Nigerian sectoral stock market has proven to be one of such following the inability of the symmetric GARCH model to capture the nature of its volatility. It therefore means that in an attempt to regulate the stock market of each sector, the regulators must put the asymmetric tendency into consideration, noting that positive shocks to stock returns will often not promote volatility as much as negative shocks will do. More so, investors in the market who intend to make forecasts with the available stock price information must take caution of this leverage effect so as

to significantly avoid potential loss on their investments. A wrong assumption that both good news and bad news have equal volatility effect, or that the former leads to higher volatility in stock returns than the latter could adversely cause the investors much.

Mean Reversion Versus Persistence

Another unique feature of the GARCH models is that they also indicate the level of volatility persistence of the series rather than just observing the one that have great impact on volatility between positive shocks and negative shocks of the same magnitude. In order to determine the level of persistence of volatility in stock returns series of the sectors, both the sum of the coefficients of the ARCH and GARCH terms (Φ and θ respectively) are taken. If the sum is less than unity (i.e. $\Phi + \theta < 1$), then there is mean reverting variance process, but a value closer to unity indicates persistence. The coefficients of both ARCH and GARCH terms are found to be significant with at both 1% and 5% with no insignificance from the model selected. The insignificance of the coefficient of the ARCH term if any thus, makes only the coefficient of the GARCH term to be used to infer the persistence of its stock returns. The results are further summarised in Table 4. Interestingly, the results reveal that Agriculture, Conglomerate, Financial service, Health, Industrial goods, and Natural services sectors have their variance process exhibit a slow mean reversion following the sum of the only significant GARCH coefficient being 0.794, 0.546, 0.797, 0.876, 0.86 and 0.995, respectively. However, there is evidence of strong persistence in the stock returns volatility of the remaining sectors following their values (sum of the ARCH and GARCH coefficients) being approximately 1, although the degree of persistence differs. For instance, the service sector, with a value of 1.565, exhibits the strongest volatility persistence, followed by the ICT sector whose value is 1.299. The sector with the least value (1.0496) among those with volatility persistence is Consumer Goods.

Table 4: Summarised Results for the Degree of Persistence and Mean Reversion

Sectors	$\Phi + \theta$	Conclusion
Agriculture	0.794	Mean reversion
Conglomerate	0.546	Mean reversion
Construction	1.222	Persistence
Consumer Goods	1.161	Persistence
Financial Services	0.797	Mean reversion
Health	0.876	Mean reversion
Information and Communication	1.299	Persistence
Industrial Goods	0.867	Mean reversion
Natural Services	0.995	Mean reversion
Oil and Gas	1.267	Persistence

Services	1.565	Persistence
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Source: Computed by the Authors

Note: Φ represents ARCH while θ represents the GARCH

This thus suggests that shocks to the stock returns of the Agriculture, Conglomerate, Financial service, Health, Industrial goods, and Natural services sectors will die out quickly due to the nature of its quick mean reversion. So, the shocks that induce volatility in the returns series do not cause permanent effect. Hence, no strong policies are required to restore normalcy to the volatility of the sector’s stock returns. For other sectors, shocks tend to be permanent on the volatility of the returns series following their high persistence degree. This further implies that shocks tend to cause a permanent effect on the volatility of the stock returns of these sectors. In other words, any market events, whether from domestic or external sources, which induce shocks will cause a permanent volatility of the stock returns, unless strong policies are put in place by the government or relevant policy makers in the market? In the absence of strong and effective measures, the shocks will remain indefinitely.

Findings of the Study

The first objective is to examine the stock price volatility under symmetric conditions using historical stock returns assisted with the use of Generalized Autoregressive Conditional Heteroskedastic models (GARCH) (1,1). Both the ARCH and GARCH effects are statistical significant for all the periods and, therefore, the evidence of volatility initially reported in different table above appears as the sums of the coefficients for the ARCH and GARCH effects are less than one and sometimes greater than one, which is required to have a mean reverting variance and persistence process. However, all the sums are close to one indicating that the variance process only mean for each period reverts slowly ranging from 0.546 to 0.995 and from 0.61 to 0.995, meaning that impacts of shocks to the firm’s stock price volatility die out rather quickly while 1.222 to 1.596 for persistence, meaning volatility take time before reversing to mean.

The second objective is to find evidence of asymmetric effects, the Threshold GARCH model (TGARCH (1,1), and therefore asymmetric models using a modified version of GARCH which is the so-called Exponential-GARCH model (EGARCH (1.1). The results obtained from the EGARCH (1,1) model shows evidence of leverage effects for all the samples considered though positive, not all significant as bad news in the stock market has the potentiality of increasing volatility in the oil price than good news where there

is evidence of short memory volatility in stock price returns using the TGARCH (1,1) model. Similarly, in the case of EGARCH, it has an equivalent interpretation for the positive sign of the coefficient on asymmetry in the TGARCH (1,1) model. Meaning that negative shocks in form of bad news have the tendency of reducing volatility more than positive shocks from good news, thereby suggesting asymmetric effects in the volatility of stock price. This is a special case of asymmetry which is the negative correlation between returns shocks and subsequent shocks to volatility (Black, 1976).

Conclusion and Recommendation

Volatility in stock price may reduce aggregate output temporarily as it delays business investment by raising uncertainty or by inducing expensive sectoral resource reallocation. It was good to consider the valuation of stocks with challenging transmitted by the stock price which is beyond the control of investors. Volatility of stock price could drive movement which could be affected by unpredictable conditions which however has significance consequence of the stock market. The tests of the study are based on the notion that special stocks which are categorised on sector basis could have special characteristics as same as size and growth in different economic phases.

As a result of improvement on the speed and availability of information to the large proportion of institutions, volatility of stock market has actually decreased over decade (Ajao & Wemambu, 2010). By disaggregating the market to form sector, the individual stock volatility of stock price displays a pattern of increasing volatility over time which is persistent and were confirmed by our trend tests of the volatility series. Moreover, the stock volatility of each firm from all the selected sectors, which the study finds out support evidence of behavioural pattern of each sector in different ways. On the average, most sector volatility of stock returns showed that impacts of shocks to the firm's stock price volatility die out rather quickly.

The assessment of volatility of stocks returns is essential to consider effective and efficient for use in Nigeria financial environment. The evidence of volatility clustering imply that high returns are followed by high return and low returns are followed by low returns in tandem with finance theory, is a different case in leverage situation. The asymmetric impact of shocks to stock prices from different sectors given significant negative value indicated that shocks to the stock prices may die out slowly as in the case of Agricultural, Conglomerate, Financial Service, Health, Industrial goods and Natural goods that died out quickly. The positive sign of the asymmetric coefficient of TGARCH model and negative sign of the asymmetric coefficient of EGARCH model confirms that negative market shock has higher impact on volatility of stock returns than positive market shock of equal magnitude. Then the recommendation is that mobilisation of fund should be introduced for the stock market especially to the sectors that the stock returns volatility are persistent

and also for sustainable development e.g. Construction, Consumer goods, ICT, Oil and Gas and Service.

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