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Volatility of the Banking Sector Stock Returns in Nigeria

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Abstract

This paper examines the nature of volatility of stock returns in the Nigerian banking sector using GARCH models. Individual bank indices and the All-share Index of the Nigerian Stock Exchange were evaluated for evidence of volatility persistence, volatility asymmetry and fat tails using data from 3rd January 2006 to 31st December 2012. Results obtained from GARCH models suggest that stock returns volatility of the Nigerian banking sector move in cluster and that volatility persistence is high for the sample period. The results also indicate that stock returns distribution of the banking sector is leptokurtic and that sign of the innovations have insignificant influence on the volatility of stock returns of the banks. Finally, the findings of this study show that the degree of volatility persistence is higher for the All Share Index than for most of the banks.

Keywords: *banking sector; GARCH models; Nigeria; stock return volatility*

1. Introduction

Volatility of stock return is a measure of dispersion around the average return of a security or an index. Investigating behaviour of stock returns volatility gained momentum with the introduction of the Autoregressive Conditional Heteroscedasticity (ARCH) model by Engle (1982) and its generalization by Bollerslev (1986). As a result, many variants of the GARCH model have evolved and understanding of volatility has improved steadily. The understanding of volatility of stock return is of crucial importance to stock market participants as variation of returns from expectation could mean huge losses or gain and hence greater uncertainty (Gujarati, 2003: 856). Again, a portfolio manager may want to sell a stock before it becomes too volatile or a market maker may want to set the bid-ask spread wider when the future is expected to be more volatile. Moreover, stock market regulators are interested in understanding volatility behaviour because high volatile stock market increases uncertainty, which reduces investors' confidence in the market, and lead to high cost of capital.

The behaviour of volatility has extensively been studied, surveyed and many stylized facts documented. One of the first stylized facts of volatility of asset prices is volatility clustering. Mandelbrot (1963) and Fama (1965) both provide evidence to show that large changes in price of an asset are followed by large changes (of either sign) and small changes are often followed by small changes. This behaviour of volatility has been confirmed in both developed and emerging stock markets (see for example, Chou, 1988; Bekaert & Harvey, 1997; Frimpong & Oteng-Abayie, 2006; Emenike, 2010). The implication of volatility clustering, according to Engle and Paton (2001), is that volatility shocks today will influence the expectation of volatility in many periods in the future. Another feature of equity volatility is asymmetry in volatility innovation. Asymmetric phenomenon occurs when a fall in return is followed by an increase in volatility greater than the volatility induced by an increase in return. Black (1976), Christie (1982), Nelson (1991), Glosten, Jagannathan and Runkle (1993) all find evidence of negative relation between volatility and stock returns. Evidence also abounds to show that the unconditional distribution of asset prices have fatter tails than the normal distribution. This feature of asset price increases the probability of extreme values in asset returns. Other volatility features include: volatility is mean reverting; exogenous variables may influence volatility and so on.

Granted that most of these stylized facts have been studied in Nigeria stock market, none of the earlier studies concentrated on the banking sector, which is the most actively traded sector on the Nigerian Stock Exchange (NSE). For instance Securities and Exchange Commission (SEC, 2010), reports amongst others, that of the twenty most actively traded equities, banks are the first five. Similarly, of the twenty most capitalised companies on the NSE, eleven are banks. Recently, Alawiye (2013) reported that the banking sector accounted for 57.98 percent of total trades in February 2013. Given the importance of the banking sector in Nigeria, investors, academics and regulators are interesting in understanding the nature of its volatility. Therefore the question is really whether or not the banking sector of Nigeria displays volatility stylized facts highlighted above.

The objective of this paper is to answer this question using the data of ten individual banks and to compare the volatility estimates of the banking sector stock returns with that market. Such evidence will have implications for academics, practitioners and regulators as it could shed new light on volatility behaviour in the banking sector as well as increase our understanding of the stock returns volatility in Nigeria.The remainder of the paper is organized as follows. Section 2 presents a brief overview of reforms in the Nigerian banking sector. Section 3 provides the methodology and data. Section 4 presents empirical results and discussions, and section 5 provides the concluding remarks.

Brief Overview of the Reforms in Nigerian Banking Sector

Long before the recent global financial crisis, a number of reforms have been introduced in the Nigerian banking system. Apart from the introduction of the World Bank/IMF-supported Structural Adjustment Programme in 1986, which commenced in 1987, the major reforms in the banking sector started with the introduction of the Universal banking model in 2001. In 2004, the Central Bank of Nigeria (CBN) announced a comprehensive reform programme aimed at consolidating the existing banks into fewer, larger, and financially stronger banks. Key elements of the reforms, amongst others, include increase in the minimum capitalization of banks from N2 billion to N25 billion by the end of December 2005; consolidation of banking institutions through mergers and acquisition; adoption of risk-based regulatory framework; automation of the process of rendition of returns by banks and other financial institutions through the electronic Financial Analysis and Surveillance System (CBN, 2005).

With the advent of the global financial crisis, a number of Nigerian banks showed signs of distress as the effects of the economic meltdown reverberated through the global economy. By the last quarter of 2008, the affected banks showed serious signs of liquidity strain as the stock market collapsed by 70% and many Nigerian banks had to be rescued (Sanusi, 2012). In order to stabilize the system and return confidence to the markets and investors, a number of measures were taken with the aim of increasing liquidity and stimulating credit supply in the banking system. These measures included a reduction in the CBN's benchmark Monetary Policy Rate (MPR) by 50 basis points from 10.25% to 9.75%; suspension of liquidity mop-up from September 2008; reduction of the Minimum Liquidity Ratio from 40% to 30%; reduction of the Cash Reserve Ratio from 4% to 2%; expansion of the discount window facility operations by admitting non Federal Government instruments as eligible securities, and extending the tenor of facilities provided under the discount window operations from overnight to 360 days (CBN, 2008).

In addition, the CBN took further remedial measures to protect depositors and creditors, restore public confidence and safeguard the integrity of the Nigerian banking industry. The measures included the removal of errant management of banks, the injection of N620 billion into eight banks in the form of Tier II Capital, introduction of the Asset Management Company to purchase non performing loans of banks, and relaxing the Universal banking model for the new banking model, which demerges deposit money banks into commercial banking (with regional, national or international authorisation), merchant (investment) banking and specialised banks (microfinance, mortgage, non-interest (regional or national) and development finance institutions). The rationale for the shift in banking regime from universal banking is to ensure that banks focus on core banking only, thereby reduce exposure to greater risk involved in covering the entire spectrum in the financial sector.

The second phase of reform advocated by the current CBN governor, tagged the Alpha Project, rests on four pillars: to restore financial stability; institutionalise good corporate governance and risk management culture in banks; protect the interest of depositors; and ensure the financial system drives sustainable economic growth and development (Sanusi, 2011). Our expectation is that all these reforms in the Nigerian banking sector would enhance efficiency of the NSE and reduce risks associated with trading bank stocks.

2. Methodology and Data

ARMA-GARCH specification is employed to model the conditional mean and conditional volatility to investigate the nature of volatility of the banking sector in Nigeria. The GARCH specification, following the ARCH model of Engel (1982) as generalised by Bollerslev (1986), volatility dynamics and the ARMA specifications captures autocorrelation in the conditional mean of the banking series. The ARMA (*p, q*) GARCH(1,1) model is specified as follows:

$$R_t = \sum_{i=1}^{p} \theta_1 R_{t-i} + \sum_{i=1}^{q} \phi_1 \varepsilon_{t-i} + \varepsilon_t \qquad (1)$$

$$\varepsilon_t \sqrt{\sigma_t^2 Z_t}, \quad Z_t \sim D(0, \sigma_t^2)$$

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \qquad (2)$$

Where R_t is the daily rate of return, θ is the AR *(p)* term in the mean equation in order to account for the time dependence in returns, φ is the MA(q) term in the mean equation, φ_t is the residual term in the mean equation, Z_t is the standardised residual sequence of IID random variables with mean zero and variance one, D represents distribution of the stock returns. Since stock returns are not normally distributed, the parameters are estimated using the normal distribution and the Generalised Error Distribution (GED). Shape coefficient of GED $s = 1$ if the return distribution is normal distribution, $s > 1$ indicates evidence of a fat-tail distribution and $c < 1$ suggests a thin-tail distribution. The GED is, therefore, leptokurtic when $1 < c < 2$. In the conditional variance equation (2), ω is the constant variance that correspond to the long run average, α_1 refers to a first order ARCH term which transmits news about volatility from the previous period and β_1, the first order GARCH term, is the new information that was not available when the previous forecast was made (Engle, 2003). If the coefficients of α_1 and β_1 are positive, then shocks to volatility persist over time. The degree of persistence is determined by the magnitude of these coefficients. The GARCH parameters (ω_1, α_1 and β_1) are also expected to be non-negative, with $\omega_1>0$, $\alpha_1>0$, $\beta_1>0$.

Following Glosten, Jagannathan and Runkle (1993), the second conditional variance specification adopted in this paper allows asymmetric effects of good and bad news on the conditional variance specified thus:

$$\sigma_t^2 = \omega + \alpha_1\varepsilon_{t-1}^2 + \beta_1\sigma_{t-1}^2 + \lambda\mu_{t-1}^2 I_{\mu<0}(\mu_{t-1}) \qquad (3)$$

Where, I is an indicator function. In GJR-GARCH model of equation (3), the effects of positive and negative shock on the conditional variance are completely different, the shock effect is asymmetric if $\lambda \neq 0$. If the λ coefficient is positive, negative shocks tend to produce higher volatility in the immediate future than positive shocks. The opposite would be true if λ were negative.

The data used in this study are made up of daily stock prices of the ten banks that comprise NSE Banking Index and the All-Share Index (ASI), which is a proxy for the Nigeria stock market. The NSE Banking Index is designed to provide an investable benchmark to capture the performance of the banking sector. It comprises the most capitalized and liquid banks listed on the NSE. The banks are Access bank Plc, ETI Plc, Diamond bank Plc, Fidelity bank Plc, and GTB Plc. Others are: Skye bank Plc, Sterling bank Plc, United Bank for Africa (UBA) Plc, Union bank Plc, and Zenith bank Plc. The period of study begins from 3rd January 2006 and ends on 31st December 2012. The data were collected from the NSE and transformed to daily stock returns as individual time series variables. The daily returns are proxied by the log difference change in the individual bank stock prices and the ASI as given in equation (4):

$$R_t = 100 * Ln\,(P_t - P_{t-1}) \qquad (4)$$

Where, R_t is the vector of daily stock returns for the individual banks under study and the ASI for day $_t$. P_t and P_{t-1} are the daily stock prices of the banks and the ASI index for day t and $t-1$. Ln is natural logarithm.

3. Empirical Results and Discussions

Descriptive Statistics

Descriptive statistics and ARCH-LM test results are presented in table 1. Accordingly, six banks have negative average returns and the remaining four banks have positive returns. ETI has the highest standard deviation of 5.709, implying an average annualized volatility of 90.25%. The ASI has the lowest standard deviation (1.0468), which translates to an average annualized volatility of 16.55%. The skewness show that the returns distribution of majority of the banks is negatively skewed. The ASI is equally negatively skewed, a common feature of equity returns. The excess kurtosis coefficient is very high in all the bank series, except Diamond Bank PLC. The excess kurtosis for the ASI is moderate (1.85). The kurtosis of a normal distribution is 3, indicating that the normality assumptions for all the series are doubtful. Finally, the Jarque-Bera test for normality of return distribution yields very high statistics for each of the series, thus rejecting the null hypotheses of normally distributed returns at conventional confidence levels.

The ARCH-LM test results show the existence of ARCH effect in the series of Diamond Bank PLC, Fidelity Bank PLC, Skye Bank PLC, and Sterling Bank PLC as well as the ASI series. Presence of ARCH effect in the series is justification to use the GARCH model.

Table 1: Descriptive Statistics and Test for ARCH Effect

	Mean %	**S. D**	**Skew.**	**E. Kurt**	**JB Stat**	**ARCH-LM**	**Observ.**
Access	0.0703	3.4540	5.088	104.870	723961.100	0.0946	1565
			(0.000)	(0.000)	(0.000)	(0.9990)	
Diamond	-0.0230	3.2040	-0.171	0.713	39.584	234.40*	1516
			(0.000)	(0.000)	(0.000)	(0.0000)	
ETI	-0.2650	5.7090	-18.830	510.800	13783785.000	0.0110	1261
			(0.000)	(0.000)	(0.000)	(1.0000)	
Fidelity	-0.0170	3.2790	-1.142	9.711	5926.380	413.80*	1429
			(0.000)	(0.000)	(0.000)	(0.0000)	
GTB	0.0350	3.0080	-2.375	22.858	38064.600	3.5700	1676
			(0.000)	(0.000)	(0.000)	(0.8920)	
Skye	-0.0330	3.4940	-0.265	13.021	9766.300	308.86*	1380
			(0.000)	(0.000)	(0.000)	(0.0000)	
Sterling	-0.0360	4.2270	2.404	60.691	204945.400	280.49*	1327
			(0.000)	(0.000)	(0.000)	(0.0000)	
Union	-0.0520	5.5480	16.490	502.900	17530390.000	0.0200	1656
			(0.000)	(0.000)	(0.000)	(1.0000)	
UBA	-0.0660	3.3970	-1.871	18.751	24421.100	4.6690	1603
			(0.000)	(0.000)	(0.000)	(0.7920)	
Zenith	0.0090	2.9100	-2.802	33.191	71574.700	2.0780	1516
			(0.000)	(0.000)	(0.000)	(0.9780)	
ASI	0.0058	1.0468	-0.043	1.850	238.180	545.27*	1666
			(0.000)	(0.000)	(0.000)	(0.0000)	

Note: P-values are displayed as (.). The ARCH LM tests are conducted under null hypothesis of no ARCH effect and at 95% confidence level using squared returns.

Unit Root Test Results

Table 2 presents the results of the augmented Dickey Fuller (ADF) unit root test, proposed in Dickey and Fuller (1979), for the individual banks' stock returns and the market returns. The unit root tests are restricted to the banks that contain ARCH effects. Unit root test is particularly important to ensure that the series are stationary, as estimate obtained from nonstationary series are not reliable. It is visible from Table 2 that the logarithmic level of all the series contain unit root at conventional confidence level (i.e., $LR_t \sim I(1)$). At first differences, however, all series do not contain unit root (i.e., $R_t \sim I(0)$).

Table 2: Augmented Dickey-Fuller Unit Root Test Results

	Log-Level		**First Difference**	
Variables	**Critical value 5%**	**Computed value**	**Critical value 5%**	**Computed value**
Diamond	-3.41528	-2.244	-3.4153	-18.9903**
Fidelity	-3.41544	-2.082	-3.4154	-20.4644**
Skye	-3.41554	-2.434	-3.4155	-23.0716**
Sterling	-3.41566	-1.943	-3.4157	-25.2625**
ASI	-3.41503	-1.806	-3.4150	-19.7008**

Note: ADF lag length is selected using Akaike information criterion (AIC). ** indicates significant at 99% confidence level.

GARCH (1,1) Model with Normal Distribution Results

Table 3 presents estimates of the GARCH model specified in equation 2 under the assumption of normal distribution in errors. Clearly, the coefficients for long-run average volatility are all significant at 5% for the four banks studied and the market (ASI). The coefficients of ARCH parameters are also significant for all samples, suggesting that previous period's volatility influence current volatility. It can be seen, however, that GARCH effect is significant at 5% for all the variables except Skye bank, which is significant at 10%. Since the parameters are tested 95% confidence level, we reject GARCH effect for Skye bank Plc. The sum of $\alpha_1 + \beta_1$ shows the degree of persistence of volatility shock, and ranges from 0 to 1. The closer the sum to unity, the higher the persistence of volatility shock. As shown in Table 3, all the variables exhibit high volatility persistence ranging from 0.612 for Skye bank to 0.930 for ASI.

Contrary to portfolio theory, which posits that portfolio risk should be lesser than the risks of individual assets that comprise the portfolio, the GARCH effect of ASI is greater than that of the individual banks. Also, Volatility persistence of the ASI is greater than those of the banks. This finding indicates that the banking sector of the NSE is more efficient than the market as a whole. This is not surprising given that out of 299 listed companies on the NSE as at the end of 2008, only 22 are banking companies (NSE, 2012). In addition, a few banking companies in Nigeria top the chart of the most capitalised listed companies and account for over 50 percent of total trades in the NSE (see, SEC, 2010; Alawiye, 2013). This indicates lack of depth and breadth for the other 11 sectors of the NSE as well as inactivity of the majority of the listed firms. If the other sectors are as vibrant as the banking sector, it will be difficult for one sector to account for 50% of trades. The domineering activities of the banking sub-sector of the financial sector on the NSE may have resulted in lesser volatility for the banking companies.

Table 3: Estimates of ARMA (p,q) GARCH (1,1) under Normal Distribution

	ARMA(p,q)-GARCH (1,1)				**Model Diagnostics**		
	ω	α_1	β_1	$\alpha_1+\beta_1$	LM (8)	LB	McL
Diamond	1.324*	0.208*	0.655*	0.863	4.830	86.374	82.92
	[2.72]	[5.20]	[8.02]		{0.77}	{0.32}	{0.42}
Fidelity	1.125*	0.207*	0.684*	0.891	1.920	71.130	131.31
	[3.22]	[5.74]	[11.34]		{0.98}	{0.60}	{0.00}
Skye	5.105*	0.471*	0.141***	0.612	3.800	74.310	17.19
	[6.70]	[8.01]	[1.92]		{0.87}	{0.50}	{1.00}
Sterling	3.301*	0.445*	0.416*	0.866	4.529	59.066	6.74
	[4.10]	[5.63]	[5.03]		{0.81}	{0.91}	{1.00}
ASI	0.056*	0.193*	0.737*	0.930	10.182	25.720	83.55
	[4.57]	[6.64]	[19.76]		{0.25}	{0.11}	{0.41}

Note: LM is ARCH-LM test at lag 8; LB is Ljung-Box Q-statistic with lag 18 and McL is McLeod-Li test at 81 lags chosen by AIC. P-values are displayed as {.} and t-statistics are displayed as [.]. The LM tests are conducted under null hypothesis of no ARCH effect in the standardized residuals, whereas the LB and McL tests are conducted under the null hypotheses of no serial correlation in the standardized residual and squared standardized residual respectively. All the tests are conducted at 5% significant level.

One way to assess the adequacy of a GARCH model is to see how well it fits the data. This is measured using non-negativity constraints and weakly stationary condition of the GARCH process. The estimates of the GARCH parameters displayed in table 3 overcome the non-negativity constraints with $\omega_1>0$, $\alpha_1>0$, $\beta_1>0$ as well as satisfies the condition $\alpha_1 + \beta_1 < 1$, which is necessary and sufficient for the first-order GARCH process to be weakly stationary.

In addition to providing good fit, the estimated standardised residuals should be serially uncorrelated and should not display any remaining conditional volatility (Enders, 2004: Engle & Paton, 2001). The later property was examined by subjecting the standardized residuals to ARCH-LM test[1], whereas the former property was examined using Ljung-Box Q test[2] and Mcleod-Li test[3].

From the results of the diagnostic tests displayed in table 3, it is visible that there is no remaining conditional volatility in the residuals of all the variables. Similarly, there is no serial correlation in the residuals and squared residuals.

GARCH (1,1) Model with Generalized Error Distribution (GED) Results

Table 4 displays estimates of the GJR-GARCH (1,1) model specified in equation 3 under the assumption that the errors follow GED. It can be seen that the three coefficients in the variance equation are significant at 99% confidence level and that they overcome the non-negativity constraints with $\omega_1>0$, $\alpha_1>0$, $\beta_1>0$ as well as satisfies the condition $\alpha_1 + \beta_1 < 1$. It is also glaring that the λ coefficient is positive for all variables except diamond bank Plc, which has a negative and insignificant λ coefficient. Out of the variables with positive λ coefficient, only two variables (ASI & Skye bank) are statistically significant. This suggests that negative shocks tend to produce higher volatility in the immediate future than positive shocks of the same magnitude for ASI and Skye Bank PLC. Fidelity Bank PLC and Sterling Bank PLC show insignificant positive coefficients.

Table 4 shows that both GARCH effect and volatility persistent coefficients of the ASI are greater than those of the banks. According to table 4, the ARCH-LM test results show evidence of no ARCH effects, indicating that there is no more conditional volatility remaining in the standardized residuals. Similarly, Ljung Box test and McLeod-Li test results show support for the null hypotheses of no serial correlation in residuals and squared residuals.

Table 4: Estimates of ARMA (p,q) GJR GARCH (1,1) under Normal Distribution

	ARMA(p,q) GJR-GARCH (1,1)					Model Diagnostics		
	ω	α_1	β_1	$\alpha_1+\beta_1$	λ	LM	LB	McL
Diamond	1.331*	0.219*	0.653*	0.872	-0.020	4.769	86.43	83.55
	[3.01]	[5.34]	[8.98]		[-0.640]	{0.78}	[0.31]	{0.40}
Fidelity	1.225*	0.184*	0.668*	0.852	0.058	4.810	86.21	145.20
	[3.18]	[4.95]	[10.33]		[1.230]	{0.77}	{0.32}	{0.00}
Skye	5.283*	0.471*	0.141	0.612	0.388*	6.890	77.95	28.02
	[8.34]	[5.22]	[1.94]		[3.720]	{0.54}	{0.57}	{1.00}
Sterling	3.309*	0.429*	0.416*	0.845	0.028	4.275	66.06	8.18
	[4.08]	[4.63]	[5.04]		[0.760]	{0.83}	{0.88}	{1.00}
ASI	0.056*	0.188*	0.735*	0.923	0.012*	10.090	11.36	84.00
	[4.52]	[5.59]	[18.69]		[0.726]	{0.25}	{0.18}	{0.38}

Note: The parameters are as explained in table 3.

GJR-GARCH (1,1) Model with Normal Distribution Results

Table 5 presents estimates of the GARCH model specified in equation 2 under assumption of GED in residuals. Here again, the three coefficients in the variance equation are significant at conventional confidence levels and they overcome the non-negativity constraints with $\omega_1>0$,

1 *ARCH-LM is the Engle's (1982) Lagrange multiplier test for the existence of ARCH effects.*

2 *Following Ljung-Box (1978) Q statistic was computed for the standardized residuals and squared standardized residual for lags 6, 12, 18, and 24. But for want of space, we present only LB-Q-statistic of standardized residual for lag 18.*

3 *McLeod-Li test is the test of serial correlation in variance according to McLeod-Li (1993).*

α_1>0, β_1>0 as well as satisfies the condition $\alpha_1 + \beta_1 < 1$. The evidence of volatility persistence displayed in table 3 is also visible here. This implies that there is volatility persistence in stock returns of banking sector of Nigeria, irrespective of the return distribution assumed. It is also clear that the shape coefficients of all the variables are significantly greater than one (1), except Diamond Bank Plc. Shape coefficient greater than 1 is evidence in support of fat-tail. The shape coefficient of Diamond Bank is approximately one, suggesting that its stock returns distribution approximates normal distribution.

The robustness of these findings is checked using the diagnostic tests displayed on the right panel of table 5. In all the variables, there is support for the null hypotheses of no ARCH effect. Similarly, the null hypotheses of no autocorrelation in residual and squared residual, up to lag 24, are accepted for all the variables. However, McLeod-Li test is significant for the squared residual of Fidelity Bank Plc.

Table 5: Estimates of ARMA (p,q) GARCH (1,1) under GED

	ARMA(p,q)-GARCH (1,1)				Model Diagnostics			
	ω	α_1	β_1	S	$\alpha_1+\beta_1$	LM (8)	LB	McL
Diamond	1.358*	0.208*	0.651*	0.973*	0.859	4.140	16.79	77.59
	[2.60]	[5.12]	[7.69]	[18.07]		{0.84}	{0.54}	{0.58}
Fidelity	1.129*	0.216*	0.677*	1.160*	0.893	4.620	16.38	149.70
	[3.03]	[5.29]	[10.31]	[15.76]		{0.79}	{0.56}	{0.00}
Skye	2.224*	0.434*	0.438*	1.484*	0.872	5.910	14.28	19.01
	[2.75]	[5.35]	[3.63]	[21.54]		{0.66}	{0.71}	{1.00}
Sterling	3.814*	0.347*	0.434*	1.351*	0.781	5.170	15.11	6.47
	[3.61]	[5.16]	[4.79]	[27.72]		{ 0.74}	{0.65}	{1.00}
ASI	0.059*	0.226*	0.707*	1.407*	0.933	6.138	19.79	87.71
	[3.92]	[5.62]	[15.03]	[22.05]		{0.63}	{0.34}	{0.28}

Note: The parameters are as explained in table 3.

GJR-GARCH (1,1) Model with Generalized Error Distribution Results

Table 6 presents the results of the GJR-GARCH (1,1) model specified in equation 3 under the assumption that the residuals follow GED. Similar to the results discussed above, ω_1, α_1 and β_1 are significant at conventional levels and they are non-negative with $\alpha_1 + \beta_1 < 1$. The results also indicate that the sign of the innovations has insignificant influence on the volatility of stock returns of the banks and NSE for the period studied.The coefficients on negative residuals squared are small and insignificant, and implies that negative innovation at time *t* does not increase the volatility at *t+1* more than positive innovation.

Table 6: Estimates of ARMA (p,q) GJR GARCH (1,1) under GED

	ARMA(p,q) GJR-GARCH (1,1)					Model Diagnostics			
	ω	α_1	β_1	$\alpha_1+\beta_1$	S	Λ	LM	LB	McL
Diamond	1.362*	0.219*	0.650*	0.879	0.974*	-0.019	0. 4.57	16.52	82.13
	[2.77]	[4.63]	[8.02]		[16.26]	[-0.44]	{0.80}	{0.56}	{0.44}
Fidelity	1.159*	0.199*	0. 671*	0.870	1.152*	0.040	4.810	17.00	142.30
	[2.88]	[4.48]	[9.48]		[17.98]	[0.79]	{0.78}	{0.52}	{0.00}
Skye	2.372*	0.410*	0. 417*	0.827	1.476*	0.060	6.380	15.32	19.19
	[2.59]	[4.79]	[3.12]		[20.54]	[0.61]	{0.60}	{0.64}	{1.00}
Sterling	3.831*	0.326*	0.435*	0.716	1.351*	0.036	0. 9.25	14.16	14.16
	[3.61]	[3.85]	[4.86]		[27.94]	[0.39]	{0.32}	{0.72}	{1.00}
ASI	0.060*	0.216*	0.705*	0.921	1.408*	0.023	6.024	19.61	87.37
	[3.92]	[4.74]	[14.87]		[21.16]	[0.48]	{0.64}	{0.35}	{0.29}

Note: The parameters are as explained in table 3. S is the GED coefficient and λ is the asymmetric coefficient.

The diagnostic tests displayed on the right panel of table 6 show support for the null hypotheses of no ARCH effect, no autocorrelation in residuals and squared residuals, up to lag 24, are accepted for all the variables. However McLeod-Li test is significant for the squared residual of Fidelity bank plc.

4. Conclusions

This paper investigates the nature of volatility in the Nigerian banking sector using GARCH models. The ASI and ten bank indices ranging from 3rd January 2006 to 31st December 2012 were examined for evidence of ARCH process. Four of the bank indices and the ASI show evidence of ARCH effect and were investigated for evidence of volatility stylized facts: volatility persistence, volatility asymmetry and fat-tails. Results obtained from GARCH (1,1) models, under the assumptions of normal and generalized error distributions, suggest that stock returns volatility of the Nigerian banking sector move in cluster as evident in significance of the GARCH coefficients. Volatility persistence is high for all variables ranging from of 0.612 to 0.993. Results of the GED suggest that the stock returns distribution of the banking sector is leptokurtic. The asymmetric coefficients also reveal that the sign of the innovations have insignificant influence on volatility of banks stock returns. Finally, the findings of this study reveal that the degree of volatility persistence is higher for the ASI than for most of the banks, implying that the banking sector is more efficient than the market.

The major policy implication of these findings is the need for adequate regulatory oversight to foster stock market efficiency by directing actions towards increasing disclosure, accountability and transparency in the stock market; sustaining the gradual returning investors' confidence which will increase activity in all sectors of the market; and ensuring maximum protection of investors' interest in the market. These regulatory efforts will not only improve efficiency and reduce volatility but will also entrench the many reforms that are aimed at increasing the depth and breadth of the Nigerian stock market.

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