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EVALUATING VOLATILITY PERSISTENCE OF STOCK RETURN IN THE PRE AND POST 2008–2009 FINANCIAL MELTDOWN

Abstract: The Nigerian stock market capitalization in 2007 was ₦ 13.181 trillion but due to the meltdown, it reduced to ₦ 7.030 trillion in 2009, indicating over 40% loss of investor's value. The government, through Securities and Exchange Commission (SEC) introduced policies to stem the tide of the crisis. Therefore, this study evaluate volatility persistence of return in the market during pre and post meltdown. The mean reverting and half-life volatility shock of the GARCH model under three error distribution was employed. Finding indicates that return on the exchange exhibit high volatility magnitude after the meltdown but very low volatility magnitude before the meltdown. The generalized error distribution give the best estimate for pre and post meltdown. The study recommend the need to strictly monitor, restrict and regulate desperately optimistic noise (rumour) traders (investors) in the market, shorting to make money.

■■■ INTRODUCTION

The Nigerian stock market capitalization in 2007 was ₦ 13.181 trillion but as a result of the meltdown, it reduced to ₦ 7.030 trillion in 2009, indicating more than 40% loss of investor's value (CBN, 2014; Okereke-Onyiuke, 2009; 2010). As a result, the Nigerian government, through Securities and Exchange Commission (SEC) introduced policies to stem the tide of the crisis on the Nigerian stock market. These policies, among others include; reduction of the transaction fees by 50%, daily 1% maximum share price loss and 5% share price gain, which was later put at 5% either way in October 2008. These and other policies were introduced which constitute a break in the structure and operation of the Nigerian stock market effected the volatility persistence of the exchange. Therefore, there is the need to evaluate the effect of the policies introduced on volatility persistence of return in the market during pre and post meltdown. This will give impetus to the effect of the policies introduced and provide a guide into the future.

Consequently, the objective of the study is to evaluate the volatility persistence of stock return in the pre and post 2008–2009 financial meltdown in the Nigerian stock exchange. This study is significant to academia, financial analyst and market participants in decision making on portfolio selection, option pricing, risk management, hedging, etc. Estimating volatility persistence provides the regulators the opportunity to formulate policies that will better the lots of investors who will subsequently make informed investment decision. The study used various volatility models and compare the volatility persistence of the pre and post financial meltdown and also offer the model with the most efficient estimate for the measurement of volatility persistence. The rest of the paper is organized into sections; section two is for literature review and section three is for methodology. Section four is for discussion of findings while section five is for summary, conclusion and recommendations.

LITERATURE REVIEW

Stock return is extensively known to display both stochastic volatility and jumps from time-series studies of stock prices and cross-sectional studies of stock options (Bakshi, Cao & Chen, 1997; Bates, 2000). Volatility denotes the extent of uncertainty (risk) on the magnitude of deviations in share price or return (Campbell, Lettau, Malkiel & Xu, 2001; Shiller, 2000; Pastor & Verone-

si, 2006). It is a statistical extent of the dispersion of returns for a given share price or market index. Volatility can be measured by using the standard deviation or variance between returns from same share price or market index (Chao, Liu & Guo, 2017). An increased volatility denotes that a share price can possibly be spread out over a higher range of prices, indicating that the share price can change radically over a short time period in any direction. A decreased volatility denotes that share price vary at a stable speed over a period, the higher the volatility, the riskier (Fostel & Geanakoplos, 2012).

Theoretically, the fair game model states the stochastic process of with the conditional information set if it has the following property:

$$E(X_{t+1}|I_t) = 0 \tag{1}$$

Expression (1) indicates that average excess return overtime is zero. The fair game model is based on the behaviour of average return over a large sample; the expected return on an asset equals its actual return. Therefore, the wealth of an investor in the previous period should be alike to that of the current period (Samuels & Yacout, 1981). The fair game model for the efficient market hypothesis for expected return is express as:

$$X_{j,t+1} = P_{j,t+1} - E(P_{j,t+1}|I_t) \tag{2}$$

When

$$E(X_{t+1}|I_t) = E\{P_{j,t+1} - (P_{j,t+1}|I_t)\} \tag{3}$$

Where $X_{j,t+1}$ is the excess of market value of security j at time $t+1$, $P_{j,t+1}$, is the actual price of security j at time $t+1$ (with reinvestment in intermediate cash income from the security), $E(P_{j,t+1}|I_t)$ is the expected value operator (expected price of security j that was projected at time t, conditional on the information set I_t or its equivalent, I is the information set that is assumed to be fully reflected in the price of security j at time t, and | is the conditional sign indicating that the price (P) of security j is conditional upon the information set I at time t.

$$Z_{j,t+1} = R_{j,t+1} - E(R_{j,t+1}|I_t) \tag{4}$$

When

$$E(R_{j,t+1}|I_t) = E\{R_{j,t+1} - (R_{j,t+1}|I_t)\} \tag{5}$$

Where $Z_{j,t+1}$ is excess return for security j at period $t+1$ as against the equilibrium expected return projected at period (unexpected or excess return for security j at time $t+1$), $R_{j,t+1}$ is the single period percentage (&) return ($\frac{P_{j,t+1}-P_{j,t}}{P_{j,t}}$) i.e the actual or observed return for security j at time $t+1$ and $E(R_{j,t+1}|I_t)$ is the equilibrium expected return at time $t+1$ projected at time based on the information set I_t.

The set of information (I_t) in (3) is very important when determining the value of the equilibrium expected return $E(R_{j,t+1})$ since the expectation of $R_{j,t+1}$ is conditional on I_t. If return can be described in terms of expected return of fair game model, the efficient market hypothesis will hold if no trading rule can be invented or used to earn abnormal profit built on the information set I_t.

Empirically, volatility model should sufficiently model heteroscadasticity in the disturbance term and capture the stylized fact inherent in the series such as volatility clustering, Auto-Regressive Conditional Heteroscadasticity (ARCH) effect (Engle, 1982). Various studies models heteroscadasticity in the disturbance term and captures the stylized fact inherent in the series (volatility persistence) include (Kuhe, 2018; Kumar & Maheswaran, 2012; Dikko, Asiribo & Samson, 2015; Adewale, Olufemi & Oseko, 2016; Fasanya & Adekoya, 2017; Muhammad & Shuguang, 2015; Kuhe & Chiawa, 2017).

In the presence of structural break, studies assert decrease in volatility persistence after the break (Lamoureux & Lastrapes, 1990; Malik, Ewing & Payne, 2005; Hammoudeh & Li 2008; Muhammad & Shuguang, 2015) for canadian stock market, Gulf Arab countries stock market and some emerging stock markets. In Nigeria, Kuhe (2018), Dikko et al. (2015), Bala and Asemota (2013), Adewale et al. (2016), Kuhe and Chiawa (2017) assert that there exist significant reduction in volatility persistence after structural Breaks.

THE RESEARCH METHODOLOGY AND THE COURSE OF THE RESEARCH PROCESS

The research population is the Nigerian Stock Exchange, the data used was the All Share Index return covering the period of Jan. 2001 till Dec. 2016 divided into pre and post financial meltdown. The weekly return series was calculated as:

$$ASI_{rt} = \frac{(ASI_t - ASI_{t-1})}{ASI_{t-1}} \tag{6}$$

Where ASI_t denote All Share Index at time t and ASI_{t-1} is All Share Index at time $t-1$.

The unit root test, the ARCH effect test and volatility clustering attribute of the All Share Index return series were conducted and analysed to determine the suitability of using the data in GARCH variant models. GARCH models suitably capture the volatility clustering, Auto-Regressive Conditional Heteroscedasticity (ARCH) effect, asymmetry and other related attributes in the series (Engle, 1982).

Model Specification

The GARCH model derived by Bollerslev (1986) replaced the Auto-Regressive Moving Average [ARMA(P)] was given as:

$$\sigma_t^2 = \omega + \sum_{i=1}^{k} \alpha \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta \sigma_{t-i}^2 \tag{7}$$

Where $\alpha, \beta > 0$ and $(\alpha + \beta) < 1$ is to avoid the possibility of negative conditional variance. Equation (7) states that the current value of the current return variance is a function of a constant and values of the previous squared residual from the mean return equation plus values of the previous return variance. The mean return equation and the return variance GARCH model used in this research are as follows:

$$ASI_{rt} = C + \alpha_t ASI_{rt_{-1}} + \varepsilon_{1t} \quad \text{Mean return equation for} \tag{8}$$

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad \text{Return variance equation GARCH model} \tag{9}$$

Where σ_t^2 is the return variance (one–period ahead forecast variance based on past information) of the error term from the mean return equations, ω is the constant, ε_{t-1}^2 is the ARCH term depicting the previous period squared error term from the mean return equations and σ_{t-1}^2 is the GARCH term depicting

the previous period return variance. The GARCH model implies that the current value of the return variance is a function of a constant and values of the squared residual from the mean return equation plus values of the previous return variance.

Volatility clustering means that period of high volatility will give way to normal (low) volatility and period of low volatility will be followed by high volatility which implies that volatility come and go. Mean reversion in volatility implies that there is a normal level of volatility to which volatility will eventually return. Long run forecasts of volatility converge to the same normal level of volatility, no matter when they are made (Engle & Patton, 2001).

The mean reverting form of the GARCH model is given as:

$$\varepsilon_t^2 - \bar{\sigma}^2 = (\alpha + \beta)(\varepsilon_{t-1}^2 - \bar{\sigma}^2) + \mu - \beta\mu_{t-1} \tag{10}$$

Where $\bar{\sigma}^2 = \omega/(1 - \alpha - \beta)$ is the unconditional long run magnitude of volatility persistence and $\mu_t = (\varepsilon_t^2 - \sigma_t^2)$.

The mean reverting rate $\alpha+\beta$ in a good fitted model is usually very close to 1 which controls the magnitude of mean reversion (volatility persistence). If the variance spikes up during crisis, the number of periods until it is halfway between the first forecast and the unconditional variance is $(\alpha + \beta)^k = \frac{1}{2} = 0.5$. Thus, the half-life of volatility shock is given by Zivot and Wang (2006) and Reider (2009) as:

$$k(halflife) = \ln(0.5)/ln(\alpha + \beta) \tag{11}$$

According to the GARCH model and the mean reverting model, it is expected that $\alpha, \beta > 0$ and $(\alpha + \beta) < 1$.

Indicating that the past squared residual of the mean return and the past return variance information individually and jointly cannot influence the current return variance while the addition (sum) of $\alpha + \beta$ reflect the magnitude of volatility persistence in return series.

The conditional distributions for the standardized residuals of returns innovations were estimated under the Gaussian distribution, student's-t distribution, and the Generalised Error Distribution (GED) for the empirical analysis are stated as;

The Gaussian (normal) distribution;

$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}}\, e^{-(x-\mu)^2/\sigma^2} \tag{12}$$

Where μ is the mean value and σ^2 is the variance of the error from the return equation. It considers the mean value (μ) = 0 and variance (σ^2) = 1.

The student's-t distribution;

$$f(x) = \frac{\Gamma[\frac{v+1}{2}]}{\sqrt{v\pi[\frac{v}{2}](1+\frac{x^2}{v})^{\frac{v+1}{2}}}} \tag{13}$$

v is the degree of freedom ($v > 2$), if v tend to ∞, the student-t distribution converges to the Gaussian distribution with kurtosis of $k = \left(\frac{6}{v} - 4\right) + 3$ for all $v > 4$.

The Generalised Error Distribution (GED) distribution;

$$f(x) = \frac{ve^{\frac{1}{2}|\frac{x}{\lambda}|}}{\lambda 2^{\frac{v+1}{v}}\Gamma 1/v}$$

$$\lambda = [\frac{2^{-2/v}\,\Gamma 1/v}{\Gamma 3/v}]^{1/2} \tag{14}$$

Including the normal distribution if the parameter v has a value of two and when $v > 2$ indicates fat tail distribution.

DATA ANALYSIS AND DISCUSSION

Table 1. ADF and PP Unit Root Test Result of All Share Index Return before the Meltdown

ASIR before meltdown	t-Statistics	P-Value	ASIR before meltdown	Adjusted t-Statistics	P-Value
ADF test statistics	-19.35467	0.0000	PP test statistics	-19.39624	0.0000
Critical values: 1%	-3.447580		Critical values: 1%	-3.447580	
5%	-2.869029		5%	-2.869029	
10%	-2.570827		10%	-2.570827	

S o u r c e : author's computations, 2018.

The unit root test result of the All Share Index returns series for the pre-meltdown period of Jan. 2001 till March 2008 as shown in table 1 revealed the P-values for the ADF and Phillip-Perron test statistics is 0.0000. This implies that the null hypothesis should be rejected indicating that the return series before the meltdown is stationery (has no unit root).

Table 2. ADF and PP Unit Root Test Result of All Share Index Return after the Meltdown

ASIR after meltdown	t-Statistics	P-Value	ASIR after meltdown	Adjusted t-Statistics	P-Value
ADF test statistics	-18.59976	0.0000	PP test statistics	-18.63701	0.0000
Critical values: 1%	-3.446443		Critical values: 1%	-3.446443	
5%	-2.868529		5%	-2.868529	
10%	-2.570558		10%	-2.570558	

S o u r c e : author's computations, 2018.

The unit root test result of the All Share Index return series after the meltdown for the periods of April 2009 till Dec. 2016 is presented in table 2. The P-values of 0.0000 under the ADF and Phillip-Perron test statistics indicates that the null hypothesis should be rejected, indicating that the return series after the meltdown has no unit root (stationery series) at 5% significant level.

Table 3. Conditional Return/Mean Equation of All Share Index Return before the Meltdown

Dependent Variable: All Share Index return before meltdown				
Variable	Coefficient	Standard Error	t-Statistic	P-Value
C	0.005581	0.001413	3.950266	0.0001
ASIRBF(-1)	0.009341	0.051184	0.182494	0.8553

S o u r c e : author's computations, 2018.

Table 4. ARCH Effect Result of All Share Index Return before the Meltdown

Test Statistics	Value	P-Value
F-statistics	39.77247	0.0000
Observed R²	36.12409	0.0000

S o u r c e : author's computations, 2018.

Table 3 shows the conditional mean/return equation for the All Share Index return before the meltdown. The ARCH effect test result on the residual of the mean equation of the All Share Index return series before the meltdown is presented in table 4. The F-Statistics and the observed R square P-values is 0.0000. It indicates that the null hypothesis of no ARCH effect is rejected, meaning that there is ARCH effect in the residuals of the mean equation of All Share Index return series on the Nigerian Stock Exchange before the financial crisis.

Figure 1. Volatility Clustering for Weekly All Share Index Return
before the Meltdown
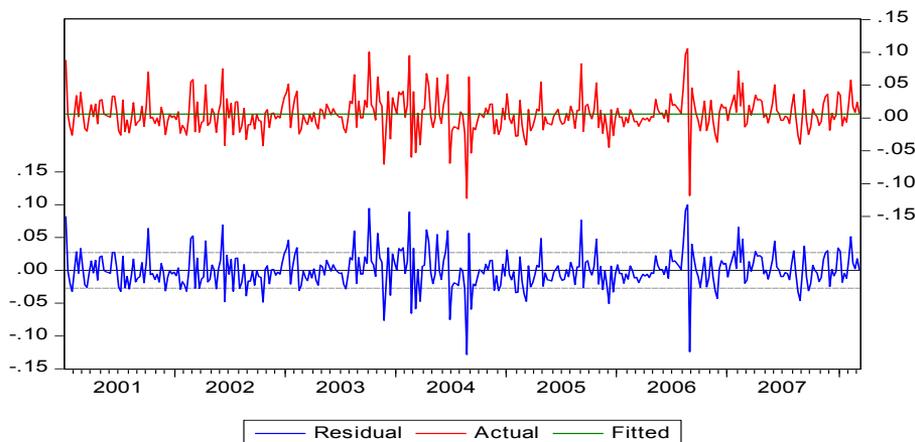
S o u r c e : author's computations, 2018.

In the same vein, the residual of the mean equation also exhibits volatility clustering as shown in figure 1, indicating that return series oscillates around the mean value (mean reverting). Figure 1 reveals that volatility of stock returns before the meltdown is low for consecutive period till 3rd quarter of 2003

(low volatility followed by low volatility for a prolonged period) and volatility is high for another consecutive period till 3rd quarter of 2004 (high volatility followed by high volatility for a prolonged period). This feature of volatility of return for a prolonged period is sustained throughout the period before the meltdown.

Table 5. Conditional Return/Mean Equation of All Share Index Return after the Meltdown

Dependent Variable: All Share Index return after meltdown				
Variable	Coefficient	Standard Error	t-Statistic	P-Value
C	0.001129	0.001540	0.733232	0.4638
ASIRAFT(-1)	0.070749	0.049886	1.418215	0.1569

S o u r c e : author's computations, 2018.

Table 6. ARCH Effect Result of All Share Index Return after the Meltdown

Test Statistics	Value	P-Value
F-statistics	6.682433	0.0101
Observed R^2	6.605304	0.0102

S o u r c e : author's computations, 2018.

The conditional mean/return equation result for the All Share Index return before the meltdown is shown in table 5. The ARCH effect test on the residual of the mean equation of All Share Index return series after the meltdown is shown in table 6. The F-Statistics and the observed R square P-values is 0.0101 and 0.0102 respectively. This indicates that the null hypothesis of no ARCH effect is rejected meaning that there is ARCH effect in the residuals of the mean equation of All Share Index return series on the Nigerian Stock Exchange after the meltdown.

Figure 2. Volatility Clustering
for Weekly All Share Index Return after the Meltdown
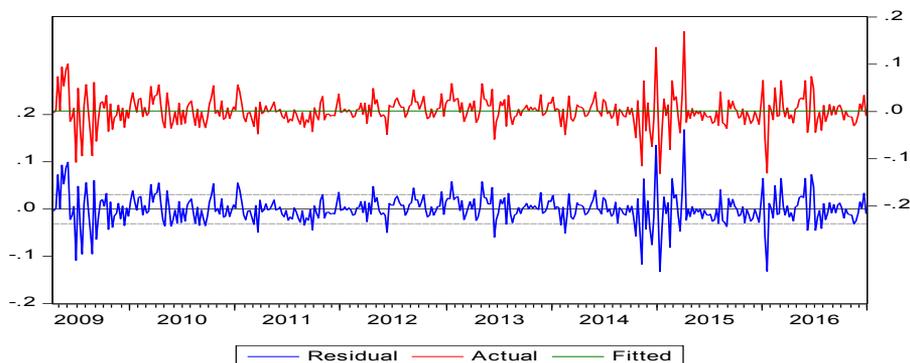
S o u r c e : author's computations, 2018.

In the same vein, the residual of the mean equation also exhibit volatility clustering as shown in figure 2. Figure 2 shows that return series oscillates around the mean value (mean reverting) showing that volatility of stock returns is high for consecutive period till 3rd quarter of 2009 (high volatility followed by high volatility for a prolonged period) and volatility is low for another consecutive period till 3rd quarter of 2014 (low volatility followed by low volatility for a prolonged period). This feature of high volatility followed by high volatility for a prolonged period and periods of low volatility followed by low volatility for a prolonged period is sustained throughout the period after the meltdown.

In conclusion, as indicated in the phases of All Share Index returns, the existence of ARCH effect signifies that the variance of the All Share Index return series of Nigerian Stock Exchange is non-constant for all periods specified. The presence of volatility clustering which is a stylized fact that financial time series exhibit gives the validity and condition necessary for the application ARCH variant models.

The objective of this study is to determine the magnitude of volatility persistence in All Share Index on the Nigerian Stock Exchange using the mean reverting and the half-life form of GARCH model stated in equation (10) and (11). Since $\alpha + \beta$ determine how quickly the variance forecast converges to the unconditional variance, the values of $\alpha + \beta$ from the GARCH model and the half-life estimate are presented in table 7, 8, and 9 for the whole All Share Index return

series, the All Share Index return before the meltdown and All Share Index return after the meltdown under the three (3) distributional assumptions.

Table 7. Mean Reversion and Half-life Estimate for All Share Index Return
(Jan.2001–Dec.2016)

Parameters	Gausian Distribution Estimates	Student's-t Distribution Estimates	Generalised Error Distribution Estimates
α	0.209177	0.306950	0.257695
β	0.731140	0.626216	0.669422
Total	0.940317	0.933166	0.927117
Half-life Estimate	11.26368	10.02061	9.159465
AIC	-4.346110	-4.423912	-4.420061
SC	-4.317776	-4.389911	-4.386059
HQ	-4.335247	-4.410876	-4.407025

S o u r c e : author's computations, 2018.

The sum of ARCH and GARCH terms presented in table 7 are 0.9403, 0.9332 and 0.9271 (volatility is highly persistent and dying very slowly) under the three (3) distributional assumptions and are close to 1. This suggests that the All Share Index return series form Jan. 2001 till Dec. 2016 on the Nigerian Stock Exchange do not follow random walk which indicated that the return series is mean reverting. The average numbers of weeks for the volatility to revert to its long run level measured by the half-life estimate are 11, 10 and 9 weeks under the normal, student's t and the generalized error distributions assumptions respectively. The All Share Index returns volatility appears to have quite long memory but it is still mean reverting and that new shock will impact on return for the period of 11, 10 or 9 weeks depending on the distributional assumption used by investor.

The student's t distribution estimates appears to have the lowest values among the model selection criterions. This suggests that the estimates under the student's t provides the best prediction on the magnitude of volatility persistence in All Share Index return on the Nigerian Stock Exchange in the period of Jan. 2001 till Dec. 2016.

Table 8. Mean Reversion and Half-life Estimate for All Share Index Return
before the Meltdown

Parameters	Gausian Distribution Estimates	Student's-t Distribution Estimates	Generalised Error Distribution Estimates
α	0.275426	0.362653	0.311980
β	0.040516	0.206215	0.170131
Total	0.315942	0.568868	0.482111
Half-life Estimate	0.601588	1.228752	0.950062
AIC	-4.493051	-4.423912	-4.602665
SC	-4.440692	-4.389911	-4.539834
HQ	-4.472264	-4.410876	-4.577721

S o u r c e : author's computations, 2018.

The results in table 8 indicate that the volatility of All Share Index returns is of low persistent (symptomatic of response function to shock dying very fast), with the sum of ARCH and GARCH terms being 0.3159, 0.5689 and 0.4821. The average numbers of weeks for the volatility to revert to its long run level measured by the half-life estimate is one (1) week under the three (3) distributional assumptions. The All Share Index returns volatility on the Nigerian Stock Exchange before the meltdown appears to have short memory and still mean reverting since sum of $\alpha + \beta$ is significantly less than one. This implied that it takes a short time (1 week) for the All Share Index return volatility on the Nigerian Stock Exchange before the meltdown to return to its mean. Indicating that All Share Index return do not follow random walk and new shock impacted on return for a short period of 1 week on the Nigeria Stock Exchange before the meltdown.

The generalized error distribution estimates appears to have the lowest values among the model selection criterions. This suggests that the estimates under the generalized error distribution provides the best prediction on the magnitude of volatility persistence in All Share Index return on the Nigerian Stock Exchange before the meltdown.

Table 9. Mean Reversion and Half-life Estimate for All Share Index Return after the Meltdown

Parameters	Gausian Distribution Estimates	Student's-t Distribution Estimates	Generalised Error Distribution Estimates
α	0.263188	0.251813	0.251136
β	0.651247	0.656755	0.655032
Total	0.914435	0.908568	0.906168
Half-life Estimate	7.749086	7.228902	7.034845
AIC	-4.432640	-4.470225	-4.470240
SC	-4.382933	-4.410577	-4.410591
HQ	-4.412959	-4.446609	-4.446623

S o u r c e : author's computations, 2018.

Table 9 shows the sum of the estimated ARCH and GARCH coefficients (persistence coefficients) for the three (3) distributional assumptions as 0.9144, 0.9086 and 0.9067 which is symptomatic of response function to shock dying very slowly (volatility is highly persistent). This suggested that the All Share Index return series on the Nigerian Stock Exchange after the meltdown do not follow random walk which indicated that the return series is mean reverting. The volatility half-life estimate is 8 weeks under the normal distribution and 7 weeks under the student's t and the generalized error distributions assumptions. The returns volatility appears to have long memory but it is still mean reverting such that new shock will impact the All Share Index return on the Nigeria stock Exchange for the period of 7 to 8 weeks after the meltdown depending on the distributional assumption used by investor.

The generalized error distribution estimates appears to have the lowest values among the model selection criterions. This suggests that the estimates under the generalized error distribution provides the best prediction on the magnitude of volatility persistence in All Share Index return on the Nigerian Stock Exchange after the meltdown.

Therefore, the null hypothesis of no volatility magnitude is rejected; therefore, the All Share Index return on the Nigeria Stock Exchange exhibit high volatility magnitude during the period after the meltdown but exhibit very low volatility magnitude before the meltdown period. Indicating that All Share In-

dex returns on the Nigerian Stock Exchange do not follow random walk and it is mean reverting.

In summary, the objective of this study is to determine the magnitude of volatility persistence in All Share Index on the Nigerian Stock Exchange using the mean reverting and the half-life form of GARCH model stated in in equation (10) and (11)under three (3) error distributional assumptions. Findings show that volatility is highly persistent under the three (3) distributional assumptions for the period of Jan. 2001 till Dec. 2016 and post meltdown period while volatility is low under three (3) distributional assumptions for the pre meltdown period. The average numbers of weeks for the volatility to revert to its long run level measured by the half-life estimate are 11, 10 and 9 weeks under the normal, student's t and the generalized error distributions assumptions respectively for the period of Jan. 2001 till Dec. 2016. The average number of week for volatility to revert after the meltdown is 8 weeks under the normal distribution and 7 weeks under the student's t and the generalized error distributions assumptions while it takes 1 week during the period before the meltdown.

The student's-t distributional assumptions of mean reverting and the half-life form of GARCH model provide the best estimate to measure the magnitude of volatility persistence in All Share Index on the Nigerian Stock Exchange for the sample period (Jan. 2001 till Dec. 2016). On the other hand, the generalized error distributional assumptions provide the best estimate for the period before and after the meltdown.

This implies that investor face higher volatility persistence in return on the Nigerian Stock Exchange during the sample period (Jan. 2001 till Dec. 2016) and after the meltdown. This finding is in agreement with Gil-Alana, Yaya and Adepoju (2015), Ahmed and Suliman (2011), Goudarzi (2013), Osazevbaru (2014), Yin, Tsui and Zhang (2011), Aluko, Adeyeye and Migiro (2016) contradicting the result of Kuhe (2018), Adewale et al. (2016). However, investors face lower volatility persistence before the meltdown in agreement with Okpara and Nwezeaku (2009) but still mean reverting in contrast with Okpara (2010), Nwidobie (2014). The findings is in agreement with Olowe (2009) who ascertain that the market crash accounted for sudden change in variance but in contrast with Goudarzi (2014) that volatility cannot be attributed to effect of sanction on Iran.

■■■ Summary, Conclusion and Recommendations

The objective of the study is to evaluate the magnitude of volatility persistence using the mean reverting and the half-life form of GARCH model on All Share Index return on the Nigerian Stock Exchange. The introduction of the study was done in section one consisting of the background information on the Nigerian Stock Market, the problem emanating from the financial meltdown of 2008––2009 was identified. This form the basis for the research questions, objectives and hypotheses. The study was found to be significant in three least ways; contribute to the debate of market efficiency from the perspective of Nigeria, examine the efficiency of the Nigerian Stock Market using the financial meltdown as event window and creates an avenue for policy mending for the regulators. Section two discusses the conceptual issues of stock return and return volatility. Related theory of fair game model were explained in relation to the study and empirical literatures were also reviewed including Kuhe (2018), Kumar and Maheswaran (2012), Dikko et al. (2015), Adewale et al. (2016), Fasanya and Adekoya (2017), etc.

Section three explained the model specifications using the GARCH model and the mean reverting form of the GARCH model to explain the information set of the residuals (shocks) in All Share Index return. The unit root statistics of ADF and PP were used to examine the stationarity of the return series. Furthermore, the mean equation, based on the market model and the distributional assumptions was stated. Section four present the data, analysis and discussion of the empirical result. The samples were found to be stationary at level [$I(0)$] which is a major requirement of econometrics analysis such as the GARCH model used in this study. The residual of the mean equations for the whole, before and after the meltdown return series also exhibit the presence of ARCH effect and volatility clustering which are requirements for the application of the GARCH family models.

The study concludes, from the findings that volatility is highly persistent for the sample period (Jan. 2001 till Dec. 2016) and after the meltdown while volatility is low during the pre-meltdown period. The results of mean reverting and half-life form of GARCH model shows that All Share Index return volatility is significantly highly persistent and dying slowly for the whole sample period and after the meltdown while volatility is significantly low persistent and dying very fast before the meltdown. The return is mean reverting for the whole

period, before and after meltdown and do not follow random walk. The average number of week for the volatility to revert to its long run level is 10 weeks for the whole period, 1 week before the meltdown and 7 weeks after the meltdown. The findings rejected the null hypothesis which stated that there is no significant magnitude of volatility persistence in the Nigerian Stock Exchange after the financial meltdown.

The implication of this result is that investors on the Nigerian Stock Exchange exhibit herding behavior as a result of their sensitivity and reaction to unexpected news which subsequently led to over and under-pricing of stocks. Thus, stock prices on the Nigerian stock market revolve around the mean price for 1 week in the pre meltdown period before increasing or reducing. However, stock prices revolve around the mean price for 8–10 weeks during the whole sample period and post meltdown period after which the price will move up or down. Thus, the Nigerian stock market is characterized by high degree of risk and uncertainty. This suggests that volatility could have permanent effect on future returns.

The study therefore recommended the need for strict monitoring, restriction and regulation to discourage desperately optimistic noise (rumour) traders (investors) in the market, shorting to make money. Short selling should only involve stocks that are inventoried by institutional investors, including pension funds, insurance companies and index funds (all of whom have long-term plans that are not expected to be negatively affected by liquidity constraints). Only large capitalised stocks should be offered for short selling (they likely to be easy and cheap to borrow) while small capitalised stocks with slight institutional ownership may be difficult and expensive.

This will prevent increase in the price of already overvalued stocks, which can extend the length and degree of bubbles. The exchange should encourage increase in the number of professionals in the market (the stockbrokers and registrars especially) to boost awareness of the importance of the stock market.

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