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# An Appraisal of Stock Market Prices Volatility in an Era of Democracy in Nigeria: 1999 – 2017

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**Abstract**

*This study appraised stock market prices volatility in an era of democracy in Nigeria. It examined the degree and persistence of volatility for the period of July 1999 to December 2017using GARCH (1,1) model. The result of the empirical analysis revealed that the components of ARCH and GARCH terms is close to one and greater than 0.5 which means that stock market prices has high level of volatility in Nigeria for the period before democracy. Therefore, the sum of square error term and conditional variance revealed that stock price volatility exist during the period under review. In the same vein, interest rate, inflation and exchange rate as appeared in the model represent an outside shock that influence the volatility in stock market price in Nigeria.*

**Keywords:** Stock Prices, Volatility, Democracy, Arch, Garch
**JEL Codes**: G24

## 1. Introduction

Stock market serves as a channel through which savings of the surplus earners are mobilized and efficiently allocated to achieve economic growth, the allocation of such surplus fund helps in enhancing capacity utilization and promoting productive activities in the economy. The banking system and the stock exchange works together to achieve the macroeconomic objective of the economy, the bank being the custodian of money help through the stock exchange to pool large and long term capital resources through issuing of shares and stocks by industries in dire need of finance for expansion purposes. Thus, the overall development of the economy is a function of how well the stock market performs (Adeniji, 2018).

Stock market volatility measures the variation in prices of financial asset over time. It basically relates with the dispersion of price changes which is highly important in the determination of returns on investment (Hongyu and Zhichao, 2006) as well as guide the investors in their decision making process since they are not only interested in returns, but also in the uncertainty of such returns (Osazevbaru, 2014). Efforts toward financial sector reforms would be an exercise in futility if volatility of stock market is not addressed. A volatile stock market weakens consumer confidence and drives down consumer spending (Porteba, 2000).

Political system significantly influences financial markets. Stock markets generally respond to new information regarding political decisions that may affect domestic and foreign policy. As such, market efficiency requires that stock markets absorb news and political events into stock prices in anticipation of outcomes of political uncertainty which occur often depending on the political system in operation in the country. Hence positive stock prices volatility is expected following the resolution of political uncertainty. In contrast, if the outcome of the political uncertainty does not allow investors to immediately measure the negative impact on the stock market, then the political outcome constitutes an uncertainty

inducing surprise (Konzelmann, Wilkinson, Fovargue-Davies & Sankey, 2010).

One of the major problems associated with price volatility is the lack of evidence of their origins. The literature follows two main streams: the first stream in the literature claims that price volatility primarily originate in news announcements. This stream is represented by Lee and Mykland (2008) or Lahaye, Laurent and Neely (2009), where the authors claim that the main source of price volatility are corporate statements or macroeconomic news announcements. In addition, many authors, e.g., Hanousek, Kocenda and Kutan (2008), claim that news announcements cannot be perceived absolutely, but rather only relatively with respect to market expectations. The second stream, on the other hand, states that the main source of price volatility is the lack of liquidity on either the bid or the ask side. Lefevre, Grunberg and Bouchaud (2008) and Bouchaud, Kockelkoren and Potters (2004), two representative works, study the so-called excess liquidity and its impact on the formation of price volatility. In addition, this stream opposes the explanation that the primary source of price volatility is revealed news. From these two streams, it cannot be far fetch that, stock prices volatility is a product of uncertainty or political instability flowing from political system through the economic system and then affecting the stock market.

Political system in Nigeria evolved over three eras; the pre-colonial era, colonial era, and the era since independence. In the first years after independence, Nigeria struggled to make the parliamentary style of government work, and then settled into military dictatorships by 1966, interspersed with attempts' to establish a civilian-led democracy. The journey to the present democratic experience in Nigeria commenced on May 29, 1999, when the military government returned power to civilian administration. The agitation for the exit of the military was embarked upon because of the popular belief among the stakeholders in the economy that, democracy, among other things, enhances overall economic performance. Supporters of democracy also argue that the motivation of citizens to work and invest, the effective allocation of resources in the market place, and profit-maximizing private activity can all be maintained in a climate of liberty, free-flowing information and secured control of property (North, 1990). Democratic structures benefit countries in numerous ways. They promote rule of law, open society, freedom of choice, and stable politics, which discourages corruption and extremist policies.

Hence, given the enormous benefits of democracy political system stated above, it is important to answer a question on the extent of the degree and persistence of stock prices volatility in the Nigerian stock market in an era of democracy. Following this introduction, the rest of the paper is structured as follows: section two reviews literature related to the study, section three presents the methodology of the study, while section four presents analysis and interpretation and section five concludes the paper.

**2. Literature Review**

The issue of stock market prices volatility has been examined by authors both in Nigerian context and as well as in other countries.

Political system and the economy are intricately linked with each other and can be said to have significant impact on each other. Political system is full of uncertainty while the economy in its unit or aggregate has its own up and down from which volatility can be generated. Karolyi, (2006) maintained that, in the time of political and civil unrests, it is not uncommon for stock markets to experience increased levels of volatility as the occurrences of major political events signal potential shift in policy which may cause market-wide valuation changes. Hence, the question of whether political factors affect the economy has been an important area of analysis (Nordhaus, 1975; Soh, 1986; Milas, 2000).

Alexakis and Petrakis (1991) conduct a broader study on the Greek market and

document a link between the behavior of stock market index and political factors. Using an event-study analysis, it has been found that when a country is undergoing a change in its political structure, stock prices react with a great deal of uncertainty and adjust negatively during the unrests. However, the market recovers after the initial shocks are over.

Using the Hang Seng index in Hong Kong, Chan and Wei (1996) show that favorable political news produces positive returns whereas unfavorable news causes negative returns. They also note that certain type of stocks and sectors are more vulnerable to political risk than the others. Specifically, their results indicate that political news has an impact on stock market volatility, mainly through the blue-chip (and not the red-chip China-related) shares.

Furthermore, Perotti and Oijen (2001) conduct a study in a number of emerging markets to determine whether political shocks have any effect on stock markets; their findings show drastic changes in excess returns when political risk increased or decreased, indicating political risk is an important pricing factor in the cross-section of stock returns. Jackson (2008) looks at the world economy after 9/11, one of the biggest events in the 21st century, and shows that although the attack took place in the U.S., markets across the world were affected. As the U.S. is a very large part of the world economy, it is not surprising to observe that the effects of 9/11 attack be far greater than other events that were analyzed in prior studies. Chesney, Reshetarb & Karamana, (2011) further investigate the effects of 77 terrorist attacks that occurred in 25 countries on the world economy and confirm that majority of the events had a negative effect on financial markets.

Lobo (1999) examines markets during the U.S. midterm elections in 1998 after a political scandal had been revealed and found there was a great deal of insecurity amongst investors. Brooks, Davidson & Faff (1997) conducted a similar study in South Africa after a significant political change and found comparable results indicating that stock market volatility is closely linked to political instability. Leon, Nicholls & Sergeant, (2000) monitored volatility in Trinidad and Tobago during a period of political uncertainty and show a significant "calming of the markets" once political stability was achieved.

Furthermore, recent researches have examined market efficiency by examining stock market responses to uncertain political events. Most empirical investigations have focused on tracking financial market movements in relation to elections (Gemmill, 1992; Gwilym and Buckle, 1994). Major studies supported the presidential election cycles, in which US stock markets make larger gains in the third and fourth year of a presidential term, while average returns in second year were found to be negative (Huang, 1985; Foerster, 1994; Stoken, 1994; Foerster and Schmitz, 1997).

Other studies have focused on the stock market preference: Academic research on such subject reported that small stock perform better under Democrats relative to Republicans. (Reilly and Luksetich, 1980; Santa-Clara and Vallcanov, 2003).

Osazevbaru (2014) empirically tested for the presence or otherwise of volatility clustering in the Nigerian stock market. Using time series data of share prices for the period 1995 to 2009, the Autoregressive Conditional Heteroscedasticity (ARCH) model and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model were estimated. The result revealed high level of volatility of 1.1783 and quite high. It is suggested that aggressive trading on a wide range of securities be encouraged as this will increase market depth and hence reduce volatility.

Given the above reviewed literature, it is evident that studies on stock market volatility is still very scanty in Nigeria and few that are available did not take into consideration the period of democratic era which is the gap this study want to fill.

**3. Methodology**

The estimation of stock market prices volatility remain one of the main concerns of financial experts, academics and policy makers. Thus, financial economists finds satisfactory mathematical models to estimate volatility. The pioneer study in this field is credited to the study of Engle (1982) who offered modeling conditional volatility by using Autoregressive Conditional Heteroscedasticity (ARCH) process; which is in simple words a function of lagged squared residuals, and the general form of the model is:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \dots\dots\dots\dots\dots 3.1$$

Where $\alpha_0$ is mean, $\alpha_i$ is conditional volatility and $\varepsilon_{t-i}$ is white noise representing residuals of time series.

However, to overcome the weaknesses that were found while applying ARCH models, especially the one related to the inability to exhibit volatility clustering. Another model (3.2) was introduced by Bollerslev (1986) study to modify the version of ARCH models, which is symmetric Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model; that synchronized both lagged squared residuals and lagged variances. In this way GARCH model is allowed to be dependent on both recent variance of itself side by side with past shocks, so at the end it will provide us with volatility clustering. In general the GARCH (p, q) model is presented in the following formula:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \alpha_j \varepsilon_{t-j}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-j}^2 \dots\dots\dots 3.2$$

Where i =0,1,2,3,… p, conditional volatility, $\omega, \alpha_j \; and \; \beta_i$ are non-negative constants with $\alpha_j + \beta_i < 1$ it should be near to unity for an accurate model, $\varepsilon_{t-j}$ is residuals and it is lagged conditional volatility. And the last part of the formula is the main difference in applying both ARCH and GARCH models. Hence, $\alpha_j$ and $\varepsilon_{t-j}^2$ are ARCH components and $\beta_j$ and $\sigma_{t-j}^2$ are GARCH components. In addition, both ARCH and GARCH models depend on a major assumption that is; all of the shock effects on volatility have a symmetric distribution.

However, the empirical results of studies applying ARCH/GARCH model in different countries found that this assumption does not hold true for many stock markets in the world due to the special characteristics for each market. Hence, even though GARCH model did capture many important issues connected to the financial time series, but on the other hand failed to detect other volatility properties for example leverage effect and heavy tailedness too. Thus, modified models were presented by multiple researchers depending on nonlinear distribution so that it can take advantage from the well-known fact which states that; negative shocks have stronger effect on increasing volatility materially in comparison to the effect of positive shocks on volatility in the same magnitude. That all-in return led to build asymmetric GARCH models that can capture the extent of availability for asymmetric distribution, parameter restrictions and leverage effect of stock return. The issue of asymmetric condition was firstly proposed by Black (1976), then across time there have been many empirical studies that provided supporting evidence for Black proposal such as Exponential GARCH (EGARCH) by Nelson (1991), GJR GARCH by Glosten, Jagannathan & Runkle (1993), Threshold GARCH by Zakoian (1994), and many other models were added to GARCH models family to estimate volatility more efficiently.

In accordance to the aforementioned, this study adopts in particular employing EGARCH model due to the ability of this model to show greater impact of volatility by large shocks, also this will be side by side with the classical models of ARCH/GARCH as well, to test and measure both asymmetric and symmetric distribution respectively and to find out the main characteristics of stock prices volatility. The formula of EGARCH can be expressed as following:

$$Ln(\sigma_t^2) = \omega + \sum_{j=1}^{p} \beta_j \ln(\sigma_{t-j}^2) + \sum_{i=1}^{q} \alpha_i \left\{ \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| - \sqrt{\frac{2}{\pi}} \right\} - \gamma_i \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \quad \ldots\ldots 3.3$$

Regarding the EGARCH formula it is easy to figure out its added advantages, in that; firstly, the parameters are guaranteed to be positive since the model uses the log of the variances. And secondly, no restrictions on the parameters included in the formula which are ω, β, γ. Moreover, to make sure that the stationery assumption still holds β must be positive and less than 1, in addition, the value of gamma (γ) is the indicator of leverage effect (asymmetric) and must be both negative and significant.

Consequently, to accomplish the objective of this study our methodology depends mainly on applying the most widely used nonlinear models for specifying volatility; which are ARCH/GARCH models to appraise the stock prices volatility.

Therefore, the first stage in the analysis process is to investigate the presence of ARCH effect in the data by generating regression residuals through applying least square method. Afterwards, next step is to test the availability of volatility clustering by using GARCH.

## 4. Data Analysis and Interpretation

*Unit Root Test*

The stationarity properties of the time series used for analysis are tested using the Augmented Dickey Fuller (ADF) model and the Philips-Perron (PP) model. The results are presented and interpreted in table 4.1:

Table 4.1: Unit Root Test Result for the era of Democracy

| Variable | Augmented Dickey-Fuller (ADF) Test | | | Phillip-Perron (PP) Test | | |
|---|---|---|---|---|---|---|
| | Level | I$^{st}$Differecne | Status | Level | 1$^{st}$Differecne | Status |
| LASI | -1.8777 | -11.49027* | I(1) | -1.8413 | -11.61457* | 1(1) |
| LSMC | -1.6076 | -10.83300 | 1(1) | -1.4887 | -10.8579* | 1(1) |
| INF | -1.5308 | -11.32955* | 1(1) | -1.3961 | -11.3210* | 1(1) |
| INT | -1.7334 | -11.84802 | I(1) | -1.0509 | -11.8228* | 1(1) |
| EXR | -1.1204 | -7.855330 | 1(1) | -1.0398 | -7.4823* | 1(1) |

*Source: Author's Computation from E-views Output 10.0; Notes: * indicates significant at one percent or a rejection of the null hypothesis of no unit root at the one percent level ** indicates significant at five percent or a rejection of the null hypothesis of no unit root at the five percent level. Number of lags was selected using the AIC criterion.*

The result presented in table 4.1 revealed that the variables were not stationary at level meaning that the null hypothesis of unit root cannot be rejected since the asymptotic critical values are less than the calculated values of ADF and PP. After all the variables were transformed to their first difference, the null hypotheses of unit root were rejected and the variables became stationary. Therefore, they are said to maintain stationarity at an integration of order one, I (1).

*Lag Length Selection Test*

The Schwarz information criterion (SC) is used to select the optimal lag length considering the smaller value of information criterion. This is presented in table 4.2:

Table 4.2: VAR Lag Order Selection Criteria

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -4381.98 | NA | 1619388 | 28.48 | 28.54 | 28.51 |
| 1 | -1247.97 | 6145.92 | 0.002765 | .8.29 | 8.66 | 8.44 |
| 2 | -1212.88 | 67.66 | 0.002590 | 8.23 | 8.89 | 8.49 |
| 3 | -1150.69 | 117.91 | 0.002035 | 7.99 | 8.96 | 8.37 |
| 4 | -1098.42 | 97.41 | 0.001706 | 7.84 | 9.08 | 8.32* |

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 5 | -1077.61 | 38.11 | 0.001754 | 7.84 | 9.41 | 8.47 |
| 6 | -1045.63 | 57.70 | 0.001678* | 7.79 | 9.67 | 8.54 |
| 7 | -1022.60 | 40.50* | 0.001704 | 7.80 | 9.98 | 8.68 |
| 8 | -100438 | 31.59 | 0.001785 | 7.85 | 10.33 | 8.84 |

*Source: Author's Computation from E-views Output 10.0*

*Cointegration Test*

Having established that the variables are integrated of the same order, we proceed to testing for cointegration. The Johansen-Juselius procedure was applied in determining the cointegrating rank of the system and the number of common stochastic trends driving the entire system. We report the trace and maximum Eigen-value statistics and its critical values at 5% in the tables 4.3.

Table 4.3: Cointegration result Before Democracy

| Unrestricted Cointegration Rank Test (Trace) | | | | Unrestricted Cointegration Rank Test (Max-Eigen) | | |
|---|---|---|---|---|---|---|
| Hypothesizd No. of CE(s) | Eigen-vale | Trace Statistic | 0.05 Critical Value | Eigen-Value | Maxi-Eigen Statistic | 0.05 Critical Value |
| Hypothesizd No. of CE(s) | Eigen-vale | Trace Statistic | 0.05 Critical Value | Eigen-Value | Maxi-Eigen Statistic | 0.05 Critical Value |
| None * | 0.23 | 84.98 | 69.81 | 0.23 | 37.77 | 33.87 |
| At most 1* | 0.17 | 47.21 | 47.85 | 0.17 | 26.18 | 27.58 |
| At most 2* | 0.08 | 21.02 | 29.79 | 0.08 | 12.64 | 21.13 |
| At most 3* | 0.04 | 8.38 | 15.49 | 0.04 | 6.77 | 14.26 |
| At most 4* | 0.01 | 1.61 | 3.84 | 0.01 | 1.61 | 3.84 |

Denotes rejection of the hypothesis at the 0.05 level.
Trace test indicates 1 cointegrating eqn at the 0.5 level
Max-eigenvalue test indicates 1 cointegrating eqn at the 0.05 level

*Source: Author's Computation from E-views Output 10.0*

The result of multivariate cointegration test based on Johansen and Juselius cointegration technique reveal that there is one cointegrating equations at 5% for the trace statistic and one cointegrating equation for Max-Eigen.

*Measurement of Stock market price volatility*

In other to measure the volatility of stock price, there is need to first check whether the series is characterized, by ARCH effects. To do this, we estimate equation 1 i.e the mean equation in section three and we plot the graph of the residual of the estimated result. These are shown below:

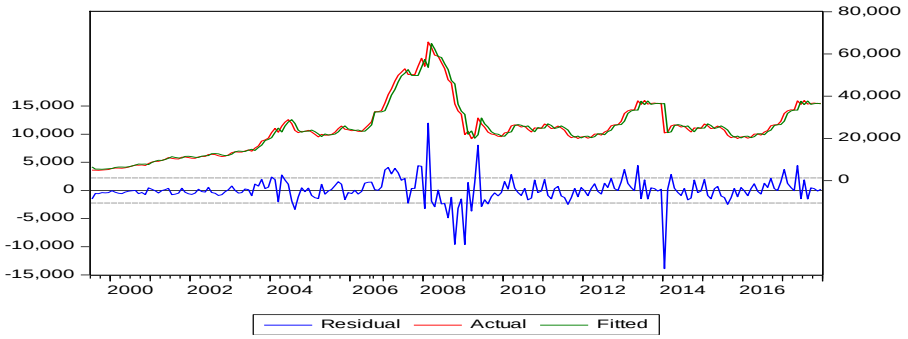


*Figure 4.1: Testing for ARCH (1) Effects in Stock Price before Democracy*

From the time plot of the series in figure 4.1 it is clearly showed that there are period with larger and smaller volatility in the sample with a prolonged period-of low volatility at some point and a prolonged period of high volatility. In other words, the period of high volatility is followed by period of high volatility and the period of low volatility is followed by that of low volatility. Therefore, the above suggest that residual or error term is conditionally heteroscedastic and it can be represented by ARCH and GARCH model.

*4.4.1 Volatility before Democracy Period*

Table 4.4 revealed the result of GARCH(1,1) model using the normal Gaussian distribution, ARCH effect is found significant meaning that information about previous values of stock market influences today's stock market volatility.

Table 4.4: ARCH and GARCH Model Result

| Variable | Coefficient | `Std Error | Z-Statistic | Prob. |
|---|---|---|---|---|
| | | Mean Equation | | |
| C | 0.019833 | 0.004656 | 4.259941 | 0.0000 |
| D(LASI(-1)) | 0.239677 | 0.128650 | 1.863010 | 0.0425 |
| | | Variance Equation | | |
| C | 0.001341 | 0.000690 | 1.944764 | 0.0418 |
| ARCH(-1) | 0.450737 | 0.079643 | 1.892654 | 0.0584 |
| GARCH(-1) | 0.528290 | 0.211311 | 2.500056 | 0.0124 |
| D(INF) | -9.20E-05 | 3.71E-05 | -2.482485 | 0.0130 |
| D(INT) | 0.000370 | 0.000126 | -2.935107 | 0.0033 |
| D(EXR) | -5.03E-05 | 7.84E-06 | -6.410950 | 0.0000 |
| | | Degree/Severity and Persistency | | |
| Degree of Volatility | | 0.979027 | | |
| Mean of Volatility | | 0.022562 | | |
| Persistency D(LASI(-1) | | 0.239677 | | |
| Residual Diagnostic | | | | |
| Jarque Bera | | 109.8788 | | |
| Prob. | | 0.000000 | | |
| Heteroskedasticity Test: ARCH | | | | |
| F- Stat | | 2.03081 | | |
| Prob. | | 0.13450 | | |

*Source: Author's Computation from E-views Output 10.0*

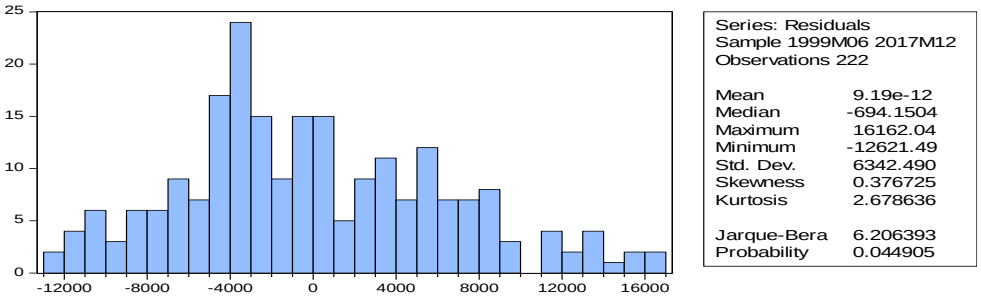


*Figure 1.2 Residual Diagnostic Test*

Also, GARCH effect is found significant which indicates that previous period volatility in stock market price can influence today's stock market price volatility. It then means that stock market price is influenced by ARCH and GARCH factors of its own shocks for the period of study.

Interest rate was also significant meaning that it is an outside shock that influence the volatility in stock market price in Nigeria, while inflation and exchange rate were found to be insignificant which is an indication that, the variable cannot be transmitted to the volatility in stock price.

Residual diagnostic test result shows that, the null hypothesis of no serial correlation, no ARCH and that the residual is normally distributed are accepted as the probability values are less than 5%.

To ascertain the degree and severity of stock price volatility in Nigeria during democracy era, the components of ARCH and GARCH terms estimated in the variance equation presented in table 4.4 are summed. The sum of the ARCH and GARH coefficients ($\alpha_4 + \alpha_5$) is 0.450737 + 0.528290 = 0.979027 which is close to one and greater than 0.5. This is a clear indication that volatility of stock price is present and persistent in Nigeria. Therefore, the sum of the square error term and conditional variance revealed that stock price volatility exist during the period under review.

## 5. Conclusion

This study appraised the existence of volatility in stock prices in an era of democracy in Nigeria. For this purpose, we examined the degree and persistence of stock prices volatility in the stock market for the period of 1999:6 to 2017:12. Using GARCH (1,1) model, the result revealed that the components of ARCH and GARCH terms is close to one and greater than 0.5 which means that volatility is highly present in stock market prices in Nigeria in democracy era. Therefore, the sum of the square error term and conditional variance revealed that stock price volatility exist during the period under review. In the same vein, interest rate, inflation and exchange rate as appeared in the model represent an outside shock that influence the volatility in stock market price in Nigeria.

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