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Federal University Gusau, Zamfara State -Nigeria

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EFFECT OF SELECTED MACROECONOMIC VARIABLES ON STOCK MARKET VOLATILITY IN NIGERIA

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Abstract
The Nigerian economy has undergone significant changes in terms of policies that are aimed at improving the performance of the economy and to be able to attract foreign direct investments. It is observed that the performance of the stock market depends to a large extent on the economic condition of the country hence macroeconomic variables are said to have potential effect on stock market volatility. The study focused on macroeconomic variables such as Economic recession, inflation rate, interest rate and stock market liberalisation using monthly data from February 2010 to September 2022. The Augmented Dickey Fuller (ADF) and Philip Perron (PP) unit root tests were conducted on the time series data. The ARCH LM tests was also carried out and the EGARCH model was estimated under the assumption of normally distributed model. The ARCH tests results revealed that there exists ARCH effects in the NGX stock returns implying the presence of volatility clustering in the return series. The results also revealed that Economic recession has a negative impact on stock market volatility. Inflation rate was also found to have a significant positive effect and Interest rate has a positive insignificance effect on volatility. Stock market liberalisation was also found to have a significant negative impact on volatility. The findings also indicate volatility persistence in the Nigerian stock market and that bad news generates higher volatility than good news of the same magnitude. It is recommended that regulators should come up with policies towards restoration of investor's confidence in the market. Nigerian exchange group should also develop robust risk management strategies to protect investments during economic downturns. This could include diversifying portfolios and using hedging techniques to ensure minimum volatility in stock market prices.

Keywords: Economic recession, Inflation rate, Interest rate, stock market liberalization and volatility

1.0 Introduction

In order to generate and attract investment that supports the nation's economic growth and development, the stock market is essential. It is impossible to overstate the importance of the

stock market in raising and luring capital for long-term investments that would guarantee economic expansion and advancement (Alashi, 2020). Two more important factors that attract stock market investments are the market return and associated risk. Return, however, is uncertain because, in theory, the stock market responds to information availability. In his Efficient Market Hypotheses (EMH), Fama (1970) asserts that because stock prices move swiftly in reaction to new information that enters the market, they accurately reflect all pertinent information about a stock, including risk. Similarly, it is often recognized that when there is good news about the market, the market value of stocks increases, and when there is bad news, it decreases. (Liu et al., 2020; Burns et al., 2012). Furthermore, according to Markowitz (1952), the market's return at any particular moment is determined by the risk involved in that return. As a result, the return increases with risk and vice versa. However, volatility is a term used in finance to quantify risk. It calculates the discrepancy between the price of an asset today and its average price over time. Risk and volatility increase with the number of variations. Accordingly, volatility can reveal the degree of conviction or strength underlying a price movement (Li et al., 2022).

In order to measure volatility, the ARCH/GARCH family models are used. A popular tool for comprehending the time-varying behavior of financial asset returns is the ARCH/GARCH family of models. Engle created the Autoregressive Conditionally Heteroskedastic (ARCH) model of volatility in 1982. It established a connection between the linear sum of the squared disturbances that happened right before and the conditional variance of the disturbance component. However, Bollerslev (1986) developed the univariate Generalized Autoregressive Conditionally Heteroskedstic (GARCH) models since the ARCH model could not relate the conditional variance to the linear combination of different lags of the disturbance element. Since then, more variations of the GARCH family have appeared, including the Threshold GARCH (TGARCH) created by Zakoian (1994), the Exponential GARCH (EGARCH) created by Nelson (1991), the GJR-GARCH created by Glosten, Jagannathan, and Runkle (1993), and the Power GARCH (PGRACH) generalized by Ding, Granger, and Engle (1993). The best models for studying stylized facts about stock market volatility are the ARCH/GARCH models, according to Bollerslev (1986), Chiang and Doong (2001), and Engle (1982). This is because these models can capture the time-varying nature of volatility and offer insights into various volatility behaviors, including asymmetric effects in stock market returns, volatility persistence, and volatility clustering.

In emerging stock markets like Nigeria, the study of stock market volatility has gained more significance because, in comparison to other developed stock markets, these markets seem to be more impacted by the contagion effect of the global financial crises, making them desirable investment destinations. Nonetheless, there are many who argue that the country's economic circumstances have a significant impact on fluctuations in stock values. Sahoo (2020) goes on to say that because the stock market indicates investors' willingness to pay greater prices, it reflects expectations about the state of the economy. An increase in stock prices indicates that investors anticipate significant economic growth, whereas a decrease in stock prices indicates that investors anticipate a slowdown in the economy. Economic data can significantly influence stock market volatility, claim Li et al. (2022). According to Hewamana, Siriwadhane, and Rathnayake (2022), stock market returns are therefore likely to be impacted by shifts in macroeconomic fundamentals like inflation, interest rates, and exchange rates, among other factors.

A number of empirical studies have attempted to establish a link between macroeconomic variables and stock market volatility in both developed and emerging economies. Some of these

studies conducted in foreign countries include Alrimawi and Kaddumi (2021), Alashi (2022) and Pole and Cavusoglu (2021) to mention a few. However, earlier studies on volatility in Nigeria dates back to the 1990's, these studies have attempted to study the determinants of volatility in the Nigerian stock market. A number of empirical evidence suggests that macroeconomic factors affect volatility in the Nigerian stock market and they include Okeobor (2022) and Aremo, Olabisi and Adeboye (2020), among others.

The Nigerian economy has undergone significant changes in terms of policies that are aimed at improving the performance of the economy and to be able to attract foreign investors. Among these reforms is the liberalisation of the Nigerian stock market. Since liberalistion of the market, market indices like the all-share index revealed that the market has been witnessing stable growth. In December 2005 an increase in ASI of 5,092.20 was recorded. And this continued until 2007/2008 when the global financial crisis hit the stock market hard as shown by the substantial fluctuations and shocks. ASI dropped drastically from 57,990.20 in 2007 to 31,450.78 in 2008 and further dropped to 20,827.17 in 2009. But the market started to recover in 2010, with ASI rising to 24,770.52. This was maintained until the official economic recession in Nigeria was declared in the second quarter of 2016 following two quarters of declining domestic output, with ASI falling to 26,874.62. This trend persisted until 2020, when ASI increased to 40,270.72 (CBN, 2020). Furthermore, as opposed to the year before, there was a 42,716.44 increase in ASI in 2021. Similarly, by the end of 2022, the ASI in Nigeria increased to 51,251.06 despite the country's high interest rate and rising inflation (NGX, 2022). As a result of the changes in macroeconomic variables that Nigeria went through during the past periods, in addition to stock price fluctuations this study intends to analyse the effect of macroeconomic variables such as economic recession, inflation rate, interest rate and stock market liberalization on stock market volatility in Nigeria. In view of the above, the study answered the following research questions.

i. To what extent does economic recession have an effect on stock market volatility?
ii. What is the effect of inflation rate on stock market volatility in Nigeria?
iii. How does interest rate affect stock market volatility in Nigeria?
iv. Does stock market liberalistaion have an effect on stock market volatility in Nigeria?

In line with the research questions the follow objectives are put forward by the study:

i. To examine the effect of economic recession on stock market volatility in Nigeria
ii. To analyse the effect of inflation rate on stock market volatility in Nigeria
iii. To determine the effect of interest rate on stock market volatility in Nigeria
iv. To examine the effect of stock market liberalistion on volatility in Nigeria

In order to answer the research questions the following hypotheses have been formulated and tested;

H_{01}: Economic recession has no significant effect on stock market volatility in Nigeria.
H_{02}: Inflation rate has no significant effect on stock market volatility in Nigeria
H_{03}: Interest rate has no significant effect on stock market volatility in Nigeria.
H_{04}: Stock market liberalization has no significant effect on stock market volatility in Nigeria

2.0 Literature Review

Attari and Safdar (2013) looked at how the Karachi Stock Exchange was affected by a few macroeconomic factors between December 1991 and August 2012, including the interest rate, inflation, and gross domestic product. The study employed the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) method. The data's heteroskedasticity and stationarity were examined using the ADF and ARCH tests, respectively. The findings demonstrate the significant impact of macroeconomic factors on stock values. The study was carried out in the setting of the Karachi Stock Exchange in India and lasted until 2012. As a result, a comparable study covering the years 2012–2022 is required in the Nigerian environment.

The impact of shifts in macroeconomic factors on stock market volatility in Nairobi Securities Exchange between 2000 and 2012 is assessed by Kirui et al. (2014). The two-step Engle-Granger approach was employed to determine the cointegrating link between macroeconomic variables and stock returns. The Threshold Genaralized Autoregressive Conditional Heteroscedasticity (TGARCH) model was also used in the study to account for the persistence of volatility and leverage effects in the NSE. The results showed that there is a substantial correlation between exchange rates and stock returns. Additionally, the Treasury bill rate, GDP, and inflation were found to have negligible correlations with volatility. The findings also revealed that the impact of news was asymmetric and there was presence of leverage effects. In addition, there is absence of volatility persistence among all the macroeconomic variables.

Another study on the short- and long-term effects of the money supply, exchange rate, interest spread, and stock market, as well as the volatility issue, was carried out by Qing and Kusairi (2019). Monthly data from January 1997 to August 2018 was used in the study. The investigation, which employed the Autoregressive Distributed Lag (ARDL) and GARCH models, demonstrated that the money supply, real effective exchange rate, and interest spread all had a long-term impact on stock market performance. Short-term stock market performance was positively impacted by the money supply and the actual effective exchange rate. On the other hand, the interest spread had a short-term detrimental impact on the performance of the stock market. However, the study utilized the ARDL which does not adequately capture volatility like the EGARCH which measures volatility persistence and leverage effects.

The association between macroeconomic factors and stock market return was also examined by Mohanty, Khan, and Mohapantra (2021) using annual data on GDP growth rate, unemployment rate, US dollar return, inflation rate, debt to GDP ratio, and manufacturing to GDP ratio. Utilizing the Auto Regressive Distributed Lag (ARDL) model, the connection between the explanatory and dependent variables is examined. A long-term relationship between the variables is confirmed by the Bound test. However, other macroeconomic factors including SML, economic slowdown, and interest rates that can have an impact on stock market performance were not taken into account in this study. In another study, Acharya (2021) used historical data spanning 25 years, from 1994 to 2018, and applied the ARDL techniques to analyze the effects of macroeconomic variables, including real gross domestic product, money supply, interest rate, inflation rate, and exchange rate, on the Nepalese stock market index. The study's conclusions show a favorable relationship between NI and RGDP, NI and MS, and NI and ER. A negative association between the MS and INFR and INTR was also discovered by the study. The results

also showed that the stock market index, interest rate, inflation rate, and the chosen other variables—such as the money supply, real gross domestic output, stock market index, interest rate, inflation rate, and exchange rate—all had co-integrating relationships. The real gross domestic product and the other variables that were chosen, on the other hand, do not appear to have a co-integrating connection. Nevertheless, macroeconomic factors like SML and economic slowdown were left out of the study.

Rana (2021) looked studied the long-term correlation between a few macroeconomic factors and Nepal's stock market results from 1995 to 2020. The study used the ARDL bounds testing and discovered that real GDP growth has a considerable long-term positive impact on stock market returns in Nepal, whereas inflation and exchange rates have a negative impact. Walia (2021) conducted a related study that examined the correlation between macroeconomic factors such GDP growth rate, exchange rate, and stock market volatility in India between May 1 and June 31, 2020. The findings of the linear regression study demonstrated a substantial and robust correlation between the NIFTY 50 stock exchange's stock volatility and macroeconomic factors. However, the study's use of the GARH family models was insufficient to describe volatility persistence and asymmetry. However, Jeyalakshmi Gracy and Mohideen (2021) used data from macroeconomic variables in China and India to analyze the impact of macroeconomic indicators on stock rate volatility. They used the major indices of China and India, such as the SSE Composite index and the Nifty, as well as dependent variables like the money supply, consumer price index, industrial price index, foreign direct investment, balance of trade, gold price, and money supply to determine the impact on stock price volatility. The findings showed that the money supply has a favorable effect on both countries' stock prices whereas the CPI has a negative effect. In China, the aforementioned macroeconomic parameters have a strong direct association with stock rate volatility, but in India, the exchange rate, balance of trade, industrial output index, and foreign direct investment have an inverse relationship with stock rate volatility. Using data from China and India, Jeyalakshmi, Gracy, and Mohideen (2021) examined the impact of factors such the money supply, gold price, balance of trade, foreign direct investment, consumer price index, and industrial price index on stock price volatility. The findings showed that the money supply has a favorable effect on both countries' stock prices whereas the CPI has a negative effect. In China, the aforementioned macroeconomic parameters have a strong direct association with stock rate volatility, but in India, the exchange rate, balance of trade, industrial output index, and foreign direct investment have an inverse relationship with stock rate volatility. Balagobei (2017) investigated how macroeconomic factors affected Sri Lankan stock market performance between 2006 and 2015. The study's findings showed that, with the exception of the money supply, all macroeconomic factors had an impact on stock market performance. The Colombo Stock Exchange's stock market return is negatively impacted by interest rates and factory industry production, but positively by inflation and exchange rates.

On the other hand, Alrimawi and Kaddumi (2021) look into how selected macroeconomic factors such as the inflation rate (INR), interest rate (IR), economic growth rate (EGR), and foreign investment (FI) affect the fluctuations of the Amman Stock Exchange (ASE) between 1999 and 2018. The analysis was conducted using both basic and multivariate linear regression analysis. The findings showed that the combined effects of INR, IR, EGR, and FI on ASE performance are not statistically significant. The findings showed that each of the factors (INR, IR, EGR, and FI) had a statistically significant effect on ASE performance.

However, Alrimawi and Kaddumi (2021) investigate the effects of a few macroeconomic variables on the Amman Stock Exchange (ASE) variations from 1999 to 2018, including the inflation rate (INR), interest rate (IR), economic growth rate (EGR), and foreign investment (FI). Both basic and multivariate linear regression analysis were used in the analysis. The results demonstrated that there is no statistically significant relationship between the combined impacts of INR, IR, EGR, and FI on ASE performance. The results demonstrated that ASE performance was statistically significantly impacted by each of the parameters (INR, IR, EGR, and FI). A study on the effects of macroeconomic variables, including the money supply, GDP, and gold prices, on stock returns in the real estate industry listed on the Indonesian Stock Exchange was conducted by Garnia et al. in 2022. Monthly data from ten real estate equities covering the years 2013–2019 served as the basis for the analysis. The money supply was found to have a negative effect on returns, but GDP had no effect on returns, according to the results of the Panel data regression analysis.

The Efficient Market Hypotheses proposed by Fama (1970, 1991) were adopted in the study. According to this idea, in an efficient market, it is extremely difficult to generate an abnormal return when new information becomes available. Therefore, "an efficient market is one in which prices always fully reflect all available information." Basically, prices respond quickly and fully to new information. Stock prices consequently reflect all of the information that investors now have access to. As a result, there's no reason to believe that prices are either too high or low. Before an investor has time to trade and profit on a fresh piece of information, stock prices fluctuate. In the stock market, the correlation between stock prices and all available information is a key metric for assessing efficiency. Therefore, the Efficient Market Hypothesis (EMH) is used to establish the relationship between stock market volatility, economic recession, GDP, inflation, exchange rates, interest rates, and stock market liberalization. This hypothesis provides a good explanation for the study because it states that the efficiency of the stock market allows for the immediate incorporation of new information into stock prices regardless of the type and magnitude of fluctuations or swings in prices. These factors include the likely effects of removing restrictions to allow free access to the market, fluctuations in the rate of interest charged on loans, the degree of economic recession, and the magnitude of inflation in a nation.

3.0 Research methodology

This section aims to illustrate the methodology used in the research. It covers the research design, data collection and analysis methods, as well as a number of diagnostic and post-estimation tests. Because it works well for investigations conducted after events have occurred and data has already been collected, this study uses an ex-post factor research approach. 108 companies that were listed on the NGX as of December 31, 2022, make up the study's population. Because the sample and the population are the same, the study uses the census sampling technique. For the study period, the Central Bank of Nigeria (CBN) statistical bulletin and CBN Statistics Database provided the monthly All Share index and monthly macroeconomic variable data that make up the time series data. The Phillips-Perron (PP) test (Philips & Perron, 1988) and the Augmented Dickey Fuller (ADF) unit root test (Dickey & Fuller, 1979) were used to evaluate the stationarity of the variables in order to avoid inaccurate results because the study uses time series data.

In the study, the Exponential Generalized Autoregressive Conditional Heteroskedastic Model (EGARCH) was employed, assuming both a generalized error distribution and normal errors. This is supported by the model's ability to capture the asymmetric influence in volatility, as shown by Ogunleye et al. (2021). Additionally, as noted by Ojo and Ojo (2020), the model is

effective in analyzing the correlation between macroeconomic variables like inflation, interest rates, and stock market volatility. The model predicts relationships equally well when high volatility is followed by high volatility and vice versa, especially as the study period includes both the pre- and post-COVID19 periods. It is also capable of capturing logarithmic specification, which allows the positive constraints between the parameters to be relaxed (Bollerslev, 1986). This is in conformity with Su (2010); Ibrahim (2010); Oseni and Nwosa (2011); Olweny and Omondi (2011); Terzungwe (2017); Babangida et al., (ND) and Ioremher et al., (2017).

In line with Mohammed (2016), who noted that the Nigerian stock market's volatility can be better captured when it is modeled to assume that conditional errors are not normally distributed but rather follow a generalized pattern, the normal distribution assumption is used, which is consistent with the most widely used literature on volatility. It is also crucial to apply the GED since returns on financial assets typically show fat tails and high kurtosis rather than a normal distribution pattern. Therefore, the model will not be properly characterized if volatility is tested using solely the EGARCH model (Poon, 2005). Model selection criteria are used to choose the model that most closely matches Nigerian data considering its volatility. Numerous pre and post estimation tests, including the ARCH LM Test for model stability and the heteroscedasticity test, were similarly carried out.

Table 1 variables measurement

S/N	Variable name	Acronyms	Variable description	Apriori
1	Stock Market Volatility	RTN	Monthly Compounded returns on the NGX All Share index	Not applicable
2	Inflation rate	INTGR	Monthly growth rate in Consumer Price index (CPI)	negative
3	Interest rate	INFGR	Monthly growth rate in Real interest rate will be used as a proxy for Interest rate (IR)	negative
4	Stock market liberalisation	SML	monthly growth rate in Portfolio Investment Inflows (FPI) in percentage	positive
7	Economic recession	ECR	Dummy variable which takes the value of '0' if before recession, and '1' otherwise	negative

Source: Authors compilation, 2023.

Model specification

The theoretical model for this study is thus stated below. The conditional mean equation is given as follows:

$$R_t = \beta_0 + \beta_1 \, ECRt + \beta_2 \, INFGRt + \beta_3 \, INTGRt + \beta_4 \, SMLt + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$R_t = \text{Log}\left(\frac{\text{NGXt}-\text{NGXt}-1}{\text{NGXt}-1}\right) \quad \text{.....................} \quad (2)$$

Where:
R_t = Return on NGX All Share Index.
NGX_t = Current values of NGX All Share Index.
NGX_{t-1} = Previous values of NGX All Share Index.
ECR_t = Economic recession
$INTGR_t$ = Growth in interest rate
$INFGR_t$ = Inflation growth rate
SML_t = Stock market liberalization
μ_t= *Random disturbance term*
On the other hand, the conditional variance equation can be stated as follows:

$$\log(\delta_t^{\,2} = \omega + \beta\log\left(\delta^2{}_{t-1}\right) + \gamma\frac{\mu_{t-1}}{\sqrt{\delta^2{}_{t-1}}} + \alpha\left[\frac{|\mu_{t-1}|}{\sqrt{\delta^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] \quad \text{....................} \quad (3)$$

Where:
$\log(\delta_t^2)$ = *Log of Conditional Variance of Return on NGX All Share Index (Stock Market Returns)*
ω = Constant term
$\log\left(\delta^2{}_{t-1}\right)$ = Log of last period forecast variance
γ = Asymmetry or leverage term
On the other hand, the conditional variance equation can be stated as follows:

$$\log(\delta_t^{\,2} = \omega + \beta\log\left(\delta^2{}_{t-1}\right) + \gamma\frac{\mu_{t-1}}{\sqrt{\delta^2{}_{t-1}}} + \alpha\left[\frac{|\mu_{t-1}|}{\sqrt{\delta^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] \quad \text{....................} \quad (3)$$

Where:
$\log(\delta_t^2)$ = *Log of Conditional Variance of Return on NGX All Share Index (Stock Market Returns)*
ω = Constant term
$\log\left(\delta^2{}_{t-1}\right)$ = Log of last period forecast variance
γ = Asymmetry or leverage term

Equation (3) will be estimated using normal and generalized error distributions. The best out of the two models estimated will be selected based on the model selection approach of Akaike Information Criteria (AIC) and Schwarz Bayesian criteria. The AIC is computed based on the following model:

$$AIC = 2l/T + 2k/T \quad \text{..........................} \quad (4)$$

Where
l= Log likelihood
T= Number of observations
k= Number of right-hand sides regressors
The Schwarz Bayesian criteria on the other hand is based on the following model:

$$SIC = 2l/T + (k\log T)/T \quad \text{..........................} \quad (5)$$

Where
SIC= Schwarz Information Criteria
log= logarithm
l, T and k are as previously defined

The model with the lowest values for the AIC and SIC will be preferred when Equation (3) is estimated using normal and generalized error distributions. As a decision rule, the lower the values of AIC and SIC, the better is a model compared to another with relatively higher values (Agung, 2009; Gujarati, 2003). E-Views 10 econometric software was used for the analysis.

4.0 Results and Discussions

Determining the stationarity of the monthly time series data utilised in the study was the first stage in the data analysis process. The following results of the ADF and PP unit root tests were presented with the aim of establishing the stationarity of the study variables:

Table 2: ***ADF and PP Test for Stationarity of Variables***

Variable	***Augmented Dickey Fuller***		***Philip Perron***	
	Test statistic	**Order of integration**	**Test statistic**	**Order of integration**
RETURN	-10.290***	I(0)	-10.293***	1(0)
ECR	-12.247***	I(1)	-12.247***	1(1)
INFGR	-5.669***	I(0)	-10.652***	1(0)
INTGR	-19.096***	I(0)	-19.630***	1(0)
SML	-13.467***	I(0)	-13.426***	1(0)

Source: **EViews10 stationarity test, (2024)**

The result of the Augmented Dickey-Fuller (ADF) stationarity test, conducted on six variables used in the study, demonstrates stationarity across all series at a significance level of 1%. Three variables namely, INFGR, INTGR and SML were found stationary at levels and ECR was found stationary at first difference. In order to come up with a robust conclusion on the stationarity of the variables as used in the study, the Phillips-Perron test was also conducted. The PP tests results revealed that three of the variables namely INFGR, INTGR, and SML were found to be highly significant at levels, while ECR, found to be highly significant at first difference hence the variables are stationary at first difference. The comprehensive conclusion drawn from these stationarity tests is that the time series data, encompassing study variables, is stationary. This implies that these variables exhibit stable characteristics over time, allowing for reliable and meaningful analysis.

Heteroskedasticity Test

To determine whether ARCH effects were present on the residuals, the Engle (1982) ARCH test was used. The ARCH effect's combined significance in the residuals is tested using the T statistical test. The findings of the Engle test for the ARCH effect are shown below in Table 2.

Table 3:

Engle ARCH Test

	Test statistic	Prob
f-statistic	3.473	0.064
chi squared	3.439	0.064

Source: Eviews 10 Engle ARCH test output (2024).

The ARCH LM test results are shown in Table 3. The corresponding p-value is 0.0644 and the F statistic is 3.473. It seems that the p-value of 0.0644 is higher than the significance level of 0.05. This implies proof that the NGX contains noteworthy ARCH advancements. Thus, the study disproves the null hypothesis, which holds that there are no appreciable ARCH effects. The chi square test is another method for checking for the ARCH effects. At the 0.05 level of significance, the chi square's p-value of 0.064 indicates that it is not significant. This further supports the evidence that ARCH effects are present in the NGX, which supports the application of the EGARCH model to analyze volatility in the Nigerian exchange group. To further appreciate the presence of ARCH effects in the NGX monthly return figure 1 presents a plot of the series. This is necessary to further buttress evidence of instability in the variance of the series over time.

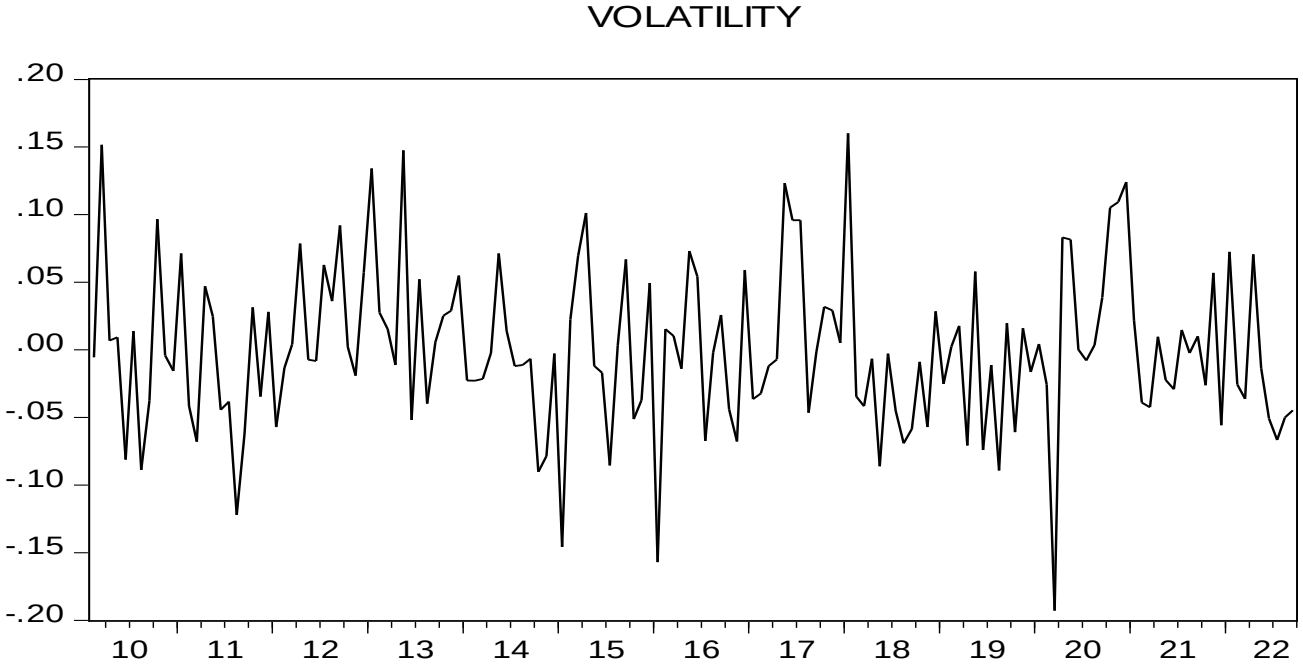

Figure 1 Volatility Trend
Source: Eviews 10, 2023

From figure 1, it is clear that there is high volatility in the NGX this is evident because the variance of the NGX return series is not stable over time some values appears to be below and others above the line of origin. A closer look reveals that from the beginning of the study period there exists high instability in the returns, it shows significant upwards and downward swings from the begining to the end of the period of the study.

Model selection criteria

The best statistical model from a group of possible models is chosen using model selection criteria. To assess various potential models and identify the one that best fits the data, AIC is utilized. A statistical model's quality and fitness are measured by the Schwarz criteria (SC), which is frequently applied when choosing a model from a limited number of models. When it comes to model comparison, AIC and SC are interpreted similarly. In other words, greater evidence for one model over the other is indicated by a higher difference in either AIC or SC. Consequently, the Correction Model Selection Criteria Statistics result is shown in Table 4.

Table 4: ***Error Correction Model Selection Criteria Statistics***

Normally distributed		**Generalised Error Distribution (GED)**	
	Test Statistic		**Test Statistic**
Akaike Information Criteria (AIC)	-2.807	AIC	-2.688
Schwarz Information Criteria (SC)	-2.567	SC	-2.429

Source: Correction Model Selection Criteria Statistics

The Akaike Information Criteria (AIC) for the Normal distribution and Generalised error distribution EGARCH model are presented in table 3. For the normal distribution model, the AIC is -2.807 which is smaller than the AIC of -2.688 for the GED model. In addition, the SC is -2.567 for the normal distribution model and -2.429 for the GED model. Therefore, comparing the EGARCH model estimated under the normal distribution assumption and the one estimated under Generalized Error Distribution assumption, the values of the AIC and SC for model fitness reveal that volatility in the NGX is better explained by the normally distributed model. This is corroborated by relatively lower values for all the model selection criteria under normal distribution. Therefore, the model can be described as better fitted when normally distributed. Thus, the normally distributed EGARCH model was selected.

Test of Hypotheses

The results of the EGARCH normal distribution model are presented in the table below:

Table 5:

EGARCH Normal Distribution model

Variable	**Coefficient**	**P- value**
C	-0.025	0.012
ECR	-0.019	0.031
INFGR	2.339	0.000
INTGR	0.058	0.605
SML	-0.003	0.000
AR(1)	0.055	0.088
ω	-1.208	0.000
α	0.907	0.000
γ	0.063	0.219
β	0.668	0.000
GED	N/A	N/A

Eviews 10 output, 2024. *, ** and *** imply significance at 10%, 5% and 1% levels

Table 5 presents the results from the asymmetric EGARCH (1, 1) model estimated under the assumption of normally distributed conditional errors. The table presented the regression analysis results in respect of the dependent and independent variable (ECR, INFGR, INTGR and SML) which describes the summary of the model and their relationship. The constant, which represents the measure of the average value of the dependent variable has a coefficient of -0.025 and a p-value of 0.012. This implies that the dependent variable (C) is positively and statistically significance. This indicates the level of volatility in the NGX and as such indicates its possibility of changing at any time due to volatility of information and the perception of users about available information in the market.

The table also indicated that ECR has a coefficient of -0.019 and a p-value of 0.031. This means that ECR has a negative and significant effect on volatility in the NGX. Implying that economic recession affects the volatility negatively, a rise in economic recession will result in decrease in volatility. A further look at the table shows that INFGR has a coefficient of 2.339 and probability of 0.000. This implies that inflation growth rate has a positive and significant impact on volatility in the NGX. An increase in INFGR by 1% will result in 2.339% increase in volatility. The table also shows that INTGR has a positive but not statistically significant impact on volatility in the NGX as the coefficient is 0.058 and a probability of 0.605 which is higher than the level of significance at 5%. This suggests that a 1% increase in the interest rate growth rate will result to approximately 5.8% increase in volatility. However, the relationship is not statistically significance and at a result, a change in interest rate growth will not result to proportionate change in volatility of the NGX.

It can also be seen from the table that SML affects volatility negatively. This is evident as the coefficient is -0.03 and a probability of 0.000 show that it is highly significant at the 5% level of significance. This implies that SML has a negative and statistically significant impact on volatility in the NGX. An increase in SML by 1% will result to 0.3% decrease in volatility. Thus, SML is a significant determinant of volatility in the NGX.

The autoregressive term (AR(1)) has a coefficient of 0.055 and a probability of 0.088. The high p-value is a clear indication that the AR(1) is not significant at the 5% level of significance indicating that the coefficient may not statistically contribute to explaining the variance in the dependent variable.

The variance equation's intercept, as shown by, has a p value of 0.000 and a coefficient of -1.208. This only indicates that, at 5%, the intercept of variance is statistically significant and negative. Similarly, the ARCH term, represented by, has a p-value of 0.000 and a coefficient of 0.907. This only indicates that there are significant ARCH effects in the NGX returns, as the ARCH term has a positive and statistically significant value of 1%. Furthermore, with a coefficient of 0.668 and a p-value of 0.000, the GARCH term represented by has a positive value and is statistically significant at 5%. This implies that the NGX returns contain GARCH effects. indicating a significant degree of persistence in the NGX's shock volatility. Nonetheless, the fact that the ARCH term's value is higher than the GARCH term indicates that the NGX does not exhibit a preponderance of volatility clustering. Additionally, the monthly NGX return series exhibit an explosive pattern since the total of the ARCH and GARCH terms is greater than unity. Additionally, the coefficient of asymmetry is 0.063, and a p-value of 0.219 shows that it is positive but not statistically significant at 5%. suggesting that negative shocks affect the conditional variance more than positive shocks of the same magnitude. This only implies that news of a negative or bad quality generates more volatility than news of the same size that is favorable. Stated differently, favorable information, or good news, reduces volatility, but negative market information increases it. This study also implies that the EGARCH is a more effective tool for evaluating NGX volatility due to the asymmetric impacts.

5.0 Conclusion, recommendations and policy implication

The paper examined the effect of some macroeconomic variables such as ECR, INFGR, INTGR and SML on volatility in the NGX using the EGARCH model. The paper compared the EGARH model under the assumption of Normal and Generalised Error distribution model. Based on the AIC and SC criteria the normal distribution model was found to be more suitable for the study.

The EGARCH (1, 1) estimated is consistent with the argument that monthly NGX returns exhibits highly persistent and highly explosive volatility. Based on the findings it was concluded that economic recession has a negative and significant effect volatility in Nigeria. Inflation was found to have a positive and statistically significant impact on stock market volatility in Nigeria implying that an increase in inflation increases volatility in the NGX. Interest rate has a positive but not significant impact on stock market volatility in the NGX implying that increase in interest rate induces more volatility in stock market. And lastly, stock market liberalization has significant negative impact on volatility in the NGX implying that liberalisation has an inverse relationship with volatility an increase in SML decreases volatility in the NGX. Consistent with the notion of volatile stock markets, the study also found evidence of ARCH innovations and volatility clustering in the NGX returns. Furthermore, the positive and significant coefficient of asymmetry is an indication that the Nigerian stock market reacts sharply and more pronounced to negative (bad) news than positive (good) news of the same magnitude. Similarly, the fact that the model fitted better under the normal distribution assumption means that the NGX returns follow a normal distribution pattern.

From the foregoing, it is appropriate to put forward the following recommendations that:

i. Nigerian exchange group should develop robust risk management strategies to protect investments during economic downturns. This could include diversifying portfolios and using hedging techniques to ensure minimum volatility in stock market prices.

ii. Furthermore, the policymakers should formulate policies that are aimed at curbing inflation in order to improve performance of the stock market. Investors and other relevant stakeholders should utilize options and futures to hedge against inflation risks, particularly in sectors that are sensitive to price changes. This can be achieved by ensuring that appropriate hedging strategies are developed to guide investors on how to appropriately hedge against inflation rate risk using futures, options and swaps.

iii. Since interest rates have an insignificant effect on market volatility, emphasize long-term investment strategies over short-term trading based on interest rate changes. This can be achieved through careful and systematic analysis to understand which sectors or stocks are more sensitive to interest rate changes and adjust portfolios accordingly.

iv. In relation to policy policy-making, Nigerian Exchange Group should consider gradual liberalization measures to allow markets to adjust and stabilize. This can be achieved by strengthening regulatory frameworks to ensure that market participants are protected, which can help mitigate volatility during liberalization.

v. Considering the level of progress in the Nigerian stock market, and how the market reacts to external shock the policy makers should institute policies and mechanism that will stabilize significant macroeconomic indicators in order to promote the stock market.

The study's findings will be pertinent to policymakers in order to ensure that they create monetary policies that will fortify the financial system and the economy as a whole. This is a significant policy implication of the research, as policymakers frequently use financial volatility estimation as an indicator of financial market and economic vulnerability. The study's conclusions are also

useful to investors and market participants in managing their portfolios, as volatility is often seen negatively since it implies risk and uncertainty. Nonetheless, if an investor decides to buy at lows and sell at peaks, volatility may be beneficial. It might also help investors in forecasting how market indices and stock prices will behave, which could result in higher earning potential.

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