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MACROECONOMIC DETERMINANTS AND STOCK MARKET VOLATILITY ADMIST THE PERIOD OF ECONOMIC RECESSION IN NIGERIA

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Abstract

The goal of liberalizing the Nigerian stock market was to improve its performance and increase market efficiency. Nonetheless, it appears that the onset of Nigeria's 2016 economic downturn has skewed the degree to which these macroeconomic factors influence volatility on the Nigerian Stock Exchange. Using monthly data from February 2010 to September 2022, the study investigated how the economic slump affected the connection between macroeconomic factors and stock market volatility in Nigeria. The exchange rate and stock market liberalization are the macroeconomic factors that are being studied. The time series data was subjected to the Philip Perron (PP) and Augmented Dickey Fuller (ADF) unit root tests. The ARCH LM tests was also carried out and the EGARCH model was estimated under the assumption on normally distributed. 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 findings also showed that the relationship between macroeconomic factors and stock market volatility is negatively impacted by economic recession. It was discovered that the exchange rate had little effect on volatility. It was also shown that liberalization of the stock market significantly reduced volatility. The results also show that there is persistent volatility in the Nigerian stock market and that negative news causes more volatility than positive news of the same size. It is recommended that authorities develop regulations aimed at reviving investor faith in the market.

Keywords: Economic recession, exchange rate, stock market liberalization, volatility.

1.0 Introduction

The financial sector has a major impact on the growth and development of any economy. In addition to mobilizing capital, a strong financial system will facilitate commerce, mitigate and diversify risk, ease the flow of goods and services, and assist in identifying and funding viable initiatives (Alashi, 2020). A crucial component of the financial sector, the stock market is

necessary for the long-term transfer of capital from the economy's surplus to its deficit components. Furthermore, the success of the stock market is one of the primary drivers of economic growth, according to Oyesiji, Sikiru, and Oladeji (2020), who believe that it is an essential part of the financial system in any economy.

Return is a fundamental idea in the stock market since it indicates how much money investors will make from their investments. Return is ambiguous in theory, however, because the stock market is prone to swings based on a number of factors, including the accessibility of information. Stock prices, according to Fama's (1970) Efficient Market Hypotheses (EMH), respond swiftly to new information that enters the market, reflecting all pertinent information about a stock, including risk. Liu, Manzoor, Wang, Zhang, and Manzoor (2020) proposed that when there is good news regarding the external environment, stocks' relative value increases. Conversely, it declines in response to bad news. Moreover, the market return at any given moment is a function of the risk attached to that return, according to Markowitz (1952). Consequently, if risk rises, so does return, and vice versa. Therefore, investors need to manage the associated risk in addition to investing with the hope of making money. Nonetheless, while making judgments, the majority of investors choose for less hazardous options.

The term volatility is used in finance to quantify risk. Stock price changes are the subject of volatility. It calculates the difference between an asset's current price and its average historical price. Risk and volatility increase with the magnitude of the variance. Nonetheless, there is a claim that the nation's economic circumstances have a significant impact on changes in stock prices. Sahoo (2020) asserts that because the stock market indicates investors' willingness to purchase at greater prices, it represents expectations for the nation's economic status. Li, Wang, Zhang, and Zhu (2022) assert that economic data can significantly affect stock market volatility. When stock prices are rising, it means that investors anticipate rapid economic growth, and when they are falling, it means that investors anticipate slower economic growth. Accordingly, stock market returns are often impacted by shifts in macroeconomic fundamentals including GDP, inflation, interest rates, currency rates, economic recession, stock market liberalization, and other factors (Hewamana, Siriwardhane & Rathnayake, 2022).

The Nigerian Exchange Group (NGX) is among the world's largest emerging stock exchanges. It is called the heartbeat of the economy due to its contribution to the country's economic progress (Aliyu 2014). However, despite its contribution to the economy the Nigerian Exchange Group is characterized as highly volatile (Soludu, 2004). Volatility breeds uncertainty which impairs effective performance of the financial sector as well as the entire economy at large. In 1995, the NGX was liberalised, the liberalisation of the capital market was aimed at repositioning the market in line with the global standards, to meet up with other international markets and increasing the share of capital flow into the market.

Since liberalisation of the stock market the market has been witnessing stable growth. This is evident as the market indices like the All-Share index (ASI) revealed an increase in December 2005 stood at 5,092.20. 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. Additionally, compared 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 had increased to 51,251.06 despite the country's high interest rate and rising inflation (NGX, 2022).

The pattern of swings in market returns throughout the years tends to indicate that volatility in the stock market has been sustained over time. The Arbitrage Pricing Theory (APT) explains that several macroeconomic factors determine the risk and return of an asset. A number of empirical studies have also established the relationship between macroeconomic factors and stock market volatility. Most of existing studies such as Nkoro and Uko (2013), Osagie and Emeni (2015), Oseni and Nwosa (2011), Okechukwu, Mbadike, Geoffrey and Ozurumba (2019), Odiche and Udeorah (2020), Matunrayo and Jonathan (2021), Oluseyi (2015), Udoka, Nya and Basse (2018), Adeyeye, Aluko and Migiro (2018), Ayopo, Isola and Olukayode (ND), Odiche and Udeorah (2020), Okereke and Amusa (2020), Oyesiji, Sikiru and Oladeji (2020), Ogunsakin, and Awe (2020), Dada, Kolapo, Mokuolu and Alabi (2021), John (2021), Okebor (2022), have shown that macroeconomic determinants affect stock market volatility. However the advent of the economic recession in Nigeria since 2016 might have challenged this existing results and it is worrisome that no recent study has paid attention to this important happening. The existing studies mainly focused on the macroeconomic determinants of stock market volatility without taking into account the likely effect economic recession could have on the relationship between these macroeconomic determinants and the Nigerian stock market. In view of the gap identified the study seeks to answer the following research questions:

- i. How much of an impact does economic recession have on the connection between macroeconomic factors and Nigerian stock market volatility?
- ii. How does Nigeria's stock market volatility relate to the exchange rate?
- iii. Does Nigerian stock market volatility change with market liberalization?

The following objectives are proposed by the study in accordance with the research questions:

- i. To ascertain how Nigeria's stock market volatility and macroeconomic factors are impacted by economic downturns.
- ii. To ascertain how the exchange rate affects the volatility of the Nigerian stock market.
- iii. To investigate the impact of stock market liberalization on Nigerian stock market volatility.

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

H0₁: The relationship between macroeconomic factors and stock market volatility in Nigeria is not significantly impacted by economic recession;

H0₂: Nigerian stock market volatility is not significantly impacted by exchange rates; and

H0₃: Nigerian stock market volatility is not significantly impacted by stock market liberalization.

The importance of this research stems from the necessity for investors, policymakers, and market practitioners to comprehend the causes of stock market volatility and its relationships with other macroeconomic factors. Investors can profit from the study's findings since they will help them manage their investment portfolios by helping them understand how macroeconomic indicators can help them accurately estimate changes in stock prices. Policymakers also want to understand the main causes of stock market volatility and the impact that volatility has on the economy as a whole. The development of policies that guarantee macroeconomic and financial stability requires this kind of knowledge. The period of the study is February 2010–September 2022. The country saw many economic disruptions during that time, especially the recession that started in the second quarter of 2016. This is the main reason

the time frame was selected. The availability of data was also a major factor in choosing the time frame. The research uses monthly time series data on all macroeconomic factors, such as stock market liberalization, currency rates, and economic slump.

The remainder of the paper is structured as follows: Section two provides a review of prior empirical studies on stock market volatility, section three addresses methodology and model building, section four examines empirical data, and section five concludes, suggests, and draws policy implications.

2.0 Literature Review

The section was design to review extensively relevant studies in relation to the subject matter of the study. It is made up of conceptual and theoretical review as well as review and syntheses of relevant empirical studies.

Concept of Volatility

Ibrahim (2017) asserts that the volatility of stock market prices can be defined as the potential for price fluctuations. Lakshmanasamy (2021) went on to say that rising volatility is a sign of rising financial risk, which can hurt investors' wealth and asset values. Another name for volatility is market shock. Investors use it to evaluate risk. Certain stylized information has been included in the literature on volatility. An excessively volatile stock market jeopardizes the stability of the market and the economy as a whole in addition to the confidence of investors. When there are extended periods of large price variation followed by extended periods of small price change and periods of minor price change followed by extended periods of significant price change, this is known as volatility clustering. In this paper, volatility is defined as the movement of asset values upward and downward over a specified period of time.

Concept of Economic Recession

According to Madurapperuma (2022), an economic recession is characterized by a decline in business profits for two quarters in a row. Default rates increase when debtors' profits are insufficient to cover their current liabilities. Mohanty and Khan (2021) define a recession as a time in which a country's gross domestic product falls for at least two consecutive quarters when compared quarter-by-quarter. Another name for it is a substantial drop-in national economic activity that lasts longer than a few months and is typically seen in real GDP growth, real income, employment, industrial production, and wholesale-retail sales. A sustained two-quarter decline in GDP has been classified as an economic recession for the purposes of this study. Therefore, economic recession can be seen as the consistent decline in the economic growth rate of a country measured using GDP for at least six-month period measured on quarterly basis.

Concept of Exchange Rate

One macroeconomic factor that is utilized to determine a nation's position in international trade and to regulate international competitiveness is the exchange rate. The value of one currency relative to another is known as the exchange rate, according to Yang and Zeng (2014). It is the price at which foreign currency can be converted into local or domestic currency per unit, according to Osigwe and Uzonwanne (2015). Furthermore, the ratio of a unit of one currency to the quantity of another that can be traded for it is what Obi, Oniore, and Nnadi (2016) defined as the exchange rate. According to Abdullahi, Fakunmoju, Abubarkar, and Giwa (2017), the exchange rate is the difference in value between the currencies of two countries. The value of one country's currency in relation to another, typically expressed in dollars, is known as the exchange rate in this research.

Stock market Liberalization

Financial liberalization is the deregulation of domestic financial markets and the liberalization of the capital account, according to Tswamuno, Pardee, and Wunnava (2007). These measures include removing restrictions on capital inflow and outflow, allowing foreign investors to freely buy and hold domestic equity and repatriate capital, dividends, and interests, doing away with directed credit allocation, denationalizing banks, liberalizing interest rates, opening up the banking industry to new players, and strengthening prudential regulations. The three forms of liberalization they described are capital account liberalization, stock market liberalization, and financial sector liberalization. Central authorities believe that removing restrictions on capital inflows and outflows will lead to an unrestricted flow of cash, which will lower the cost of capital; similarly, risk diversification will be achieved and investment in ventures with higher returns will be encouraged; therefore, the implementation of capital account liberalization policies will counteract low savings rates and increase investment, employment, and economic growth. However, this is usually the first step towards capital account liberalization. Henry (2000) argued that "stock market liberalisation" is a form of capital account liberalisation that is a government initiative to permit foreign investors to engage in a domestic stock market. The process of eliminating barriers to allow for unfettered capital inflows and outflows from the domestic stock market is referred to as stock market liberalization in the context of this study.

Empirical review

The impact of macroeconomic conditions on stock market volatility in both developed and developing countries has been extensively studied. Numerous studies have attempted to establish a connection between macroeconomic factors such as exchange rates, stock market liberalization, and economic recessions (financial crises) and stock market volatility using a variety of approaches and time periods.

The impact of the global financial crisis on the stock returns of China, Japan, India, and the United States was examined by Cenk and Tussupove (2016) using the EGARCH model. Utilized were the daily stock values between January 6, 2006, and April 22, 2011. The research concludes that all equity markets have seen considerable volatility as a result of the crisis. However, the crisis had less of an impact on the Shanghai stock exchange than it did on the US stock market. The absence of a stationarity test on the data could have affected the study's results. The study takes into account a number of nations with varying degrees of economic growth. A study is therefore needed to examine this phenomenon on a country-by-country bases. In a similar study Cenk and Tussupove (2016) found that the global financial crises moderately impact the Chinese stock exchange. But the study did not provide any evidence of stationarity test. Additionally, the impact of the global financial crisis on the Nigerian stock market is examined by Onuoha and Nwaiwu (2016). The data was analyzed using regression analysis, and the findings show that the Nigerian stock market has suffered significantly as a result of the global financial crisis, which is characterized by crises in foreign investment, currency, credit, and liquidity. However, regression modeling is not enough to take volatility into consideration. The ability to determine the true influence of microeconomic factors on stock market volatility may also be impacted by the choice of the time period of global financial crises. Adeyeye et al. (2018) also examined the impact of the global financial crisis on the volatility of the Nigerian stock market during and after the crisis. The study was performed using the GARCH, EGARCH, and ARCH models. The findings suggest that the volatility of the Nigerian stock market is not much impacted by the global financial crisis. After the crisis, market volatility persisted. However, additional factors that may affect stock market volatility were not examined in this study.

In different research, Al Rajab and Azzam (2012) used the GARCH-M model to quantify the impact of the financial crisis on Jordan's stock market volatility and returns. They discovered that during financial crises, stock returns are invariably negative. Not every macroeconomic element that may have affected the behavior of the stock market returns was taken into consideration in the research. Madurapperuma (2022) found that the economic crises, macroeconomic factors, and stock price movement had a steady, long-term association. Other macroeconomic factors that are anticipated to affect stock market volatility, such GDP and SML, were not examined in this study. Furthermore, Faycal and Hamoudi (2022) discovered that macroeconomic variables had a statistically significant positive effect on stock market development, whereas financial crises had a negative impact.

Exchange rate and stock market volatility

Khan (2019) investigates how the exchange rate impacts the stock returns of the Shenzhen stock market by analyzing the short- and long-term connections between the study variables using the ARDL model. The estimated ARDL's results demonstrate that the exchange rate has a substantial and adverse impact on the stock returns of the Shenzhen stock market. Nevertheless, volatility is not taken into account by the ADRL model, which only considers the short- and long-term connections between the variables. Additionally, the impact of other macroeconomic factors on stock market volatility was not taken into account, which might have an impact on the study's conclusions. Jude (2019) discovered that the exchange rate and stock return volatility were statistically related. Nevertheless, as the GARCH family models capture the persistence of volatility in the data, the results would have been more broadly applicable.

In different research, Okechukwu et al. (2019) used the GARCH (1.1) approach on monthly time series data from 1995 to 2014 and discovered that the exchange rate had a substantial positive effect on Nigerian stock market volatility. However, because the data is time series in nature, the study did not check for the existence of a unit root, which could have impacted the results. In addition, the study did not analyze other macroeconomic variables that could likely have an impact on stock market returns, such as economic recession and stock market liberalization. In an emerging stock market over time, Okonkwo (2019) found a causal association between a few macroeconomic factors and stock return volatility. The Granger causality impact assessment test found that the index of industrial output and the exchange rate are statistically significant macroeconomic variables that have a large influence on stock return volatility. However, the Johansen cointegration test does not account for the persistence of volatility.

Fakunmoju, Kasali, and Malik-Abdulmajeed (2020) found that changes in inflation and foreign currency rates were negatively correlated with stock return volatility in the Nigerian stock market. An economic downturn's possible effects on the relationship between variables and volatility were not considered in the study. Sreenu and Naik (2020) employed the autoregressive distributed lag (ARDL) co-integration approach, together with the Error Correction Model, GARCH, and the ARDL's error correction parameterization. The findings show that currency rates and stock market performance are strongly correlated in the near term. Nevertheless, because to its inherent characteristics, the GARCH model only takes into account the size of shocks, not their positivity or negativity. Furthermore, Pole and Cavusoglu (2021) examined the effects of currency rates and inflation, among other macroeconomic factors, on stock return volatility in the Nigerian exchange group using monthly data from 1998 to 2019. The study's research, which employed the ARDL model, demonstrated that exchange rates and inflation had a detrimental effect on stock returns in the Nigerian exchange group.

Additionally, they concluded that both short- and long-term market stock returns were significantly influenced by macroeconomic factors. However, a more trustworthy approach, like the EGARCH model, would have shown volatility asymmetry and persistence in the stock market because the ARDL model ignores volatility.

Additionally, Ngure, Kariuki, and Mburugu (2022) discovered a strong inverse relationship between stock returns and the exchange rate. The results could have been impacted by the study's failure to provide proof of a stationarity test. However, Benson, Habanabakize, and Fortune (2022) found that South African stock prices benefit from the exchange rate. The study did not look at other macroeconomic factors that may affect stock prices, and it was unable to provide proof of the stationarity test.

Stock market liberalization and stock market volatility

Using the autoregressive distributed lag (ARDL), Awoleye and Dada (2018) examined the impact of financial liberalization on stock market volatility in Nigeria between 1986 and 2016. Their findings indicated that financial liberalization had a positive short- and long-term impact on stock market volatility in Nigeria. However, this study only looked at one variable financial liberalization but the results would have been stronger if other factors had been taken into consideration. Additionally, the ADRL model does not take volatility into account. Alrafayia (2018) looked into the connection between information and changes in stock returns after the financial industry was deregulated. The GARCH model's findings showed that the Jordanian Stock Exchange's pattern of fluctuations was impacted by stock market liberalization, and that information flow to the market became more accurate and faster after it was liberalized.

The ARCH (1), GARCH (1,1), and TGARCH models were used by Al-Kandari and Abul (2020) to analyze the market KSE's volatility before and after liberalization. The findings showed that liberalization had decreased the KSE's volatility; as a result, the Kuwaiti Stock Exchange was more volatile before liberalization than it was after. The TGARCH model is the most effective model for evaluating the volatility of the KSE, according to the data. However, additional macroeconomic factors that can influence volatility were not included in the study. In different research, Aremo, Olabisi, and Adeboye (2020) found that while money supply and trade openness have a significant beneficial influence on stock market returns over the long term, foreign direct investment inflows and external debt had no discernible effect on Nigerian stock market returns. If the time frame had been expanded to include Nigeria's present economic downturn, a more compelling outcome would have been obtained. Similarly, Oyesiji, Sikiru, and Oladeji (2020) found that financial liberalization and foreign portfolio investment had a positive effect on stock returns after using the ARCH and GARCH models to examine the effect of financial liberalization on Nigerian stock market returns. However, the ARCH and GARCH models have been criticised for failing to account for volatility persistence and leverage effects.

In summary, the numerous earlier studies that looked into both established and developing markets point to the increasing significance of research on the macroeconomic factors that influence volatility in the modern era. The review also found that the frequency of ARDL, the symmetric ARCH and GARCH models, which are unable to capture asymmetric (leverage) effects, the lack of stationarity tests on time series data, and the failure to capture other significant macroeconomic variables that may have an impact on volatility are the main limitations of the studies. In addition, the advent of economic recession in Nigeria could affect the relationship between these macroeconomic variables and volatility in the Nigerian stock exchange. Hence a gap in the literature which this study seeks to address.

There are different theories that explain the relationship between macroeconomic factors and stock market volatility. However, the present study adopts the Efficient Market Hypotheses and Arbitrage Pricing theory (APT) as the theoretical underpinning for the study.

The Efficient Market Hypotheses

Fama (1970, 1991) promoted the Efficient Market Hypothesis, which maintained that it is very impossible to generate exceptional profits in an efficient market when new information becomes available. Therefore, "a market in which prices always fully reflect all available information is called efficient." This means that prices react to new information quickly and, generally speaking, without bias. Thus, all pertinent information at any particular time is reflected in current stock prices. Therefore, there is no justification for determining that prices are either too high or too low. Prior to an investor having the opportunity to profit from fresh knowledge, stock prices change. This theory explains how the new information is incorporated into the stock prices as quickly as possible hence it explains how the stock market reacts to any new information regarding any of the macroeconomic variables hence it was found suitable for the study.

The Arbitrage Pricing Theory (APT)

The APT is a multifactor asset pricing model that makes the assumption that a linear connection between the expected return of a stock and a number of macroeconomic factors that take systematic risk into account may be used to predict the returns of an asset or stock. The theory contends that returns are a function of several factors and highlights the direct link between returns and their covariance with other important elements. Although the APT theory is applicable to this research because it makes the assumption that risk premiums and a number of macroeconomic factors influence stock returns, the theory is pertinent to the study since it clarifies the connection between macroeconomic factors and stock returns.

Employing both EMH and APT in this study provides a comprehensive framework for analyzing stock market behavior during economic recessions in Nigeria. The EMH offers insights into the overall efficiency of the market in processing information, while APT allows for the dissection of specific macroeconomic factors influencing stock returns. On the other hand, understanding market efficiency and the impact of macroeconomic variables can inform policymakers in designing interventions to stabilize the stock market during economic downturns. However, from the investors point of view, these theories provide a basis for developing strategies that account for macroeconomic risks and for identifying potential arbitrage opportunities arising from mispricing during periods of heightened volatility. Therefore, integrating EMH and APT into the study of macroeconomic determinants and stock market volatility during economic recessions in Nigeria offers a robust analytical framework. This approach enhances the understanding of how macroeconomic factors influence the stock market and aids in the development of informed investment and policy decisions.

3.0 Research methodology

This research uses an ex-post factor design. This is due to the fact that ex post factor study is conducted using data that has already been collected and events that have already occurred. The study's population comprises 108 companies that were listed on the NGX as of December 31, 2022 (NGX, 2022). Because the sample and the population are the same, the study uses the census sampling approach. The monthly All Share index and monthly macroeconomic variable data make up the time series data, which will be taken from the Central Bank of Nigeria (CBN) statistics bulletin and CBN Statistics Database for the research period. The Phillips-Perron (PP) test (Phillips & Perron, 1988) and the Augmented Dickey Fuller (ADF)

unit root test (Dickey & Fuller, 1979) were used to assess the stationarity of the variables because the data utilized is time series in nature. This was done to prevent false findings. The model that assumes normal errors is the Exponential Generalized Autoregressive Conditional Heteroskedastic Model (EGARCH). According to Bollerslev (1986), the EGARCH model is considered the best fit for this study because it can incorporate asymmetries in stock return volatilities, capture logarithmic specification, which allows the relaxation of positive constraints among the parameters, and successfully capture the persistence of volatility shocks. This is in conformity with Su (2010); Ibrahim (2010); Oseni and Nwosa (2011); Olweny and Omondi (2011); Terzungwe (2017); Babangida et al., (ND) and Sokpo et al., (2017). Various pre and post estimation tests will be conducted ranging from, multicollinearity test, heteroscedasticity test and model stability test using ARCH LM Test.

As previously used by Osagie (2012), Maku and Atanda (2010), Mohammed (2016), and Okonkwo and Jude (2019), the dependent variable, stock market volatility (SMV), is measured using return on the monthly All Share Index, which is used to measure the stock market trends and performance for the entire Nigerian stock market. The independent variables, Stock Market Liberalization (SML) and Exchange Rate (EXR), are measured using the monthly growth rate in foreign portfolio investment inflows (FPI) in percentage. The FPI indicates the inflow of foreign capital, hence measuring the degree of financial openness of the nation (Chizoba et al., 2019). Economic recession is measured using a dummy variable which takes the value of '0' for the period before and '1' for the period after.

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

$$R_t = \beta_0 + \beta_1 ECR_t + \beta_2 ERT + \beta_3 SML_t + \mu_t \dots \dots \dots (1)$$

$$R_t = \text{Log} \left(\frac{NGX_t - NGX_{t-1}}{NGX_{t-1}} \right) \dots \dots \dots (2)$$

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
- ERT_t = Exchange rate
- SML_t = Stock market liberalization
- μ_t = Random disturbance term

On the other hand, the conditional variance equation can be stated as follows:

$$\log(\delta_t^2) = \omega + \beta \log(\delta_{t-1}^2) + \gamma \frac{\mu_{t-1}}{\sqrt{\delta_{t-1}^2}} + \alpha \left[\frac{|\mu_{t-1}|}{\sqrt{\delta_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] \dots \dots \dots (3)$$

Where:

- $\log(\delta_t^2)$ = Log of Conditional Variance of Return on NGX All Share Index (Stock Market Returns)
- ω = Constant term
- $\log(\delta_{t-1}^2)$ = 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:

$$AIC = 2l/T + 2k/T \dots\dots\dots (4)$$

Where

l = Log likelihood

T = Number of observations

k = Number of right hand side regressors

The Schwarz Bayesian criteria on the other hand is based on the following model:

$$SIC = 2l/T + (k \log T)/T \dots\dots\dots (5)$$

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

The first step taken to analyze the data for this study was to establish the stationarity of the monthly time series data used in the study. To ensure that the variables are stationary the ADF and PP unit root tests were conducted and the results are presented below:

Table 1: 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)	-0.293***	1(0)
ECR	-12.247***	I(1)	-2.247***	1(1)
ERT	-11.625***	I(1)	-11.663***	1(1)
SML	-13.467***	I(0)	-13.426***	1(0)

Source: EViews10 stationarity test, 2024

The findings of the ADF and PP tests for stationarity performed on the variables are shown in Table 1. The table shows that the variable return has a t-statistic of -10.29 and is statistically significant at 1% based on the results of the ADF test. SML has a t-statistic of -13.426, which is statistically significant at 1% and is stationary at level and integrated in order I(0), while ECR ADF's t-statistic of -12.247 is significant at 1% and was discovered stationary at first difference and integrated in order I(1). However, the table also displays the results of the PP unit root test, and as can be seen, Return is stationary at levels and integrated in order I(0), has a t-statistic of -10.293, and is statistically significant at 1%. With a t-statistic of -12.247, ECR is integrated in order I(1), stationary at first difference, and statistically significant at 1%. SML is stationary at levels and integrated in order I(1), with a t-statistic of -13.249 that is significant at 1%. In line with the methodology of the study the collinearity tests was also conducted. Collinearity refers to the correlation between independent variables in a regression model, and

it can pose challenges to the reliability and interpretability of the regression results. The results are presented in table 2 below.

Table 2: Collinearity Test Results

Variable	Coefficient variance	Centered VIF
C	0.00	Na
ECR	0.00	2.84
ERT	2.57	1.32
SML	5.99	1.00
Mean VIF		9.38

Source: EViews collinearity test Results, 2024

The ECR variable shows a VIF of 2.84, suggesting a moderate level of correlation with other variables. The variable ECR has a centered VIF of 1.32 which shows a more stable correlation when centering is considered. The SML variable shows a VIF of 1.00, indicating a low level of correlation when centering is considered. This suggests a weak correlation with other variables, contributing to the stability of regression coefficients. Overall, the VIF analysis reveals the absence of collinearity among the study variables. This implies that there is no disturbing evidence of variance inflation for any of the independent variables used in this study.

Table 3: Engle ARCH Test

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

Source: EViews Engle ARCH test output 2023.

Table 3 displays the ARCH LM test results. There is a p-value of 0.0644 and a F statistic of 3.473. With a p-value of 0.0644, the significance level of 0.05 seems to be exceeded. This implies proof that the NGX has substantial ARCH innovations, thus we reject the null hypothesis, which holds that there are no appreciable ARCH effects. The chi square test may also be used to check for the ARCH effects. At the significance level of 0.05, the chi square's p-value of 0.064 indicates that it is not significant. The EGARCH model is used to account for volatility in the Nigerian stock market because this further supports the suggestion that ARCH effects are present in the NGX.

The EGARCH model was also estimated under the assumption of normal errors distribution and the results are presented in table 4.

Table 4: EGARCH Normal Distribution model

Variable	Coefficient	P- value
C	-0.025	0.012
ECR	-0.019	0.031
ERT	0.000	0.165
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

Source: Eviews 10 output, 2023. *, ** and *** imply significance at 10%, 5% and 1% levels

Table 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, ERT, and SML) which describes the summary of the model and their relationship. The first part presents the result for specific individual variables while the second part presents vital statistics of the model estimated. Results from the first part of the table shows that 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 0.629 is negative and statistically insignificant.

Additionally, the table showed that ECR has a p-value of 0.031 and a coefficient of -0.019. This indicates that the link between macroeconomic factors and stock market volatility is significantly and negatively impacted by ECR. It is implied that economic recession has a negative impact on stock market volatility, and that an increase in economic recession will cause stock market volatility to decline. Furthermore, the table indicates that ERT has a 0.000 coefficient and a non-significant p-value of 0.165. This suggests that the effect of exchange rate on stock market volatility is not significant. Thus a 1% increase in exchange rate will result in 0% increase in stock market volatility. However, being insignificant implies that the effect of exchange rate on stock return volatility is not pronounced during the sample period.

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 intercept of the variance equation as represented by ω has a coefficient of -1.208 and a p value of 0.000. This simply means that the intercept of variance has a negative and is statistically significant at 5%. In the same vein, the ARCH term as denoted by α has a coefficient of 0.907 and a p-value of 0.000. This simply means that the ARCH term has a positive and statistically significant at 1% implying strong presence of ARCH effects in the NGX returns.

Additionally, with a coefficient of 0.668 and a p-value of 0.000, the GARCH term has a positive and is statistically significant at 5%. This shows that the NGX returns contain GARCH effects, suggesting a significant degree of persistence in the NGX's shock volatility. However, the NGX does not exhibit dominance of volatility clustering, as indicated by the ARCH term's value being higher than the GARCH term. Moreover, the monthly NGX return series exhibit an explosive pattern as the total of the ARCH and GARCH terms is higher than unity. Furthermore, a p-value of 0.219 indicates that the coefficient of asymmetry is positive but not statistically significant at 5%, and the coefficient of asymmetry is 0.063, implying that compared to positive shocks of the same size, negative shocks have a greater impact on the conditional variance. This only suggests that news that is poor or negative causes more volatility than news that is favorable and of the same size. This finding also suggests that

because of the asymmetric impacts, the EGARCH is a better tool for assessing volatility in the NGX.

5.0 conclusion

Using monthly ASI and macroeconomic variable data from February 2010 to September 2022, the study examined how the economic downturn affected the connection between macroeconomic factors and stock market volatility in Nigeria. The EGARCH model, assuming normal distribution errors, was used in the investigation. The findings showed a negative and substantial impact of economic recession on the link between volatility and macroeconomic factors. The results also showed that the NGX's volatility is not much influenced by the exchange rate, whereas stock market liberalization has a negative effect on volatility and is a major factor in Nigeria. The study also found evidence of ARCH innovations and volatility clustering in the NGX returns, which is consistent with the idea of volatile stock markets. Additionally, the positive and significant coefficient of asymmetry indicates that the Nigerian stock market reacts more strongly and sharply to negative (bad) news than to positive (good) news of the same magnitude. Based on the findings, the study suggests that regulators should develop policies to restore investor confidence in the market, and that policy makers should implement policies and mechanisms that will stabilize important macroeconomic indicators in order to increase stock prices.

An important policy implication from this study is that since volatility in the NGX occurs in cluster, it can be predicted by market players through rigorous technical analysis therefore predicting volatility for the Nigerian stock market can be an important instrument for understanding market risks and in constructing optimal portfolios by investors in the stock market.

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