Economy
Vol. 12, No. 2, 40-50, 2025
ISSN(E) 2313-8181: / ISSN(P) 2518-0118:
DOI: 10.20448/economy.v12i2.6779

Modelling asymetric response of stock market volatility to monetary policy: Empirical evidence from Nigeria

Zainab Said Suwaid[1]
Lawal Wasiu Omotayo[2]✉

[1,2]*Department of Economics Bayero University Kano and Al-Hikmah University Ilorin, Nigeria.*
Email: zzsuwaid.sce@buk.edu.ng
Email: suki4wisdom@yahoo.com

(✉ *Corresponding Author)*

Abstract

This paper analyses how stock market volatility responds to monetary policy during bull and bear market phases in the period from the first quarter of 1990Q1 to the fourth quarter of 2023Q4 using MS-VAR model. It investigated stock market fluctuation in both the bull and bear periods using the composite index of the Nigerian Stock Exchange (NSE), the All Share Index and the most appropriate monetary policy indicator, the interest rates. The monetary policy shocks were found to positively respond to the stock market volatility with relatively small volatility in the first regime. For the second regime, the graph shows that an increase in monetary policy shock positively affects volatility at the onset before afterwards turning the move into the negative side of volatility. This policy advice is that the Central Bank of Nigeria (CBN) should be extra cautious when setting and enforcing fiscal measures. Furthermore, due to the erratic performance by Nigeria stock market, the government and the relevant authorities should avoid interfering with the market during these situations as such interferences may trigger further instabilities to the market, because such measures merely slow the causes down, and do not bring lasting solutions.

Keywords: Exchange rate, Interest rate, Money supply Markov switching.

Citation | Suwaid, Z. S., & Omotayo, L. W. (2025). Modelling Asymetric response of stock market volatility to monetary policy: Empirical evidence from Nigeria. *Economy, 12*(2), 40-50. 10.20448/economy.v12i2.6779
History:
Received: 26 April 2025
Revised: 19 May 2025
Accepted: 10 June 2025
Published: 16 June 2025

Publisher: Asian Online Journal Publishing Group

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not Applicable
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Data Availability Statement: The corresponding author may provide study data upon reasonable request
Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

Contents

1. Introduction 41
2. Literature Review 42
3. Methodology 44
4. Results and Findings 45
5. Discussion of Findings 48
6. Conclusion and Recommendation 48
References 49
Appendix 50

Contribution of this paper to the literature

A major weakness observed in the previous studies is that annual data were employed However, this study has used monthly and quarterly data. Consequently, the bulk of the studies utilized the stock market as the representation of the overall financial market neglecting the rest of the market segments. Among all but one or two of the literatures scrutinized in this section, only two incorporate the usage of MS VAR.

1. Introduction

CBN's major responsibility as stated expressly in the CBN Act of 2007 was to achieve price stability and a sound monetary system. In achieving these, updated information and tendencies related to the functioning of the economy must be well established. As a result, research towards a better perspective of the Nigerian economy will assist the CBN in attaining its monetary policy goals. Stock market fluctuation has been a worrisome factor in the financial markets among policy makers, analysts, corporate executives and economists. During the 1980's there was explosive development of new financial markets in the international level as futures and options contracts on interest rates, stock indices, and foreign exchange rates. These markets experienced spectacular expansion until the world stock market was damped in October 1987, resulting into serious consideration on shocks and effects of these new financial products. Hence, a number of reforms concerning the financial markets were introduced and instituted. As the economies experienced high growth and high fluctuations in asset prices, there arise the need to question the efficient markets hypothesis, which asserts that financial markets must provide the correct value for securities.

Monetary policy and its impact on stock market volatility have also received considerable attention in the literature with focused on developed countries (Bomfim, 2003; Chatziantoniou, Duffy, & Filis, 2013; Chen & Clements, 2007; Farka, 2009; Konrad, 2009; Lobo, 2002; Vähämaa & Äijö, 2011). The synthesis of various previous studies reveals that central bank monetary policy is an important determinant of stock market volatility. The evidence indicates that the responses of stock returns and volatility to policy interest rate changes are symmetric. While analyzing stock returns, Lobo (2000); Bernanke and Kuttner (2005); Chuliá, Martens, and Van Dijk (2010) and Zare, Azali, and Habibullah (2013) investigated the asymmetries associated with the direction of the monetary policy shocks. Guo (2004); Andersen, Bollerslev, Diebold, and Vega (2007) and Basistha and Kurov (2008) worked on business cycles asymmetry. Besides, Jiang (2018) focused on the asymmetrical effects of the positive and negative monetary policy shocks on stock market volatility. However, existing literature testing the asymmetry effect of stock market volatility to monetary policy during the bull and bear phases remains scanty.

In the last four decades, co-movement between stock markets and monetary variables has attracted considerable emphasis from economists and financiers of the developed and emerging economies (Hassan, 2017). Theoretically this linkage is perhaps obvious since monetary variables are known to have a pivotal role in the course of determining a firm's cash flows and the systematic risk of the firm. Because stock prices equal the present value of expected dividend tutorials, any prospective or contingent alteration in information related to inflation, interest rates, exchange rates and other monetary variables might disturb stock prices through alliterating either expectations of dividends or discount rates, or perhaps both (Arnold & Vrugt, 2006). Hence, it is theoretically plausible to claim that the conditional variance of current stock returns is associated with the conditional variance of expected future cash flows and discount rates, together with their conditional covariance. Since both expected cash flow and discount rate depends on monetary variables, it is not surprising to find that higher variability of these variables cause a similar response in the volatility of current returns on stock (Poon & Granger, 2003). A cross-section of African countries have operated in the context of continuing macroeconomic troubles accentuated by constant shifts in monetary and macroeconomics. As a result, the over-arching question arise; to what extent are these policies yielding the desired economic impacts with regards to the financial market? Currently, people have differing views in relation to the impacts of monetary policy. For instance, while asserting their tenets, monetarist vehemently support that monetary policy plays a very important role in impacting economic activities, they argue that unexpected changes in stock of money cause movements in output and growth. They further strengthen that only if the money supply rises unexpectedly can the central bank stimulate economic growth (Adeolu, Kehinde, & Bolarinwa, 2012).

The analysis of the available literature also shows that decisions on monetary policy affect the real part of the economy (Ioannidis & Kontonikas, 2008). From their study, found out that monetary policy affects stock prices and that there is a pass-through effect on consumption and investment spending in the real sector. This is in congruency with Modigliani's life cycle hypothesis where there is a positive relationship between consumer's and investment spending as well as Tobin's q hypothesis, investment expenditure and prices for stocks (Ewing, 2001). Further, Chami, Cosimano, and Fullenkamp (1999) established that the main policy channel through which the effects of monetary policy are transmitted is significantly different from the money and credit channels, but rather it involves change in asset prices. This is supportive of the idea that the monetary policy might be transmitted through the stock market as an additional mechanism. Moreover, Laopodis (2013) established that monetary policy affects the real economy through financial markets implying that these markets are essential component in transmitting effects of monetary policy actions on the real economy.

Several studies on the monetary policy and the financial market can also be explained with reasonable body of literature such as Ajie and Nenbee (2010) using co-integration and Error Correction Modeling found that money supply and interest rate (the proxy for monetary policy) had short-run significant effects on stock prices in Nigeria, in the same year (Okpara, 2010) carried out same study and found that monetary policy is significant in determining stock market returns only in the long run using Two Stage Least Squared method. This study is in line with the work undertaken by Adeniji, Ben, and E. (2018) who applied bi-variate and multivariate VAR and partly in line with the study undertaken by Osakwe and Chukwunulu (2019) who employed the Ordinary Least Square regression techniques. Different from this results is the work of Abaenewe and Ndugbu (2012) this research proved monetary policy does not explain changes in equity prices in Nigeria. Although the literature suggests an interaction between monetary policy and the stock market, a major gap exists, However, as Pitelis (2013) has noted and as Laopodis (2013) has observed and included in our previous discussion, there is no unique model that organizes the empirical findings of this relationship across several economies or different types of monetary systems. Of interest therefore is to ask whether or not bull and bear market response asymmetry to monetary policy reforms exist? This may be the missing link on the variant of the monetary policy inability to exact its main targets. After the introductory section, this study is organized into four additional sections. Section 2.0 reviews the existing conceptual, theoretical, and empirical literature, while Section 3.0 outlines the methodological framework for the empirical investigation. In Section 4.0, the empirical model is estimated, and the findings are discussed. Finally, Section 5.0 presents the conclusions and offers policy recommendations.

2. Literature Review

Monetary policy is deliberate manipulation of quantity, price and availability of money and credit by the monetary authorities to attain certain macroeconomic objectives relating to internal and external balance. This is achieved through controlling money supply and or interest rates so as to control the general money supply in the economy. Okigbo (2008) stated that monetary policy literally made reference to all the steps which were taken to regulate the supply of money and credit in an economy. On the other hand, the financial market is a small platform that brings together surplus units and deficit units for various income generating activities. This includes financial institutions of savers who mobilize funds in the form of savings and lenders who need these funds. While financial intermediation is the payments made from one center having excess funds to another center in need. This role of transferring financial resources from the surplus units to the deficit units is what is referred to as financial intermediation. Reszat (2008) classified financial markets into internal financial markets and external financial markets.

In Nigeria like every other countries, the central bank of Nigeria has other mandates that include; to attain full employment, to have maximum sustainable growth, and stable interest and exchange rates. To achieve these objectives they regulate and interfere with the financial markets (Central Bank of Nigeria, 2018).

Monetary policy influences the real economy mainly through the financial market, this appears to be which the missing connecting link through which the monetary policy and the real economic segment of the country. There are several different ways through which monetary policy impacts the financial markets. Nevertheless, all possible transmission mechanisms starting from the monetary policy on the financial markets going down to the real sector of the economy stem from the monetary policy instrument. More specifically, the paper shows that in the case of emerging markets (EMs) the conditions influencing financial development have mainly depended on long-term international interest rates which in turn are connected with the monetary policies of developed countries (Sobrun & Turner, 2015). Typically, the monetary policy instrument a price in any financial market that is not directly set directly by or closely monitored by the monetary authority. For the majority of central banks with flexible foreign exchange regimes today, this instrument is a short term interest rate. In fixed a fixed exchange rate regime, a particular exchange rate serves as the instrument whereas, in monetary targeting regime, the amount of central bank money in the banking system is usually as the instrument.

This research is based on the present value or discounted cash flow theory which gives much understanding in a situation where changes in monetary policies affect stock markets and their prices. The above model depicts that $S_t = D_{(t+j)} / R$, t is specifically postulating the constant discount rate. For its simplified form it posits that the investors are free to choose between two deliberate investment options: either a stock with an expected gross return $E_t \lfloor S_{(t+1)}+D_{(t+1)} \rfloor / S_t$ or invest in a risk-less bond with constant nominal gross rate of return 1+R within a given period of time (one period). According to the theory of arbitrage concept, if investors are to pay lesser attention to the one to pick from the two choices possible, then the return on investing in the stock or bond must be anticipate i.e., $E_t[S_{t+1} + D_{t+1}]/S_t = 1 + R$. When taken further, this gives rise to anticipated difference equation presented in Equation 1 below;

$$S_t = E_t\left[\sum_{j=1}^{k}(\frac{1}{1+R})^j D_{t+j}\right] + E_t\left[\left(\frac{1}{1+R}\right) S_{t+k}\right] \quad (1)$$

In this context, $E_t$represents the conditional expectations operator based on information available to market participants at time t, R is the return rate used by these participants to discount future dividends, and K refers to the investor's time horizon (or stock holding period). The standard transversality condition indicates that as the horizon K increases, the second term on the right side of Equation 1 approaches zero, implying that there are no rational stock price bubbles, as demonstrated in Equation 2 below:

$$\lim_{k\to\infty} E_t\left[(\frac{1}{1+R})^k S_{t+k}\right] = 0 \quad (2)$$

Thus, based on the discussion by Campbell and MacKinlay (1996) regarding models of rational bubbles that relax the transversality condition, along with their development of the present value model using variable discount rates, we arrive at the familiar form of the present value model presented in Equation 3.

$$S_t = E_t\left[(\sum_{j-1}^{k}\frac{1}{1+R})^j D_{t+j}\right] \quad (3)$$

From Equation 3, it can be inferred that a variation in monetary policy can move stock prices in two folds.

The empirical studies of monetary policy interactions and financial market fluctuations can be divided into three. These will involve examining studies on developed countries, the second will be on emerging economies and the last on developing economies.

Andrés, Mestre, and Vallés (1999) explained how prices, output and the exchange rate responded to a monetary policy shock. The evidence based on the SVAR model confirms that the Spanish economy is characterized by the efficiency of the asset price adjustment, nominal rigidities and long run monetary non-neutrality. The main source of the shock is the interest rate, while the exchange rate has a tendency to over-reverse the long-term value. Also, the estimates are not characterized by a liquidity puzzle, price puzzle, or exchange rate puzzle. Again, Mumtaz and

Zanetti (2013) analyzed the impact of monetary policy uncertainty by employing structural vector autoregression (SVAR), model enriched in two ways. First, it allows for time-varying variance of monetary policy shocks with a stochastic volatility model. Second, it allowed exhibiting the dynamics of the interactions between the levels of the endogenous variables of the VAR and the time varying volatility. The results shows that nominal interest rate, output growth, and inflation fall in reaction to an increase in the volatility of monetary policy in the US. It also builds a Dynamic stochastic general equilibrium model with stochastic volatility in monetary policy which gives similar results.

Furthermore, Ma, Wang, and He (2022) analyse the within and cross-sectional mechanisms and interaction between economic policy uncertainty (EPU) and stock market realized volatility in G7 countries. The directional spillover indicator was then computed utilizing the monthly economic policy uncertainty index and the realized volatility series for each country. The analysis showed that the degree of the spillover effect of economic policy uncertainty on volatility of the stock markets is higher in the USA, Japan, and Canada and reveals regional resemblance. Meanwhile, we find that economic and policy uncertainty has stronger and more persistent responses to the stock markets of France, Germany as well as Italy and its effects last for 3 to 18 months. More recently, Yang, Zhou, Du, Du, and Zhou (2023) analyzed the link between the global oil price, stock prices, and policy interactions for China and US. The study applied time-varying parameter stochastic volatility vector autoregression model to examine the transmission of the global oil price shocks, Chinese and US stock market volatility and economic policy uncertainty indices in China and the US for the period 2003-2020. The analysis established positive and significant relationship between fluctuations of the stock markets in the two countries and shifts in the international prices of oil. It was identified that the US stock market had a higher effect on the global oil market than the Chinese stock market. Besides, the research showed that the increase of the economic policy uncertainty steepens the oil price volatility in the global markets while the increase in oil price volatility enhances the volatility of the stock markets and economic policy uncertainty in the two countries.

Yoshino, Taghizadeh-Hesary, Hassanzadeh, and Prasetyo (2014) in their study on emerging economies employed VECM on Tehran stock prices with respect to exogenous monetary policy shocks for the period 1998Q1to2013Q2. They found that monetary policy affects stock market prices through three channels: money supply, rates of exchange, and inflation. The evidence are in favour of their hypothesis that stock prices invariably increase following a change in monetary policy regime. The variance decomposition analysis further shows that after ten periods, more than half of the forecast error variance in Tehran Stock Exchange Price Index originates from the US dollar–Iranian rial exchange rate shocks while a less than one fifth fraction of this variance owes its source to the Iranian real GDP shocks. They argue that this evidence is explained by an endogenous adjustment of stock price to monetary policy shocks. Interestingly, Atiş and Erer (2018) examined the asymmetric responses of stock market returns and volatility to monetary policy during bull and bear markets in Turkey from 2002 to 2016. The study uses markov switching model with the policy rate as the monetary policy measure. The empirical results revealed that monetary policy is more potent during a bull market environment. Again, Si, Zhao, Li, and Ding (2021) investigated the fluctuating volatility interconnectedness between different forms of policy uncertainty and sectoral markets in China in time and frequency variations. Base on the time frequency connectedness index method, the empirical results illustrated a highly connected network between policy uncertainty and Chinese sectoral stock market especially under mid and long run horizons. Most significantly, policy makers were least concerned with the monetary policy contributing the least to spillovers of the four classification types of policy uncertainty.

In Nigeria, Babajide, Isola, and Olukayode (2016) who uses autoregressive Distributed Lag bound testing techniques with the view of analyzing the relationship between monetary policy instruments and the stock market in Nigeria. The accumulation of evidence suggested that monetary policy tools affected the character of stock market in the country. Partially, this study is relevant to Shehu UR (2021) work, which applied GARCH and EGARCH methodologies to test the effect of monetary policy innovations on stock returns prior to the Nigeria stock exchange during the Global Financial Crisis. The empirical analysis showed that the unsystematic (unexpected) parts of policy innovations concerning money supply and monetary policy rate are negatively associated with Nigeria stock exchange returns while systematic (anticipated) parts are not. In the same vein, Adeniji et al. (2018) applied an empirical analysis on the impact of monetary policy shocks on stock market price volatility in Nigeria using time series data from June 1999 to December 2016. Two quantitative methods were used in the analysis, the autoregressive distributed lag (ARDL) model and the exponential generalized conditional heteroscedasticity (EGARCH) model. The study discovered that monetary policy shocks affect stock market price thereafter experiencing increased volatility in Nigeria. However, among the set of monetary policy indicators, interest rate on its own was significant at both the short and long run in trying to explain the variability of the stock market prices, while M1 was only significant in the short run only. Osakwe and Chukwunulu (2019) analyzed the relationship between monetary policy and stock market performance in Nigeria for the period of 1986 to 2015 using OLS regression analysis. Consequently, the findings revealed that money supply and exchange rate positively influenced stock price movements and were respectively highly significant, but interest rate was insignificantly negative. In all, it emerges that variables of monetary policy explain 94 percent of the fluctuations of stock market performance in Nigeria. In particular, Aliyu (2021) noted that monetary policy can be used to control stock market operations, his present work proved that it has a significant positive impact on stock market performance.

From the literatures reviewed, it can be deduced that most studies on financial market in Nigeria were confined mainly to the stock market segment of the financial market and the methodologies which were employed were primarily VAR, OLS and VECM. A major weakness observed concerning the previous studies is that annual data were employed except for some of them. However, this study has used monthly and quarterly data. Again, the bulk of the studies utilized the stock market as the representation of the overall financial market neglecting the rest of the market segments. Among all but one or two of the literatures scrutinized in this section, only two incorporate the usage of MS VAR.

3. Methodology

Hamilton (1989) Markov-Switching (MS) autoregressive models have become widely recognized as an effective alternative for representing key features of the business cycle. Consequently, a growing number of empirical studies have adopted regime-switching models to capture the nonlinearities and asymmetries observed in various macroeconomic variables (Boldin, 1996; Garcia & Perron, 1996; Kim, Nelson, & Startz, 1998; Krolzig, 1996; Krolzig & Toro, 2001).The basic specification of the Markov Switching model assumes that deviations of dependent variable from its mean follow a p-th order autoregressive process:

$$\Delta y_t - \mu(s_t) = \alpha_1(\Delta y_{t-1} - \mu(s_{t-1})) + \ldots, \alpha_2(\Delta y_{t-p} - \mu(s_{t-p})) + \varepsilon_t \quad (4)$$

The errors, et are assumed to be independently and identically distributed (ii) with a mean of zero and a constant variance of σ2 while the process mean, μ is influenced by a latent variable, st. This relationship suggests that different regimes correspond to distinct conditional distributions of yt the latent variable strepresents the state of the business cycle, distinguishing between two regimes: "expansion" and "contraction." The autoregressive parameters in model (3.1) can vary depending on the state st within the Markov chain.

$$\Delta y_t - c(s_t) = \alpha_1(s_t)\Delta y_{t-1} + \ldots + \alpha_p(s_t) + \varepsilon_t \quad (5)$$

If st can assume one of M distinct values represented by the integers 1 through M, Equation 5 illustrates a mixture of M autoregressive models. In the case of two regimes, model 3.1 characterizes a "falling" state when st = 1 and a "rising" state when st = 2 for the yt variable. Regime 1 is categorized as an economy in recession and can be represented as follows:

$$\Delta y_t - c_1(s_t) = \alpha_{11}\Delta y_{t-1} + \ldots + \alpha_{p1}\Delta y_{t-p} + \varepsilon_t \quad (6)$$

Regime 2 is classified as an economy in expansion and can be represented as:

$$\Delta y_t - c_2(s_t) = \alpha_{12}\Delta y_{t-1} + \ldots + \alpha_{p2}\Delta y_{t-p} + \varepsilon_t \quad (7)$$

The latter process is an ergodic Markov chain with a finite number of states, characterized by its transition probabilities.

$$\rho_{ij} = \rho_r(s_t = j / s_{t-1} = i), \quad \sum_{i=j}^{M} \rho_{ij} = 1 \quad (8)$$

For ∀ij =1. . , M, it is specifically assumed that st follows an ergodic Markov process with M states, characterized by an irreducible transition matrix.

However, fixed or constant transition probabilities are too restrictive to fully capture stock market dynamics. As a result, an extension of Hamilton (1989) model allows for time-varying transition probabilities, as explored by Filardo (1994) and Diebold, Hahn, and Tay (1999). The Markov Switching model with time-varying transition probabilities provides more flexibility than models with fixed probabilities. For example, it can identify systematic changes in transition probabilities around turning points, better capturing complex patterns of temporal persistence and enabling the modeling of varying expected durations over time.

The applied Markov model enables volatility to vary across regimes, allowing it to capture the time-varying volatility characteristic of stock markets, which is an important stylized fact in financial markets. In this regard, the model incorporates Filardo (1994) framework.

$$P_{i\,j,t} = P_r[R_t = j / R_t = i, Z_{t-1} = \frac{exp(\lambda_{i,j,0} + Z'_{t-1}\lambda_{i,j,1})}{1 + exp(\lambda_{i,j,0} + Z'_{t-1}\lambda_{i,j,1})} \quad (9)$$

Where:

$i = 1,2\ldots, M;\ j = 1,2\ldots, M-1$ and $P_{i,j,m,t} = P_r[R_t = M / R_t = i, Z_{t-1}] = 1 - \sum_{j=1}^{m-1} P_{i,j,t}, i = 1,2;\ldots, M$

M represents the number of regimes, and R_t is a first-order Markov variable. Z_t is a vector of economic variables that drive the transition between regimes. The study applies Filardo (1994) time-varying probabilities to analyze the effect of oil price shocks on stock market performance, modeled under two distinct regimes. Transitions between these regimes are determined by a probability process.

Regime 1: $$P_r[R_t = 1 / R_{t-1} = 1] = \frac{\exp(\lambda_{10} + \sum_{j=1}^{n} Z'_{t-1}\lambda_{1j})}{1 + \exp(\lambda_{10} + \sum_{j=1}^{n} Z'_{t-1}\lambda_{1j})} \ldots\ldots(10)$$

Regime 2: $$P_r[R_t = 2 / R_{t-1} = 2] = \frac{\exp(\lambda_{20} + \sum_{j=1}^{n} Z'_{t-1}\lambda_{2j})}{1 + \exp(\lambda_{20} + \sum_{j=1}^{n} Z''_{t-1}\lambda_{2j})} \ldots\ldots(11)$$

The probability of staying in a low stock performance regime is determined by the previous regime, which could either be low or high stock performance, while the probability of transitioning to a high stock performance regime is similarly based on whether the prior regime was low or high stock performance. Zt is a vector of j macroeconomic and policy-related variables used to forecast the future trajectory of stock performance. This approach aligns with the arbitrage pricing theory, which posits that mispriced securities may create short-term risk-free profit opportunities. By allowing transition probabilities to fluctuate over time, we can better understand the factors driving shifts between the low stock performance regime (R_{t-1}, R_{t-1}) and the high stock performance regime (Rt=2), as well as the reverse transitions.

The key parameters that influence the transition probabilities between regimes are the coefficients λ. evaluating the sign of these coefficients is crucial. For example, if the coefficient 11λis positive, the associated economic factor Z significantly increases the probability of staying in the high stock performance regime (regime 1). On the other hand, if the coefficient is negative, the corresponding macroeconomic variable Z reduces the likelihood of remaining in the low stock performance regime and raises the probability of transitioning between high and low stock performance regimes (regime 2). Similarly, the coefficient 12λ reflects the effect of the exogenous variable Z on the probability of remaining in the high stock performance regime (regime 2) or shifting to the low stock performance regime (regime 1), depending on whether this coefficient is positive or negative, respectively. The period of investigation spanned 1990Q1 to 2023Q4 Published time series data which give numerical values about the variables under study will be collected from relevant secondary sources which include; National Bureau of Statistics (NBS) publications, Nigeria Stock Exchange (NSE). Publications, World Bank and International Financial Statistics (IFS), and Central Bank of Nigeria (CBN) Annual Reports and Statistical Bulletin (various issues).

4. Results and Findings

4.1. Statistical Properties of Variable

The result of the descriptive statistics presented in Appendix 1 shows evidence of significant variations as shown by the huge difference between the minimum and maximum values for all variables except for M2 which has lesser variation. The study utilised skewness, kurtosis and Jarque-Bera statistics to test for normality of the data series. The skewness test indicates that some of the variables are negatively skewed while some are positively skewed. The EXRATE is the least skewed among the variables which implies that information in the variables has a long tail in the negative direction. From the kurtosis statistics, the study observed all variables are leptokurtic which portrays the asymmetry of the distribution. Jarque-Bera statistic is the most encompassing normality test which further reinforced the earlier tests by showing that the study can reject the null hypothesis of normality for all the variables because as seen the test statistic for all variables is not close to zero. The average for the variables is greater than the standard deviation except for TBILLS and REALGDP. This indicates that all observations are closer to the mean with the exception of TBILLS and REALGDP. It is important to mention that the descriptive statistics only provides a historical background for the behaviour of the time series data as such information obtain cannot be used to make a general inference.

The Markov Switching Vector Autoregressive model in regime 1 presented in the Table 1 shows that the lag of interest rate has significant effects on interest rate, the lag of IPI is also significant in explaining IPI. Also, the lag of M2 significantly affected M2, also the lag of ALLSHR has significant effects on ALLSHR. Unlike regime 1, in regime 2 the lag of EXR has significant effects in EXR whereas the lag of INTR is has no significant effects in INTR. The lag of IPI has significant effects on IPI. However, the lag of M2 and ALLSHR has no significant effects on M2 and ALLSHR.

Table 1. VAR estimation.

	EXR	INTR	IPI	M2	ALLSHR
Regime 1					
EXR	0.120 0.001	0.003 0.005	0.008 0.011	-0.002 -0.005	0.245*** -0.103
INTR	0.006 0.018	0.330*** -0.068	-0.018 -0.006	0.011 0.006	-0.030 0.157
IPI	-0.221 0.074	0.020 -0.049	0.213*** 0.317***	-0.017 0.008	0.281 0.151
M2	0.537 0.578	-0.147 0.258	-0.094 0.061	0.328*** 0.337***	0.252 -1.750**
ALLSHR	-0.04 -0.082	-0.034 0.062	0.012 0.012	0.001 -0.009**	0.254*** 0.076
Regime 2					
EXR	-0.084 3.132***	0.063 -0.003	-0.009 -0.124	0.089*** -0.016	0.427 -0.913
INTR	2.076 11.466	-0.085 -1.897	-1.038* -0.304	0.076 -0.121	0.640 -7.418
IPI	29.213 -11.446	-2.533 1.684	5.351** -0.419	-0.750 0.044	-16.200 8.474
M2	6.320 -0.962	10.487 -10.605	3.407 -1.520	1.772 1.297	17.017 -20.234
ALLSHR	7.368 0.115	-0.449 -0.008	0.035 -0.045	-0.154 0.0248	-2.360 0.206

Note: *** indicates significant at 1% (2.58), ** at 5% (1.96), * at 10% (1.65).

4.2. Transition Probabilities

The constant Markov transition probabilities and expected durations for sample 1990Q1 to 2023Q4 is presented below.

Note that P(i,k) = $P(s(t)) = k|s(t_{-1} = i)$

Where row = i and column = k

$$P_{ij} = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix} = \begin{bmatrix} 0.923162 & 0.076838 \\ 1.000000 & 4.91E-11 \end{bmatrix}$$

Hence $P_{11} = 0.923162, and\ P_{22} = 4.91E-11. Where;\ P_{11} + P_{12} = 1, P_{21} + P_{22} = 1$

Constant expected durations:

1	2
13.01439	1.000000

The transition probabilities output shows the probability of the stock market being in state 1 or state 2 at time t given its state at time t-1. The constant transition probabilities indicate that when the stock market is in state 1, there is a 92.32% probability it will remain in that state in the next period and a 7.68% probability it will transition to state 2. On the other hand, when the stock market is in a state 2, there is a very low probability of 4.91E-11 (essentially zero) that it will remain in that state in the next period, and a 100% probability it will transition to state 1. The expected durations provide the average length of time the stock market is expected to remain in each state before transitioning to the other state. The expected duration for state 1 is 13.01 quarters, while the expected duration for state 2 is 1 quarter. These transition probabilities and expected durations suggest that the stock market is more likely to remain in state 1 for an extended period, and if it transitions to state 2, it is likely to return to a state 1 relatively quickly. This asymmetric response of the stock market to both states may be due to the influence of monetary policy, as the VAR model suggests.

The probability of being in State 1 (recession economy that is the bear market period) as indicated in Figure 1 is relatively high during the period of 2009 to 2013, but it gradually decreases afterwards. Also, the probability of being in State 2 (expansion economy that is the bull market period) is relatively low during the period of 2009 to 2013, but it gradually increases afterwards. Consequently, from around 2016 onwards, the probability of being in State 2 becomes higher than the probability of being in State 1, indicating that the economy is more likely to be in an expansion state than a recession state during this period. In all, the smoothed regime probabilities suggests that the economy went through a period of recession during the aftermath of the 2008 financial crisis, but it gradually recovered and shifted towards an expansion state in the following years.

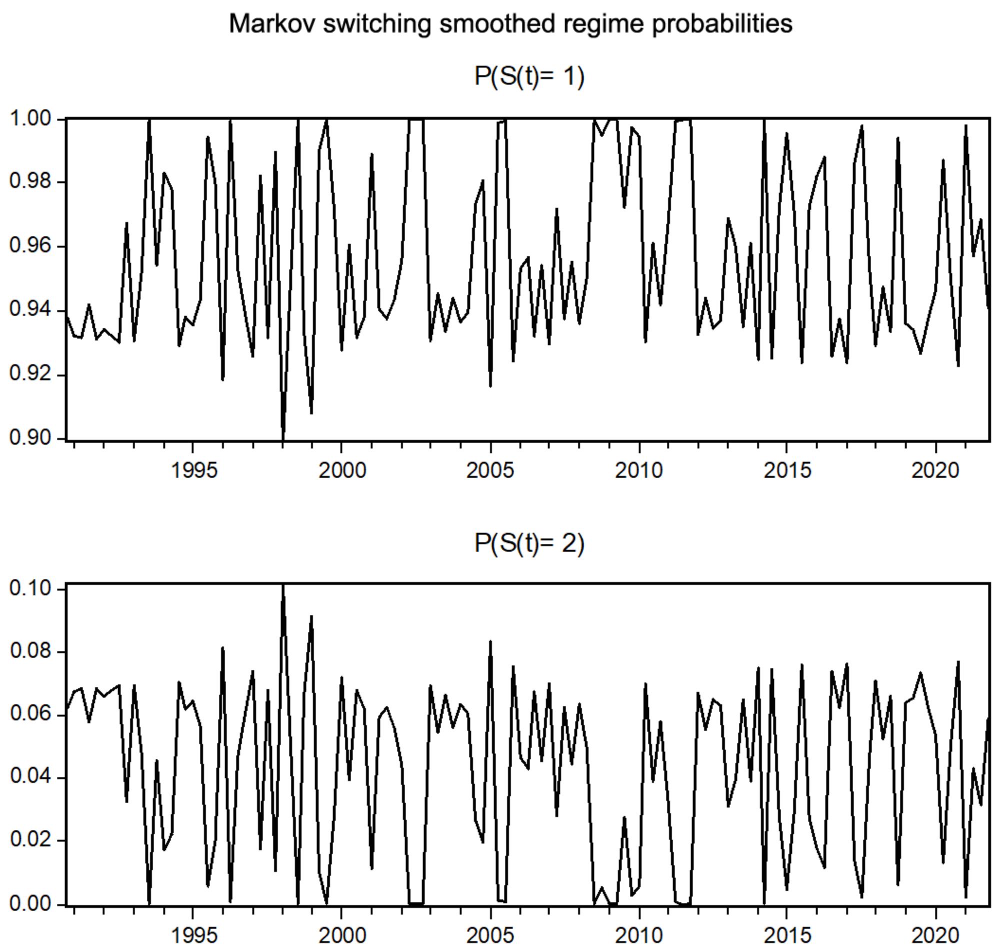

Figure 1. Markov switching probabilities.

As indicated in the Figure 2a, the response of NASI to INTR (monetary policy) shocks is mostly positive, except for the second period where it is negative. This suggests that during state 1, monetary policy has a positive impact on stock market volatility, except for the immediate response. However, we also see that the magnitudes of the responses are relatively small. The largest response occurs in period 3, where the increase in stock market volatility due to monetary policy shock is around 0.009. In contrast, the smallest response occurs in period 10, where the increase in stock market volatility due to monetary policy shock is only 0.000394. In all, the regime 1 IRF suggests that there is a slightly positive reaction of stock market volatility to changes in monetary policy, but the magnitudes of the responses are relatively small.

Regime Dependent IRF

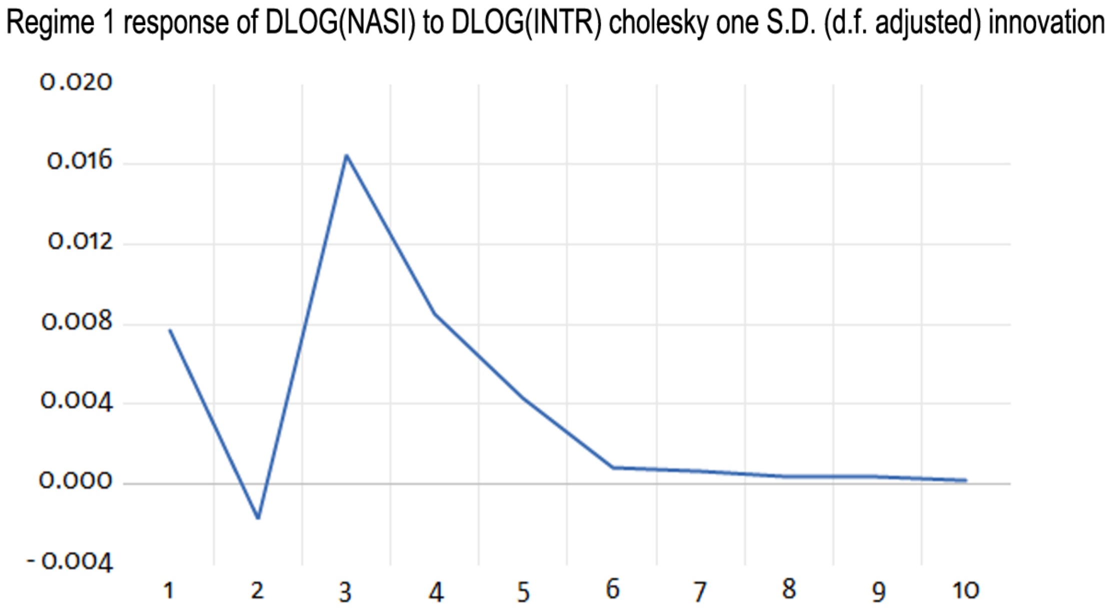

Figure 2a. Regime Dependent IRF for regime 1.

Again, as indicated in Figure 2b in regime 2, an increase in monetary policy shock (INTR) initially results in a positive impact on stock market volatility (NASI). However, this effect is short-lived, as volatility quickly declines into negative territory in the following period. The negative response of stock market volatility to monetary policy in this regime suggests that contractionary monetary policy can negatively affect the stock market during bear markets. Conversely, an increase in monetary policy shock also leads to an initial positive impact on stock market volatility in the first period, but this effect strengthens in subsequent periods and lasts longer. The positive response of stock market volatility to monetary policy in this regime indicates that expansionary monetary policy can have a stimulating effect on the stock market during bull markets.

This supports one view of how monetary policy affects the stock market, which suggests that an increase in the money supply leads to higher stock prices, thereby stimulating both the stock market and the wider economy. Since stock prices are influenced by expected dividends and interest rates, any unexpected changes in monetary policy are likely to impact stock prices either directly through the interest rate channel or indirectly by altering the factors that affect dividends. The findings of this study align with those of Zare et al. (2013).

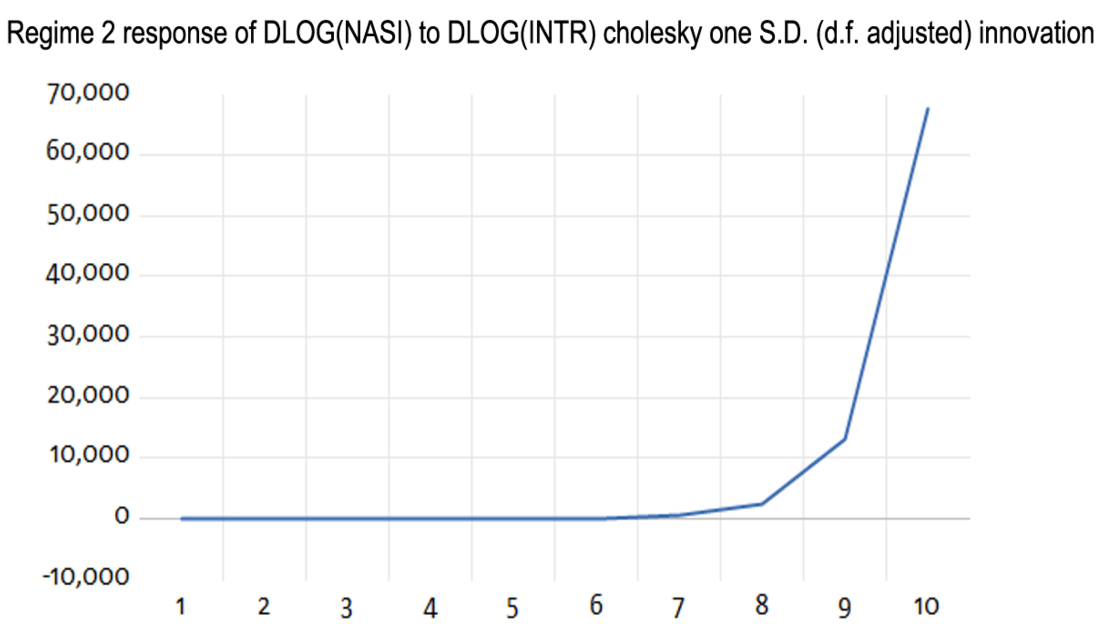

Figure 2b. Regime dependent IRF for regime 2.

4.3. Diagnostic Checks

The reliability of any estimated econometric model is based on passing some diagnostic check. The most known diagnostic check in VAR framework are the serial correlation and normality test. This study employs the Breusch-Godfrey test for serial correlation and the AR roots test for normality. The result for the model estimated for Nigeria is presented with Table 2 for stability test as well as Figure 3 and Table 3 for serial correlation test of the model. The result of the test indicates no serial correlation and also passed the normality test.

Table 2. Stability test result.

Root	Modulus
0.714	0.714
0.242	0.242
0.206	0.206
0.046	0.046

No root lies outside the unit circle. VAR satisfies the stability condition.

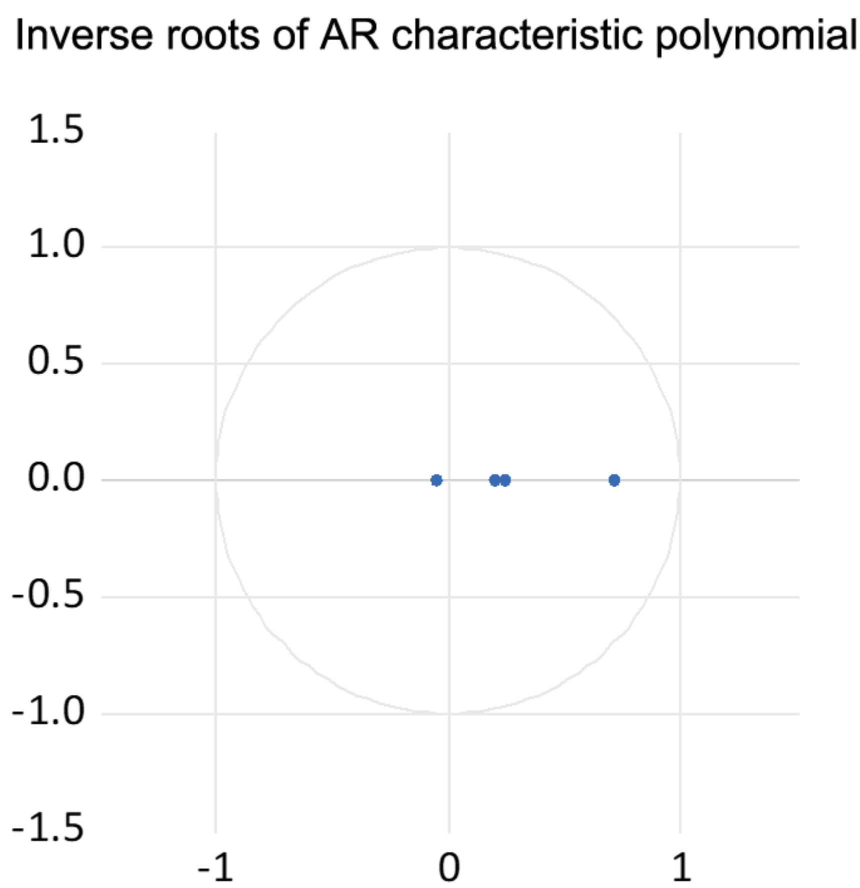

Figure 3. Inverse root polynomial.

The result of the inverse root as illustrated in Figure 3 indicated that no root lies outside the unit circle as such the VAR satisfies the stability condition.

Table 3. Serial correlation.

Lags	Q-stat	Prob.	Adj Q-stat	Prob.	DF
1	1.553	----	1.565	----	----
2	12.243	0.727	12.428	0.714	16

Note: *test is valid only for lags larger than the VAR lag order. DF is degrees of freedom for (approximate) chi-square distribution.

From the Table 3, probability is greater than 0.5 and the rule states that if probability is less than 0.5 there is serial correlation and if probability is greater than 0.5 there is no serial correlation. Therefore, in this case since probability is greater than 0.5 there is no case of serial correlation.

5. Discussion of Findings

In alignment with the study's objective to explore the asymmetric response of stock market volatility to monetary policy during bull and bear market periods using the Markov Switching Vector Autoregressive framework, the study analyzed stock market volatility during both bullish and bearish phases by utilizing the aggregate stock market indices from the Nigeria Stock Exchange (NSE) specifically, the All-Share Index—and the interest rate as a relevant monetary policy indicator. To enhance the empirical findings, additional control variables were included in the model, such as money supply (M2), the spot exchange rate (EXRATE), and the Industrial Production Index (IPI). The results indicate a slightly positive response of stock market volatility to monetary policy shocks, though the magnitude of these responses is relatively small in regime 1. In contrast, regime 2 suggests that an increase in monetary policy shock initially has a positive impact on stock market volatility. However, the effect is brief, with volatility quickly shifting to negative territory in the second period. The empirical results from the Markov-switching analysis also suggest that monetary policy is more effective during bear market periods (regime 1) than during bull markets (regime 2), thus reinforcing the estimates of asymmetry. These findings align with previous studies by Chen and Clements (2007); Kurov (2010); Jansen and Tsai (2010) and Konrad (2009) which demonstrated that monetary policy tends to be more effective in bear markets. The negative response of stock market volatility to monetary policy in this regime indicates that contractionary monetary policy may adversely impact the stock market during bear phases. This aligns with the research of Adeniji et al. (2018) and Laopodis (2013). Furthermore, these findings support the expectations of the discounted cash flow model theory, which posits that changes in monetary policy can influence stock returns. Specifically, there is a direct effect on stock returns due to changes in the discount rate used by market participants. A more restrictive monetary policy raises the capitalization rate for firms' future cash flows, which causes a decrease in stock prices.

6. Conclusion and Recommendation

This study examined the relationship between monetary policy dynamics and financial market volatility in Nigeria. This relationship is a 2-way relationship as one affects the other and also the latter has effects on the former. Information from the financial market is crucial for both market participants and the central bank. The

central bank seeks to understand how its monetary policy actions influence financial markets, while market participants use this information to evaluate stock prices and manage their portfolios. In theory, stock prices reflect the expected present value of future net cash flows. As a result, an expansionary monetary policy typically boosts future cash flows or lowers the discount rates applied to them, leading to a positive relationship with stock prices.
This study explored the dynamics of monetary policy and financial market volatility in Nigeria. Using Markov Switching Vector Autoregressive model from 1990q1 to 2023q4. It was discovered that there is slightly positive response of stock market volatility to monetary policy shocks, but the magnitudes of the responses are relatively small during bear market periods. Whereas bull market period suggests that an increase in monetary policy shock leads to an initial positive impact on stock market volatility which is short lived and then later becomes negative. Consequent upon this findings, it is well established that financial markets are highly responsive to economic policies, so the government and the Central Bank of Nigeria (CBN) must exercise caution when formulating and implementing these policies. To mitigate the impact of economic policies on the stock market and lessen the risk of volatility, it is recommended that greater emphasis be placed on the formulation of monetary policy.

List Abbreviation

(NBS) National Bureau of Statistics, (NSE) Nigeria Stock Exchange, World Bank and International Financial Statistics (IFS) and (CBN) Central Bank of Nigeria Annual Reports and Statistical Bulletin.

References

Abaenewe, Z. C., & Ndugbu, M. O. (2012). Analysis of the effect of monetary policy development on equity prices in Nigeria. *West African Journal of Industrial and Academic Research*, *5*(1), 140-155.

Adeniji, S. O., Ben, O., & E., O. (2018). Impact of oil price shocks on stock market prices volatility in Nigeria: New evidence from a non-linear ARDL cointegration. *Journal of Global Economy*, *14*(3), 173-190.

Adeolu, A. M., Kehinde, J. S., & Bolarinwa, S. A. (2012). Fiscal/monetary policy and economic growth in Nigeria: A theoretical exploration. *International Journal of Academic Research in Economics and Management Sciences*, *1*(5), 75-88.

Ajie, H., & Nenbee, S. (2010). An econometric analysis of monetary policy and stock prices in Nigeria: 1986-2008. *International Journal of Economic Development Research and Investment*, *1*(1), 175-192.

Aliyu, S. U. (2021). *What have we learnt from modelling stock returns in Nigeria: Higgledy-Piggledy?* Bayero University Kano Professorial Inaugural Lecture No. 47.

Andersen, T. G., Bollerslev, T., Diebold, F. X., & Vega, C. (2007). Real-time price discovery in global stock, bond and foreign exchange markets. *Journal of International Economics*, *73*(2), 251-277. https://doi.org/10.1016/j.jinteco.2007.02.004

Andrés, J., Mestre, R., & Vallés, J. (1999). Monetary policy and exchange rate dynamics in the Spanish economy. *Spanish Economic Review*, *1*, 55-77. https://doi.org/10.1007/s101080050003

Arnold, I. J., & Vrugt, E. B. (2006). *Stock market volatility and macroeconomic uncertainty: Evidence from survey data*. NRG Working Paper No. 06-08.

Atiş, A. G., & Erer, D. (2018). The impact of monetary policy on stock returns during bull and bear markets: The evidence from Turkey. *Ege Akademik Bakis*, *18*(4), 699-710. https://doi.org/10.21121/eab.2018443927

Babajide, A. A., Isola, L. A., & Olukayode, S. R. (2016). Stock market response to economic growth and interest rate volatility: Evidence from Nigeria. *International Journal of Economics and Financial Issues*, *6*(1), 354-360.

Basistha, A., & Kurov, A. (2008). Macroeconomic cycles and the stock market's reaction to monetary policy. *Journal of Banking & Finance*, *32*(12), 2606-2616. https://doi.org/10.1016/j.jbankfin.2008.05.012

Bernanke, B. S., & Kuttner, K. N. (2005). What explains the stock market's reaction to Federal Reserve policy? *The Journal of Finance*, *60*(3), 1221-1257.

Boldin, M. D. (1996). A check on the robustness of Hamilton's Markov Switching model approach to the economic analysis of the business cycle. *Studies in Nonlinear Dynamics & Econometrics*, *1*(1). https://doi.org/10.2202/1558-3708.1010

Bomfim, A. N. (2003). Pre-announcement effects, news effects, and volatility: Monetary policy and the stock market. *Journal of Banking & Finance*, *27*(1), 133-151.

Campbell, J. Y., & MacKinlay, A. C. (1996). *The econometrics of financial markets*. Princeton, NJ: Princeton University Press.

Central Bank of Nigeria. (2018). *Statistical bulletin 2018*. Abuja, Nigeria: Central Bank of Nigeria.

Chami, R., Cosimano, T. F., & Fullenkamp, C. (1999). *The stock market channel of monetary policy*. IMF Working Paper, International Monetary Fund, WP/99/22.

Chatziantoniou, I., Duffy, D., & Filis, G. (2013). Stock market response to monetary and fiscal policy shocks: Multi-country evidence. *Economic Modelling*, *30*, 754-769.

Chen, E. T. J., & Clements, A. (2007). S&P 500 implied volatility and monetary policy announcements. *Finance Research Letters*, *4*(4), 227-232.

Chuliá, H., Martens, M., & Van Dijk, D. (2010). Asymmetric effects of federal funds target rate changes on S&P100 stock returns, volatilities and correlations. *Journal of Banking & Finance*, *34*(4), 834-839.

Diebold, F. X., Hahn, J., & Tay, A. S. (1999). Multivariate density forecast evaluation and calibration in financial risk management: high-frequency returns on foreign exchange. *Review of Economics and Statistics*, *81*(4), 661-673. https://doi.org/10.1162/003465399558526

Ewing, B. T. (2001). Monetary policy and stock returns. *Bulletin of Economic Research*, *53*(1), 73-79.

Farka, M. (2009). The effect of monetary policy shocks on stock prices accounting for endogeneity and omitted variable biases. *Review of Financial Economics*, *18*(1), 47-55.

Filardo, A. J. (1994). Business-cycle phases and their transitional dynamics. *Journal of Business & Economic Statistics*, *12*(3), 299-308.

Garcia, R., & Perron, P. (1996). An analysis of the real interest rate under regime shifts. *The Review of Economics and Statistics*, *78*, 111-125. https://doi.org/10.2307/2109851

Guo, H. (2004). Stock prices, firm size, and changes in the federal funds rate target. *The Quarterly Review of Economics and Finance*, *44*(4), 487-507.

Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica: Journal of the Econometric Society*, *57*(2), 357-384.

Hassan, H. A. (2017). *An empirical study on the optimal monetary policy and financial market volatility in Egypt*. Thesis Submitted for the Degree of Doctor of Philosophy in Economics at the University of Leicester.

Ioannidis, C., & Kontonikas, A. (2008). The impact of monetary policy on stock prices. *Journal of Policy Modeling*, *30*(1), 33-53.

Jansen, D. W., & Tsai, C.-L. (2010). Monetary policy and stock returns: Financing constraints and asymmetries in bull and bear markets. *Journal of Empirical Finance*, *17*(5), 981-990. https://doi.org/10.1016/j.jempfin.2010.08.002

Jiang, C. (2018). The asymmetric effects of monetary policy on stock market. *Quarterly Journal of Finance*, *8*(03), 1850008.

Kim, C.-J., Nelson, C. R., & Startz, R. (1998). Testing for mean reversion in heteroskedastic data based on Gibbs-sampling-augmented randomization. *Journal of Empirical Finance*, *5*(2), 131-154.

Konrad, E. (2009). The impact of monetary policy surprises on asset return volatility: The case of Germany. *Financial Markets and Portfolio Management*, *23*(2), 111-135. https://doi.org/10.1007/s11408-009-0102-5

Krolzig, H.-M. (1996). *Statistical analysis of cointegrated VAR processes with Markovian regime shifts*: Citeseer.

Krolzig, H., & Toro, J. (2001). *A new approach to the analysis of business cycle transitions in a model of output and employment*. Economics Series Working Papers, University of Oxford, Department of Economics.

Kurov, A. (2010). Investor sentiment and the stock market's reaction to monetary policy. *Journal of Banking & Finance, 34*(1), 139-149. https://doi.org/10.1016/j.jbankfin.2009.07.010
Laopodis, N. T. (2013). Monetary policy and stock market dynamics across monetary regimes. *Journal of International Money and Finance, 33*, 381-406.
Lobo, B. J. (2000). Asymmetric effects of interest rate changes on stock prices. *Financial Review, 35*(3), 125-144.
Lobo, B. J. (2002). Interest rate surprises and stock prices. *Financial Review, 37*(1), 73-91.
Ma, Y., Wang, Z., & He, F. (2022). How do economic policy uncertainties affect stock market volatility? Evidence from G7 countries. *International Journal of Finance & Economics, 27*(2), 2303-2325. https://doi.org/10.1002/ijfe.2274
Mumtaz, H., & Zanetti, F. (2013). The impact of the volatility of monetary policy shocks. *Journal of Money, Credit and Banking, 45*(4), 535-558.
Okigbo, P. (2008). *Nigeria's financial system: Structure and growth.* Ibadan: Longmans.
Okpara, G. C. (2010). Monetary policy and stock market returns: Evidence from Nigeria. *Journal of Economics, 1*(1), 13-21. https://doi.org/10.1080/09765239.2010.11884920
Osakwe, A. C., & Chukwunulu, J. I. (2019). Monetary policy and stock market performance in Nigeria. *EPRA International Journal of Research and Development, 4*(5), 58-65.
Pitelis, C. (2013). *The asymmetric effects of investor sentiment and monetary policy on stock prices. ResearchGate.* Retrieved from https://www.researchgate.net/publication/272415321_The_asymmetric_effects_of_investor_sentiment_and_monetary_policy_on_stock_prices
Poon, S.-H., & Granger, C. W. J. (2003). Forecasting volatility in financial markets: A review. *Journal of Economic Literature, 41*(2), 478-539.
Reszat, B. (2008). *European financial systems in the global economy.* Chichester, England: Wiley Publishers Ltd.
Shehu UR, A. (2021). Reactions of stock market to monetary policy shocks during the global financial crisis: The Nigerian case. *CBN Journal of Applied Statistics, 1*(3), 17-41.
Si, D.-K., Zhao, B., Li, X.-L., & Ding, H. (2021). Policy uncertainty and sectoral stock market volatility in China. *Economic Analysis and Policy, 69*, 557-573.
Sobrun, J., & Turner, P. (2015). *Bonds markets and monetary policy dilemmas for the emerging markets.* Bank for International Settlements Working Papers No. 508.
Vähämaa, S., & Äijö, J. (2011). The Fed's policy decisions and implied volatility. *Journal of Futures Markets, 31*(10), 995-1010. https://doi.org/10.1002/fut.20503
Yang, T., Zhou, F., Du, M., Du, Q., & Zhou, S. (2023). Fluctuation in the global oil market, stock market volatility, and economic policy uncertainty: A study of the US and China. *The Quarterly Review of Economics and Finance, 87*, 377-387. https://doi.org/10.1016/j.qref.2021.08.006
Yoshino, N., Taghizadeh-Hesary, F., Hassanzadeh, A., & Prasetyo, A. D. (2014). Response of stock markets to monetary policy: The Tehran stock market perspective. *Journal of Comparative Asian Development, 13*(3), 517-545. https://doi.org/10.1080/15339114.2014.985458
Zare, R., Azali, M., & Habibullah, M. S. (2013). Monetary policy and stock market volatility in the ASEAN5: Asymmetries over bull and bear markets. *Procedia Economics and Finance, 7*, 18-27. https://doi.org/10.1016/s2212-5671(13)00213-x

Appendix

Appendix 1. Descriptive statistics.

Variables	INTR	EXCHR	IPI	M2	ALLSHR
Mean	15.56	95.8	789	12.4	356
Median	14.27	99.8	809	12.6	347
Maximum	30.23	206	217	16.1	777
Minimum	5.91	7.60	145	8.20	313
Std deviation	5.23	57.60	535	2.26	258
Skewness	0.69	0.001	0.61	0.02	0.15
Kurtosis	3.27	2.09	2.72	1.70	1.44
Jaque-Bera	10.60	4.50	8.28	8.98	13.5
Probability	0.00	0.11	0.02	0.01	0.001
Sum	199	123	1.02	203	455
Sum sq develop	350	421	3.63	130	8.43
Observation	128	128	128	128	128