Influences of macroeconomic variables on Indian stock market volatility: an empirical study

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Abstract

The relationship between macroeconomic variables and stock market performance has attracted considerable attention in financial economics; however, existing evidence for the Indian stock market remains inconclusive, as previous studies have generally relied on a single econometric technique, shorter sample periods, or linear modelling approaches. Consequently, limited evidence is available on how macroeconomic variables simultaneously influence long-run equilibrium, short-run dynamics, asymmetric responses, volatility persistence, and regime-dependent market behaviour, particularly in the post-COVID period. Addressing these methodological, empirical, temporal, and theoretical gaps, this study develops an integrated econometric framework to examine the impact of inflation, crude oil prices, exchange rates, foreign institutional investment (FII), and gold prices on the BSE Sensex using monthly data from 2000–01 to 2024–25. Unlike previous studies, the analysis combines Quantile Regression, Autoregressive Distributed Lag (ARDL) Bounds Testing, Granger Causality Analysis, ARCH, GARCH, EGARCH, and Markov Switching Regression within a unified framework, thereby enabling the simultaneous investigation of long-run relationships, short-run adjustments, nonlinear responses, volatility dynamics, and market regime shifts. The empirical results confirm the existence of a stable long-run cointegrating relationship between the selected macroeconomic variables and the Sensex, with FII emerging as the only statistically significant long-run determinant. Quantile regression reveals that inflation exerts stronger adverse effects during weak market conditions, whereas crude oil prices, gold prices, and FII inflows contribute more positively during bullish market phases. The volatility models confirm significant volatility clustering, persistence, and asymmetric responses to market shocks. At the same time, the Markov Switching Regression identifies distinct bull and bear market regimes, demonstrating that macroeconomic effects vary across market states. By integrating multiple complementary econometric techniques within a single analytical framework, this study extends the literature on emerging financial markets. It provides a more comprehensive understanding of the nonlinear and regime-dependent interactions between macroeconomic fundamentals and stock market performance. The findings offer valuable implications for policymakers, financial regulators, and investors in promoting financial stability, managing market risk, and formulating evidence-based macroeconomic and investment strategies.

Keywords: *Indian stock market, Macroeconomic variables, Volatility, GARCH family models, ARDL model, Markov-switching regression.*
JEL Classification*: G10, G14, E44, C32, C58, F21*

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1. Introduction

Financial markets play a crucial role in economic development by facilitating capital formation, resource allocation, and investment decisions. Among these, stock markets serve as important barometers of economic performance because they rapidly incorporate information regarding macroeconomic conditions, corporate profitability, and investor expectations (Fama, 1970; Fama, 1990; Naik & Padhi, 2012). Consequently, understanding the interaction between macroeconomic variables and stock market behaviour has become an important area of research for economists, policymakers, financial institutions, and investors.

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As one of the world's fastest-growing emerging economies, India has experienced remarkable expansion in its financial markets over the past two decades. The Bombay Stock Exchange (BSE) Sensex, one of the country's principal benchmark indices, reflects the performance of major listed companies and serves as a key indicator of investor confidence and economic activity. However, the Indian stock market is increasingly exposed to both domestic and international macroeconomic forces, including inflationary pressures, fluctuations in crude oil prices, exchange rate movements, foreign institutional investment (FII) flows, and changes in gold prices. These macroeconomic factors directly or indirectly influence corporate earnings, production costs, capital flows, investor sentiment, and financial market stability. Gold, historically perceived as a safe-haven asset, experiences increased demand during periods of uncertainty, which in turn affects stock market performance (Naik & Padhi, 2012). Similarly, crude oil prices have a significant impact on inflation, input costs, and corporate profitability, which in turn shape stock returns, particularly for India, which depends heavily on oil imports (Tripathy, 2011). FII flows represent another critical driver, as foreign investors' decisions, largely influenced by global liquidity, currency stability, and domestic growth prospects, can lead to sharp fluctuations in stock indices (Kaur, 2009). The exchange rate, especially the rupee–dollar relationship, plays a central role in trade competitiveness, external debt sustainability, and investment attractiveness, thereby influencing equity market behaviour (Makan et al., 2012). CPI, as a measure of inflation, determines purchasing power and monetary policy stance; its fluctuations are strongly associated with investor expectations and stock valuations (Joshi & Giri, 2015). Given these complicated linkages, understanding the dynamic relationship between stock market volatility and macroeconomic variables is not only an academic exercise but also a policy imperative. The simultaneous interaction among these macroeconomic variables creates a complex environment in which stock market performance cannot be adequately explained by simple linear relationships alone.

A considerable body of empirical research has examined the relationship between macroeconomic variables and stock markets using diverse econometric techniques, including cointegration analysis, vector autoregression, autoregressive distributed lag (ARDL) models, and GARCH-family models. Although these studies have significantly advanced the understanding of financial market dynamics, their findings remain inconclusive. While some studies report positive relationships between crude oil prices, exchange rates, gold prices, and stock market performance, others find negative, insignificant, or time-varying effects. Moreover, recent international research increasingly demonstrates that financial markets exhibit asymmetric, nonlinear, and regime-dependent behaviour, suggesting that the effects of macroeconomic shocks differ across market conditions and periods of financial stress.

Despite the expanding literature, several important research gaps remain. First, most previous studies employ a single econometric technique and therefore fail to simultaneously examine long-run equilibrium, short-run dynamics, asymmetric responses, volatility persistence, and regime-switching behaviour. Second, relatively few studies incorporate recent post-COVID observations that capture the structural transformation of financial markets. Third, empirical evidence for India remains mixed regarding the magnitude and direction of macroeconomic influences on stock market performance. Finally, limited attention has been paid to nonlinear and regime-dependent market behaviour, despite growing international evidence that financial relationships vary across market conditions (Keswani et al., 2024).

Motivated by these limitations, the present study develops a comprehensive empirical framework to investigate the influence of inflation, crude oil prices, exchange rates, foreign institutional investment, and gold prices on the BSE Sensex, using monthly data spanning 2000–01 to 2024–25. Unlike previous studies, this research integrates Quantile Regression,

ARDL Bounds Testing, Granger Causality Analysis, ARCH, GARCH, EGARCH, and Markov Switching Regression within a single analytical framework. This integrated approach enables the simultaneous examination of long-run equilibrium relationships, short-run adjustments, asymmetric effects, volatility persistence, and regime-dependent dynamics, thereby providing a more comprehensive understanding of stock market behaviour than studies that rely on individual econometric techniques.

The problem is further compounded by structural changes in the global economy, including commodity price fluctuations, exchange-rate volatility, and cyclical capital flows, which expose the Indian market to both domestic vulnerabilities and international shocks (Magbondé & Konté, 2022). The study addresses these gaps by adopting an integrated approach to examine the volatility of the Indian stock market and its relationship with key macroeconomic indicators, using robust econometric techniques.

The motivation for the study stems from the need to provide clarity during a period of heightened uncertainty, when inflationary pressures, oil price fluctuations, and global capital movements can alter the trajectory of financial markets within a short span. Moreover, as India continues to attract international investors, insights into how FIIs respond to macroeconomic shifts and influence stock market volatility are crucial for maintaining financial stability.

The relevance of this study extends to multiple stakeholders: for policymakers, it provides empirical evidence to support decisions on monetary and fiscal policies aimed at stabilising markets; for investors, it offers guidance on portfolio diversification and risk management strategies; and for academicians, it adds to the growing body of literature on emerging markets by incorporating long-term data and advanced volatility modelling. Furthermore, analysing the nexus among inflation, exchange rates, global commodity prices, and capital flows provides businesses with practical insights for forecasting costs, demand, and overall financial risks in a rapidly globalising environment (Gyamfi et al., 2021). While past studies have examined individual macroeconomic influences on stock market performance, a comprehensive framework that simultaneously captures short-run adjustments, long-run equilibrium, and volatility persistence remains limited. By bridging this gap, the present research seeks to contribute valuable insights into the dynamics of India's financial markets, thereby enhancing academic understanding and supporting more informed economic and investment decisions.

This study addresses several research questions.

RQ1. *How do selected macroeconomic variables affect the long-run equilibrium, short-run dynamics, volatility persistence, asymmetric responses, and regime-dependent behaviour of the Indian stock market during the period 2000–01 to 2024–25?*

This question is particularly relevant because the Indian financial market has undergone significant structural changes following the COVID-19 pandemic, geopolitical tensions, commodity price shocks, and shifts in global capital flows. Understanding these interactions is essential for policymakers, investors, and market regulators seeking to improve financial stability and investment efficiency.

RQ2. *To make the question study more precise and aligned with the study, further supporting sub-questions can be framed:*

i. What is the nature of the short-run and long-run relationship between selected macroeconomic variables and the Indian stock market?
ii. Do macroeconomic indicators exhibit asymmetric effects on stock market performance in India?
iii. How do macroeconomic variables affect stock market volatility over time?

iv. Are there persistent volatility and leverage effects in the Indian stock market during the period 2000–01 to 2024–25?

The rest of the paper is as follows. Section 2 presents the literature review. Section 3 discusses the data and methods. Section 4 deals with the empirical results and analysis. Section 5 concludes the study.

2. Literature Review

A substantial body of literature has examined the influence of macroeconomic variables on stock market performance, particularly in emerging economies where financial markets are highly sensitive to both domestic economic fundamentals and global shocks. Previous research has explored these relationships using a variety of econometric techniques, including cointegration analysis, vector autoregression (VAR), autoregressive distributed lag (ARDL) models, GARCH-family models, and, more recently, nonlinear and quantile-based approaches. Despite this extensive literature, a consensus has not yet been reached regarding the magnitude, direction, and stability of macroeconomic influences on stock markets, particularly in the Indian context.

2.1. Macroeconomic determinants of stock market performance

Early empirical studies established that macroeconomic fundamentals such as inflation, crude oil prices, exchange rates, foreign capital flows, and gold prices significantly influence stock market performance. Fama (1970, 1990) argued that stock prices incorporate available macroeconomic information, thereby reflecting broader economic conditions. In another emerging market context, Yahyazadehfar and Babaie (2012) focused on Iran's Tehran Exchange Dividend Price Index (TEDPIX) and assessed the impact of gold prices, housing price index, and interest rate using monthly data from March 2001 to April 2011. Using a Vector Auto Regression (VAR) and Johansen-Juselius cointegration framework, they found a positive association between TEDPIX and the housing price index, while interest rates and gold prices were negatively related to stock performance, with impulse responses showing rapid stock market reactions to shocks. Likewise, Gyamfi et al. (2021) and Magbondé and Konté (2022) argued that stock markets were sensitive to broader economic cycles and global shocks, reinforcing the interconnectedness of financial systems.

In the Indian context, Tripathy (2011) reported significant causal relationships between stock prices and major macroeconomic variables, while Naik and Padhi (2012) documented long-run associations between industrial production, inflation, money supply, and stock prices. Similarly, Cidar and Mary (2017), Rahman et al. (2017), and Ajayakumar (2017) confirmed that exchange rates, crude oil prices, inflation, and gold prices exert considerable influence on Indian equity markets. However, the direction and magnitude of these relationships differ across sectors and sample periods. Joseph and Rajeshwari (2023) analysed daily data from 1996 to 2022 using a VAR and impulse response functions, concluding that no long-run cointegration existed among gold, oil, and the Sensex. However, short-term linkages revealed that oil prices influenced both gold and the Sensex, and that causality ran one-way from gold prices to the Sensex. More recent studies by Bhattacharjee (2024), Sharma (2024), Keswani et al. (2024), and Maity and Dutta (2026) further demonstrate that crude oil prices, exchange rates, and foreign capital movements remain important determinants of Indian stock market behaviour, particularly during periods of economic uncertainty.

2.2. Volatility, nonlinear relationships, and market asymmetry

Recent research suggests that the relationship between macroeconomic variables and financial markets is inherently nonlinear and varies across different market conditions.

Traditional linear regression models often fail to capture asymmetric responses during periods of market stress or extreme price movements. To address these limitations, researchers increasingly employ GARCH-family models, nonlinear ARDL, and quantile-based techniques. Bhunia and Ganguly (2020) documented significant volatility clustering in the Indian stock market using ARCH and GARCH models, demonstrating that crude oil prices, exchange rates, and FII flows significantly influence market volatility. Likewise, Bhattacharjee (2024) employed nonlinear ARDL to reveal asymmetric long-run effects of crude oil and exchange rate shocks on the Sensex. These findings indicate that stock market responses depend not only on the magnitude of macroeconomic shocks but also on prevailing market conditions.

The growing importance of distributional analysis has been emphasised by Ul-Durar et al. (2025), who comprehensively reviewed the application of quantile regression in economics and finance. Their survey demonstrates that quantile regression provides richer insights than conventional mean-based models because it captures heterogeneous relationships across different parts of the conditional distribution. They argue that macroeconomic variables frequently exert stronger effects during market booms or financial crises than under normal market conditions, making quantile-based approaches particularly appropriate for financial market analysis.

2.3. International evidence on dynamic spillovers and regime-dependent behaviour

Recent international literature has increasingly recognised that macroeconomic and financial relationships are dynamic, state-dependent, and characterised by spillover effects across markets. Dimitriadis et. al. (2025) employed Quantile-VAR and GDCC-GARCH models to examine international financial spillovers and demonstrated that interconnectedness among financial and commodity markets becomes substantially stronger during periods of financial stress. Similarly, Kyriazis et. al. (2026) showed that financial relationships differ considerably across market states using a Quantile-VAR framework combined with financial stress indicators. These studies collectively suggest that analysing financial markets using a single linear specification may overlook important nonlinear dynamics, asymmetric responses, and regime-dependent behaviour.

2.4. Synthesis of the literature

Overall, previous studies consistently acknowledge that macroeconomic variables play an important role in shaping stock market behaviour. However, three important observations emerge from the existing literature. First, empirical findings remain mixed regarding the direction and significance of macroeconomic influences, particularly for crude oil prices, exchange rates, and gold prices. Second, most Indian studies rely on a single econometric framework, focusing independently on long-run relationships, volatility modelling, or causality analysis. Third, although recent international research increasingly emphasises nonlinear, distributional, and regime-dependent relationships, comprehensive evidence for the Indian stock market using an integrated empirical framework remains limited.

Consequently, there is a need for an empirical investigation that simultaneously examines long-run equilibrium, short-run dynamics, asymmetric responses, volatility persistence, and market regime shifts using recent post-COVID data. The present study addresses this need by integrating Quantile Regression, ARDL Bounds Testing, Granger Causality Analysis, ARCH, GARCH, EGARCH, and Markov Switching Regression within a unified analytical framework for the Indian stock market over the period 2000–01 to 2024–25.

2.5. Research gap

Despite the growing body of literature examining the relationship between macroeconomic variables and stock market performance, several important gaps remain. First,

a methodological gap exists, as most previous studies have employed a single econometric approach, such as VAR, ARDL, cointegration analysis, or GARCH-family models, to investigate stock market behaviour. While these techniques provide valuable insights into specific dimensions of financial market dynamics, they do not simultaneously capture long-run equilibrium relationships, short-run adjustments, asymmetric responses, volatility persistence, and regime-dependent behaviour within a unified analytical framework. Consequently, a comprehensive understanding of stock market dynamics remains limited. Second, a temporal gap is evident in the existing literature. A substantial proportion of empirical studies rely on data preceding the COVID-19 pandemic or cover relatively short sample periods. However, the post-COVID era has been characterised by unprecedented economic disruptions, global supply-chain constraints, heightened inflationary pressures, geopolitical conflicts, commodity price shocks, and substantial fluctuations in international capital flows. These structural changes may have altered the relationships between macroeconomic variables and the Indian stock market, thereby necessitating fresh empirical evidence based on an extended and updated dataset. Third, an empirical gap persists because existing evidence on the influence of macroeconomic variables on the Indian stock market remains inconclusive and often contradictory. While some studies report positive effects of crude oil prices, gold prices, exchange rates, and foreign institutional investment on stock market performance, others document negative, insignificant, or time-varying relationships. Such inconsistent findings may stem from differences in sample periods, econometric methodologies, market conditions, and variable selection. Therefore, further empirical investigation is required to provide more robust and comprehensive evidence regarding these relationships in the Indian context. Finally, a theoretical gap remains in explaining the nonlinear and regime-dependent nature of stock market behaviour. Traditional linear econometric models generally assume constant relationships among variables and cannot adequately capture asymmetric responses to market conditions or structural shifts between bull and bear market regimes. Recent developments in financial economics suggest that macroeconomic shocks influence financial markets differently during periods of market expansion and contraction, highlighting the importance of incorporating nonlinear and regime-switching approaches into empirical analysis.

Addressing these gaps, the present study develops an integrated empirical framework by combining Quantile Regression, ARDL Bounds Testing, Granger Causality Analysis, ARCH, GARCH, EGARCH, and Markov Switching Regression using monthly data for the period 2000–01 to 2024–25. This comprehensive approach enables the simultaneous examination of long-run equilibrium, short-run dynamics, asymmetric responses, volatility persistence, and regime-dependent market behaviour, thereby providing a more holistic understanding of how macroeconomic variables influence the Indian stock market and extending the existing literature on emerging financial markets.

2.6. Objectives of the study

This study aims to (i) analyse both short-run and long-run linkages between the Indian stock market and key selected macroeconomic indicators, and (ii) assess the extent to which macroeconomic factors influence the volatility patterns of the Indian stock market. The following hypotheses are formulated:

H_{01}. *No significant long-run association exists between the Indian stock market and the selected macroeconomic variables.*

H_{02}. *The selected macroeconomic variables have a significant relationship between the volatility behaviour and the Indian stock market.*

3. Data and methodology

3.1. Data and variables used

The analysis considers the BSE Sensex as the dependent variable representing stock market performance. The independent variables include Gold Price, Crude Oil Price, Exchange Rate (INR/USD), Inflation (measured by CPI), and Net Foreign Institutional Investment (FII). Monthly time-series data spanning the period 2000–01 to 2024–25 has been employed. The data has been sourced from the BSE Database, the Reserve Bank of India Database, the U.S. Energy Information Administration (EIA), and the World Gold Council.

3.2. Tools used

To evaluate the objectives, a combination of descriptive and inferential tools was applied. Descriptive statistics and correlation analysis were used to identify basic properties and associations among variables. The Augmented Dickey-Fuller (ADF) unit root test was employed to check the stationarity of the series. Based on integration properties, the Autoregressive Distributed Lag (ARDL) model was applied to capture both short-run adjustments and long-run equilibrium relationships. The Granger Causality Test has been used to identify causal relationships among the selected variables. To model and analyse volatility, advanced conditional heteroskedasticity frameworks were employed, namely ARCH, GARCH, and EGARCH. These models help capture persistence in volatility, identify clustering patterns, and examine the presence of leverage effects.

3.3. Model specification

3.3.1. General functional form

Let SM_t = Stock market index (BSE Sensex) at time t, GP_t = Gold price at time t, COP_t = Crude Oil Price at time t, EX_t = Exchange rate (INR/USD) at time t, CPI_t = Inflation measured by consumer price index at time t, FII = Net foreign institutional investment at time t, and ε_t = Error term. The general functional form:

$$SMt = f(GPt, COPt, EXt, CPIt, FIIt) + \varepsilon t.$$

3.3.2. Stationarity test (ADF test)

For each variable Y_t, the Augmented Dickey-Fuller test equation:

$$\Delta Yt = \alpha + \beta t + \gamma Yt - 1 + \sum \delta i \Delta Yt - i + ut \quad (1)$$

Where H_0: $\gamma = 0$ (non-stationary) and H_1: $\gamma < 0$ (stationary)

3.3.3. Long-run and short-run dynamics (ARDL model)

If the variables are I(0) and I(1), an ARDL(p,q) model can be applied.

$$SMt = \alpha 0 + \sum \beta i SMt - i + \sum \theta 1 j GPt - j + \sum \theta 2 j COPt - j + \sum \theta 3 j EXt - j + \sum \theta 4 j CPIt - j + \sum \theta 5 j FIIt - j + \varepsilon t \quad (2)$$

Error Correction Representation (ECM) of ARDL:

$$\Delta SMt = \lambda(SMt - 1 - \Phi 1 GPt - \Phi 2 COPt - \Phi 3 EXt - \Phi 4 CPIt - \Phi 5 FIIt) + \sum \Psi \Delta Xt - i + ut \quad (3)$$

where λ is the speed of adjustment parameter.

3.3.4. Granger causality test

$$SMt = \alpha 0 + \sum i = 1 p \alpha i SMt - i + \sum i = 1 p \beta i GPt - i + \sum i = 1 p \gamma i COPt - i + \sum i = 1 p \delta i EXt - i + \sum i = 1 p \phi i CPIt - i + \sum i = 1 p \theta i FIIt - i + \varepsilon t \quad (4)$$

3.3.5. Volatility modelling (ARCH, GARCH, EGARCH)

3.3.5.1. ARCH (q) Model

$$SMt = u + \varepsilon t, \varepsilon t \mid \Omega t - 1 \tilde{} N(0, ht) \quad (5)$$

$$ht = \alpha 0 + \sum \alpha i \varepsilon 2 t - i \quad (6)$$

3.3.5.2. GARCH (p,q) Model

$$ht = \alpha 0 + \sum \alpha i \varepsilon 2t - I + \sum \beta j ht - j \quad (7)$$

where h_t is the conditional variance (volatility)

3.3.5.3. EGARCH(p,q) Model (for leverage effects)

$$ln(ht) = \omega + \sum \alpha i \, \varepsilon t - i / \sqrt{ht - i} + \sum \gamma i \, (/\varepsilon t - I // \sqrt{ht - i} - \sqrt{2}/\Pi + \sum \beta j \, ln(ht - j) \quad (8)$$

where ω captures the asymmetric/leverage effect

4. Empirical results and analysis

4.1. Descriptive statistics

Table 1 presents the descriptive statistics of the selected variables over the study period. It has been observed that the mean exceeds the median for all variables (except FII), indicating right-skewed distributions. The value of the skewness result also confirms that. The standard deviation reflects the variability of the variables. The result confirms that FII, Sensex, gold prices, and crude oil are more volatile than CPI and the exchange rate. The Jarque-Bera test confirmed non-normality for all variables, consistent with the stylised facts of financial and macroeconomic time series (Gujarati & Porter, 2009; Brooks, 2019). This means the strong presence of skewness, kurtosis, and non-normality, suggesting that advanced econometric techniques are more appropriate.

Table 1. Descriptive Statistics

	CPI	Crude Oil	Exchange Rate	FII	Gold Price	Sensex
Mean	6.13	3789.53	58.45	5524.89	23967.58	26013.22
Median	5.35	3557.98	54.30	2911.45	24304.40	19387.79
Maximum	16.22	9065.71	87.33	93538.00	82977.30	84299.78
Minimum	1.46	934.21	39.32	-118203.10	3891.72	2811.60
Std. Dev.	2.75	1779.41	13.85	21443.79	17054.91	20549.50
Skewness	1.05	0.39	0.44	-0.59	0.90	1.03
Kurtosis	3.81	2.41	1.82	9.93	3.53	3.22
Jarque-Bera	63.18	12.11	27.29	618.57	44.25	53.19
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Observations	300	300	300	300	300	300

4.2. Correlation analysis

Table 2 offers the Pearson correlation analysis among the Indian stock market and selected macroeconomic variables. The Sensex shows a strong positive correlation with gold price, exchange rates, and crude oil prices, suggesting that stock market movements are closely associated with commodity prices and currency fluctuations. Again, there is a very low positive correlation between the Sensex and the FII. The results in Table 2 indicate that the CPI negatively correlated with the Sensex under study. This suggests a cluster of market-driven variables moving together, while CPI and FII behave more independently.

Inflation (CPI) has not been strongly linked with the financial markets under study. Oil price movements are closely tied to currency fluctuations, gold markets, and stock market performance. Finally, it can be concluded that a global integrated financial system exists in the Indian stock market when commodity prices, currency, and the stock markets are tightly interlinked. However, inflation and capital flows operate on different dynamics**.** These correlation patterns provided preliminary insights into potential co-movements and relationships that can be further explored using econometric models (Gujarati & Porter, 2009; Wooldridge, 2016).

Table 2. Correlation Analysis

	CPI	Crude Oil	Exchange Rate	FII	Gold Price	Sensex

CPI	1.00					
Crude Oil	0.30	1.00				
Exchange Rate	-0.20	0.63	1.00			
FII	0.04	0.02	0.02	1.00		
Gold Price	0.02	0.76	0.91	0.06	1.00	
Sensex	-0.10	0.75	0.91	0.08	0.96	1.00

Although the correlation matrix indicates relatively high pairwise correlations, multicollinearity diagnostics based on centred VIF values (ranging from 1.02 to 9.48) show that all explanatory variables remain below the conventional threshold of 10, suggesting multicollinearity is not severe. Furthermore, the consistency of coefficient signs and significance across Quantile Regression, ARDL, GARCH-family models, and Markov Switching Regression demonstrates that the estimated relationships are robust across alternative econometric specifications. The detailed VIF results are reported in Appendix Table A1.

4.3. ADF unit root test results

Table 3 reports the results of the Augmented Dickey-Fuller (ADF) unit root test conducted to examine the stationarity of the selected variables. At the level form, CPI, exchange rate, gold, and Sensex were found to be non-stationary as their t-statistics did not exceed the critical value at the 5% significance level, while crude oil and FII were stationary. However, after first differencing, all variables became stationary, indicating that they were integrated of order one, I(1). The probability values at 1(1) confirmed statistical significance at the 1% level for all variables. These results justify the use of the Autoregressive Distributed Lag (ARDL) approach, which allowed for a combination of I(0) and I(1) variables to estimate both short-run and long-run relationships (Gujarati & Porter, 2009; Brooks, 2019). Establishing stationarity was a critical prerequisite for avoiding spurious regression and ensuring reliable econometric analysis.

Table 3. ADF Unit Root Test Results

	ADF at Level				**ADF at 1st Difference**			
	t-statistics	**C.V. @ 5%**	**Prob.**	**Remarks**	**t-statistics**	**C.V. @ 5%**	**Prob.**	**Remarks**
CPI	-1.68	-3.42	0.77	NS	-7.46	-3.42	0.00	S
Crude Oil	-3.53	-3.42	0.04	S	-13.02	-3.42	0.00	S
Exchange Rate	-1.95	-3.42	0.62	NS	-16.58	-3.42	0.00	S
FII	-12.98	-3.42	0.00	S	-13.01	-3.42	0.00	S
Gold Price	2.85	-3.42	1.00	NS	-11.96	-3.42	0.00	S
Sensex	-1.13	-3.42	0.92	NS	-17.54	-3.42	0.00	S

4.4. Lag length selection

Table 4 presents the results of the lag length selection process based on multiple criteria, namely the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn (HQ). At lag 0, the information criteria values are high, and no LR test statistic is reported. As the lag length increased, both LogL values and LR statistics improved, while the FPE, AIC, SC, and HQ declined, indicating better model fit. The results showed that the AIC suggested lag 3 as the optimal choice, supported by the lowest value at this lag. Similarly, the FPE also selects lag 3, while the SC favours lag 1, and HQ indicates lag 2. The criteria point **is** lag 3 as the most suitable lag order for further analysis.

Table 4. Lag length selection

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-13525.2	NA	7.17E+32	92.67974	92.75529	92.71
1	-11054.2	4823.579	4.09E+25	76.00147	76.53032*	76.21331

2	-10979.2	143.3158	3.14E+25	75.73437	76.71652	76.12778*
3	-10933.4	85.60892	2.93e+25*	75.66736*	77.10281	76.24234
4	-10907.7	47.11047	3.15E+25	75.73749	77.62624	76.49405
5	-10877.7	53.52266	3.29E+25	75.779	78.12104	76.71713
6	-10838.2	69.08582	3.23E+25	75.75465	78.54999	76.87435
7	-10814.8	39.926	3.53E+25	75.84088	79.08952	77.14216
8	-10783.8	51.47210*	3.68E+25	75.87564	79.57758	77.35848

Note: * indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

4.5. Quantile regression

Quantile regression (Table 5) has been performed to assess nonlinear sensitivities between the Sensex and other independent variables. The analysis found that CPI has a consistently negative coefficient across all quantiles, suggesting that higher inflation exerts downward pressure on Sensex returns. Notably, the negative impact diminishes at higher quantiles, indicating that in periods when the market is doing better (upper quantiles), inflation has a smaller negative effect. It has also been observed that Crude oil has a positive and significant effect on the Indian stock market. However, its impact is greater in the highest quartile (0.75) than in the other quartiles. This suggests that higher crude oil prices are associated with higher Sensex values, which may reflect oil price increases coinciding with broader economic growth phases or strong equity markets. The exchange rate has a positive effect on the Indian stock market, but none of the effects is statistically significant at the 5% level. This suggests a weak or inconclusive relationship between the exchange rate and Sensex, which may indicate market resilience to short-term currency fluctuations. The coefficients and significance level of FII are positive and increase slightly across the lower quartiles. This implies that FII inflows have a stronger impact under high-performing market conditions, highlighting investors' sensitivity to sentiment in bullish markets. Coefficients of gold prices are positive and statistically significant at the 1% level across all quantiles, and the positive impact increases with higher quantiles, suggesting that rising gold prices are associated with higher Sensex values, especially in stronger market conditions. The positive and significant coefficients for gold prices across all quantiles suggest that gold and equity markets may respond jointly to favourable macroeconomic conditions rather than behaving as substitute assets. So, the Sensex reacts asymmetrically to macroeconomic factors: negative shocks such as inflation weigh more heavily when markets are weak, while positive drivers such as oil prices, gold, and FII flows strengthen returns when markets are strong.

Table 5. Quantile Regression (Dependent Variable: Sensex)

Variable	**tau = 0.25**		**tau = 0.50**		**tau = 0.75**	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	-8363.909	0.3072	-7972.490	0.1130	-5176.170	0.1230
CPI	-1474.976	0.0001	-719.4682	0.0006	-493.6128	0.0000
Crude Oil	1.726993	0.0000	2.119976	0.0000	2.501430	0.0000
Exchange Rate	234.5262	0.1826	158.6578	0.1222	76.91003	0.2684
FII	0.039256	0.0694	0.054320	0.0295	0.050232	0.0000
Gold Price	0.797727	0.0000	0.913249	0.0000	0.965975	0.0000

4.6. ARDL test results

Since some variables were non-stationary at 1(0) but became stationary after first differencing, the bounds testing procedure developed by Pesaran et al. (2001) was considered appropriate. Accordingly, this study employed the ARDL bounds test to evaluate the long-run association between the selected variables and the Sensex. The F-statistic was applied to test the joint significance of the coefficients of the lagged level terms, which helped determine the presence of a long-run relationship.

Table 6. ARDL bound test results for Sensex

Test Statistic	Value	C.V. (%)	I(0)	I(1)
F-statistic	32.91508	5%	2.39	3.38

The ARDL bounds test indicates that the calculated F-statistic (32.92) was well above the upper bound critical value at the 5% significance level. This confirms the existence of a cointegrating relationship between the Sensex and the five macroeconomic variables considered in the model.

Table 7. ARDL bound test results for Long-Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-669.8964	686.3947	-0.975964	0.3299
Sensex(-1)	0.000568	0.013778	0.041215	0.9672
CPI	-34.64692	33.49976	-1.034244	0.3019
Crude Oil	0.063646	0.068187	0.933399	0.3514
Exchange Rate	15.26238	14.00121	1.090076	0.2766
FII	0.047307	0.003300	14.33595	0.0000
Gold Price	-0.008420	0.016750	-0.502711	0.6156
D(Sensex(-1))	-0.257386	0.049651	-5.183913	0.0000
D(Sensex(-2))	-0.102935	0.047404	-2.171436	0.0307

Table 7 reports the long-run coefficients estimated through the ARDL model. The constant term is negative and insignificant. The lagged value of Sensex (at 1st lag) shows a negative coefficient that is also insignificant, whereas at 2nd and 3rd lags, Sensex shows a negative significant coefficient, suggesting a marginal influence. Among the explanatory variables, the CPI and Gold Price have a negative and insignificant effect, indicating that inflationary pressures and commodity prices have a negative long-term relationship with the Sensex. FII only shows a positive and statistically significant coefficient at the 1% level, implying that higher capital inflows strongly contribute to stock market performance. On the other hand, crude oil and the exchange rate exhibit positive coefficients but are insignificant, suggesting no meaningful long-term relationship with the Sensex. The results emphasise the significant roles of FII in shaping the long-term dynamics of the Sensex, while the other selected macroeconomic variables appear less relevant.

Table 8. ARDL bound test results for Short-Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Sensex(-1))	-0.169209	0.052590	-3.217506	0.0014
D(Crude Oil)	0.725196	0.177153	4.093604	0.0001
D(Exchange Rate)	-343.4220	57.60604	-5.961561	0.0000
D(FII)	0.041718	0.002923	14.27366	0.0000
CointEq(-1)*	-0.004667	0.000519	-8.991324	0.0000

Table 8 presents the short-run coefficients obtained from the ARDL model. The lagged value of the Sensex is statistically significant at the 1% level but has a negative coefficient, indicating strong short-run persistence in stock market movements. Among the macroeconomic indicators, crude oil and FII exhibited positive and statistically significant effects, suggesting that changes in these variables exert immediate influence on the Sensex. In contrast, the exchange rate shows a highly negative but significant coefficient, implying an inverse short-run relationship with the market. The error correction term (ECT) has a coefficient of -0.004667 and is significant, confirming that any short-run disequilibrium is fully adjusted within the period and ensuring the model's stability. Model diagnostics support the robustness of the estimated model.

Table 9. Granger Causality Test

Null Hypothesis:	F-Statistic	Prob.
Sensex does not Granger-cause CPI	0.28209	0.8383
Sensex does not Granger-cause Crude Oil	5.58440*	0.0010

Sensex does not Granger-cause the exchange rate	1.93595	0.1239
Sensex does not Granger-cause FII	5.91361*	0.0006
Sensex does not Granger-cause Gold Price	2.94794*	0.0332
CPI does not Granger-cause Sensex	1.43412	0.2330
Crude Oil does not Granger-cause Sensex	2.16450	0.0923
The exchange rate does not Granger-cause Sensex	2.12710	0.0969
FII does not Granger-cause Sensex	0.08342	0.9690
Gold Price does not Granger-cause Sensex	1.91439	0.1273
CPI does not Granger-cause crude oil	1.12477	0.3393
CPI does not Granger-cause the exchange rate	1.66192	0.1754
CPI does not Granger-cause FII	1.79274	0.1486
CPI does not Granger-cause Gold Price	0.73427	0.5323
Crude Oil does not Granger-cause CPI	0.17206	0.9152
Crude Oil does not Granger-cause the Exchange Rate	4.56242*	0.0039
Crude Oil does not Granger-cause FII	0.90224	0.4404
Crude Oil does not Granger-cause Gold Price	1.04434	0.3733
The exchange rate does not Granger-cause crude oil	2.01701	0.1117
The exchange rate does not Granger-cause CPI	0.70210	0.5514
The exchange rate does not Granger-cause FII	2.10939	0.0991
Exchange Rate does not Granger-cause Gold Price	0.77221	0.5103
FII does not Granger-cause crude oil	2.62236	0.0509
FII does not Granger-cause CPI	0.59893	0.6162
FII does not Granger-cause the exchange rate	0.31006	0.8181
FII does not Granger-cause the Gold Price	1.24060	0.2952
Gold Price does not Granger-cause Crude Oil	5.35725*	0.0013
Gold Price does not Granger-cause CPI	0.71290	0.5450
Gold Price does not Granger-cause Exchange Rate	4.51883*	0.0041
Gold Price does not Granger-cause FII	0.55643	0.6442

Note: * at a significant level.

4.7. Granger causality test

The Granger causality test (Table 9) is employed to examine the dynamic interrelationships among the stock market (Sensex), macroeconomic indicators, and key financial variables, including the Consumer Price Index, Crude Oil prices, Exchange Rate, Foreign Institutional Investors flows, and Gold Price. The Sensex is mostly driving other variables, not being driven by them. The causality test results confirm that a unidirectional relationship runs from the Sensex to Crude Oil, FII, and Gold Price. The Granger causality results indicate predictive precedence rather than structural economic causation. The strong causality from the Sensex to FII flows further suggests that foreign institutional investors respond to domestic market performance rather than being primary drivers of it. Conversely, there is only weak evidence supporting reverse causality from crude oil prices and the exchange rate to the stock market, indicating that macroeconomic shocks have limited short-term predictive power for stock returns within the studied framework. The results highlight significant causal relationships within commodity and foreign exchange markets. Gold prices are found to Granger-cause crude oil prices and the exchange rate, while crude oil prices also Granger-cause exchange rate movements. The Consumer Price Index does not exhibit any significant causal relationship with the other variables in the system. Neither does CPI Granger-cause financial variables, nor do they influence CPI. Moreover, the Indian stock market serves as a dominant driver, influencing capital flows and commodity prices. Commodity and exchange rate markets are interconnected, with significant spillover effects. Inflation (CPI) remains detached from the financial system in terms of short-run predictive relationships.

4.8. ARCH test results

Table 10 reports the results of the ARCH model estimation. The constant term was negative and not significant, indicating a downward shift in the mean equation. Among the

explanatory variables, crude oil and gold prices have positive and statistically significant coefficients, indicating that fluctuations in these variables strongly affect market volatility. Again, the exchange rate and FII show positive and statistically insignificant coefficients. Finally, CPI shows a negative coefficient that is statistically significant. In particular, gold and crude oil prices exhibit a pronounced influence on volatility. The variance equation further reveals that the constant term (ω) is positive and significant. At the same time, the ARCH effect (α) arrived at unity and is statistically significant at the 1% level, indicating a strong presence of volatility clustering in the series. This means past shocks have a persistent influence on future volatility. The results confirm that macroeconomic variables, especially crude oil, exchange rate, and gold, are critical determinants of stock market volatility, with evidence of strong autoregressive conditional heteroskedasticity.

Table 10. ARCH test results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2578.890	2664.844	-0.967745	0.3332
CPI	-657.2850	122.6506	-5.359004	0.0000
Crude Oil	1.205299	0.301204	4.001605	0.0001
Exchange Rate	85.22428	56.66457	1.504014	0.1326
FII	0.029097	0.018958	1.534834	0.1248
Gold Price	0.943903	0.056650	16.66190	0.0000
	Variance Equation			
ω (constant)	124859.1	45674.94	2.733646	0.0063
α (ARCH effect)	1.002758	0.003435	291.8995	0.0000

Table 11. GARCH test results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-13133.69	925.5244	-14.19054	0.0000
CPI	-211.1814	27.97309	-7.549449	0.0000
Crude Oil	2.415766	0.105590	22.87864	0.0000
Exchange Rate	232.5020	18.50239	12.56605	0.0000
FII	0.063093	0.004698	13.43105	0.0000
Gold Price	0.780214	0.019751	39.50247	0.0000
	Variance Equation			
ω (constant)	59721.79	57748.61	1.034169	0.3011
α (ARCH effect)	0.689065	0.144061	4.783138	0.0000
β (GARCH effect)	0.460663	0.061911	7.440679	0.0000

4.9. GARCH test results

Table 11 presents the results of the GARCH estimation. The constant term is negative and statistically significant at the 1% level, reflecting a downward adjustment in the mean equation. All the explanatory variables, namely crude oil, exchange rate (ER), foreign institutional investment (FII), and gold, display positive and statistically significant coefficients. In contrast, CPI shows negative and statistically significant coefficients in the study. This indicates that each of these variables contributed strongly to explaining stock market volatility, with crude oil and gold showing particularly strong influence. The exchange rate also exerts a substantial impact, while CPI demonstrates negative but significant effects. In the variance equation, the constant term (ω) is positive but statistically insignificant, suggesting a limited contribution to volatility by itself. The ARCH effect (α) is positive and statistically significant at the 1% level, indicating that past shocks have a strong and direct influence on current volatility. The GARCH effect (β) is also positive and significant, implying that volatility is persistent over time. Together, the results confirm the presence of both short-run shock effects and long-run volatility persistence in the market.

4.10. EGARCH test results

Table 12 reports the estimates from the EGARCH model. The constant term is negative and statistically significant at the 1% level, consistent with previous results. Crude oil, foreign institutional investment (FII), and gold are positive and statistically significant at the 1% level, highlighting their important role in influencing stock market volatility. The exchange rate shows positive and strongly insignificant coefficients under study. But CPI is negative, and the coefficients are statistically significant at the 1% level in the study. In the variance equation, the constant term (ω) was positive but statistically insignificant, suggesting a limited role in volatility dynamics. The ARCH effect (α) is positive and statistically significant at the 1% level, indicating that past shocks have a statistically significant influence on current volatility. The GARCH effect (β), however, is statistically insignificant, implying weak evidence of long-term volatility persistence in this specification. Importantly, the leverage effect (γ) is positive and statistically significant at the 1% level, confirming that the positive and statistically significant leverage coefficient confirms the presence of asymmetric volatility responses, indicating that market volatility reacts differently to shocks of varying signs and magnitudes.

Table 12. EGARCH test results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-3287.811	1050.008	-3.131226	0.0017
CPI	-272.7094	26.99523	-10.10213	0.0000
Crude Oil	1.187047	0.090988	13.04613	0.0000
Exchange Rate	36.06917	21.58302	1.671183	0.0947
FII	0.045884	0.004317	10.62773	0.0000
Gold Price	1.072209	0.020621	51.99584	0.0000
	Variance Equation			
ω (constant)	0.683934	0.704036	0.971447	0.3313
α (ARCH effect)	1.400303	0.208591	6.713164	0.0000
β (GARCH effect)	0.008931	0.110723	0.080662	0.9357
γ (leverage effect)	0.882882	0.047715	18.50335	0.0000

The findings from the ARDL and GARCH-family models should not be interpreted as contradictory because the two approaches capture different economic mechanisms. The ARDL model estimates long-run equilibrium relationships among macroeconomic variables, where only FII exerts a statistically significant long-run influence on the Sensex. In contrast, the GARCH-family models explain conditional volatility rather than mean returns. Consequently, macroeconomic variables such as crude oil prices, gold prices, exchange rates, and inflation may not permanently determine the equilibrium level of stock prices. Still, they can significantly influence the magnitude and persistence of short-term market volatility. Therefore, the results are complementary rather than conflicting.

4.11. Markov switching regression

Markov Switching Regression (MSR) (Table 13) allows the Sensex to behave differently under two regimes, capturing regime-dependent dynamics such as bull vs bear markets. Both intercepts are negative and statistically significant at the 1% level. Still, Regime 2 has a much larger magnitude, suggesting it represents a low-return or bear-market state, whereas Regime 1 represents a moderate-return or bull-market state. The pronounced difference indicates significant regime shifts in the Sensex level. The crude oil price shows a positive coefficient and is statistically significant at the 1% level. That indicates that rising oil prices boost the Sensex, likely reflecting periods when global growth coincides with rising oil prices. The Exchange Rate also shows a positive and significant relationship, indicating that Sensex rises with INR depreciation against USD (possibly due to FII inflows or export-oriented stock gains). The FII is also positive and statistically significant at the 1% level, implying that foreign investments drive Sensex returns. The Gold Price shows a strong positive impact across both regimes, indicating either a parallel investment effect or sentiment correlation. There is a

negative and statistically significant impact of Inflation at the 1% level, indicating that higher inflation reduces the Sensex, consistent with previous quantile regression results. The highly significant value of LOG (SIGMA) indicates that residual volatility is substantial, implying substantial variability in Sensex returns. The MSR model captures time-varying volatility across regimes.

Table 13. Markov Switching Regression Result

Variable	Coefficient	Std. Error	z-Statistic	Prob.
		Regime 1		
C	-6793.014	2012.406	-3.375568	0.0007
		Regime 2		
C	-19885.35	2098.758	-9.474818	0.0000
		Common		
CPI	-533.1975	85.22326	-6.256479	0.0000
Crude Oil	2.517980	0.191627	13.13998	0.0000
Exchange Rate	105.0414	41.99416	2.501334	0.0124
FII	0.059734	0.008321	7.179095	0.0000
Gold Price	0.923449	0.034639	26.65952	0.0000
LOG(SIGMA)	7.948826	0.041956	189.4567	0.0000

In short, this MSR model provides a clear picture of bull vs bear market dynamics in the Sensex while showing that macro factors consistently drive returns across regimes, as illustrated Table 14.

Table 14. Summary results

Factor	Bear Market / Low Quantile	Bull Market / High Quantile	Across Regimes
Inflation	Strongly negative	Weakly negative	Negative in both, more impact in downturns
Crude Oil	Positive, moderate	Stronger positive	Positive in all regimes, stronger in bull markets
FII	Weakly positive	Strongly positive	Positive across regimes; more influence in bull markets
Gold	Positive, moderate	Strong positive	Consistent positive across regimes
Exchange Rate	Insignificant	Slightly positive	Positive in both regimes
Sensex	Low	High	Lower in Regime 2, higher in Regime 1

5. Conclusion

This study examined the dynamic relationship between selected macroeconomic variables and the Indian stock market by investigating the effects of inflation (CPI), crude oil prices, exchange rates, foreign institutional investment (FII), and gold prices on the BSE Sensex over the period 2000–01 to 2024–25. Motivated by the structural changes in financial markets following the COVID-19 pandemic and the growing evidence of nonlinear market behaviour, the study employed an integrated econometric framework comprising Quantile Regression, ARDL Bounds Testing, Granger Causality Analysis, ARCH, GARCH, EGARCH, and Markov Switching Regression. This comprehensive framework enabled the simultaneous examination of long-run equilibrium relationships, short-run dynamics, asymmetric responses, volatility persistence, and regime-dependent market behaviour.

The empirical findings reveal that the Indian stock market exhibits complex and nonlinear responses to macroeconomic fundamentals. The ARDL results confirm a stable long-run cointegrating relationship between the Sensex and the selected macroeconomic variables, with foreign institutional investment emerging as the only statistically significant long-run determinant of stock market performance. In contrast, the short-run analysis demonstrates that crude oil prices, exchange rates, and FII significantly influence market movements, indicating

that stock prices respond more rapidly to short-term macroeconomic shocks than to long-run structural changes.

The Quantile Regression results further reveal that the effects of macroeconomic variables vary across different market conditions. Inflation exerts a stronger negative influence during bearish market conditions, whereas crude oil prices, gold prices, and FII inflows contribute more positively during bullish phases. These findings demonstrate that investor behaviour and market responses are heterogeneous across the conditional distribution of stock returns, thereby supporting the use of distribution-sensitive econometric approaches instead of conventional mean-based models.

The volatility models provide additional insights into the behaviour of the Indian stock market. The ARCH and GARCH models confirm significant volatility clustering and persistence, indicating that past shocks strongly influence current market volatility. Furthermore, the EGARCH model identifies statistically significant asymmetric volatility responses, implying that market volatility reacts differently to shocks depending on their direction and magnitude. The Markov Switching Regression further demonstrates that the Indian stock market operates under distinct bull and bear market regimes, with the influence of macroeconomic variables varying across these regimes. Collectively, these findings confirm that stock market dynamics are nonlinear, asymmetric, and state-dependent.

5.1. Theoretical contributions

This study makes several important contributions to the existing literature on financial economics and emerging capital markets. First, it extends the growing body of evidence supporting the proposition that macroeconomic–stock market relationships are nonlinear and regime-dependent rather than constant over time. Second, by simultaneously examining long-run equilibrium, short-run dynamics, volatility persistence, asymmetric responses, and market regime shifts, the study provides a more comprehensive understanding of stock market behaviour than previous studies relying on a single econometric technique. Third, the findings contribute to the literature on emerging markets by providing updated empirical evidence for India using an extended dataset that incorporates both pre- and post-COVID economic conditions. Consequently, the study bridges methodological, temporal, empirical, and theoretical gaps identified in previous research.

5.2. Practical and policy implications

The findings have important implications for policymakers, regulators, and market participants. For policymakers, the significant influence of inflation and exchange rate movements highlights the importance of maintaining macroeconomic stability through appropriate monetary and fiscal policies. The Reserve Bank of India should continue to monitor inflationary pressures and exchange rate volatility to minimise adverse effects on financial markets. The long-run significance of FII indicates that maintaining investor confidence through stable macroeconomic conditions, transparent regulatory policies, and a predictable investment environment is essential for sustaining capital market growth.

For market regulators, particularly the Securities and Exchange Board of India (SEBI), the presence of volatility clustering, asymmetric market responses, and regime-dependent behaviour suggests that continuous monitoring of capital flows and market risk is necessary to strengthen financial stability. Regulatory measures aimed at improving market transparency and reducing systemic risk may help mitigate excessive market fluctuations during periods of economic uncertainty.

For investors and portfolio managers, the findings demonstrate that investment decisions should not rely solely on average market behaviour. Since macroeconomic variables exert different effects across bearish and bullish market conditions, dynamic portfolio allocation, effective risk management, and diversification strategies should incorporate information on inflation, commodity prices, exchange rate movements, and foreign capital flows. The evidence of regime-dependent behaviour also suggests that investment strategies should be adjusted according to prevailing market conditions rather than following static portfolio allocation rules.

5.3. Limitations of the study

Despite its contributions, the study has certain limitations. First, the analysis is confined to five macroeconomic variables and a single benchmark stock market index (BSE Sensex). Other potentially important determinants, such as interest rates, industrial production, money supply, fiscal policy, geopolitical risk, economic policy uncertainty, and investor sentiment, were not incorporated. Second, although the study captures regime-dependent behaviour using Markov Switching Regression, it does not explicitly investigate the effects of individual economic crises or structural break events. Third, the analysis focuses exclusively on the Indian stock market, limiting the generalisability of the findings to other emerging or developed economies.

5.4. Future research directions

Future research may extend the present study in several directions. First, additional macroeconomic and financial variables may be incorporated to provide a more comprehensive explanation of stock market dynamics. Second, comparative studies involving other emerging economies or BRICS countries would improve understanding of whether the observed relationships are country-specific or common across developing financial markets. Third, future studies may analyse sector-specific stock indices to examine whether macroeconomic variables affect different industries differently. Fourth, advanced econometric approaches, including Time-Varying Parameter VAR, Dynamic Conditional Correlation (DCC)-GARCH, Quantile Vector Autoregression, wavelet analysis, and machine learning techniques, may provide further insights into nonlinear market behaviour. Finally, the use of high-frequency financial data could improve the understanding of short-term market reactions to macroeconomic announcements and external shocks.

In conclusion, this study demonstrates that the relationship between macroeconomic variables and the Indian stock market is dynamic, nonlinear, and regime-dependent. By integrating multiple complementary econometric techniques within a unified analytical framework, the study provides a more comprehensive understanding of how macroeconomic fundamentals influence stock market performance across different time horizons and market conditions. The findings contribute to the growing literature on emerging financial markets while offering valuable guidance for policymakers, regulators, and investors seeking to enhance financial stability, improve risk management, and formulate evidence-based investment and macroeconomic policies.

Although the correlation matrix shows relatively high pairwise correlations, multicollinearity diagnostics based on centred VIF values show that all explanatory variables remain below the conventional threshold of 10, suggesting multicollinearity is not severe. Furthermore, the consistency of coefficient signs and significance across Quantile Regression, ARDL, GARCH-family models, and Markov Switching Regression demonstrates that the estimated relationships are robust across alternative econometric specifications.

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Appendix

Table A1. Variance Inflation Factors (VIF)

Variable	Centered VIF
Inflation	1.671586
Crude Oil	2.915400
Exchange Rate	8.380987
FII	1.017088
Gold Price	9.478237