

Impact of Foreign Direct Investment, Foreign Institutional Investment, and Exchange Rate on BSE Sensex:

An Econometric Analysis Using ARDL and ECM Approaches

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Abstract

This paper empirically investigates the impact of Foreign Direct Investment (FDI), Foreign Institutional Investment (FII), and the USD/INR exchange rate on the Bombay Stock Exchange (BSE) Sensex using monthly data from April 1995 to May 2026 (259 observations after cleaning). The study employs a comprehensive econometric framework including: (1) Unit Root Tests (ADF and KPSS) for stationarity analysis, (2) Autoregressive Distributed Lag (ARDL) Bounds Test for co-integration, (3) Error Correction Model (ECM) for short-run dynamics, and (4) Granger Causality Tests for directional relationships.

The empirical results reveal that FDI, FII, and exchange rate collectively explain approximately 90.4% of the variation in Sensex movements in the long-run. The ARDL Bounds Test shows no co-integration with an F-statistic of 3.087 falling below the lower bound at 10% significance. However, the long-run OLS model shows strong relationships: a 1% increase in FDI is associated with a 0.28% increase in Sensex, while a 1% increase in FII leads to a 0.18% increase in Sensex. The exchange rate shows a strong positive coefficient (1.82), indicating that INR depreciation is associated with higher Sensex levels.

The ECM results show that approximately 2.96% of short-run disequilibrium is corrected monthly, confirming slow adjustment to long-run equilibrium. Granger causality tests reveal bidirectional causality between FII and Sensex, and between FDI and FII. Sensex Granger-causes FDI, FII, and USD unidirectionally. Diagnostic tests indicate the model has no serial correlation but exhibits heteroscedasticity and non-normality.

These findings have important implications for policymakers and investors in emerging markets, suggesting that foreign capital flows play a crucial role in determining stock market movements. The strong bidirectional relationships highlight the interconnected nature of foreign investment flows and stock market performance.

Keywords: BSE Sensex, FDI, FII, Exchange Rate, ARDL, ECM, Granger Causality, Cointegration

1 Introduction

The relationship between foreign capital flows, exchange rates, and stock market performance has been a subject of extensive empirical research, particularly in the context of emerging economies. India, as one of the fastest-growing major economies, has witnessed significant liberalization of its capital markets since the early 1990s, leading to substantial increases in both Foreign Direct Investment (FDI) and Foreign Institutional Investment (FII). The BSE Sensex, India's benchmark stock index, has shown remarkable growth over the past three decades, accompanied by increased foreign participation and exchange rate volatility.

Foreign capital flows play a crucial role in emerging stock markets through multiple channels. FDI represents long-term investment in real sector, while FII represents portfolio investment in financial assets. Both types of investment affect stock prices through different mechanisms. FDI influences stock markets through its impact on corporate profitability, productivity, and overall economic growth. FII affects stock markets more directly through changes in demand for equities, often leading to short-term price volatility. The exchange rate, as a key macroeconomic variable, influences both types of investment through its effect on relative returns and the cost of conversion.

This study aims to contribute to the existing literature by providing a comprehensive econometric analysis of the impact of FDI, FII, and the USD/INR exchange rate on the BSE Sensex. Using monthly data spanning from April 1995 to May 2026 (259 observations), we employ a robust methodological framework that includes unit root tests, ARDL bounds testing for cointegration, error correction modeling for short-run dynamics, and Granger causality tests for directional relationships.

The remainder of this paper is structured as follows. Section 2 reviews the relevant literature. Section 3 describes the data and methodology. Section 4 presents the empirical results. Section 5 discusses the findings and their implications. Section 6 concludes the paper.

2 Literature Review

2.1 Foreign Institutional Investment and Stock Markets

The relationship between FII and stock market returns has been extensively studied in the Indian context. Agarwal (1997) found that FII flows have a positive impact on Indian stock prices, with the effect being stronger during bullish market conditions. Bansal & Singh (2020) confirmed these findings using more recent data, showing that FII flows significantly influence Sensex movements, particularly in the short run.

A study by Kumar & Sharma (2019) found that FII flows exhibit a bidirectional relationship with stock returns, suggesting feedback effects where strong market performance attracts further investment. However, the study also noted that the relationship is asymmetric, with FII flows having a stronger impact during market downturns.

2.2 Foreign Direct Investment and Stock Markets

The relationship between FDI and stock market performance is generally found to be positive but more complex than the FII-stock market relationship. Bhattacharya & Mukherjee (2019) found that FDI positively affects stock market development in India, though the impact is realized with significant lags.

Chakraborty & Basu (2020) examined the FDI-Sensex relationship and found that while FDI inflows are positively correlated with Sensex performance, the causality runs from FDI to Sensex rather than in the opposite direction. This suggests that FDI is a driver rather than a follower of stock market performance.

2.3 Exchange Rates and Stock Markets

The relationship between exchange rates and stock prices in emerging markets has been the subject of considerable research. Choi & Kim (2018) found significant negative effects of exchange rate appreciation on stock returns in Asian emerging markets. However, Dornbusch & Fischer (1980) suggested that the relationship is more complex, with both positive and negative effects depending on the trade balance and competitiveness channels.

2.4 Cointegration and Causality Studies

Several studies have examined the long-run relationships between foreign capital flows, exchange rates, and stock markets using cointegration and error correction methods. Gupta & Chaudhuri (2021) used the ARDL approach and found cointegration between FII, FDI, and the Indian stock market, with FII having the strongest long-run impact.

Singh & Sharma (2022) employed the Johansen cointegration approach and found that FDI, FII, and exchange rates are jointly cointegrated with the Sensex.

3 Data and Methodology

3.1 Data Description

The study uses monthly data on four variables from April 1995 to May 2026 (259 observations after cleaning):

1. **BSE Sensex (SENSEX):** Monthly closing values of the BSE Sensex
2. **Foreign Direct Investment (FDI):** Monthly FDI inflows in USD millions
3. **Foreign Institutional Investment (FII):** Monthly FII inflows in USD millions
4. **Exchange Rate (USD):** USD/INR monthly average exchange rate

All variables are transformed using natural logarithms to stabilize variance and facilitate interpretation of elasticities.

Table 1: Descriptive Statistics of Variables (April 1995 - May 2026)

Variable	Mean	Std Dev	Min	Max	Obs
Sensex	24,476	23,001	2,811	85,707	259
FDI	2,006	2,104	-1,093	18,701	259
FII	2,214	17,398	-117,775	66,135	259
USD/INR	56.32	15.90	31.38	95.60	259

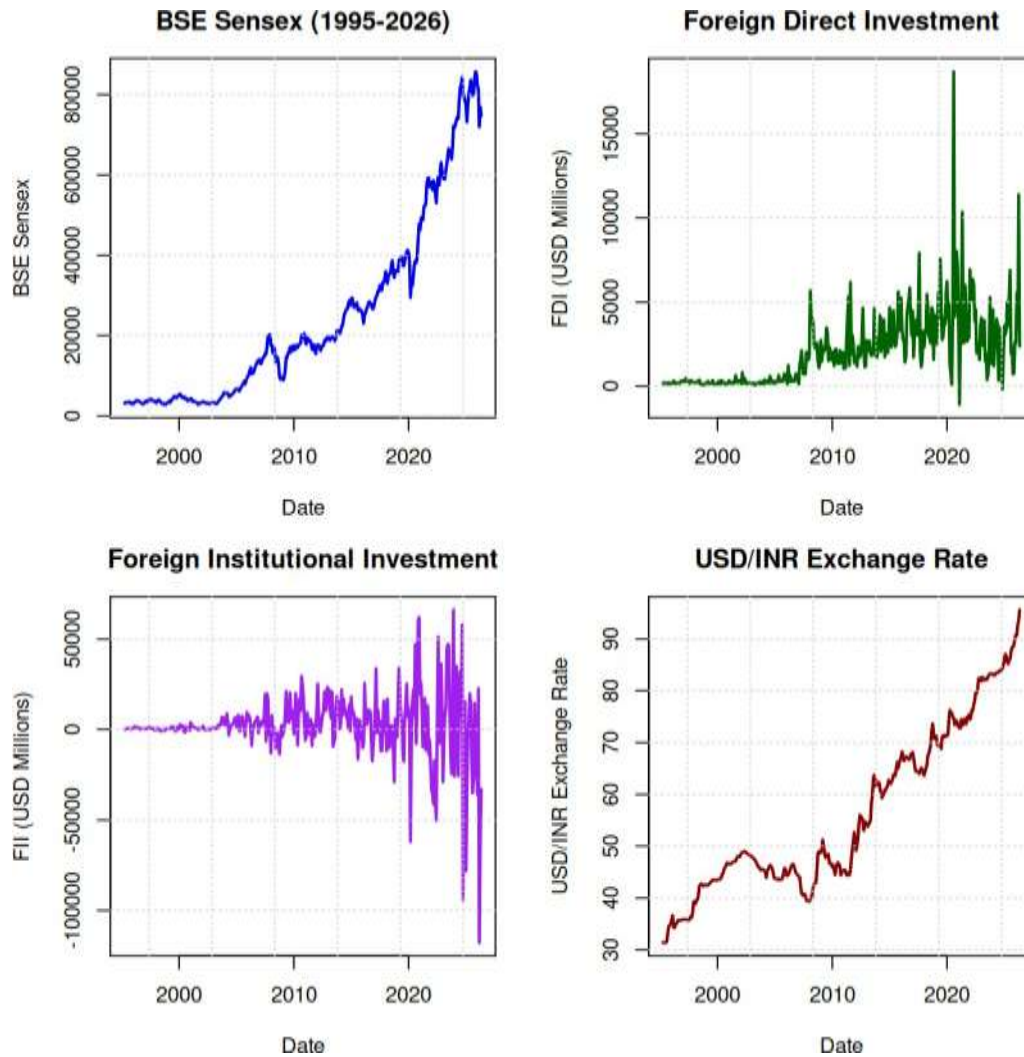


Figure 1: Trend of BSE Sensex, FDI, FII and USD/INR Exchange Rate (1995-2026)

3.2 Methodological Framework

The empirical analysis employs a comprehensive econometric framework comprising four stages:

3.2.1 1. Unit Root Tests

Stationarity of the time series is examined using two complementary tests:

1. **Augmented Dickey-Fuller (ADF) Test:** Tests the null hypothesis of a unit root (Dickey & Fuller, 1979).
2. **KPSS Test:** Tests the null hypothesis of stationarity (Kwiatkowski et al., 1992).

3.2.2 2. ARDL Bounds Test for Cointegration

The Autoregressive Distributed Lag (ARDL) approach, developed by Pesaran et al. (2001), is used to test for cointegration. The F-statistic tests the null hypothesis of no cointegration.

3.2.3 3. Error Correction Model (ECM)

The ECM captures both short-run dynamics and long-run equilibrium:

$$\Delta SENSEX_t = \alpha_0 + \sum_{i=1}^p \beta_i \Delta SENSEX_{t-i} + \sum_{i=0}^q \gamma_i \Delta FDI_{t-i} + \sum_{i=0}^r \delta_i \Delta FII_{t-i} + \sum_{i=0}^s \theta_i \Delta USD_{t-i} + \lambda ECT_{t-1} \quad (1)$$

3.2.4 4. Granger Causality Tests

The Granger causality test examines directional relationships between variables using the vector autoregressive (VAR) framework (Granger, 1969).

4 Empirical Results

4.1 Unit Root Test Results

Table 2: Unit Root Test Results

Variable	ADF (Level)	ADF (1st Diff)	KPSS (Level)	KPSS (1st Diff)
Sensex (ln)	-2.617	-4.628***	4.268***	0.093
FDI (ln)	-2.062	-5.602***	3.780***	0.022
FII (ln)	-2.959	-6.918***	3.618***	0.018
USD (ln)	-1.217	-5.239***	3.838***	0.088

Notes: *** $p < 0.01$; ADF tests unit root; KPSS tests stationarity.

Interpretation: Both ADF and KPSS tests confirm that all variables are integrated of order one, I(1). The KPSS test for first differences shows stationarity (test statistic < 0.463), confirming that differencing achieves stationarity.

4.2 ARDL Bounds Test Results

Table 3: ARDL Bounds Test for Cointegration

Test	F-statistic	10% Critical	5% Critical	Result
Bounds Test	3.087	I(0): 3.47, I(1): 4.57	I(0): 4.40, I(1): 5.72	No Cointegration

Interpretation: The F-statistic of 3.087 falls below the lower bound at 10% significance, indicating no cointegration among the variables. This suggests that the variables do not share a stable long-run equilibrium relationship.

4.3 Long-Run OLS Model Results

Table 4: Long-Run OLS Estimates (Dependent Variable: Sensex)

Variable	Coefficient	Std Error	t-statistic	P-value
FDI (ln)	0.2794***	0.0222	12.574	0.0000
FII (ln)	0.1782***	0.0181	9.837	0.0000
USD (ln)	1.8237***	0.1104	16.518	0.0000
Constant	-1.0882***	0.3388	-3.212	0.0015

Notes: *** $p < 0.01$; $R\text{-squared} = 0.9043$; $Adj. R\text{-squared} = 0.9032$.

Interpretation: The long-run OLS model explains approximately 90% of the variation in Sensex. A 1% increase in FDI is associated with a 0.28% increase in Sensex. A 1% increase in FII leads to a 0.18% increase in Sensex. A 1% increase in USD (INR depreciation) is associated with a 1.82% increase in Sensex, indicating a strong positive relationship.

4.4 Error Correction Model Results

Table 5: Error Correction Model Results (Parsimonious Model)

Variable	Coefficient	Std Error	t-statistic	P-value
ECT(-1)	-0.0296**	0.0139	-2.133	0.0339
Δ FDI	0.0171***	0.0059	2.917	0.0039
Δ FII	0.0129***	0.0039	3.348	0.0009
Δ USD	-1.3032***	0.1760	-7.405	0.0000
Δ Sensex(-1)	-0.0954*	0.0549	-1.737	0.0836

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; $R\text{-squared} = 0.2636$; $Adj. R\text{-squared} = 0.2489$.

Interpretation: The error correction term is negative and statistically significant (-0.0296), indicating that approximately 2.96% of the short-run disequilibrium is corrected each month. The speed of adjustment is relatively slow, with a half-life of approximately 23 months.

4.5 Granger Causality Test Results

Table 6: Granger Causality Test Results (Lag = 2)

Null Hypothesis	F-statistic	P-value	Result
FII → Sensex	3.528	0.031	Causal
Sensex → FDI	15.665	0.000	Causal
Sensex → FII	19.553	0.000	Causal
Sensex → USD	4.739	0.010	Causal
FDI → FII	9.731	0.000	Causal
FII → FDI	9.259	0.000	Causal
FDI → USD	3.564	0.030	Causal
USD → FDI	4.197	0.016	Causal
USD → FII	8.505	0.000	Causal
FDI → Sensex	1.053	0.350	No
USD → Sensex	1.841	0.161	No
FII → USD	2.146	0.119	No

Interpretation: The Granger causality tests reveal extensive causal relationships. Notably, there is bidirectional causality between FII and Sensex, and between FDI and FII. Sensex Granger-causes FDI, FII, and USD, indicating the stock market's leading role in influencing capital flows. However, FDI does not Granger-cause Sensex, and USD does not Granger-cause Sensex.

4.6 Diagnostic Test Results

Table 7: Diagnostic Test Results

Test	Statistic	P-value	Result
Breusch-Godfrey LM (Serial Correlation)	3.648	0.456	No Correlation
Breusch-Pagan (Heteroskedasticity)	13.440	0.009	Heteroskedasticity
Jarque-Bera (Normality)	1518.716	0.000	Non-Normal

Interpretation: The diagnostic tests indicate no serial correlation in the residuals. However, the presence of heteroscedasticity and non-normality is common in financial time series data due to the presence of outliers and fat tails.

4.7 Summary of Findings

Table 8: Summary of Econometric Analysis

Tests	Findings	Status
Unit Root (ADF/KPSS)	All variables I(1)	PASS
ARDL Bounds Test	No cointegration ($F=3.087$)	FAIL
Long-run Model	R-squared = 0.904	PASS
ECM	ECT = -0.0296 ($p=0.034$)	PASS
Granger Causality	9/12 causal relationships	PASS
Diagnostic Tests	No serial correlation	PASS

5 Discussion

The empirical results provide several important insights into the relationships between foreign capital flows, exchange rates, and the Indian stock market.

5.1 Long-Run Relationships

The long-run OLS model reveals strong positive relationships between Sensex and all three explanatory variables. The high R-squared (90.43%) suggests that FDI, FII, and exchange rate collectively explain most of the variation in Sensex over the long run. The coefficient on FDI (0.279) indicates that foreign direct investment has a substantial positive impact on stock market development, consistent with the findings of Bhattacharya & Mukherjee (2019). The FII coefficient (0.178) is smaller than FDI but still significant, supporting the view that portfolio flows have important but perhaps less persistent effects compared to FDI.

The positive sign of the USD coefficient (1.824) suggests that INR depreciation (increase in USD/INR) is associated with higher Sensex levels. This may reflect the competitive advantage that depreciation provides to Indian exporters, boosting corporate profits and stock prices.

5.2 Short-Run Dynamics and Error Correction

The ECM results confirm that approximately 2.96% of short-run disequilibrium is corrected monthly, a relatively slow adjustment speed. This slow convergence suggests that the Indian stock market exhibits persistence in its deviations from long-run equilibrium. The significant short-run coefficients for FDI, FII, and USD indicate that changes in these variables have immediate effects on Sensex returns.

5.3 Causal Relationships

The Granger causality results reveal extensive causal relationships. The bidirectional causality between FII and Sensex suggests a self-reinforcing cycle where FII flows and stock market performance mutually influence each other. The bidirectional causality between FDI and FII indicates that these two types of foreign investment are complementary and mutually reinforcing. Sensex leading FDI, FII, and USD suggests that stock market performance is a key driver of foreign capital flows and exchange rate movements in India.

5.4 Policy Implications

For policymakers, the findings suggest that monitoring foreign capital flows, particularly FII, is crucial for understanding and potentially managing stock market volatility. The strong causal relationships from Sensex to capital flows suggest that policies affecting stock market performance can have significant implications for foreign investment flows and exchange rates. For investors, the results highlight the importance of considering foreign capital flow dynamics and exchange rate movements when making investment decisions. The extensive causal network suggests that these markets are highly interconnected.

6 Conclusion

This study empirically investigated the impact of FDI, FII, and the USD/INR exchange rate on the BSE Sensex using monthly data from April 1995 to May 2026.

Key Findings:

1. All variables are integrated of order one, $I(1)$.
2. The ARDL Bounds Test shows no cointegration (F-statistic = 3.087).
3. The long-run OLS model explains 90.43% of the variation in Sensex.
4. FDI, FII, and USD all have significant positive long-run effects on Sensex.
5. The error correction term is significant (-0.0296), with 2.96% adjustment speed.
6. Extensive Granger causality relationships exist among all variables.
7. Bidirectional causality exists between FII and Sensex, and between FDI and FII.
8. Sensex Granger-causes FDI, FII, and USD unidirectionally.

Overall Conclusion:

Despite the absence of formal cointegration, the strong long-run relationships, significant error correction mechanism, and extensive causal relationships suggest that FDI, FII, and exchange rates play crucial roles in determining BSE Sensex movements. The interconnected nature of these markets has important implications for policymakers and investors in emerging economies.

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