EXAMINING EXCHANGE RATE VOLATILITY EFFECTS ON NIFTY50 AND SENSEX: A STUDY FROM APRIL 2016 TO MARCH 2021

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ABSTRACT

Background: The relationship between exchange rates and stock market indices has long been a subject of interest in financial research, particularly in emerging markets like India. Understanding how fluctuations in exchange rates impact stock market performance is crucial for investors and policymakers alike.

Objective: This study aims to analyze the relationship between USD/INR exchange rates and two key Indian stock market indices, Nifty50 and Sensex, over the period from April 1, 2016, to March 31, 2021. The objectives include examining correlations, testing for stationarity, assessing normality of residuals, and conducting Granger Causality tests to explore potential causal relationships.

Research Methodology: An analytical research design was adopted for this study. Secondary data sources were utilized, comprising daily closing prices of Nifty50, Sensex, and USD/INR exchange rates. Statistical tools such as correlation analysis, normality tests (Jarque Bera), unit root tests (Augmented Dickey-Fuller), and Granger Causality tests were employed to analyze the data.

Results: Correlation analysis revealed moderate correlations between exchange rates and both Nifty50 (0.451176) and Sensex (0.524274). Normality tests indicated that residuals were not normally distributed across all variables. Unit root tests confirmed stationarity after first differencing for all variables, implying stable time series data. Granger Causality tests demonstrated that changes in exchange rates Granger cause movements in both Nifty50 and Sensex.

Conclusion: This study concludes that fluctuations in USD/INR exchange rates have a moderate yet significant influence on the Indian stock market indices, Nifty50 and Sensex. The findings suggest a causal relationship where changes in exchange rates can predict movements in stock market indices. These insights are crucial for stakeholders looking to better understand and manage risks associated with currency movements in equity markets. Future research could explore additional factors and employ more advanced modeling techniques to enhance predictive accuracy and policy implications in financial markets.

I. INTRODUCTION

The volatility of exchange rates plays a pivotal role in influencing the dynamics of financial markets worldwide, particularly in emerging economies like India. This study focuses on examining how fluctuations in the USD/INR exchange rate have impacted two major Indian stock market indices, namely Nifty50 and Sensex, during the period spanning April 2016 to March 2021. The exchange rate between the US Dollar (USD) and the Indian Rupee (INR) is a critical indicator of economic stability and investor sentiment in India, given the country's reliance on imports, exports, and foreign investments.

Over the past decade, India has witnessed significant economic growth and structural reforms, making its stock markets increasingly sensitive to global economic trends and currency movements. The Nifty50 and Sensex indices, which represent a basket of large-cap stocks listed on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) respectively, serve as barometers for investor confidence and market sentiment in the Indian economy.

The period from April 2016 to March 2021 was marked by several global and domestic economic events, including shifts in global interest rates, geopolitical tensions, and policy reforms within India. These factors have contributed to varying levels of volatility in exchange rates, thereby influencing the performance of stock market indices. Understanding the relationship between exchange rate movements and stock market performance is crucial for investors, policymakers, and analysts seeking to manage risks and optimize investment strategies in the Indian financial markets.

This study employs rigorous analytical methods to assess the degree of correlation between USD/INR exchange rate fluctuations and movements in Nifty50 and Sensex. By conducting correlation analysis, Granger Causality tests, and evaluating the stationarity of time series data, the research aims to uncover whether changes in exchange rates precede and potentially cause changes in stock market indices. "Such insights not only enhance our understanding of market dynamics but also provide valuable implications for financial decision-making and policy formulation in India's economic landscape."

1.1 EXCHANGE RATE VOLATILITY

Exchange rate volatility refers to the degree of fluctuation or variability in the value of a currency relative to another currency over a specific period of time. It is a measure of how much an exchange rate deviates from its average or expected value. Exchange rate volatility is

influenced by various factors including economic indicators, geopolitical events, central bank policies, market speculation, and global economic conditions.

High exchange rate volatility indicates rapid and unpredictable changes in currency values, which can impact international trade, investment decisions, and financial market stability. For businesses engaged in import-export activities, currency volatility introduces uncertainty in pricing and profitability. For investors, exchange rate volatility can create opportunities for profit through currency trading but also poses risks due to potential losses from sudden currency value shifts.

Governments and central banks often monitor and may intervene in currency markets to stabilize exchange rates and reduce volatility, aiming to maintain economic stability and support sustainable economic growth. Exchange rate volatility is typically measured using statistical metrics such as standard deviation, historical volatility, or implied volatility derived from options pricing models in financial markets.

1.2 NIFTY50 AND SENSEX

Nifty50 and Sensex are prominent stock market indices in India, each serving as a crucial gauge of the country's equity market performance and investor sentiment. The Nifty50 index represents the top 50 companies listed on the National Stock Exchange (NSE), encompassing diverse sectors of the economy. On the other hand, Sensex, or the S&P BSE Sensex, tracks the performance of 30 large, publicly-owned companies on the Bombay Stock Exchange (BSE), reflecting a cross-section of India's corporate sector.

These indices play pivotal roles in providing investors, analysts, and policymakers with insights into the overall health and direction of the Indian stock market. They serve as benchmarks for portfolio performance, indices for various financial products like mutual funds and exchange-traded funds (ETFs), and indicators of economic vitality and market sentiment. "As such, movements in Nifty50 and Sensex are closely monitored both domestically and internationally, influencing investment decisions and market strategies."

The composition of Nifty50 and Sensex indices is periodically reviewed and adjusted based on market capitalization, liquidity, and other factors to ensure they accurately reflect the evolving dynamics of the Indian economy. Their performance reflects broader economic trends, market reactions to corporate earnings, policy changes, global economic conditions, and investor sentiment, making them essential tools for understanding India's financial landscape.

In summary, Nifty50 and Sensex indices are not merely measures of stock market performance but also barometers of economic health and investor confidence in India. Their movements and trends are pivotal in shaping market perceptions, influencing investment flows, and guiding strategic decisions across the financial spectrum.

II. REVIEW OF LITERATURE

Mishra et al. (2007). Studying volatility spillovers offers valuable insights into the transmission of information between the stock market and the foreign currency market, and vice versa. This study investigates the transmission of volatility between the Indian stock market and foreign currency market. The findings suggest that there is a two-way transfer of volatility between the Indian stock market and the foreign currency market, except for the S&P CNX NIFTY and S&P CNX 500. The study's results indicate that both markets exhibit a high degree of correlation and have a long-term association with each other. The presence of substantial bidirectional volatility spillover indicates that there is a transfer of information between these two markets, and that they are mutually interconnected. Financial managers may have a deeper understanding of how these two factors impact the management of their international portfolio. This is of special significance to both local and foreign investors for the purpose of hedging and diversifying their portfolio.

In their study, **S.V. Ramana Rao et al. (2008)** said that the stock market in India is now experiencing a significant upswing. The research analysed the volatility of the Nifty index in order to get insights into the patterns and trends of the Indian stock market. The research examines the daily fluctuations of the nifty index and other economic events between 1991 and 2008. The findings indicate that the market saw the greatest level of volatility in 1992, followed by 1993, 2000, and 2008. "The Nifty saw a significant decline from 1992 to 1995, followed by a subsequent period of growth." This conclusion is supported by examining the volatility of monthly returns and daily returns over the course of a year. The highest number of spikes occurred in the years 1992, 2000, 1997, and 2008, which were the most turbulent years. These atypical years, months, and days were thoroughly examined to identify the logical explanations for the unusually low returns on the given market day. The causes for the extraordinary returns are distinctive and indicate that the market would respond strongly to economic, political, and policy matters. The research recommended that market participants should exercise caution in managing their investment portfolios during these periods of high volatility.

Nateson C and Suganya (2012) did a research to examine the volatility of the widely followed stock index SENSEX. The research uses the closing time series data of SENSEX, which spans from 3rd January 2000 to 30th June 2011. The year 2008 exhibited more volatility in comparison to the other years studied in the research. The level of volatility decreased in 2009 compared to the peak reached in 2008. The following years were somewhat more tranquil. In 2000, the Volatility was elevated, indicating more market activity. The daily volatility of the SENSEX index was roughly 1.70 percent, while the annualised volatility was somewhere between 25 percent and 26 percent. Events with daily returns above +/-5 percent have also been observed.

Kanojia and Arora (2016) analyzed the bull and bear market phase in return and volatility in Indian stock market. For this purpose, they collect closing data of Sensex and Nifty indices from April 1995 to June 2014. In this study, they used Bry and Boschan Algorithm and find that various investment like FIIs inflow, macroeconomic variable, inflation and interest rate, and economic condition is also some factors which affect the volatility of a market.

Krishna JyotreddyMaguluri (2020). Identify the variables that influence the equity share prices of manufacturing businesses in the NIFTY 200 index and analyse the impact of these factors on share prices. This study aims to identify the key elements that have a substantial impact on the determination of equity share prices. These aspects will be examined from the standpoint of a firm, industry, and macroeconomic conditions. The present research conducted a comprehensive review of databases and journals in several domains, including business management, finance, and economics, in order to get the necessary literature. The conceptual paper conclusions address the elements that impact perceptions, including values, environmental circumstances, and media. Additionally, the article examines if an investor's distinctive traits affect their investing choices about equity shares. The research concludes that certain elements significantly influence the determination of equity share prices. It is crucial to take into account the investor's comprehension of the presently accessible information. The concluding parts outline the methods for conducting the current research on the impact of basic elements on the determination of equity share prices, as well as the attitudes and views of investors towards equity investments.

Victor and colleagues (2021). The objective of this research was to examine the immediate and long-term connections between exchange rates and the NSE NIFTY index using a Johansen cointegration test and a Granger causality test. The cointegration study findings indicate that there is no enduring link between exchange rates and the NIFTY index. This finding suggests that the changes in currency rates seen in this research may not have a substantial impact on the NIFTY index over a lengthy period of time. Therefore, investors engaged in long-term trading should not be too concerned by short-term volatility in exchange rates. The findings of the Granger causality test show a statistically significant positive association between the exchange rates of USD, CNY, JPY and the NIFTY index. The results are also reinforced by the Impulse Response Function study, which provides the duration needed for the NIFTY index to reach stability after an initial disturbance. This discovery suggests that stakeholders must closely monitor the temporary changes in the currency rates indicated above if they want to participate in short-term trading. An inherent constraint of this research is its reliance on traditional techniques of cointegration and Granger causality to evaluate the correlation between the variables. Subsequent research in this field should take into account the transmission of volatility effects by using more suitable methodologies.

Ashneet Kaur and Aditi Tyag 2022. Over the last decade, the Indian Capital market has seen

extreme liberalisation in the FDI rules, resulting in a significant attraction of international investors. India has seen a significant rise in foreign direct investment, establishing itself as a very desirable investment destination. The rise in foreign direct investment (FDI) has been shown to have a significant impact on the patterns of the Indian stock market. Hence, the current study aims to examine the interaction between foreign direct investment (FDI) and the Indian stock market, specifically focusing on the correlation between FDI and the NIFTY index, as well as the link between FDI and the Sensex index. "This research mostly relies on secondary data spanning the period from January 2010 to December 2019. E-views version 9 is used for quarterly record analysis." The research is characterised by its descriptive approach and relies on secondary data obtained from the websites of BSE, NSE, and DIPP. The Augmented Dickey Fuller Model, also known as the Unit root test, and multiple regression are analytical models used to assess the impact of independent factors on a dependent variable. The study's findings indicate a significant correlation between FDI and both Nifty and Sensex.

Kumar, M. & Kalchuri, R.S. (2024). The financial system's dynamic and essential stock market component is critical to the economy's advancement. It acts as a platform for people and organizations to conduct transactions involving shares, bonds, debentures, and other financial instruments. Essentially, it serves as a trading platform for different assets and derivatives. Stock markets also gauge the success and growth of the Indian economy. The Securities and Exchange Board of India (SEBI), established by international trends, was the first step towards reforming the Indian stock market. Still, the 1991 stock market scandal gave it real momentum. With the creation of SEBI and technological improvements, the Indian stock market has reached new heights, set new benchmarks, and positively impacted our economy by increasing the value of equities, debentures, bonds, and real estate. In India, the stock market's main goal was to raise money and use it wisely to support the economy. India experienced poor growth, escalating public deficits, and balance of payment issues before reforms in 1991. Economic growth was hampered by the policy of defending native industry against international competition. "SEBI's establishment revolutionized the market as an independent organization, which increased investor confidence and paved the way for developing NSE and Depository Participants." However, prospective investors continue to have reservations. Building trust, giving accurate information, defending investor rights, and highlighting the stock market's significance to the economy are all government duties. India's economy could use some help compared to advanced nations like the U.S.A. and Japan.

III. OBJECTIVES OF THE STUDY

The main objectives of the study are as follows:

1. To examine the impact of USD/INR exchange rate fluctuations on Nifty50 and Sensex.

2. To determine if USD/INR exchange rates Granger-cause movements in Nifty50 and Sensex.

IV. RESEARCH METHODOLOGY

Research Design:

This study adopts an analytical research design, focusing on examining the relationships and interactions between variables through statistical analysis.

Data Collection:

Secondary data sources are utilized for this study, encompassing publicly available records and historical data repositories.

Variables Used:

Independent variable: USD/INR Exchange rates serve as the primary independent variable in this study. Fluctuations in this exchange rate are examined for their potential impact on the dependent variables.

Dependent variables: The study analyzes the Nifty50 and Sensex indices as dependent variables. These indices reflect the overall performance of the Indian stock market.

Sample Size:

The study encompasses daily data from April 1, 2016, to March 31, 2021, for Nifty50, Sensex, and USD/INR Exchange rates. This period allows for a comprehensive examination of long-term trends and short-term dynamics.

Tools Used for Analysis:

The following statistical tools are employed to analyze the data:

- **Correlation analysis:** To measure the strength and direction of relationships between variables.

- **Normality test:** To assess the distributional characteristics of the data.

- **Unit root test:** To determine the presence of non-stationarity in time series data.

- **Granger Causality test:** To explore potential causal relationships between variables, specifically whether changes in USD/INR Exchange rates 'Granger-cause' changes in the Nifty50 and Sensex indices.

V. ANALYSIS AND INTERPRETATIONS

5.1 CORRELATION

Correlation between the Exchange rate and Sensex and Nifty50

	Exchangerate	Nifty50	Sensex
Sensex	0.524274	0.995543	1.000000
Nifty50	0.451176	1.000000	0.995543
Exchangerate	1.000000	0.451176	0.524274

The above table shows the correlation between the independent (Exchange rate) and dependent (Sensex and Nifty50) variables. As the value of correlation coefficients lies between 0.3 to 0.7 we can say that moderate correlation exists between the correlation coefficients –Exchange rates and Nifty50, Sensex.

5.2 NORMALITY TEST (Jarque Bera):

H_0: Residuals are normally distributed.

H_1: Residuals are not normally distributed

	Exchangerate	Sensex	Nifty50
Median	69.14020	35163.98	10618.20
Mean	69.34327	35063.96	10556.57
Minimum	63.26500	24673.84	7546.450
Maximum	77.57000	52154.13	15314.70
Standard deviation	3.683969	5862.998	1607.044
kurtosis	1.877034	3.229960	3.448588
Skewness	0.167017	0.543478	0.518817
Probability	0.000000	0.000000	0.000000
Jarque–bera	73.26411	63.67215	65.33351
Sum sq. deviation	17371.69	4.25E+10	3.17E+09
Sum	88828.73	43409179	12952917
Observations	1281	1238	1227

In all these three variables, the probability level is 0.000000 which is less than 0.05. So the null hypothesis is rejected and the alternate hypothesis is accepted. i.e, Residuals are not normally distributed.

5.3 UNIT ROOT TEST - AUGMENTED DICKEY-FULLER TEST:

5.3.1 Nifty 50

At level:

Null Hypothesis: CLOSE has a unit root

Exogenous: Constant

Lag Length: 6 (Automatic - based on SIC, maxlag=22)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.967116	0.7666
Test critical values	**10% level**	-2.568015	
	5% level	-2.863784	
	1% level	-3.435687	

MacKinnon (1996) one-sided p-values.

At first difference:

Null Hypothesis: D(CLOSE) has a unit root

Exogenous: Constant

Lag Length: 5 (Automatic - based on SIC, maxlag=22)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-14.20168	0.0000
Test critical values	**10% level**	-2.568015	
	5% level	-2.863784	
	1% level	-3.435687	

MacKinnon (1996) one-sided p-values.

H$_0$: The data is non stationary (unitroot) exists.

H$_1$: The data is stationary (unit root) does not exist.

5.3.2 Sensex

At level:

Null Hypothesis: CLOSE has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=22)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-0.521814	0.8844
Test critical values	**10% level**	-2.567953	
	5% level	-2.863668	
	1% level	-3.435423	

MacKinnon (1996) one-sided p-values.

At first difference:

Null Hypothesis: D(CLOSE) has a unit root

Exogenous: Constant

Lag Length: 5 (Automatic - based on SIC, maxlag=22)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-14.39036	0.0000
Test critical values	**10% level**	-2.567959	
	5% level	-2.863679	
	1% level	-3.435449	

MacKinnon (1996) one-sided p-values.

5.4 EXCHANGE RATE

At level:

Null Hypothesis: CLOSE has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=22)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-1.135216	0.7037
Test critical values	**10% level**	-2.567921	
	5% level	-2.863608	
	1% level	-3.435287	

MacKinnon (1996) one-sided p-values.

At first difference:

Null Hypothesis: D(CLOSE) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=22).

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-43.77570	0.0001
Test critical values	**10% level**	-2.567921	
	5% level	-2.863608	
	1% level	-3.435287	

MacKinnon (1996) one-sided p-values.

From all the above analysis it is understood that the Probability of the three variables (Exchange rate, Nifty and sensex) is 0.0000 and 0.0001 which is less than 0.05 so, reject the null hypothesis (H0) and accept the alternte hypothesis (H1). The data is stationary and (unit root) does not exist.

5.5 GRANGER CAUSALITY TEST

H_0: Exchange rate does not granger cause Nifty50 and Sensex.

H_1: Exchange rate granger cause Nifty50 and Sensex.

Pairwise Granger Causality Tests

- Date: 11/25/21
- Time: 22:54
- Sample: 4/01/2016 3/31/2021
- Lags: 2

NullHypothesis:	Obs	F-Statistic	Prob.
SensexdoesnotGrangerCauseNifty50		0.15476	0.8566
Nifty50doesnotGrangerCauseSensex	1205	0.07655	0.9263
Sensexdoesnot GrangerCauseExchangerate		42.2382	2.E-18
ExchangeratedoesnotGrangerCauseSensex	1194	11.5366	1.E-05
Nifty50doesnotGrangerCauseExchangerate		45.1922	1.E-19
ExchangeratedoesnotGrangerCauseNifty50	1175	10.5191	3.E-05

Discussion:

Based on the analysis provided, it can be concluded that the F-statistic values of the variables exceed 3.84. This indicates that the null hypothesis should be rejected in favour of the alternative hypothesis. "Hence, the exchange rate has a Granger causality relationship with the Nifty50 and Sensex indices."

The aforementioned study and interpretation indicate a modest link between Sensex, Nifty50, and exchange rates. The residuals do not follow a normal distribution when the data is stationary and there is no unit root present. According to the Granger Causality test, there is evidence to suggest that the exchange rate has a causal influence on the Nifty50 and Sensex.

VI. CONCLUSION

Based on the analytical research design employed in this study, which focused on investigating the relationships between USD/INR Exchange rates and the Indian stock market indices (Nifty50 and Sensex) over the period from April 1, 2016, to March 31, 2021, several significant findings have emerged.Firstly, the analysis revealed moderate correlations between Exchange rates and both Nifty50 (0.451176) and Sensex (0.524274). These findings suggest that fluctuations in Exchange rates may influence the performance of the Indian stock market to a certain extent, highlighting the interconnectedness between global currency movements and domestic equity market dynamics.

Furthermore, the normality tests conducted on residuals indicated that they deviate significantly from a normal distribution pattern across all variables (Exchange rates, Sensex, and Nifty50). This implies that while the relationships between variables are statistically significant, they may not adhere strictly to typical Gaussian assumptions, warranting careful consideration in interpreting the results.Regarding stationarity, the unit root tests confirmed that all variables achieved stationarity after first differencing. This finding suggests that the data series for Exchange rates and stock market indices are stable over time, without exhibiting non-stationary behavior that could complicate predictive modeling and analysis.

Most notably, the Granger Causality tests provided compelling evidence that Exchange rate movements Granger cause changes in both Nifty50 and Sensex. This causal relationship implies that shifts in Exchange rates could potentially predict future movements in the Indian stock market indices, offering valuable insights for investors and policymakers alike.

In conclusion, this study contributes valuable insights into the complex dynamics between Exchange rates and the Indian stock market. It underscores the importance of Exchange rate fluctuations as a determinant of stock market performance and highlights the need for robust analytical frameworks in understanding these relationships. Future research could delve deeper into specific economic contexts or employ more advanced modeling techniques to further refine our understanding of these dynamics in different market conditions and timeframes. Such endeavors promise to enhance our ability to predict and manage risks in the financial markets effectively.

Future Directions:

Future research could explore:

- The impact of specific economic events or policy changes on the observed relationships.

- Time-varying effects or nonlinear relationships between Exchange rates and stock market indices.

- Comparative studies across different time periods or international markets to generalize findings.

By addressing these avenues, further insights can be gained into the intricate dynamics between Exchange rates and stock market performance, aiding better investment strategies and policy decisions.

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