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Research Article

Dynamic Interaction Between The Nifty Index And Exchange Rate: Evidence From VAR Analysis

Suman S[1*], Dr. Raju G[2]

[1*]Research Scholar, Faculty of Commerce, Department of Kerala Studies, University of Kerala. (Assistant Professor of Commerce, Sanatana Dharma College, Alappuzha), Ph: 9567206688, e-mail:suman.s@sdcollege.in
[2]Professor (Retired), Department of Commerce, Govt. College for Women, Thiruvananthapuram, Ph: 9539125991, e-mail:drrajug1@gmail.com

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ABSTRACT

Two significant components of financial market in an economy are the stock market and the foreign exchange market. This paper investigates the dynamic interaction between the Nifty Index and Exchange Rate in the Indian financial market from July 1990 to June 2019. Unlike previous studies that have focused on broader terms or specific stocks/indices, this research specifically targets the Nifty index, a crucial benchmark for the Indian stock market. By utilizing daily data and advanced econometric techniques such as Vector Error Correction Models (VECM), the study aims to fill the gap in the literature by providing a comprehensive analysis over a longer timeframe. The hypothesis testing, including ADF test, Johansen Cointegration test, VECM, Impulse Response Function, and Error Variance Decomposition, sheds light on the causal relationship between the Nifty index and exchange rate. The findings reveal bidirectional causality between these variables, highlighting the intricate dynamics at play. This paper contributes to a deeper understanding of how macroeconomic factors, particularly exchange rates, influence stock market performance in India. The results offer valuable insights for investors, policymakers, and researchers, emphasizing the importance of considering the interplay between the Nifty Index and Exchange Rate in financial decision-making.

Keywords: Exchange rate, Nifty index, Stock Market, VECM, Granger Causality, Impulse Response Function.

I. Introduction

The capital market plays a vital role in the development of an economy by mobilizing surplus funds and channelizing the same into productive investments in corporate sector. Capital market includes primary market which helps in capital formation and secondary market which provides liquidity. Many economists point out that fluctuations in the stock market are due to various macroeconomic factors, such as exchange rates, inflation rates, interest rates, money supply, and GDP. Among these factors, the exchange rate stands out as a crucial determinant, exerting a significant impact on stock market volatility.

Exchange rate fluctuations significantly impact stock prices due to the increased business risk for domestic companies engaged in import and export activities. It signifies that the exchange rate fluctuations affect the earning value and cost of funds along with their stock prices because companies start to borrow in foreign currencies in order to fund their processes (Dornbusch and Fischer 1980). The export of goods becomes attractive when there is a depreciation in the local currency, and it leads to an increase in foreign demand. As a result, the revenue of a firm appreciates along with the appreciation in the firm's value and stock prices. Similarly, when the local currency appreciates, it leads to a decrease in profits of a firm that exports goods as there is a decrease in its products' foreign demand. However, there is a change in the sensitivity of the value of the firm to the change in the exchange rate, and it depends on whether it is an importing firm or an exporting firm (Nath and Samanta 2003).Movements in exchange rates may also be accompanied by changes

in inflation and interest rates, further impacting stock prices. Franck and Young (1972) studied the effects of exchange rates on stock prices of multinational firms during the Bretton Woods Agreement period but found inconsistent results. Fluctuation in exchange rates is one of the significant factors that affect stock prices, which subsequently influences a firm's market value. Despite the fact that this topic has been discussed worldwide, there is still a lack of unanimity in the literature regarding the relationship between exchange rates and stock market indices (Mroua and Trabelsi 2020). While existing literature studies the relationship between exchange rates and stock prices, inconsistencies abound, highlighting the need for further exploration. Two main theories explain the relationship between exchange rates and stock prices: the traditional approach, which suggests that exchange rates lead stock prices, and the equity-oriented economic theory expressed in the portfolio balance model.

The traditional theory, combined with flow-based models, proposes that exchange rate movements influence stock prices. This relationship is described as unidirectional causality, with exchange rates affecting stock prices. Gavin (1989) supported this concept, explaining that fluctuations in exchange rates impact firm value through changes in competitiveness and the value of foreign currency-denominated assets and liabilities. Whereas Equity-oriented models, such as the portfolio balance model, suggest a negative relationship between stock prices and exchange rates. Capital inflows from foreign investors have been drawn by an attractive performance of a stock market, which increases the demand for domestic currency. On the other hand, the demand for the local currency depreciates when there is a fall in stock prices as the foreign investors start selling their stocks (Adebiyi et al. 2009). Jorion (1991) concluded that currency appreciation negatively affects exporting firms' profits and stock prices. Even domestic firms with minimal international activities are affected by exchange rate fluctuations, experiencing transaction, translation, and economic risks.

Equity markets play a crucial role in economies by diversifying domestic savings and attracting foreign capital for investment and capital formation. The degree to which the equity-oriented model explains currency movements is contingent upon the liquidity of the equity markets. In this context, this paper attempts to contribute to the understanding of the dynamics between exchange rates and stock market volatility, with a specific focus on the Indian context. By analyzing whether fluctuations in the Indian Rupee/USD exchange rate affect the NSE Nifty Index, using advanced econometric techniques and an extended timeframe for analysis, this study seeks to shed light on an underexplored aspect of the relationship between macroeconomic variables and stock market performance in India.

II. Literature Review

The literature review examines numerous studies investigating the complex interplay between macroeconomic variables, specifically exchange rates, and stock prices in India. Chouy (1996) utilized the GARCH model to reveal the impact of time-variant macroeconomic conditions on conditional volatility in India's stock market. Murinde & Abdalla (1997) found a Granger causality between exchange rates and stock prices in India, South Korea, and Pakistan during 1985-1994. Pethe (2000) analyzed various factors, including the Indian rupee exchange rate, prime lending rate, money supply, and industrial production index, to understand their influence on stock prices, particularly in financial markets since the early 1980s.

Ibrahim (2000) scrutinized the relationship between stock prices and exchange rates in Malaysia, using Cointegration and Granger causality tests. Although no enduring link between stock prices and exchange rates was found, evidence of cointegration emerged when considering M2 money supply and reserves, suggesting short-run impacts of exchange rates on stock market prices. This aligns with other studies indicating a lack of long-term significance between exchange rates and stock market indices, as demonstrated by Franck and Young (1972) and Bhattacharya and Mukherjee (2002).

Phylaktis and Ravazzolo (2005) explored short-run and long-run effects between stock prices and exchange rates across Pacific Basin countries for a period between 1980 and 1998. Employing a structured cointegration and multivariate Granger causality test, the results showed a positive long-run and short-run causality between stock prices and exchange rates. Similarly, Gulati and Kakhani (2012) found weak positive correlation between INR/Dollar exchange rates and stock market indices (SENSEX and NIFTY) for a period from 2004–2012 using Granger causality and correlation analysis. Whereas Nataraja, Ganesh et al. (2014) discovered a negative correlation between the Indian Stock Market and Foreign Exchange Data (Fx). Bhattacharya and Dasa (2014) identified three macroeconomic factors—International Import Prices, Monthly Expenditures, and Global Index/Exchange Rate—using Factor Analysis, showing a negative relationship with the stock market.

Chkili and Nguyen (2014) studied exchange rate and stock market returns in BRICS countries for 16 years (1997–2013) using Markov autoregressive model and VAR model. The results showed that the returns from the stock market were higher than exchange returns in all BRICS countries. Among BRICS countries, South Africa is less volatile, and Russia is more volatile and changes in exchange rate do not affect the stock market return of BRICS countries. Inversely, the impact from stock market returns to exchange rates is significant for all BRICS countries. In Pakistan, Ihsan et al. (2015) found no long-run relationship between exchange rates and Karachi stock exchange (KSE 100 Index, Pakistan) using the Johansen cointegration test and Granger causality test.

Poornima and Ganeshwari (2016) identified a unidirectional relationship between exchange rates and the NIFTY Index in India. Similarly, Kumarasamy and Chellasamy (2017) conducted a study on Indian stock markets and foreign exchange rates of USD, Euro, Yen, and Pound sterling against the Indian rupee (INR) was conducted for a period of five years, 2011–2015, using Granger causality test. The study concluded that the cause and effect between stock market indices (Sensex and NIFTY) shows an inverse relationship between returns from foreign exchange rates USD, GBP, EURO, and YEN and the relationship between currency returns to other currency returns against INR shows a positive relationship.
Chakrabarti (2001) employed the VAR model, establishing a negative correlation between the Indian stock market and exchange rates. Kim (2003) demonstrated a negative correlation between S&P's common stock price and exchange rates. Gordon and Gupta (2003) and Babu (2007) argued that foreign investors acted as market makers due to their substantial investments. Mishraa and Swain (2007) highlighted a long-term correlation between stock prices and exchange rates. Takeshi (2008) used cointegration tests, showing that stock prices and exchange rates in India were no longer in balance.
The gap lies in the absence of comprehensive studies focusing specifically on the Nifty index, a crucial benchmark for the Indian stock market, in relation to exchange rates. Existing studies either examine this relationship in broader terms or focus on specific stocks or indices. Furthermore, many studies have limited timeframes, often ending in the early 2000s, failing to capture recent developments in India's economic landscape. There is a pressing need for more recent and extensive research covering a longer timeframe, to fully understand the dynamics between exchange rates and the Nifty index. Additionally, the lack of studies utilizing Vector Error Correction Models (VECM) for the Nifty index represents another gap, as VECM could provide insights into both short-term dynamics and long-term equilibrium relationships. Moreover, contradictory findings in the literature regarding the correlation between exchange rates and stock prices in India highlight the need for further research to reconcile these disparities and achieve better understanding of the relationship. This paper aims to investigate the relationship between exchange rate and Indian stock market from July 1990 to June 2019. The analysis focuses on the Nifty, a comprehensive national stock exchange index comprising 50 stocks, aiming to contribute to this complex field of study.

III. Data and Methodology

An empirical study is conducted to analyse whether Indian Rupee/USD exchange rate affect Nifty index using daily data over a period from July 1990 to June 2019. The data consists of i) the daily closing price of the Nifty Indices used for stock price calculations and ii) daily INR/USD prices used for exchange rate calculations. Daily returns and exchange rates are adjusted by calendar days. Data sourced from NSE website and Investing.com, the currency site, (https://m.in.investing.com/currencies/usd-inr-historical-data).
The main purpose of this study is to analyse whether there is a relationship between the two variables, the Nifty index and the exchange rate, and the hypothesis is as follows.
H0: There is no significant relationship between exchange rate and Nifty index.
The notation used for Nifty Index is NI and exchange rate is denoted as ER.
ADF test, Johansen Cointegration test, VECM, Impulse Response Function and Error Variance Decomposition were performed to test the hypothesis.

IV. Results and Analysis

The graphical presentation of the data: NI and ER are given in figure 1 and figure 2 respectively.

Nifty

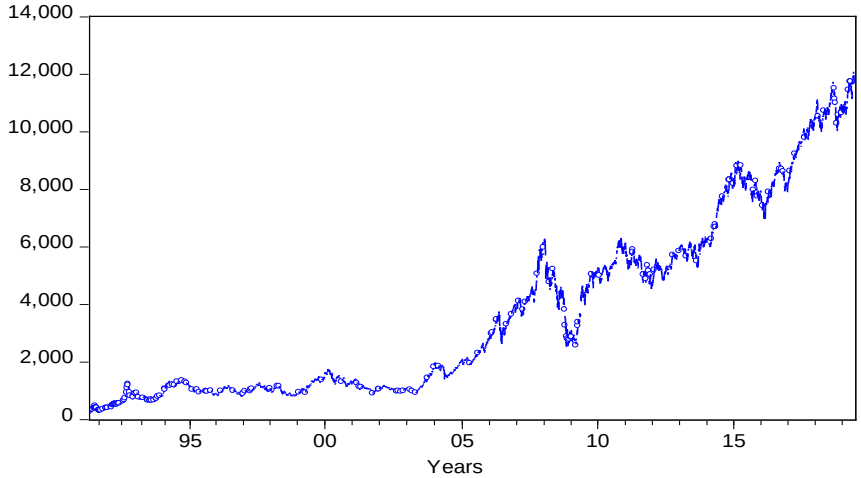

Figure 1: Graph Showing Trend of Nifty

Figure 1 shows an upward trend of Nifty from 1990 to 2019. In June 1990 the exchange rate was 279.02 whereas in June 2019 it is about 11788.85. During this period the highest exchange rate shown was on 3rd June 2019 being 12088.55.

Exchange Rate

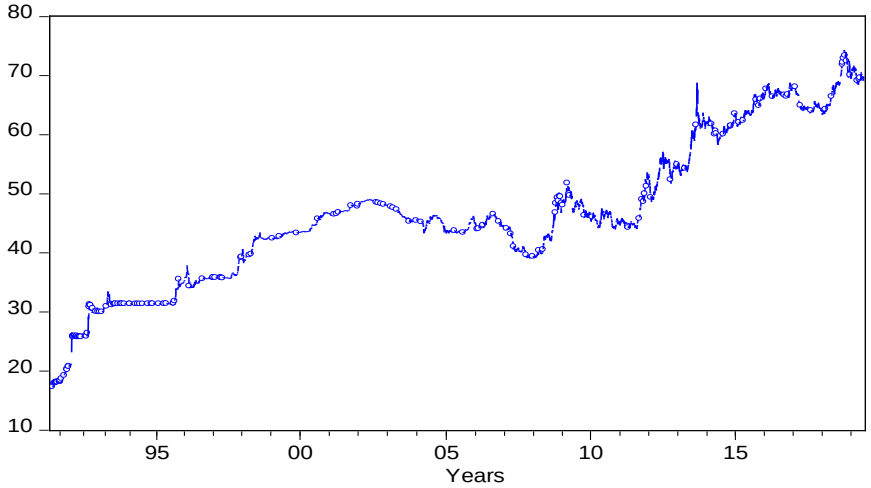

Figure 2: Graph Showing Trend of USD – INR Exchange Rate

Figure 2 shows an upward trend of USD-INR exchange rate from 1990 to 2019. In June 1990 the exchange rate was 17.416 whereas in June 2019 it is about 68.95. During this period the highest exchange rate shown was in Oct 2018 being 74.34 and the lowest was in August 1990 being 17.313.

Unit Root Test

To check stationarity, Augmented Dicky-Fuller test and the Phillips-Perron test were applied to both the level and first difference series. The results of unit root tests for both the Nifty index series and the exchange rate series are shown in Table 1. The p-values corresponding to the ADF and PP test statistics for the two series are above 0.05 for levels. This indicates that the levels of both series are non-stationary. However, the first difference is stationary (because both the ADF and PP test series have p-values less than 0.05). From this it can conclude that both variables are integrated of order one, i.e.,I(1), indicating that they tend to revert to their mean over time after experiencing shocks or fluctuations.

Table 1: Result of Dicky Fuller and Phillips-Perron Tests

Variables		Dicky Fuller Test	Phillips-Perron Test
NI	Level	-1.409043(0.8586)	-1.281211(0.8921)
	First Difference	-77.91121(0.0001)**	-77.74128(0.0001)**
ER	Level	-2.435048(0.3611)	-2.424146(0.3668)
	First Difference	-34.45914(0.0000)**	-82.53450(0.0001)**

Figures in brackets are P values
** indicates significance at 5 per cent level

Johansen Co-integration Test

As the series are found to be non-stationary, the cointegration test, coined by Johansen, was employed to determine whether there was a relationship between the variables over time. The Johansen cointegration method (Johansen 1988) is based on the following system of equations, a pth order VAR in two variables:

$$NI_t = \alpha + \sum_{j=1}^{p} \alpha_{1j} NI_{t-j} + \sum_{j=1}^{p} \alpha_{2j} ER_{t-j} + e_{1t} \quad (1)$$

$$ER_t = \alpha' + \sum_{j=1}^{p} \alpha_{3j} NI_{t-j} + \sum_{j=1}^{p} \alpha_{4j} ER_{t-j} + e_{2t} \quad (2)$$

This is reparameterised into VECM as follows:

$$\Delta NI_t = \alpha + \sum_{j=1}^{p-1} \beta_{1j} \Delta NI_{t-j} + \sum_{j=1}^{p-1} \beta_{2j} \Delta ER_{t-j} + \gamma_1 EC_1 + e_{1t} \quad (3)$$

$$\Delta ER_t = \alpha' + \sum_{j=1}^{p-1} \beta_{3j} \Delta NI_{t-j} + \sum_{j=1}^{p-1} \beta_{4j} \Delta ER_{t-j} + \gamma_2 EC_1 + e_{2t} \quad (4)$$

The result of the Johansen Cointegration test for the series NI and ER have been given in Table 2.

Table 2: Result of cointegration test

Hypothesis	Eigen Value	λ Trace	λ max
r = 0	0.004357	38.97882(0.0000)**	30.46413(0.0001)**
r ≤ 1	0.001220	8.514687(0.0663)	8.514687(0.0663)

Figures in brackets are P values
** indicates significance at 5% level

The test evaluates various hypotheses about the number of cointegrating vectors (r) between the variables. The eigenvalues, trace statistic, and λmax statistic are utilized to determine the presence of cointegration. Test results as shown in Table 2 indicates that both the trace statistic and the λmax statistic fail to accept the null hypothesis that no cointegration exists (r = 0). This rejection implies that there is evidence of a long-term equilibrium relationship between the exchange rate and the Nifty index. It can be concluded that the Nifty index and the exchange rate are cointegrated, suggesting that despite short-term fluctuations, the exchange rate and the Nifty index are tied together by a stable, long-term relationship. This relationship could be due to various economic factors, such as trade dynamics, investment patterns, or overall market sentiment that influences both variables in the long run.

Vector Error Correction Model

VECM is the restricted VAR used in cointegration for non-stationary series. Cointegration term is also known as error correction term, as deviations from long term equilibrium are corrected by partial short term equilibrium. Regression analysis using non-stationary time series often makes the results spurious. Taking the first difference may not make the variables suitable for regression in most cases as information regarding co-movement may be lost in the process and ultimately result in poor forecasting (Sims 1980). In order to solve this issue, Engle and Granger (1987) suggested testing for cointegration among non-stationary time series. If the variables are cointegrated of the same order, then an “error correction” is said to exist, which explains the short-run dynamics between the cointegrated variables. In such cases, the appropriate method is to estimate the Vector Error Correction Model (VECM), which is the same as the Vector Auto Regression (VAR) in the first difference with a vector of cointegrating residuals. If the variables are not cointegrated, then a VAR model can be fitted. VECM can be interpreted as an adjustment mechanism, where any deviation from previous period equilibrium relationship as shown by et-1 is corrected by Yt. The term ECT refers to the degree of deviation from long term equilibrium. Coefficient refers to the adjustment parameter, which describes the rate of recovery of the imbalance in the following period. Coefficients associated with lagged first order differences indicate short term relationships between endogenous variables (Enders 1995).The long-run relationship between the exchange rate and the Nifty index defining the cointegration between the two is given as:

$$ER_{(-1)} = 48.32064 + 0.004824\ NI_{(-1)}$$
$$[3.98836]^{**}$$

*Figures in square brackets are t values and ** shows significance at 5 per cent level*

The term "ER (-1)" represents the lagged value of the exchange rate and "NI (-1)" represents the lagged value of the Nifty index. The coefficient 48.32064 is the intercept, indicating the expected value of the exchange rate when the lagged value of the Nifty index is zero. The coefficient 0.004824 is the coefficient associated with the lagged value of the Nifty index, representing the impact of changes in the Nifty index on the exchange rate. The t value of 3.98836 indicates the statistical significance of the coefficient at the 5% level. The positive sign of the error correction parameter (ECT) coefficient and its statistical significance imply that there is a positive and significant relationship between the Nifty index and the exchange rate in the long run, indicating that as the Nifty index increases (or decreases), the exchange rate tends to increase (or decrease) as well over time. Moreover, the value of the ECT coefficient (0.004824) suggests that the relationship between the Nifty index and the exchange rate is converging towards its long-term equilibrium level. This implies that deviations from the equilibrium level will be corrected over time, with changes in the Nifty index having a positive impact on the exchange rate, supporting the adjustment towards equilibrium. The test result suggests that the Nifty index and the exchange rate are interlinked, with movements in one variable influencing the other, and there is a tendency for the relationship to return to its long-term equilibrium after experiencing short-term deviations.

Granger Causality Test

The Granger causality test is performed to determine whether past values of one variable are useful in predicting changes in another variable. The Granger causality test was conducted to understand the causal relationship between the Nifty index (NI) and the exchange rate (ER). The methods followed in this study are based on the procedure given by Granger (1969) and Engle and Granger (1987). Nevertheless, the specific technique to be used mainly depended upon the presence of cointegration among the variables. The Block Exogeneity Wald test, which is a variant of the Granger causality test, was used. This test examines whether one variable is exogenous to another variable, meaning whether it influences changes in the other variable. The test assesses whether there is bidirectional causality between the Nifty index and the exchange rate.

Table 5: VEC Granger Causality/Block Exogeneity Wald Tests Dependent variable: D (ER)

Excluded	Chi-sq	df	Prob.
D(NI)	22.30419	7	0.0023**

Dependent variable: D (NI)

Excluded	Chi-sq	df	Prob.
D(ER)	24.96289	7	0.0008**

** indicates significance at 5 per cent level

The results of the Block Exogeneity Wald test are presented in Table 5. The table shows the chi-square statistic, degrees of freedom (df), and the probability (Prob.) associated with excluding one variable (NI or ER) from the model while considering the other variable as the dependent variable. For the dependent variable D(ER) (changes in the exchange rate), when the Nifty index (NI) is excluded from the model, the chi-square statistic is 22.30419 with 7 degrees of freedom, and the probability (Prob.) is 0.0023**. Similarly, for the dependent variable D(NI) (changes in the Nifty index), when the exchange rate (ER) is excluded from the model, the chi-square statistic is 24.96289 with 7 degrees of freedom, and the probability (Prob.) is 0.0008**. The ** symbol indicates significance at the 5% level, meaning that the probability values are less than 0.05. Therefore, both probabilities are statistically significant, suggesting that there is bidirectional causality between the Nifty index and the exchange rate. Based on these results, it can be concluded that past values of the Nifty index are useful in predicting changes in the exchange rate, and vice versa. Specifically, the Nifty index Granger causes changes in the exchange rate, and conversely, changes in the exchange rate Granger cause changes in the Nifty index.

The Impulse Response Function

The Granger causality test is used to determine the relationship between variables, however, the strength of the relationship between variables should be evaluated. An impulse response function in very simple terms could be explained as a technique used to examine the path of a variable of interest in a VAR model after encountering a shock. The transmission of a shock could be tracked with the help of an impulse response function which facilitates the proper assessment of the behavior of a variable (Alloza 2017). There are two commonly used methods for this purpose: the impulse response function and Error Variance decomposition. According to Shin et al.(2014), the impulse response function measures the temporal profile of the effect of a shock on a variable's expected future values within a dynamic system at a given point in time.

The impulse response function is defined as:

$IR(m, h, Z_{t-1}) = E(Y_{t+m}/et=h, Z_{t-1} - E(Y_{t+m}/Z_{t+m})$

Where m denotes time, h = (h1.....hm) is nx1vector denoting the size of the shock, Z_{t-1} denotes accumulative information about the economy from the past to time t-1.

The primary challenge for impulse response functions lies in the determination of the impulse response, which consequently places additional constraints on the VAR system for the purpose of identification. According to Choleski's decomposition, one series is not affected simultaneously by the other series.

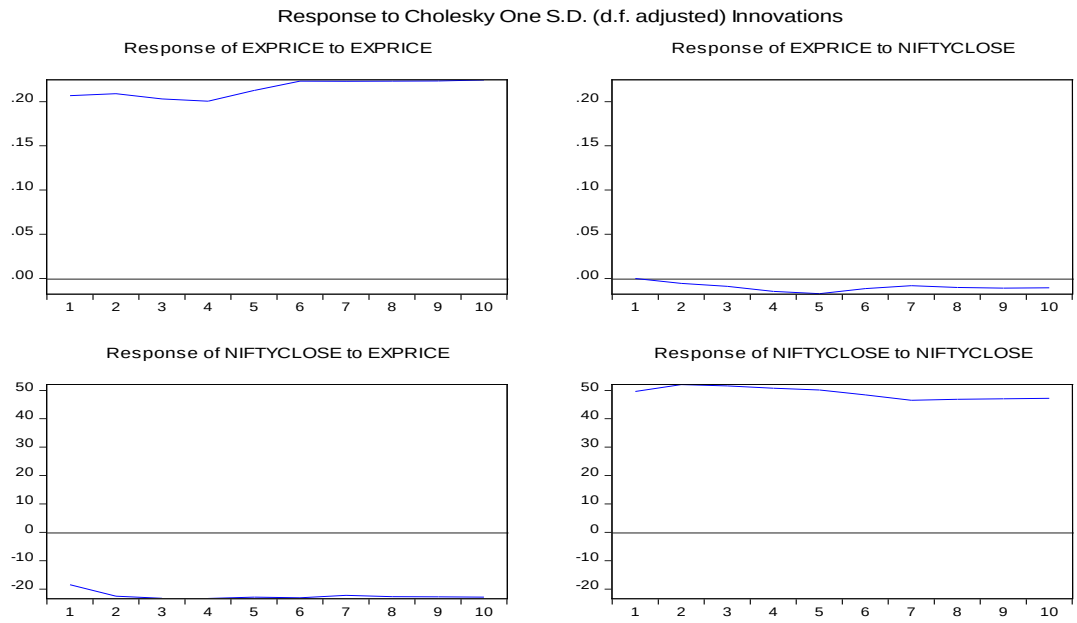

Figure 3: Impulse Response Function

Figure 3 displays the Impulse Response Function based on standard deviation shocks of the Nifty index (NI) on both itself and the exchange rate (ER), as well as shocks of the exchange rate on both itself and the Nifty index. Impulse Response Function for these shocks is shown, to analyze the impact of shocks in one variable on the other variable over multiple periods. The response from ER to NI shows that there is a slight decrease in response from ER to NI suggesting that a shock in the exchange rate initially leads to a small decrease in the Nifty index. However, after the fifth period, there is a slight increase in the response, indicating that the impact of the shock on the Nifty index becomes more pronounced over time. This pattern suggests that while shocks in the exchange rate may initially have a negative effect on the Nifty index, this effect diminishes over time, and eventually, the Nifty index may even experience a positive response to such shocks.
The response from NI to ER shows that initially there is a slight decline in the response from the Nifty index to the exchange rate, indicating that a shock in the Nifty index leads to a small decrease in the exchange rate. However, after the second period, the response becomes almost stable, suggesting that the impact of shocks in the Nifty index on the exchange rate remains relatively constant over time. This stable response indicates that shocks in the Nifty index consistently influence the exchange rate in a similar manner over multiple periods.
The Impulse Response Function highlights the significant interaction between the Nifty index and the exchange rate. While shocks in one variable initially lead to certain responses in the other variable, the dynamics of this interaction evolve over time.

Forecast Error Variance Decomposition

Enders defines forecast error variance to be the rate of change in a series as a function of its own variability and the variability of other variables. This analysis of variance helps to explain the relative significance of each random variation in the variability of the variables in the VAR model. Forecast error variance analysis is used to assess the effect of different types of shocks on the forecast error variance and determine how much of the total variability of one variable is explained by innovations in the variability of another variable. It helps in understanding the dynamic interactions and the extent to which the variability of one variable is driven by shocks or innovations in another variable.

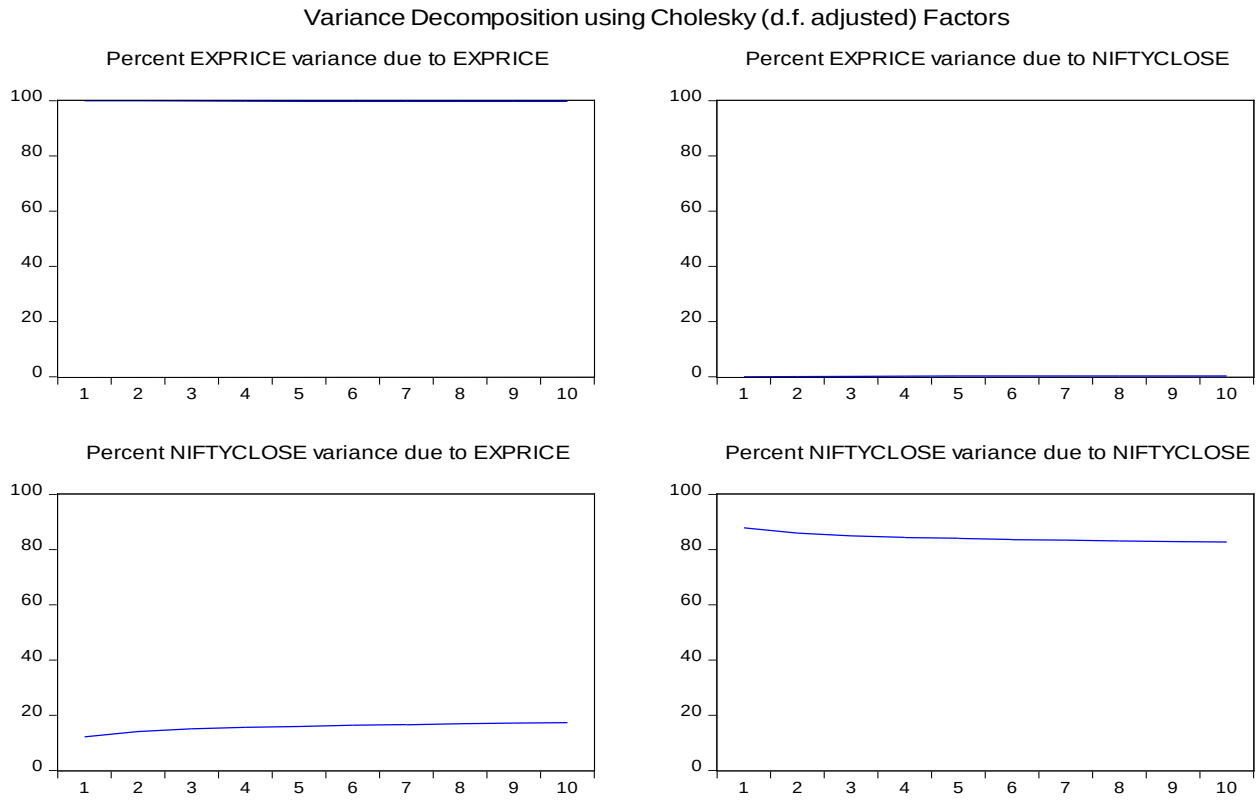

Figure 4: Error Variance Decomposition

Figure 4 illustrates the dynamic interaction between the Nifty index (NI) and the exchange rate (ER). The analysis reveals that NI responds significantly to shocks or innovations in ER, indicating that fluctuations in the exchange rate have a notable impact on the Nifty index. This implies that changes in ER lead to corresponding changes in NI, highlighting the influence of exchange rate movements on the variability of the Nifty index. Conversely, ER does not exhibit a significant response to shocks in NI. This suggests that fluctuations in the Nifty index do not substantially affect the exchange rate. Even during periods of volatility in the Nifty index, the exchange rate remains relatively stable. Overall, the findings suggest an asymmetrical

relationship between NI and ER, with the variability of the Nifty index being notably influenced by movements in the exchange rate, while the exchange rate is driven by factors other than fluctuations in the Nifty index.

I. Conclusion

The stock market is considered the most sensitive part of the economy, where changes in various macroeconomic factors or indicators affect stock market returns. The main objective of this study is to examine the relationship between the Nifty Index and Exchange Rate, highlighting the significant impact of exchange rate fluctuations on stock market volatility. Through a comprehensive analysis taking data on the daily closing price of the Nifty index and the price of the Indian rupee - US dollar spanning from July 1990 to June 2019, the study explores the causal link between these two key financial variables in the Indian context.
The findings reveal bidirectional causality between the Nifty index and the exchange rate, indicating a complex interplay where changes in one variable can influence the other and vice versa. The empirical analysis, which includes ADF tests, Johansen Cointegration tests, VECM, Impulse Response Function, and Error Variance Decomposition, provides valuable insights into the relationship dynamics over the studied period.
The result is in conformity with the conventional view that exchange rates drive stock prices. The theory that stock prices can interact with exchange rates is incorporated into the “flow-based” models in Dornbusch and Fisher (1980). The theory that exchange rate movements drive stock price movements is called “unidirectional” or “exchange rates “causing” stock prices” in the language of the Granger-Sims causal model. This model is grounded in the macroeconomic theory that stock prices are a discount rate of a firm’s expected future cash flows, and that the transmission channel originates from exchange rate movements that affect firm value through changes in competitiveness and the value of firms’ foreign-currency-dominated assets and liabilities, thereby affecting firm profits and hence the value of equity.
By addressing the gap in existing literature and focusing specifically on the Nifty index in relation to exchange rates, this paper contributes to understand how macroeconomic factors impact stock market performance in India. The utilization of advanced econometric techniques and a longer timeframe enhances the robustness of the study, offering valuable implications for investors, policymakers, and researchers in the financial domain.
Moving forward, further research utilizing Vector Error Correction Models (VECM) and incorporating recent developments in India's economic landscape can provide deeper insights into the evolving dynamics between the Nifty Index and Exchange Rate. By continuing to explore this complex relationship, future studies can enrich our understanding of the factors driving stock market volatility and contribute to more informed decision-making in the realm of finance and investments.

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