NEXUS BETWEEN FOREIGN EXCHANGE RATES AND STOCK MARKET INDICES: EVIDENCE FROM INDIA

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Abstract   *The foreign exchange market and the stock markets in India are among the most important financial markets that are constantly being monitored by the investors, regulators, and the policy-makers. The present study makes an attempt to investigate whether any causal relationship exists between the foreign exchange market and the stock markets in India. The BSE and the NSE annual returns have been used as a substitute for the stock prices, while the currency rate of Indian Rupee against the US Dollar (INR/USD) has been considered as a substitute for the exchange rate exposure covering a time-period of 20 years, from 1 January 2000 to 31 December 2019. The applications of the unit root or Augmented Dickey-Fuller test, Johansen cointegration, and Granger causality tests, as employed in the present study, examined the relationship between the USD/INR exchange rates and Indian stock market indices (SENSEX and NIFTY-50). The Granger causality test indicated that both the BSE and NSE stock indices granger cause INR/USD exchange rates. However, the INR/USD rates do not granger cause the BSE and NSE stock returns. The study has portrayed a unidirectional relation between the stock indices and INR/USD rates, but a bi-directional relation between the BSE and NSE stock returns.*

Keywords: *BSE, NSE, Exchange Rate, Unit Root, Cointegration, Granger Causality*

JEL Classification: *D53, F31, O16*

INTRODUCTION

As an economy moves in a cycle, the stock market also obeys a similar kind of pattern. For the economy, there are growth and recession phases. Likewise, in the stock market, there is a bull and bear phase. For any stock market investor, it is crucial to determine the bull phase (rising prices) and the bear phase (falling prices) in the stock market. Similarly, the foreign exchange rates can be classified as strong and weak exchange rates, depending on the relative position of a country's national currency against its foreign currency per unit.

The exchange rate is volatile in nature and any fluctuations in the exchange rate can either strengthen or weaken the stock market indices of a country, yet there is still no consensus on the exact nature of relationship prevailing between the foreign exchange markets and the stock markets. The issue of an inter-temporal relation between stock returns and exchange rates has recently occupied the minds of economists, for theoretical and empirical reasons, since they both play important roles in influencing the development of a country's economy. In addition, the relationship between stock returns and foreign exchange rates has frequently been utilised in predicting the future trends of each other

by investors (Agrawal et al., 2010). A higher exchange rate does have a positive effect on companies whose revenues are largely dependent on foreign exports. On the contrary, it has a negative effect on companies whose raw materials are mostly imported from abroad. As a result, a higher foreign exchange rate fetches more home currency from its exports, while paying out more of the home currency for importing goods and services. In contrast, when the exchange rate is low, it is good for imports, but impacts inversely on exports. Interactions between stock and foreign exchange market came to the forefront because these two markets are the most sensitive segments of the financial system and are considered as the barometers of economic growth through which the country's exposure towards the outer world is most readily felt (Gulati & Kakhani, 2012). Thus, understanding the relationship between the stock prices and the exchange rates remains a moot point for discussion and considerable research.

In light of this context, the present study makes an attempt to empirically examine the nature of relationship and inter-dependence between the INR/USD foreign exchange rates and the BSE and NSE (SENSEX and NIFTY-50) stock indices. The present study aims to benefit the prospective researchers, potential investors, stock-brokers, academicians, regulators, and the policymakers in making sound investment decisions and adopting remedial measures

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in improving upon the shortcomings of the country's two major financial markets.

The present study has been structured as follows. The next section deals with the review of literature relevant to the present study. The subsequent section on research methodology discusses about the research objectives, data sources, sample selection, and the empirical techniques used to analyse the dataset. The following section explains the findings and analysis of the results as obtained in the present study. The penultimate section provides the concluding observations and future scope of research. The final section discusses the limitations of the present study. A list of research materials used has been provided at the end for future reference to academicians, researchers, and industry practitioners.

LITERATURE REVIEW AND RESEARCH GAP

Considerable economic researches have been previously conducted in examining the relationship between the stock market and foreign exchange market. A plethora of researches has been conducted in the past; however, a majority of them merely considered the correlation between the two variables – stock returns and exchange rates. Some of the more recent, major studies have been reviewed over the period 2006 to 2015, commencing with Agrawal et al. (2010), which examined the statistical relationship between the stock returns and USD/INR exchange rates. Various statistical tests were applied to study the impact of USD/INR exchange rates on the stock market index in India using the daily closing indices of NIFTY-50, which were taken from October 2007 to March 2009. They employed correlation and Granger causality test and found that Nifty returns and USD/INR exchange rates were not normally distributed and they were stationary at their levels. The study has found a negative relationship between the Nifty returns and the exchange rates using the correlation test. In addition, the Granger causality test further showed a unidirectional relationship between NIFTY-50 stock returns and USD/INR exchange rates. Our study is an improvement on this research, as we have considered an extended time-period of 20 years for a much conclusive evidence.

Bhattacharya and Mukherjee (2006) studied the causal relationship between the stock market returns, Foreign Institutional Investments (FIIs), and the USD/INR foreign exchange rates in India. The study has used the application of statistical tools like unit root, cointegration, and Granger causality test to examine the causal relationship between the variables, covering monthly data for the period January 1993 to March 2005. The study concluded with an observation that a bi-directional causal relation existed between the stock returns and FIIs, and a unidirectional causal relation existed

between the exchange rates and stock returns, with no causal relationship prevailing between the exchange rates and net investment by FIIs.

Gulati and Kakhani (2012) made an attempt to examine the causal relationship between the USD/INR foreign exchange rates and the stock market returns. Statistical tools like correlation and Granger causality test were applied to test the relationship between the variables covering the period 2004 to 2012. The correlation showed very less degree of positive correlation between the two variables, though the Granger causality test depicted no existence of a relationship between the two variables during the period under review.

Ray (2012) made an attempt to study the Indian foreign exchange reserves and its impact on stock market capitalisation, using secondary data sources covering a time-period of 20 years, from 1990-1991 to 2010-2011. The study has employed the application of ordinary least square method to interpret whether there was any relationship between the variables; the Augmented Dickey-Fuller (ADF) test was used to determine whether the time-series data were stationary or not; the Johansen cointegration test was used to determine the number of vectors that cointegrate to form the results; and the Granger causality test was used to determine the relationship between the FOREX reserves and stock market capitalisation. The results showed the existence of a significant positive impact of foreign exchange reserves on stock market capitalisation.

Singh (2015) investigated the causal relationship between the USD/INR exchange rates and the stock price returns covering a period of 7 years, from March 2007 to March 2014. The NSE NIFTY-50 index was used as a substitute for the stock prices. Johansen cointegration test was used to determine the nature of relationship that existed between the variables, and the Granger causality test was further used to determine the causal relationship between the variables. The results concluded that stock prices and NIFTY-50 returns were cointegrated, and hence a long-term relationship existed between them. The Granger causality test showed that the exchange rate significantly affects the stock prices, and vice versa, and hence there exists a bi-directional causal relationship between the exchange rate and stock prices.

Sinha and Kohli (2013) investigated the interactions between the foreign exchange rates and the stock market returns in India, in addition to the major economic factors which could have influenced the Indian Rupee vis-à-vis the US Dollar over two decades, ranging from 1990-2011. Three major indices, such as the BSE SENSEX, BSE IT sector, and BSE Oil and Gas sector were considered, to examine the impact of exchange rates on the said market indices. The result showed no significant interactions between the USD/INR foreign exchange rates and stock returns. However, economic

variables like inflation differential, lending interest rates, and accounting deficit were found to significantly affect the USD/INR exchange rates.

Suriani et al. (2015) investigated the relationship between the stock markets and foreign exchange markets in Pakistan. The Karachi Stock Exchange (KSE-100) index was used as a substitute of the stock prices, while the currency rate of Pak Rupee against the US Dollar (Rs/US$) was considered as a substitute for exchange rate exposure. The study covered a time period of 6 years, from January 2004 to December 2009, based on monthly data. The findings of the study indicated no existence of relationship between the exchange rates and stock prices in Pakistan, and both the variables were considered to be independent of each other.

In conclusion, the various empirical studies reviewed here showed mixed results with the existing literature, which were found to be inconclusive on the issue of causality. Having reviewed the most relevant literature, the researchers have found a positive and often contradictory relationship between stock markets and foreign exchange markets. In addition, none of the past studies could give conclusive evidence on the nature of relationship existing between the two major financial markets in India or abroad. This mixture of findings and conclusions emanated from differences in empirical methodologies, variables used, and the period of study. As a result, the present study intended to fill that research gap by employing a suitable methodology in line with the review of past studies. Further, the use of 2000-2019 study period is a significant improvement to the existing literature.

OBJECTIVES AND METHODOLOGY

Research Objectives

The present study has two-fold objectives which are:
- To examine the nature of relationship between the INR/USD exchange rates and the BSE & NSE (SENSEX and NIFTY-50) stock returns, covering the period 2000 to 2019.
- To investigate whether INR/USD exchange rates have any impact on the BSE and NSE (SENSEX and NIFTY-50) stock returns, or vice versa, during the period under review.

Research Hypothesis

The present study attempts to provide answers to the following alternative hypotheses:

H_{A1}: The BSE and the NSE (SENSEX and NIFTY) stock indices granger cause INR/USD foreign exchange rates.

H_{A2}: The INR/USD foreign exchange rates granger cause BSE and NSE (SENSEX and NIFTY) stock indices.

Sample Selection

The present study has considered the INR/USD foreign exchange rates, along with the stock returns of BSE and NSE (SENSEX and NIFTY-50), in line with the objectives of the present study. Hence, the purposive sampling approach has been employed to empirically investigate the relationship between the stock market indices and the foreign exchange rates in India. The annual time-series data relating to a period of 20 years, from 2000 to 2019, has been considered in the present study. Besides this, the reporting of the data was not so structured before the year 2000, and hence the time-period before 2000 was kept out of the purview of the present study. Further, the choice of the observed variables was based on extensive literature review on the past studies related to the two major financial markets in India.

Research Framework

While deciding on the most suitable tool of analysis, the researchers have found that extensive literature review reveals the application of unit root test (or, Augmented Dickey-Fuller test), Johansen cointegration, and Granger causality tests as the most widely used techniques in examining the relationship between the stock markets and the foreign exchange markets in India. Hence, the researchers have used the application of the aforesaid methods using the statistical software E-views v11.0, in line with the review of relevant past studies (Ray, 2012; Singh, 2015).

A time-series data can be stationary or non-stationary in nature. The unit root test or the Augmented Dickey-Fuller (ADF) test helps to determine the stationarity of the time-series variables. A series is said to be stationary if the mean and variance of the dataset are time-invariant, i.e. [(E (Yt)] and variance [Var (Yt)] of Y remains constant over time for all time-period t, and the co-variance [Covar (Yt, Ys)] between any two values of Y taken for different time periods, 't' and 's', depends on the differences between the two values. This difference in time period is considered as lag. Lag often helps to make the time-series data stationary. The ADF test considers both the differenced data and lagged data. The lagged data gives the values from the earlier point of time. Differenced data is taken to stabilise the mean of the time-series, thereby eliminating the trend and seasonality of the observed data.

If the series is found to be non-stationary, Johansen cointegration test is used to check the causality and the integration between the observed variables. The Granger

causality test can be applied solely on stationary time-series data to determine the cause-effect relationship between the variables. This method takes the lagged values to stabilise the trend of the time-series data, if the series is found to be non-stationary. The test for unit root is further conducted on the lagged values of the time-series variables to check the stationarity of the time-series data. The Granger causality test measures the information given by one variable (say, X) in explaining the latest value of another variable (say, Y). In addition, it also states whether variable Y is Granger caused by variable X and vice-versa. The variable Y is said to be granger-caused by variable X, only if variable X helps to predict the changes in the value of variable Y. It further indicates that the lagged values of variable X obtained from the ADF test are statistically significant in explaining variable Y.

Data Sources

The present study is restricted to secondary data sources collected from the official website of the Reserve Bank of India (RBI) relating to the INR/USD foreign exchange rates. Further, the daily observations of closing stock prices of NSE and BSE (SENSEX and NIFTY-50) were collected from the historical records available in the websites of the National Stock Exchange (NSE), Bombay Stock Exchange (BSE), and Securities and Exchange Board of India (SEBI), covering a time-period of 20 years, from 1 January 2000 to 31 December 2019.

EMPIRICAL RESULTS AND DISCUSSION

The descriptive statistics, as shown in Table 1, depicted the means, medians, standard deviations, and minimum and maximum values against each of the three observed variables, covering a period of 20 years, from 2000 to 2019. It is clear from the table that the variable BSE_RETURNS ranged between the minimum and maximum values of Rs. 3262.330 and Rs. 41253.74, respectively. Similarly, the other variable NSE_RETURNS depicted a mean value of Rs. 5471.854, with minimum and maximum values of Rs. 1059.260 and Rs. 12168.91, respectively. The next variable, INR_USD_RATES, showed a mean value of Rs. / $ 53.77381, with a maximum value of Rs. / $ 70.39430 during the observed period. Further, there were insignificant differences observed between the positive values of Skewness and Kurtosis across the values of all the three observed variables. The significant Jarque-Bera statistics show that the data considered are found to be non-normal at 5% significance level.

Table 1: Descriptive Statistics of Selected Variables

Particulars	BSE_RETURNS	NSE_RETURNS	INR_USD_RATES
Mean	18091.05	5471.854	52.77381
Median	18445.76	5553.435	47.76240
Maximum	41253.74	12168.91	70.39430
Minimum	3262.330	1059.260	41.48930
Std. Dev.	11362.20	3400.594	9.746208
Skewness	0.381430	0.381194	0.639734
Kurtosis	2.196597	2.120771	1.787909
Sampled Obs.	20	20	20
Jarque-Bera Test Statistic	1.022843	1.128566	2.588500
Probabilities (*or p-values*)	0.599643	0.568768	0.274103

Source: Calculated by the authors.

Unit Root Test

The unit root test or the Augmented Dickey-Fuller (ADF) test was performed to check the unit roots and stationarity of the observed variables. Table 2 depicted the findings of the unit root test on the selected financial variables for the observed period, based on the following alternative hypothesis.

H_{A3}: BSE_RETURNS, NSE_RETURNS, and INR_USD_RATES are stationary at their levels.

Table 2: Unit Root Test at Second Differences of the Selected Variables

Null Hypothesis: BSE_RETURNS has a Unit Root				
Exogenous: Constant				
Lag Length: 2 (Automatic – based on SIC, max-lag = 4)				
			test-statistic	Prob.*
Augmented Dickey-Fuller test statistic			1.007902	0.9944
Test critical values:	1% level		−3.886751	
	5% level		−3.052169	
	10% level		−2.666593	

Null Hypothesis: NSE_RETURNS has a Unit Root				
Exogenous: Constant				
Lag Length: 2 (Automatic – based on SIC, max-lag = 4)				
			test-statistic	Prob.*
Augmented Dickey-Fuller test statistic			1.104425	0.9956
Test critical values:	1% level		−3.886751	
	5% level		−3.052169	
	10% level		−2.666593	

Null Hypothesis: INR_USD_RATES has a Unit Root			
Exogenous: Constant			
Lag Length: 2 (Automatic – based on SIC, max-lag = 4)			
		test-statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.497984	0.9818
Test critical values:	1% level	−3.831511	
	5% level	−3.029970	
	10% level	−2.655194	
*MacKinnon (1996) one-sided p-values.			
Probabilities and critical values calculated for 20 observations.			

Source: Calculated by the authors.

From the above results, the ADF test statistic of BSE_RETURNS of 1.007902 was found to be greater than the critical value of (−) 3.052169 at 5% significance level. The probability (or p-value) of 0.9944 of the observed variables was also higher than 0.05 or 5% significance level, thereby accepting our null hypothesis and indicating the observed variable BSE_RETURNS as non-stationary. Similar results were reported in the case of the remaining financial variables with ADF test statistic of NSE_RETURNS and INR_USD_RATES of 1.104425 and 0.497984 being greater than the critical values of (−) 3.052169 and (−) 3.029970, respectively, at 5% significance level. The unit root test results further depicted the probabilities (or p-values) of 0.9956 and 0.9818, which are higher than 0.05 or 5% significance level against the variables NSE_RETURNS and INR_USD_RATES, respectively. This shows clear evidence of the acceptance of our null hypothesis, with an indication that the variables under review were found to be non-stationary at their levels.

As the time-series data of the observed variables were found to be non-stationary, the Granger-causality test cannot be performed on the dataset, unless the unit root test of either the first or second differences of the three time-series variables were found to be stationary. However, if the series was found to be non-stationary as observed in the present study, it provides a favourable indication for the execution of Johansen cointegration test to check the causality and integration between the observed variables.

Johansen Cointegration Test

The Johansen cointegration test is an extension of the unit root test, if the time-series variables are not stationary at their levels. Since the observed variables were found to be non-stationary during the period under review, the Johansen cointegration test was employed to determine the number of cointegration vectors existing between the selected financial variables, and whether they signify a robust relationship between the variables in the long run.

Table 3 depicted the findings of the Johansen cointegration test on the selected financial variables, based on the following alternative hypothesis.

H_{A4}: Cointegration exists between BSE returns, NSE returns, and INR_USD rates.

Table 3 depicted the calculated results of the cointegration test between the observed variables, based on the E-Views software version 11.0, where both the trace test and maximum eigen value showed the presence of at least one cointegrating equation at 0.05 or 5% significance level.

Table 3: Cointegration Test of the Selected Variables

Trend Assumption: Linear Deterministic Trend				
Series: BSE_RETURNS, NSE_RETURNS, INR_USD_RATES				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesised		Trace	0.05	
No. of CE(s)	Eigen Values	Statistic	Critical Value	Prob.**
None *	0.887245	49.31627	29.79707	0.0001
At most 1	0.378779	10.03060	15.49471	0.2784
At most 2	0.077978	1.461358	3.841465	0.2267
Trace test indicates 1 cointegrating equation(s) at the 0.05 level.				
*denotes rejection of the hypothesis at the 0.05 level.				

Unrestricted Cointegration Rank Test (Maximum Eigen Value)				
Hypothesised		Max-Eigen	0.05	
No. of CE(s)	Eigen Value	Statistic	Critical Value	Prob.**
None *	0.887245	39.28568	21.13162	0.0001
At most 1	0.378779	8.569239	14.26460	0.3238
At most 2	0.077978	1.461358	3.841465	0.2267
Max eigen value test indicates 1 cointegrating equation(s) at the 0.05 level.				
*denotes rejection of the hypothesis at the 0.05 level.				
**MacKinnon-Haug-Michelis (1999) p-values.				

Source: Calculated by the authors.

The trace statistic of 49.31627 and the max-eigen statistic of 39.28568 were found to be greater than the critical values of 29.79707 and 21.13162, respectively at the 5% level of significance. Further, the probabilities (or p-values) of 0.0001 were found to be less than 0.05 or 5% significance level, thereby rejecting our null hypothesis against the observed financial variables. The Johansen cointegration test results thus confirmed an existence of a robust relationship between BSE returns, NSE returns, and INR_USD exchange rates in the long run.

BSE returns, NSE returns, and INR_USD exchange rates were found to be interlinked, as proven by the Johansen

cointegration test; however, there was no evidence that could indicate the nature of relationship between the variables from either direction. To provide further evidence of the cause-and-effect relationship between the selected variables, Granger causality test needs to be conducted to check whether the selected financial variables affect each other or not. However, the Granger causality test cannot be applied on non-stationary time-series variables, hence there remains a necessity to perform the unit root test at the first differences of the selected variables in the present study.

Unit Root Test at First Differences

The results of the unit root test previously conducted on the selected financial variables rejected our null hypothesis, indicating that the observed time-series variables are non-stationary. If the series is non-stationary, the Granger causality test cannot be employed to check the causal relationship between the variables. Hence, the necessity to perform the unit root test at the first differences of the observed variables remains a pre-requisite to test the stationarity of the time-series data before the subsequent application of the Granger causality test.

Table 4 presented the findings of the unit root test at the first differences on the selected time-series variables, based on the following alternative hypothesis.

H_{A5}: BSE returns, NSE returns, and INR/USD rates are stationary at their first differences.

Table 4: Unit Root Test at First Differences of Selected Variables

Null Hypothesis: First Difference of BSE_RETURNS has a Unit Root				
Exogenous: Constant				
Lag Length: 1 (Automatic – based on SIC, max-lag = 4)				
			Test-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic			−4.993870	0.0011
Test critical values:	1% level		−3.886751	
	5% level		−3.052169	
	10% level		−2.666593	

Null Hypothesis: First Difference of NSE_RETURNS has a Unit Root				
Exogenous: Constant				
Lag Length: 1 (Automatic – based on SIC, max-lag = 4)				
			Test-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic			−5.252015	0.0007
Test critical values:	1% level		−3.886751	
	5% level		−3.052169	
	10% level		−2.666593	

Null Hypothesis: First Difference of INR_USD_RATES has a Unit Root				
Exogenous: Constant				
Lag Length: 1 (Automatic – based on SIC, max-lag = 4)				
			Test-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic			−3.502305	0.0204
Test critical values:	1% level		−3.857386	
	5% level		−3.040391	
	10% level		−2.660551	
*MacKinnon (1996) one-sided p-values.				
Probabilities and critical values calculated for 20 observations				

Source: Calculated by the authors.

The ADF test statistic of BSE_RETURNS of (−) 4.993870 was found to be less than the critical value of (−) 3.052169 at 5% significance level. The probability (or p-value) of 0.0011 of the observed variable of BSE_RETURNS was also less than 0.05 or 5% significance level, thereby rejecting our null hypothesis and indicating the variable to be stationary at their first difference unit root test. Similar results were reported in the case of the remaining financial variables, with ADF test statistic of NSE_RETURNS and INR_USD_RATES of (−) 5.252015 and (−) 3.502305 being less than the critical values of (−) 3.052169 and (−) 3.040391, respectively, at their first difference unit root test. The unit root test results further depicted the probabilities (or p-values) of 0.0007 and 0.0204, which are less than 0.05 or 5% significance level against the variables NSE_RETURNS and INR_USD_RATES, respectively. This gives an indication of the rejection of our null hypothesis, and hence the observed variables were found to be stationary at their first difference unit root test. The evidence of stationarity of all the three time-series data at their first difference unit root test hinted at the favourable execution of the Granger causality test in the present study.

Granger Causality Test

As the dataset was found to be stationary for all the observed variables under review, the Granger causality test was applied to determine whether the variables are independent or affect each other. The Granger causality test further seeks to determine whether past values of a particular variable help to predict changes in the other variable. The test results were displayed against each of the observed variables at the probabilities (or p-values) of 0.05 or 5% significance level. The results of the Granger causality test have been shown in Table 5.

Table 5: Granger Causality Test of Selected Variables (at First Differences)

Pair-Wise Granger Causality Tests		
Lags: 1		
Null Hypothesis:	F-Statistic	Prob.*
NSE_RETURNS does not Granger Cause BSE_RETURNS	6.97044	0.0088
BSE_RETURNS does not Granger Cause NSE_RETURNS	5.04999	0.0238
INR_USD_RATES does not Granger Cause BSE_RETURNS	3.20061	0.0741
BSE_RETURN does not Granger Cause INR_USD_RATES	4.34415	0.0359
INR_USD_RATES does not Granger Cause NSE_RETURNS	3.41967	0.0641
NSE_RETURNS does not Granger Cause INR_USD_RATES	4.01132	0.0440

* Probabilities or p-values.
Source: Calculated by the authors.

The Granger causality test showed that there exists a bi-directional relationship between BSE returns and NSE returns, as their probabilities or p-values of 0.0088 and 0.0238, respectively, were found to be less than 0.05 or 5% significance level. This rejected the null hypothesis, thereby confirming that NSE returns granger cause BSE returns, and BSE returns in turn granger cause NSE returns. This indicated that both the major market indices of India, namely the BSE SENSEX and NSE NIFTY-50, were highly related to each other. Further, there exists a unidirectional relationship between BSE returns and INR_USD exchange rates, but not vice versa, as the probability of 0.0359 is less than the 5% significance level. This indicated that BSE returns granger cause INR_USD rates, thereby signifying that any change in BSE returns adversely impacts changes in INR_USD exchange rates, but there is no significant evidence as to whether INR_USD exchange rates affect BSE returns. Similarly, there exists a unidirectional relationship between NSE returns and INR_USD rates as the probability of 0.0440 was found to be less than the 5% significance level. This further indicated that NSE returns granger cause INR_USD exchange rates, signifying that any change in NSE returns adversely impacts changes in INR_USD exchange rates, but there is no significant evidence as to whether the INR_USD exchange rate affects NSE returns.

CONCLUSION AND FUTURE SCOPE OF STUDY

The present study tried to investigate the relationship between the stock market indices (SENSEX and NIFTY-50)

and the INR/USD foreign exchange rates in India, covering a period of 20 years, from 2000 to 2019. The concluding observations can be summarised as follows:

● There existed a robust relationship between BSE returns, NSE returns, and INR/USD exchange rates, as evidenced from the Johansen cointegration test.

● The Granger causality test results confirmed the existence of a causal relationship between BSE and NSE returns, between BSE returns and INR/USD exchange rates, and between NSE returns and INR/USD rates.

● The result was found to be bi-directional in the case of BSE and NSE returns, running from BSE returns to NSE returns, and vice versa.

● The result was found to be unidirectional in the case of BSE returns and INR/USD exchange rates, running from BSE returns to INR/USD rates; further, the result was unidirectional in the case of NSE returns and INR/USD exchange rates, running from NSE returns to INR/USD rates.

The present study attempts a new dimension in the field of research in financial markets by exploring a nexus between the stock market indices (SENSEX and NIFTY) and the INR/USD foreign exchange rates in India. Hence, there are ample opportunities for future researchers to analyse similar applications, with several other major foreign exchange rates in India as well as sector-specific indices, using the same construct or different relevant constructs. Empirical studies covering more financial variables for an extended time-period can also be considered as probable areas for future research. However, insights from this study can be further replicated in other emerging and developing economies of the world, as an extension to the present study.

LIMITATIONS OF THE STUDY

The data collected for the present study has been derived from secondary data sources, with no emphasis on primary research. Hence, the study incorporates all the limitations that are inherent in the published financial records. Moreover, the study is restricted to a time-span of 20 years, covering the post-reform phase of the Indian financial markets. Like most of the studies on the financial markets, data availability for the present study is also restricted to the information published by the Indian stock exchanges in compliance with the regulators, RBI and SEBI.

REFERENCES

Agrawal, G., Srivastav, A. K., & Srivastava, A. (2010). A study of exchange rates movement and stock market

volatility. *International Journal of Business and Management*, *5*(12), 62-73.

Bhattacharya, B., & Mukherjee, J. (2005, December). *An analysis of stock market efficiency in the light of capital inflows and exchange rate movements: The Indian context.* Paper Presented at the Annual Conference of Money & Finance. Mumbai: Indira Gandhi Institute of Development Research. Retrieved from http://www.igidr. ac.in/conf/oldmoney/mfc_08/An%20Analysis%20of%20 Sock%20Market%20Efficiency...Basabi%20&%20 Jaydeep.pdf

BSE SENSEX Historical Index Data. (2000-2019). Retrieved from https://www.bseindia.com/indices/ IndexArchiveData.html

Gulati, D., & Kakhani, M. (2012). Relationship between stock market and foreign exchange market in India: An empirical study. *Pacific Business Review International, 5*(5), 66-71.

NSE NIFTY-50 Historical Index Data. (2000-2019). Retrieved from https://www1.nseindia.com/products/ content/equities/indices/historical_index_data.htm

Ray, S. (2012). Foreign exchange reserve and its impact on stock market capitalization: Evidence from India. *Research on Humanities and Social Sciences*, *2*(2), 46-60.

Reserve Bank of India USD Reference Rate Archive. (2000-2019). Retrieved from https://www.rbi.org.in/scripts/ ReferenceRateArchive.aspx

Singh, P. (2015). Indian stock market and macro-economic factors in current scenario. *International Journal of Research in Business Management*, *2*(11), 43-54.

Sinha, P., & Kohli, D. (2013). *Modelling exchange rate dynamics in India using stock market indices and macroeconomic variables* (pp. 1-18). Munich Personal RePEc Archive Paper (MPRA). Retrieved from https:// mpra.ub.uni-muenchen.de/id/eprint/45816

Suriani, S., Kumar, M. D., Jamil, F., & Muneer, S. (2015). Impact of exchange rate on stock market. *International Review of Economics and Finance*, *5*(Special Issue), 385-388.