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Interconnection between Stock Market and Foreign Exchange Market

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ABSTRACT

Purpose: The present study attempts to examine the interaction between stock prices and exchange rates in Indian economy which are considered to be very sensitive as well as crucial variables in the world of financial market. It adds to the existing literature on Integration between markets since the results are not unanimous in this area.

Design: For the analysis of the data pertaining to the present study, Granger causality test has been applied in the VAR environment after converting stock prices and exchange rates into stationary form

Findings: The results reveal the unidirectional causality from stock prices to exchange rates.

Keywords: Integration, Granger Causality Test, VAR, Impulse response function, Variance decomposition

Introduction:

A proper and a well-functioning stock market is imperative for the economic development of a country. Stock market being a portrayal of a company's earnings encompasses within itself various intricacies as it is shaped by the dynamics of investor's behaviour. One sphere which has been debated and discussed all over the world since quite long is the interconnection between stock market and foreign exchange market. It is crucial to understand the extent of linkages between these markets so that the benefits derived can be proliferated. Studies have shown that the increased integration between these two markets as a result of economic reforms in 1991 have led to an increase in the profitability of various sectors of the economy as well. Ghosh (2012) observed that the penetration of foreign banks in India has led to improved profitability as well as overall asset quality. In theoretical parlance, the researchers have explained this relationship in terms of Stock oriented approach and Flow oriented approach. Stock oriented approach assumes the unidirectional causality running from stock market to foreign exchange market (Branson, 1983, and Frankel 1983) whereas the Flow oriented approach postulates the running of unidirectional causality from foreign exchange market to stock market (Dornbusch and Fischer 1980). As stated by Eugene Fama in Efficient Market Hypothesis, stock prices are a pure reflection of all the information having relevance to it and if the flow oriented approach holds true, it would be justified to state that foreign exchange market information too would act as a stimuli for the stock market.

Interconnection among various markets may take different forms which are studied using different techniques. One market may lead the other. Such lead lag relationships are identified using Vector Error Correction Model (VECM). It may also happen that one market is changing in response to the change in the other market which may be studied using Impulse Response Function. And sometimes an event occurring in one market may affect other market which is defined as Volatility Spillover. Volatility refers to the fluctuations in the prices of any asset and when such variations are caused by the events or information in any other market it is referred as volatility spillover. These are tested using EGARCH, BEKK- GARCH, MV-GARCH etc. There has been a marked increase in the studies pertaining to volatility spillover after the global financial crisis 2008 which acted as an event affecting not only US but other markets also across the world.

Though a lot of studies have been done by the researchers on the above areas but no unanimity has been observed in the conclusions drawn by them and also such studies have been scanty in the developing economies like India. The introduction of economic reforms has led to an increased integration of stock market with foreign exchange market. These accompanied with two- way fungibility of ADRs/ GDRs have acted as catalyst to this interconnection leading to an increased number of studies to gauge the interaction between the market enabling the investors and portfolio managers to frame the diversification strategies accordingly..

Review of Literature:

The relationship between Stock prices and exchange rates has been very well documented in the literature and a review of it exhibits that the association between them is very complex. Ajayi and Mougoue (1996) discovered that an increase in exchange rate (domestic currency depreciation) had negative effect on stock market in the short run as well as the long run. The possible reason can be the negative effect of currency depreciation for an import oriented economy (Ma and Kao 1990). Further their analysis revealed that an increase in stock price led to currency depreciation in the short run possibly because of the inflationary expectations (Solnik 1987) while in the long run it led to appreciation.

Nath G.C. and Samanta G.P. examined the integration between foreign exchange market and capital markets in India covering period from 1993 to 2003 using granger causality and geweke feedback measures. The results of granger causality revealed absence of significant relationship between the two variables whereas a strong bidirectional causality was reported while using geweke feedback measures. Nath and Samanta (2003) explored the relationship between stock and foreign exchange market from 1993 to 2002 using granger causality test and reported the absence of causal relationship between the two except in recent years causality was found to be running from stock market to foreign exchange market Bhattacharya and Mukherjee investigated the causal relationship between stock returns, net FII and exchange rate in India and found out unidirectional causality running from exchange rate to stock return thereby supporting flow oriented approach. Ramasamy and Yeung concluded that causality is dependent on the time period taken. While taking pooled time period from 1st January 1997 to 31st December 2000, their results revealed stock prices granger causing exchange rates to vary except for Hong Kong where bidirectional causality was seen. But when the analysis was done on quarterly basis, results varied from no causality to unidirectional causality to bidirectional causality implying that the variations in both the markets were short term occurrences. Ibrahim (2000) applied cointegration test and granger test to examine the long run relationship and short term interactions between exchange rates and stock market index of Malaysia. He observed the absence of cointegration between the two variables in a bivariate framework while in the multivariate framework including money supply and reserves evidence for cointegration was found. In case of short term interactions unidirectional causality from stock market to foreign exchange market was observed and money supply and reserves granger caused exchange rates and stock index to vary.

Research Objectives:

The present study intends to analyse the interconnection between stock market and foreign exchange market by employing VAR and causality tests. The importance of analysing stock market has been recognised in the recent years as exposure of any economy to the outer world happenings can be gauged through movements in stock market. The present study makes an effort in the above direction.

Research Methodology:

To examine the interaction between stock prices and exchange rates we employ the Granger Causality test in the VAR environment. Application of VAR offers an advantage when we don't have any prior information regarding the exogeneity and endogeneity of variables since the system of VAR considers all the variables as endogenous.

1. Granger's Causality Test

Granger causality test states that if it is possible to predict the values of a particular variable say, SP using the lagged values of another variable say, ER then it can be said that ER granger causes SP and vice versa. The test can be written in the form of equation as:

$$SP_t = \gamma_0 + \sum_{i=1}^{n} \alpha_i \, ER_{t-i} + \sum_{j=1}^{n} \beta_j \, SP_{t-j} + \varepsilon_{1t} \qquad (1)$$

$$ER_t = \gamma_1 + \sum_{i=1}^{m} \lambda_i \, ER_{t-i} + \sum_{j=1}^{m} \delta_j \, SP_{t-j} + \varepsilon_{2t} \qquad (2)$$

In the first equation, for exchange rate to granger cause stock prices: the coefficient α_i should not be equal to 0 and in the second equation, for stock price to granger cause exchange rate: the coefficient δ_j should not be equal to zero.

Before proceeding towards the granger causality testing, the assumption of stationarity of the series involved in it must be met and the appropriate lag length can be determined using any of the lag length criteria such as Akaike Information Criterion(AIC), Final Prediction Error(FPE), Schwarz Information Criterion(SIC), Likelihood Ratio Test(LR), Hannan-Quinn Information Criterion (HQC) etc.

2. Vector Auto Regression (VAR):

When we are having two variables, VAR would consist of the regression equations where the current value of each variable can be determined using different set of lagged values of both the variables. This can be represented as follows:

$$SP_t = \beta_{10} + \beta_{11} \, SP_{t-1} + \ldots\ldots + \beta_{1k} \, SP_{t-k} + \alpha_{11} ER_{t-1} + \ldots\ldots + \alpha_{1k} \, ER_{t-k} + \varepsilon_{1t}$$

$$ER_t = \beta_{20} + \beta_{21} \, ER_{t-1} + \ldots\ldots + \beta_{2k} \, ER_{t-k} + \alpha_{21} SP_{t-1} + \ldots\ldots + \alpha_{2k} \, SP_{t-k} + \varepsilon_{2t}$$

Where ε_{1t} and ε_{2t} are error terms having zero mean and constant variances and

$$E(\varepsilon_{1t}, \varepsilon_{2t}) = 0$$

Both the series again need to be stationary before applying the model. In VAR, coefficients of the lagged variables may change sign across lags which can make it difficult to interpret as to what would the effect of the change in the values of the given variable on the future values of the other variable. Hence this methodology is accompanied with Block Exogeneity

Test/Granger Causality Test, Impulse Response Function and Variance Decomposition to make the interpretation more clear.

3. Data and Variables:

For the present study we have taken two variables pertaining to stock prices represented by the closing prices of NIFTY50 and exchange rate of Indian Rupee vis- a -vis US Dollar. The data covers a period of 5 years from April 2013 to March 2018. The data has been retrieved from the official websites of NSE and RBI.

Findings:

As stated above the first and foremost requirement before proceeding towards the analysis is ensuring that the data is stationary. So we applied Augmented Dickey Fuller test and Phillips- Perron test to check the existence of unit root if any and the null hypothesis of unit root could not be rejected i.e. the data was found to be non-stationary at level. So we have converted both the series into Logarithmic differenced series (Return Series). The following tables reports the results of the unit root test carried out on both the series

Table 1 : Null Hypothesis: Exchange Rate series has unit root.

Unit Root Test		ADF test	PP Test	ADF Test	PP Test
		Level	Level	First Diff	First Diff
t-statistic		-2.841	-2.92248	-26.8762	-34.789
Critical values:	1% level	-3.96571	-3.96571	-3.96572	-3.96571
	5% level	-3.41356	-3.41356	-3.41356	-3.41356
	10% level	-3.12883	-3.12883	-3.12883	-3.12883

Source: Computed by Author

Table 2 : Null Hypothesis: Stock Prices has unit root

Unit Root Test		ADF test	PP Test	ADF Test	PP Test
		Level	Level	First Diff	First Diff
t-statistic		-2.31559	-2.17069	-31.332	-31.1882
Critical values:	1% level	-3.96571	-3.96571	-3.96571	-3.96571
	5% level	-3.41356	-3.41356	-3.41356	-3.41356
	10% level	-3.12883	-3.12883	-3.12883	-3.12883

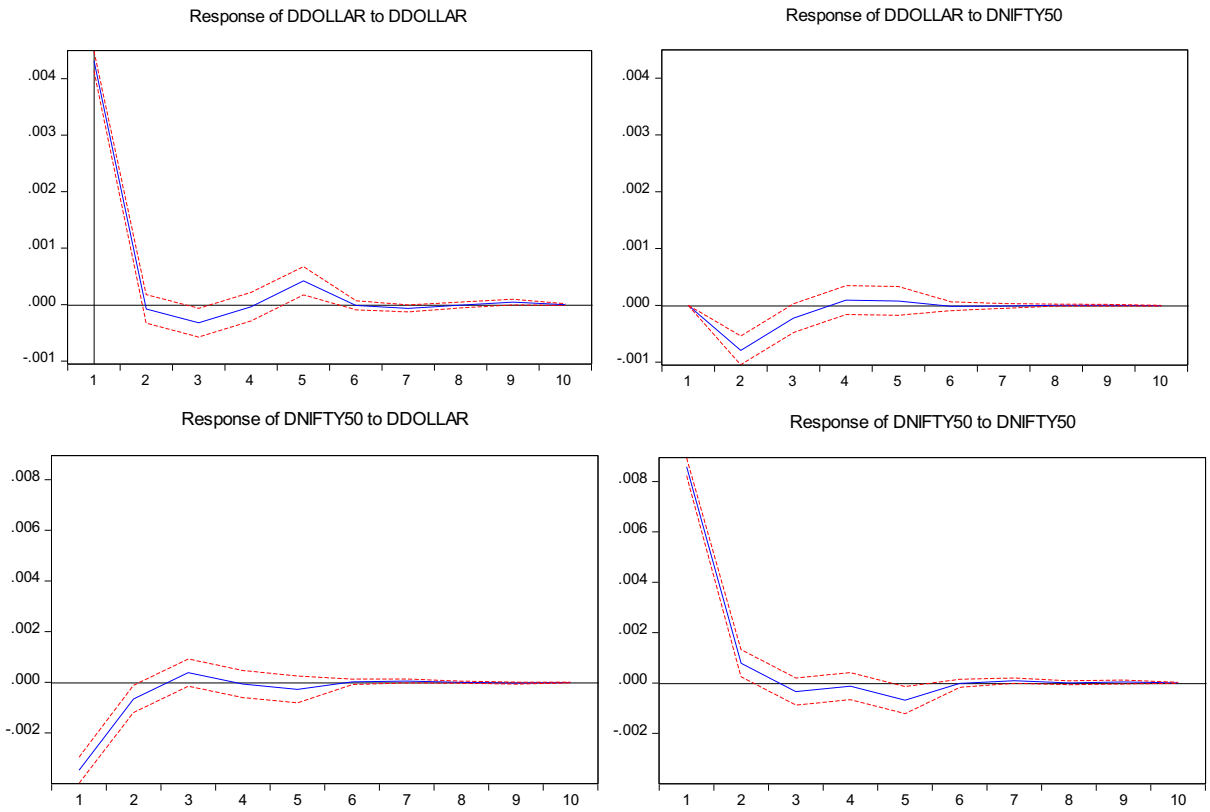
Source: Computed by Author

The Series of stock prices is converted into stock returns and series of exchange rate into exchange rate returns. The descriptive statistics for both stock returns and exchange rate returns is shown in the table 3. The Jarque-Bera statistic is significant rejecting the null hypothesis of normal distribution.

Table 3 : Impulse Response Function:

	Ex. Rate Returns	Stock Returns
Mean	0.00015	0.00047
Median	1.20E-05	0.000431
Maximum	0.0402	0.03738
Minimum	-0.026793	-0.060973
Std. Dev.	0.004411	0.009338
Skewness	0.869178	-0.386253
Kurtosis	14.5988	5.771931
Jarque-Bera	6883.43	414.3633

Figure 1 Results of Impulse Response Function



The above figure comprising the four graphs displays the results of impulse response function which is the responsiveness of variables to a one standard deviation shock in the VAR system. The first row shows the responsiveness of the exchange rate return to a shock in the stock returns as well as in itself. The results reveal that there is a reduction in the exchange rate after a one standard deviation shock is given to the stock returns over 4 years after which it becomes stable. The second row displays the responsiveness of stock returns to a shock in the exchange rate returns and in itself. The results depict that the shock in exchange rate return cause stock returns to respond negatively over 3 years after which it achieves stability.

Variance Decomposition:

Table 4

Variance Decomposition of Exchange Rate Returns:			
Period	S.E.	DDOLLAR	DNIFTY50
1	0.004315	100	0
2	0.004388	96.73022	3.26978
3	0.004405	96.49209	3.507912
4	0.004407	96.4502	3.549803
5	0.004427	96.45287	3.54713
6	0.004427	96.45159	3.548414
7	0.004428	96.45183	3.54817
8	0.004428	96.45178	3.54822
9	0.004428	96.4521	3.5479
10	0.004428	96.4519	3.548097

Variance Decomposition of Stock Returns:			
Period	S.E.	DDOLLAR	DNIFTY50
1	0.00925	14.03655	85.96345
2	0.00931	14.36289	85.63711
3	0.00933	14.48791	85.51209
4	0.009331	14.4901	85.5099
5	0.00936	14.48962	85.51038
6	0.00936	14.48989	85.51011
7	0.009361	14.49102	85.50898
8	0.009361	14.49101	85.50899
9	0.009361	14.49186	85.50814
10	0.009361	14.49187	85.50813

The results of variance decomposition of exchange rate returns reveal that its variance is mostly due to its own innovations while in the variance decomposition of stock returns, approximately 14% of the variance is due to innovations in the exchange rate while remaining 86% accounts for its own innovations

Table 5 reports the result of Granger Causality applied in the VAR environment on Stock returns and Exchange rate returns. The appropriate lag length has been determined taking into account Akaike Information Criterion and Final Prediction Error which reports 4 lags as the .appropriate lag length

Table 5

VAR Granger Causality/Block Exogeneity Wald Tests			
Dependent Variable: Exchange rate returns			
Excluded	Chi-square	Df	Prob.
Stock Returns	44.24161	4	0.0000
All	44.24161	4	0.0000
Dependent Variable: Stock returns			
Excluded	Chi-square	Df	Prob.
Exchange rate returns	6.176344	4	0.1864
All	6.176344	4	0.1864

The results of the Block Exogeneity test in the table 5 depict that there is no significant causality from Exchange rate returns to stock returns whereas causality was seen from Stock returns to Exchange rate returns. Thus the results support the stock oriented model which posits the unidirectional causality from stock prices to exchange rates. These results may be attributed to the fact that the number of frauds in the corporate sector has increased in the recent years leading to a withdrawal in the confidence of foreign investors thereby causing changes in the exchange rate.

Conclusions:

In the present study we have analysed the interconnection between the stock market and foreign exchange market and the result portray stock prices causing changes in exchange rate in the recent years and this points the dominance of foreign investment in the stock market which cause change in the foreign exchange market as well. However the results may vary with period of time. Thus more in-depth research can be conducted in this frontier with the application of more robust tools and techniques

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