Article

Relationship between Foreign Portfolio Investment and Exchange Rate: The Case of India Using VECM Testing Approach

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Abstract

India attracts a large sum of foreign investments every year. These foreign investments have a remarkable impact on Indian economy. Real economy is assumed to be affected by foreign investment through its constituents like exchange rate, foreign exchange reserves, economic growth, etc. Exchange rate movements are also believed to affect the foreign portfolio investment, especially foreign institutional investment coming to the country. The unit root test is applied to determine stationary of the time series data. Vector error correction model is applied to determine the dynamics of the relationship between foreign investment and exchange rate. The result shows that foreign portfolio investment, foreign direct investment, index of industrial production, interest rate and wholesale price index have a positive impact on the exchange rate (REER), that is, Indian rupee appreciates whereas import has negative impact on exchange rate in India that is, Indian rupee depreciates. In short, foreign portfolio investment in India may lead to rupee appreciation with several other currencies and their selling and disinvestment may lead to its depreciation.

Keywords

Foreign portfolio investment, Exchange rate index, ADF, VECM

Introduction

For the economic growth of a nation, capital is an important element. Most nations depend on foreign investors for capital because they cannot meet their capital requirements through internal sources alone.

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According to Harrison (1996), it cannot be denied that a country cannot remain an island, and does require capital from other countries of the world. Both developed and the developing countries depend on foreign capital to stimulate investment, generate employment, improve production and bridge the gap between savings and investment. In this decade, international capital flows, especially portfolio investment flows, increased rapidly with advances in globalisation, financial deregulation, and improved information technology in the world economy.

Foreign portfolio investment (FPI) is the investment by foreign investors in Indian securities including shares, government bonds, corporate bonds, convertible securities, units of business trusts, etc. The class of investors who invest in these securities is known as foreign portfolio investors. FPIs are primarily governed by the Securities and Exchange Board of India (SEBI). SEBI has recently revised the SEBI (Foreign Portfolio Investors) Regulations, 2019, repealing the 2014 regulations. Further, FPIs are also required to comply with the Foreign Exchange Management Act, 1999, and the Income-tax Act, 1961. In March 2016, FPIs were permitted to invest in units of the real estate investment trust (REIT) and the infrastructure investment trust (InvIt). The Indian rules for FPIs have undergone several regulatory changes in the last few years to ease investment. FPIs primarily consist of securities and other financial assets passively held by foreign investors, generally for a short-term speculation. Foreign portfolio investment differs from foreign direct investment in that it does not give the investor direct ownership of the financial assets. Prior to January 2014, FPIs were divided into foreign institutional investors, qualified foreign investors and sub-accounts. Responding to the market pressure, in January 2014, SEBI notified new rules which were designed to bring India in line with the international norms and establish a simplified regulatory framework for foreign investors who fit the FPI framework. The new rules merged foreign institutional investors, qualified foreign investors, and sub-accounts together to form the new foreign portfolio investor class. The rules took effect on 1 June 2014.

Foreign investment plays an important role in the long-term economic development of a country by bridging the gap between savings and investment, increasing the availability of capital and raising productivity. Encouraged by this, many developing countries opened their economies to foreign capital flows in the late 1980s and early 1990s. Portfolio investment, an important form of international capital flows, began at a reasonable scale in the early 1990s in developing and emerging markets. The Indian economy liberalised in 1991 following the Balance of Payment (BOP) crisis. When foreign investors invest funds in Indian stock market, the price of shares goes up, which also pushes the liquidity in the secondary market. As an effect of this, the cost of issuing shares goes down, which enhances the equity as it increases the local demand as well as foreign demand due to improved access to capital. Thus, it encourages other investors and causes higher efficiency in the market by increasing supply, demand and liquidity. Foreign capital inflow affects the exchange rate, international reserves, monetary policy, saving and investment behaviour of the country. Huge foreign investments lead to rise in the demand for domestic currency and its consequent appreciation in the exchange rate index.

Foreign Institutional Investors (FIIs) were allowed to invest in India from September 1992 onwards. FIIs since then have become important players in the domestic financial markets and become an important source of portfolio investment in the country. Since liberalisation, FII flows have grown in importance in India. For every dollar FIIs bring into the country, the demand for rupee is created and the RBI has to print and release the money in the country due to this. That means FII investing in India may lead to rupee appreciation with respect to several other currencies.

The economic growth of a country requires foreign capital to play a greater role in its economy . There was a surge in foreign capital flows into India after 1992 because of the profound changes in India's policies and regulations. Then, the Government of India started relaxing certain barriers to

facilitate foreign capital inflow and improvement of the country's financial structure. Today, FIIs are drivers of the Indian financial markets.

The floating exchange rate regime since the early 1970s has heightened the interest of MNCs in developing techniques and strategies for foreign exchange exposure management. Exchange rate movements are an important issue in international finance as well as for the managers of multinational firm, international investors, the importers and the exporters. There are several macroeconomic factors that affect the exchange rate. Elements influencing the exchange rate are inflation rate, economic growth rate, money supply, index of industrial production, current account deficit, foreign investment, exports and imports, etc. Using various macroeconomic barometers and models that the factors that affect the value of rupee and the important factors which control the exchange rate index are established.

Fluctuations in the exchange rate between currencies of the two countries have the potential to impact the performance and growth of their economies positively as well as negatively. Theoretically specking, in the case of India, foreign investment has a positive impact on exchange rate as a result of the appreciation of the Indian rupee. However, when exchange rate fluctuations lead to the depreciation of the Indian currency, it will have a negative impact on the Indian economy. These facts make not only make the real impact of foreign investment uncertain but also necessitate to study the factors that influence the exchange rate and take appropriate measures to stabilise the exchange rate of all countries including India. The exchange rate is the most crucial indicator of the strength or weakness of a country's economy. Thus, it becomes pertinent to understand the factors that influence the exchange rate and take apposite measures to stabilise the exchange rate.

Review of Literature

The literature review is meant to see whether the existing theories suggest a relationship between foreign exchange rate and foreign capital flows or not. There are two theories that attempt to explain the relationship between foreign exchange rate and foreign investment, namely the theories of purchasing power parity and the interest parity.

Gustav Cassel, a Swedish economist, first explained the concept of purchasing power parity (PPP) in 1918 (Shapiro, 1983). It was founded on the law of one price, which is held to be true in the absolute version. According to the theory, worldwide levels of exchange-adjusted price should be the same, which means that the purchasing power of a home currency unit should be similar the world over when the difference in the aggregate price between two countries is matched by the depreciation in the home currency relative to the foreign currency (Sarno & Taylor, 2002). This means that in effect when issues such as transportation cost, tariff and quotas are taken into account, PPP is not a complete exchange rate calculation theory. However, a deviation from the theory has continued in the literature (Krugman & Obstfeld, 2009). The theory states that exchange rates are determined by considering the trade patterns changes that take place due to the difference in inflation rates across countries and that the exchange rate will keep on changing so as to maintain the purchasing power parity (Schreyer & Koechlin, 2002).

The changes in foreign currency stated in percentages should change in such a way that they maintain parity between the two countries' new price indices. The challenge of the theory lies in its explanation of how exchange rates relate to the barriers to trade and the type of goods from a country. The theory assumes that all goods are the same in different countries and that barriers to trade including transportation costs are always low in different countries. However this cannot be true (Sarno & Taylor, 2002). Ideal situations are observed with PPP. In perfect conditions, foreign capital investment flows would not be

influenced by exchange rates as the profit gained by operating in a country whose currency is weaker would not materialise. All costs would be the same, thus no need to invest elsewhere except in the home country (Krugman & Obstfeld, 2009).

Keynes proposed the theory of interest rate parity (IRP) in 1930. It is based on the price law that states that similar securities are priced the same such that identical securities should have the same price if priced in the common currency. IRP is an equilibrium that comes about when market forces cause the adjustment of the interest and exchange rates (Madura & Fox, 2011). When the interest differential between countries equals the difference between the forward rate and spot rate, IRP is at equilibrium. This arbitrage condition holds with international financial markets in equilibrium. Investors only tend to hold on higher value assets and both local and foreigners hold onto foreign assets and not local assets when the returns expected from the foreign asset are higher.

If the domestic interest rate is higher than the foreign one, a positive appreciation is expected. This will compensate for lower foreign interest rates (Mishkin & Eakins, 2009). The domestic interest rate can be calculated by subtracting the expected appreciation of the domestic currency from foreign interest rates. This theory is important as it describes the situation whereby an investor decides on which country to invest in. IRP does not mean that all countries must have same interest rate. The effect of other currencies can be neutralised by a currency experiencing high inflation and high interest rates because of its devaluation (Madura & Fox, 2009). Twarowska and Kąkol (2014) explained that determining an exchange rate for a long term depends upon the nation's PPP and the short-term exchange rate is determined by uncovered interest parity (UIP). The authors classify the factors that affect exchange rate into two groups based on long and short terms and on economic and non-economic factors.

According to Kumarasamy (2010) FDI inflow leads to a real exchange rate appreciation, that is, FDI has a direct impact on the exchange rate. Chaudhary et al. (2012) developed a vector auto regressive model and found a positive relation between FDI and real exchange rate in the long term. FIIs also have an impact on exchange rate and FIIs investment in India can lead to rupee appreciation and disinvestment can lead to its depreciation. FIIs inflows leads to the appreciation of the currency of the host countries. Accordingly FIIs investment in India can lead to the appreciation of the Indian rupee with several other currencies and vice versa.(Klein & Rosengren, 1992).

Some macroeconomic factors also affect the movement of exchange rate in India. Domestic inflation or deflation affects the exchange rate by affecting the demand- and supply side of the domestic currency in a foreign exchange market. When the home inflation rate is high, the home currency will lose value and vice versa. Inflation and exchange rate are thus negatively related. A country with lower inflation exhibits an increasing currency value and vice versa. Changes in the market inflation rate leads to changes in exchange rates. A country with a higher inflation faces depreciation in its currency with relation to the currencies of their trading partner nations. A country with a consistently lower inflation rate exhibits appreciation in domestic currency as its purchasing power increases relative to other currencies. Achsani (2010), Mirchandani (2013) and Hsing (2006) also have put forward this argument.

High interest rates indicate that a country's currency is more valuable. From a foreign investor's perspective, saving or investing in that country is more likely to yield better returns. Thus, this would increase the demand for that country's currency. To take advantage of the high rates offered, investors would move their funds in that country. When demand for a currency goes up vis-à-vis another currency (or currencies), it is strengthened or appreciated and its exchange rate improves.

The role of interest rate in the equilibrium of exchange rate is a debated issue. Frenkel (1979) argues that interest rate differentials between countries determine the exchange rates of their currencies. Cruz (2013) shows that interest rate is not significant and has a negative relationship with exchange rate.

However, Utami (2009) estimated the movement of exchange rate that could be influenced by interest rate from 2003 to 2008 using the exchange rate of five countries—the USA, Japan, Singapore and the UK and also Indonesia. He found that interest rate differential had a positive but not significant relationship with the exchange rate of countries such as USA, Singapore, UK and Japan. However he found a negative relation between two in the case of Indonesia.

Economic growth has an indirect effect on exchange rates of a nation's currency. An increase in real GDP will lead to the appreciation of local currency. This happens because an increase in real GDP signifies an increase in productivity, which drives the general price level in the economy down. A decrease in the price level will then drive down the inflation and also the exchange rate, leading to appreciation of the local currency.

India's consistent trade deficit has led to a devaluation of rupee and to the consequent hike of exchange rate, since India imports more goods and services than it exports. India's large current account deficit tends to put downward pressure on the currency. This is because more foreign currency is spent by the country for imports than is earned through its exports. On the other hand, countries with a strong export growth and current account surpluses have an appreciating currency and improved economic performance of the economy (De Grauwe, 1988; Jhingan, 2005).

Zerrin (2018) examined various macroeconomic variables and their relationship with exchange rate. The study concluded that domestic investment, money supply and trade openness increased the real effective exchange rate volatility. This study also pointed out that a rise in the FDI, output and government expenditures reduced the real effective exchange rate volatility. Mishra (2018) argued that, on the basis of ordinary regression analysis, GDP, total reserve and import have a significant impact on foreign exchange rate and exports; industrial production and inflation on the other hand did not have a significant impact on foreign exchange rate. Kotai (2013) assessed the empirical relationship between GDP and inflation concerning the exchange rate for the period 1990–2010. The result shows that there is a causal relationship between foreign exchange rate, GDP and inflation.

Twarowska and Kakol (2014) assessed the major causal elements of Poland's exchange rate against the Euro. The author argues that current account deficit and inflation rate are the most prominent factors that affect the exchange rate while other determinants of exchange rate are the prevalent interest rate in the economy and the government deficit.

Mirchandani (2013) studied various macroeconomic variables that lead to a variation in the foreign exchange rate. These factors were inflation, interest rate, current account deficit, and were found correlated with the variation in foreign exchange rate. Ramasamy and Abar (2015) examined the relationship of exchange rates of three different countries through selected macroeconomic variables using the bootstrapping technique. They described that psychological elements like investor confidence dominated economic variables in determining the exchange rates. Khera and Singh (2015) gives an idea about the effect of various macroeconomic factors affecting the exchange rate post globalization. This study proposed to reduce import and increase FDI to improve the exchange rate. Thus, it can be seen that the relationship between foreign capital flows and exchange rate remains open to debate.

Mohd. et al. (2016) studied the relationship of exports, interest rate and inflation on the exchange rate of selected ASEAN countries. They proposed that export played a vital role in the movement of exchange rate. Vidyavathi et al. (2016) evaluated the leading macroeconomic indicators that affected the exchange rate. They discovered an inverse relationship between GDP and exchange rate, inflation and exchange rate, interest rate and exchange rate, external debt and exchange rate and a weak positive relationship between FDI and exchange rate.

The empirical studies reviewed here have focused mainly on foreign portfolio investment despite FDI is a part of the foreign investment capital flows. The literature review shows that there are conflicting

results, with some finding a positive relationship while others a negative relationship between foreign investment and the macroeconomic variables in relation to exchange rate. This shows that there is a research gap that needs to be addressed. The exact impact of foreign investment on exchange rate can be analysed using econometric tools and techniques. Exchange rates are important because when the local currency has a higher value compared to other currencies, the goods sold in terms of other currencies are more affordable for the locals as they become cheaper (Goldberg & Kolstad, 1995). However, how exchange rates relate to foreign capital flows is still open to debate.

Significance of the Study

Exchange rate fluctuation and its effect on the volume of international trade has become an important subject for empirical investigation after the adoption of floating exchange rate in 1973. Globalisation has encouraged the management of foreign exchange, since so many macroeconomic factors are responsible for the variation in foreign exchange rates. Thus macroeconomic factors, which are responsible for the variation in foreign exchange rates, need to be studied.

We undertake such a study and it will be useful in determining the relationship between foreign capital and exchange rate and in understanding how foreign capital flows and exchange rate are related. We analyse the impact of the foreign investment, especially foreign portfolio investment, on the exchange rate in particular and examine the relationship between foreign portfolio investment and exchange rate index of the Indian rupee. The result can provide inputs for policies that can boost foreign investment in India's economy and for stabilising the value of exchange rate. Besides, it will also be beneficial for the regulators in implementing various measures from time to time to make sure that the foreign exchange market is stable.

Sources of Data

Most of the data are collected from the RBI data base, the *Handbook of Statistics on Indian Economy* and Indian securities market review among others. The monthly data collected for the study covers the period from 1995 to 2020. The independent variables for the study are foreign direct investment, foreign portfolio investment, the index of industrial production proxy for measuring growth rate, interest rate, inflation and import of the Indian economy. The dependent variable is exchange rate index (REER). EViews was used for the purposes of mathematical and statistical analysis.

Data Analysis

We use both descriptive and inferential statistics to analyse and evaluate the results. Descriptive statistics have been used to find out the structural properties of the data. Augmented Dicky Fuller (ADF) test is used for testing the stationary properties of the data. Akaike Information Criteria (AIC) is used to determine the optimum lag length of the model. Vector error correction model (VECM) is developed to find out the short-term dynamics and long-term coefficient of FPI on the exchange rate of India. The most important criteria of employing the VECM is that all variable must be non-stationary at level but stationary at their first difference I(1). The absence of standardised data related to foreign

Table 1. Correlation Matrix of Foreign Portfolio Investment and Exchange Rate

Particulars	FPI	REER
FPI	1.00	–0.070
REER	–0.070	1.00

Source: Authors' calculation.

investment and exchange rate might have limited the accuracy of the analysis in certain context especially in measuring the intensity of the impact of foreign investment on exchange rate volatility. Dependent and independent variables used here are a combination of absolute and relative forms of variables in this model. We mainly focus on the direction or relationship of foreign investment on exchange rate index in India.

Exchange rate volatility is the fluctuation in the rate of exchange of domestic currency with some other foreign currency. The depreciation of the Indian currency has become a serious concern for the country. Foreign exchange is one of the most important term used in any developed or developing countries to measure their economic health.

Foreign portfolio investment is negatively related to exchange rate index in India, which leads to the depreciation of rupee (Table 1; Figure 1). The Pearson correlation coefficient for foreign portfolio investment and exchange rate is significant at 5% with the coefficient of -0.07. It shows that FPI has a

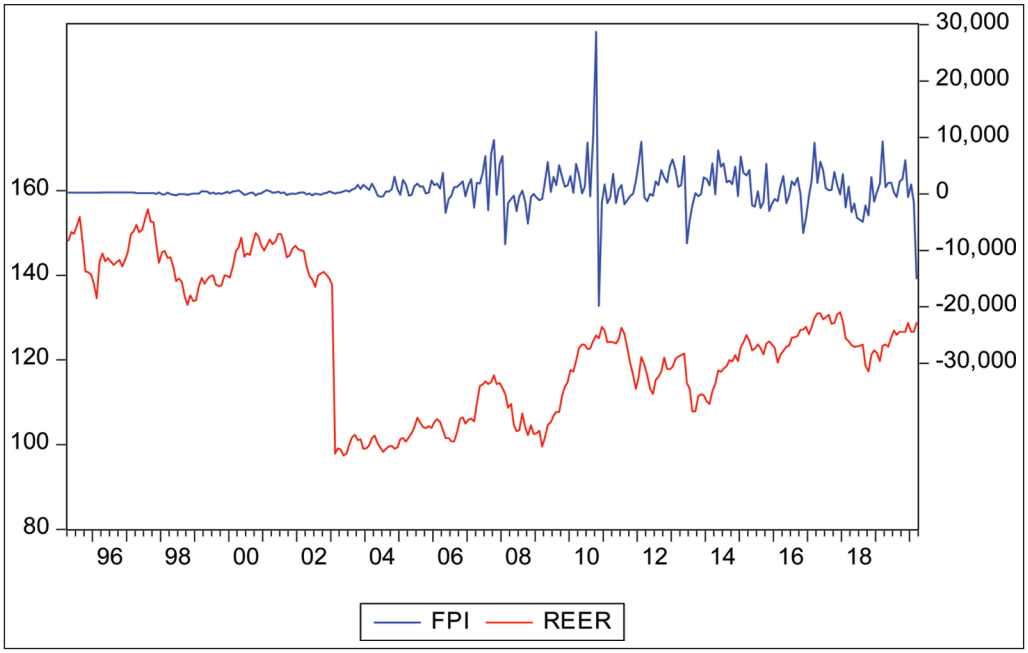

Figure 1. Foreign Portfolio Investment and Exchange Rate of Indian rupee

Source: Authors' compilation from RBI Database.

Table 2. Results of Descriptive Data Analysis

Variables	Obs	Mean	S.D	Skewness	Kurtosis	J-B coefficient	p-Value
FDI	300	1467	1534.30	1.23	4.08	83.26	0.001
FPI	300	920	3239.11	1.60	28.17	7407.91	0.001
WPI	300	120	41.45	0.31	1.67	25.71	0.001
IR	300	7.26	3.39	3.99	28.59	8265.26	0.001
IMP	300	18866	14475.9	0.308	1.493	30.468	0.001
IIP	300	123.96	47.35	0.074	1.495	26.33	0.001
REER	300	123.7	17.62	0.134	1.681	19.85	0.001

Source: Authors' calculation.

negative correlation with the exchange rate index, which means a depreciation of the exchange rate index. However, the exact impact of foreign investment on exchange rate in India can be analysed through the following econometric model and statistical test which confirms the positive relationship between foreign investment and exchange rate.

Exchange rate has two aspects: nominal effective exchange rate (NEER) and real effective exchange rate (REER). The indices of NEER and REER are used as indicators of external competitiveness. NEER is the weighted average of bilateral nominal exchange rates of the home currency in terms of foreign currencies. Conceptually, REER, defined as a weighted average of nominal exchange rates adjusted for the relative price differential between the local and foreign countries, relates to the PPP hypothesis. The NEER and REER indices show appreciation (index above 100) or depreciation (index below 100) of the national currency against a basket of selected currencies for a certain period relative to a base period. The indices of the REER of Indian rupee (six currency trade-based weights) with the base year 2004–2005 are taken in this study for the analysis.

Descriptive Analysis

Table 2 shows the mean, the standard deviation and other descriptive statistics of both dependent and independent variables for 1995 to 2020. The standard deviation for foreign portfolio investment is 3239.11, which is a little higher than the mean while that of REER is 17.02. Other independent variables include FDI, interest rate, inflation rate and import, whose mean values are 14677, 7.26,120 and 18866, respectively. The result for the standard deviation of the independent variables FPI, FDI, interest rate, inflation rate and import are 3239.11, 1534.30, 3.39, 41.45, and 14475.9, respectively. Jarque-Bera statistic is used to check the normality of the residuals. According to the test, a data series is considered to be normal if the probability value is more than 0.05. In this study, however, the probability value is found to be less than 0.05, which means that the used data series is not normal.

Empirical Model

$$REER = \alpha + \beta_1 LFPI + \beta_2 LFDI + \beta_3 LIIP + \beta_4 LIMP + \beta_5 LIR + \beta_1 LWPI + \epsilon$$

Table 3. Expected Relationship between Exchange Rate and its Linkage with Macroeconomic Variables in India

Dependent Variable	Independent Variables	Expected Relationship
REER	FDI	Positively related
	FPI	Positively related
	WPI	Negatively related
	IR	Positively related
	IIP	Positively related
	IMP	Negatively related

Source: Authors' Compilation.

Econometric Model

$$REER = \alpha + \beta_1 REER_{t-1} + \beta_1 REER_{t-2} + \beta_3 FPI_{t-1} + \beta_4 FPI_{t-2} + \beta_5 FDI_{t-1} + \beta_6 FDI_{t-2} + \beta_7 IIP_{t-1} + \beta_8 IIP_{t-2} + \beta_9 IMP_{t-1} + \beta_{10} IMP_{t-2} + \beta_{11} IR_{t-1} + \beta_{12} IR_{t-2} + \beta_{13} WPI_{t-1} + \beta_{14} WPI_{t-2} + \epsilon$$

for both of which,
REER = Real effective exchange rate
LFPI = Natural logarithm of foreign portfolio investment
LFDI = Natural logarithm of foreign direct investment
LIIP = Natural logarithm of index of industrial production
LIMP = Natural logarithm of import
LIR = Natural logarithm of interest rate
LWPI = Natural logarithm of wholesale price index
L = Natural logarithm
ε = Error term

Unit Root Test

It is necessary to test for the stationarity of the time series before proceeding to test the co-integration and long-term relationship in the model. The results of both ADF test and Phillips Peron (PP) test (Table 4) show that real effective exchange rate, foreign portfolio investment, foreign direct investment, index of industrial production, import, interest rate and wholesale price index are integrated of order one and the null hypothesis that the data series is not stationary is accepted at level but rejected at the first difference. In other words, these variables are stationary at the first difference or I(1).

Optimum Lag Length Selection Criteria

Table 5 presents the selection procedure for the optimum lag lengths of the model by using five criterions: Likelihood ratio (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ). It can be seen that

Table 4. Unit Root Test Results

Variables	Stationary
REER	I(1)
LFDI	I(1)
LFPI	I(1)
LIIP	I(1)
LIMP	I(1)
LWPI	I(1)
LIR	I(1)

Source: Authors' calculation.

Table 5. VAR Lag Order Selection Criteria for Exchange Rate and Macroeconomic Variables in India

Lag	LogL	LR	FPE	AIC	SC	HQ
0	–878.0469	NA	3.15e-06	7.195503	7.295248	7.235666
1	917.8533	3474.994	2.14e-12	–7.006937	–6.208975*	–6.685635
2	1043.736	236.4134	1.14e-12*	–7.631998*	–6.135819	–7.029556*
3	1086.603	78.06763*	1.21e-12	–7.58214	–5.387745	–6.698559
4	1121.192	61.02252	1.36e-12	–7.464976	–4.572365	–6.300256
5	1145.155	40.91216	1.68e-12	–7.261421	–3.670594	–5.815562
6	1172.020	44.33773	2.03e-12	–7.08146	–2.792416	–5.354461
7	1201.711	47.31335	2.41e-12	–6.924481	–1.93722	–4.916343
8	1238.477	56.49328	2.72e-12	–6.825013	–1.139536	–4.535736

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5%)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Authors' calculation.

the maximum lag length of the model is 8, and the optimum lag length is selected on the basis of the minimum value of each criterion. The result suggests that the optimal lag length is 2, based on AIC, FPE and HQ.

Johansen Cointegration Test

This test is mainly used for testing the long-term relationship or cointegration among exchange rate and macroeconomic variables for India. Johansen cointegration test uses two likelihood estimators, trace test and maximum eigenvalue test. The result shows that Johansen Test consist of three cointegrated equations and two cointegrated equations at 5% respectively. Therefore, there is a long-term relationship or cointegration between macroeconomic variables and REER in India.

Table 6. Johansen Cointegration Test for Exchange Rate and its linkage with Macroeconomic Variables in India

Trend assumption: Linear deterministic trend
Series: REER LFPI LFDI LIIP LIMP LIR LWPI
Lags interval (at the first difference): 1 to 2
Unrestricted cointegration rank test (trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.221313	190.3321	125.6154	0.0000
At most 1 *	0.175268	126.2948	95.75366	0.0001
At most 2 *	0.116444	76.96426	69.81889	0.0120
At most 3	0.086042	45.27126	47.85613	0.0857
At most 4	0.042753	22.23884	29.79707	0.2854
At most 5	0.028685	11.05313	15.49471	0.2083
At most 6	0.013973	3.602365	3.841466	0.0577

Trace test indicates three cointegrating *equations* at 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted cointegration rank test (maximum eigenvalue)

Hypothesised No. of CE(s)	Eigenvalue	Max Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.221313	64.03731	46.23142	0.0000
At most 1 *	0.175268	49.33051	40.07757	0.0001
At most 2	0.116444	31.69300	33.87687	0.0120
At most 3	0.086042	23.03242	27.58434	0.0857
At most 4	0.042753	11.18571	21.13162	0.2854
At most 5	0.028685	7.450770	14.26460	0.2083
At most 6	0.013973	3.602365	3.841466	0.0577

Max-eigenvalue test indicates two cointegrating equations at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Authors' calculation.

VECM Model: Exchange Rate and its linkage with Macroeconomic Variables in India

After the ADF and Johansen cointegration tests, it was observed that the variables are stationary at the first level and are cointegrated. For cointegrated data that exhibits a long-term relationship, it is not advisable to develop a VAR model but it is recommended to develop a vector error correction model. This model is used to test the long-run and short-term casualty of the dependent and independent variables. We have the exchange rate as a dependent variable while FDI, FPI, IIP, IR, WPI and import are independent variables. After running the VECM is used to test the long-term association among the variables which shows that the coefficient (C1) is negative and significant. For the long-term relationship, the coefficient should be negative and the p-value less than 5% significant.

Table 7. Normalised Co-integrating Coefficients (Long-term Coefficient) of Exchange Rate and Macroeconomic Variables in India

REER	LFPI	LFDI	LIIP	LIMP	LIR	LWPI
1.000000	–193.379 (30.3892)	–31.5774 (4.78192)	–37.3473 (44.2674)	81.23946 (13.9679)	–17.8396 (6.74691)	–47.3748 (32.5848)

Source: Authors' calculation.
Note: Standard error is in the parentheses.

Normalised Cointegrating Coefficients (Long-term Coefficient)

The normalised cointegration coefficients are presented in Table 7, which reveals that FDI, FPI, IIP, IR and WPI have a positive impact on exchange rate in the long run, which means the Indian rupee is appreciated. On the other hand, import have a negative impact on the exchange rate in India in the long run, which means Indian rupee is depreciated.

Table 7 shows the normalised cointegration coefficient of exchange rate and macroeconomic variables in India. The estimated equation by cointegration is given in Equation (1). The signs of the normalised cointegrating coefficients are reversed to enable proper interpretation.

Cointegration Equation (VECM Estimated Model)

$$NEER = 193.37LFPI + 31.57\ LFDI + 37.34\ LIIP + 17.83\ LIR + 47.37LWPI - 81.23LIMP \quad (1)$$

We notice from equation (1) and Table 8 that foreign investment has a positive relationship with the exchange rate in India, that is, there is a positive correlation between foreign investment and exchange rate index in India. It may be concluded that foreign investment could stabilise the exchange rate and produce a positive impact on the Indian economy. With the increase in foreign investment every year, the value of Indian currency appreciates against the dollar. A high value of Indian currency may negatively impact Indian exports and bring low foreign investments whereas a low value of the currency may have a negative impact on the current account and fiscal deficit. So, the government and the central bank could focus on balancing both factors while implementing various policies, especially the monetary policy.

The coefficient of the interest rate indicates a positive and statistically significant influence on exchange rate in the long run in India. High interest rates indicate that a country's currency is more valuable. From a foreign investor's perspective, saving or investing in that country is more likely to yield

Table 8. VECM Result of Exchange Rate and its Linkage with Macroeconomic Variables in India

Dependent Variable	Independent Variables	Actual Relationship
REER	FDI	Positively related
	FPI	Positively related
	WPI	Positively related
	IR	Positively related
	IIP	Positively related
	IMP	Negatively related

Source: Authors' calculation.

better returns. This would increase the demand for that country's currency. To take advantage of the high rates offered, investors would move their funds in that country.

When the demand for a currency goes up vis-à-vis another currency (or currencies), it is said to have strengthened or appreciated. When a country's interest rates are low, its currency is considered less attractive, so its demand in the foreign exchange markets falls. This leads to its depreciation and results in a weak exchange rate vis-à-vis other stronger currencies. The increase in interest rate strengthens the value of the local currency through high inflow of investment and minimisation of the outflow of investment by the residents of the country.

Inflation has a positive and statistically significant effect on the exchange rate. India has consistently lower inflation rate that leads to appreciation of Indian currency. In addition, IIP as a proxy for measuring the economic growth has a positive significant impact on the exchange rate. On the other hand, the coefficient of import indicates the negative and significant influence on exchange rate in the long run. That means depreciation of Indian rupee. High fiscal deficit can be regarded as other reasons of the depreciation in the Indian currency in compare to other currencies.

VECM Estimated Model

$$D(REER) = C(1)*(REER(-1) - 193.37*LFPI(-1) - 31.57*LFDI(-1) - 37.34*LIIP(-1) + 81.23*LIMP(-1) - 17.83*LIR(-1) - 47.37*LWPI(-1) + 1674.31) + C(2)*D(REER(-1)) + C(3)*D(REER(-2)) + C(4)*D(LFPI(-1)) + C(5)*D(LFPI(-2)) + C(6)*D(LFDI(-1)) + C(7)*D(LFDI(-2)) + C(8)*D(LIIP(-1)) + C(9)*D(LIIP(-2)) + C(10)*D(LIMP(-1)) + C(11)*D(LIMP(-2)) + C(12)*D(LIR(-1)) + C(13)*D(LIR(-2)) + C(14)*D(LWPI(-1)) + C(15)*D(LWPI(-2)) + C(16).$$

Table 9. Estimates of Error Correction Term for Exchange Rate

Coefficient		Std. Error	t-Statistic	Prob.
C(1)	–0.03004	0.011104	–2.70492	0.0069
C(2)	0.087322	0.065521	1.332722	0.1828
C(3)	–0.0176	0.067322	–0.26145	0.7938
C(4)	–3.37137	2.110143	–1.5977	0.1103
C(5)	–1.20335	1.732051	–0.69475	0.4873
C(6)	–0.79838	0.441351	–1.80895	0.0706
C(7)	–0.3224	0.403322	–0.79937	0.4242
C(8)	1.677165	5.258674	0.318933	0.7498
C(9)	–0.1845	5.410721	–0.0341	0.9728
C(10)	–2.84144	2.60406	–1.09116	0.2754
C(11)	–1.13481	2.51934	–0.45044	0.6525
C(12)	0.603965	0.758962	0.795777	0.4263
C(13)	0.688024	0.745296	0.923156	0.3561
C(14)	15.05805	38.06021	0.395638	0.6924
C(15)	18.34567	40.09612	0.457542	0.6473
C(16)	–0.15792	0.27525	–0.57372	0.5662

Estimation Method: Least squares
Total system (unbalanced) observations: 1799

Source: Authors' calculation.

Table 10. Variance Decomposition Analysis of REER

Period	S.E.	REER	LFPI	LFDI	LIIP	LIMP	LIR	LWPI
1	3.256385	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	4.759166	98.53548	0.254697	0.010670	0.033102	0.687863	0.434347	0.043842
3	5.891724	96.53366	0.844998	0.186547	0.068696	1.103312	1.191826	0.070964
4	6.837006	94.84138	1.571725	0.444924	0.104260	1.550004	1.420758	0.066951
5	7.684091	93.51310	2.056851	0.660507	0.165703	1.952287	1.598037	0.053518
6	8.466721	92.45758	2.421044	0.829649	0.207853	2.264142	1.761467	0.058260
7	9.192823	91.62903	2.715819	0.949854	0.242105	2.516747	1.874473	0.071969
8	9.867870	90.98530	2.923418	1.042288	0.274693	2.727822	1.955424	0.091055
9	10.50146	90.47967	3.080443	1.113266	0.299297	2.897504	2.017816	0.112005
10	11.10084	90.07603	3.207741	1.167873	0.318973	3.031999	2.066428	0.130951

Source: Authors' calculation.

Table 9 presents the results of error correction mechanism (ECM). The purpose of ECM is to indicate the speed of adjustment from the short-term equilibrium to the long-term equilibrium state. If the error correction term or C (1) is negatively signed and significant, it indicates that the speed of adjustment between the two equilibria is at the rate of 3%. As this study has a coefficient of -0.03003. Its sign shows a 3% speed of adjustment, which is significant at 1% level. Finally, it is postulated that if there is an exogenous shock, it will make 3% adjustment per month to reach the long-term equilibrium. This indicate that there is a long-term causal relationship between exchange rate and macroeconomic variables in India.

Variance Decomposition Analysis

Variance decomposition refers to the breakdown of the forecast error variance for a specific time horizon. As the result shows, in the long run (after 10 months), exchange rate explains 90% of its own innovative shocks or effects and the remaining 10% change is explained by other determinants of exchange rate in India (Table 10). Explanatory variables like FPI, FDI, WPI, IIP, IR and import explain 3.2%, 1.16%, 0.13%, 0.31%, 2.06% and 3.03%, respectively. In short FPI and import are the main factors influencing the fluctuation of exchange rate in India.

Figure 2 shows that the VECM satisfies the stability condition, since no root lies outside the unit circle. The points in the graph (Figure 2) are the inverse roots of the VECM. Autoregressive (AR) polynomial has the modulus less than one and lie inside the unit circle. Therefore, the estimated VECM model is stable.

Scope for Further Research

Future researchers should try to cover a longer duration of more than 25 years with different variables like external debt, crude oil price, capital flows, gross domestic product, etc. The present study can be extended for other currencies of both developing and developed economies. Furthermore, future research can provide better insight into the dependent variable that is, exchange rate index considering structural break, for instance, during the subprime crisis (2008), which is expected to offer a better insight into the dependent variable that is, exchange rate index.

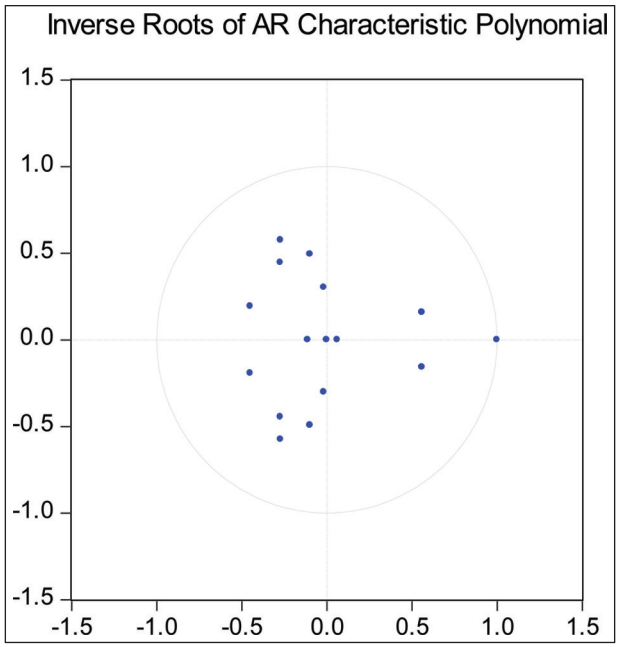

Figure 2: Autoregressive (AR) polynomial

Source: Authors' calculation.

Conclusion

The Indian financial markets have undergone remarkable changes in the last 15 years. With the contribution of FPI, Indian markets have become more efficient and competitive and this has brought a positive impact on the country's economic development. By reviewing the major economic indicators, it can be realised that FPI plays a significant role in the financial stability of the country. This research examined the relationship between foreign portfolio investment and exchange rate using a VECM model. A high foreign investment in India leads to appreciation of the rupee, which leads to increase (appreciation) in exchange rate and vice versa. Large capital inflow through foreign investment witnesses an appreciation in the local currency as its demand rises. When foreign investors want to convert their currency into a local currency, the latter's increases and it will appreciate. When the demand for the local currency increases, foreign investors have to pay more in their currency in order to buy the local currency. This increased demand for Indian rupee results in an increase in its value. For every dollar investors bring into the country, a demand for rupee is created and RBI has to print or release the money in the country. Since the foreign investments create a demand for rupee, it will appreciate. Thus, foreign investment in India leads to the appreciation of the rupee.

It may be concluded that foreign investment could stabilise the exchange rate and produce a positive impact on the Indian economy. Exchange rate is essential for the policymakers, investors, business personnel, common man and other players in the foreign exchange market. The instability of exchange rate greatly affects the decision making of the stakeholders in the foreign exchange market and all the economic activities for business transactions.

The findings of the study would aid economists and policymakers to take effective monetary and regulatory measures to curb high volatility in the exchange rate in future and to maintain the macroeconomic stability and healthy environment in the economy.

Policy Implications

It is well-known that exchange rate and inflow of foreign portfolio investment are positively correlated. A high value of Indian currency may negatively impact the Indian exports and low foreign investment whereas low value of the currency may have negative impact on the overall current account and fiscal deficit. So, the fiscal and monetary authorities should focus on balancing both the factors while making the policies. Fiscal policy and monetary policy should be made with the consideration of their effects on the exchange rate variability. Foreign trade and openness of the economy should be increased to bring prosperity in the country. The authorities should intervene to make exchange rate stable whenever there is high variability. Policymakers must consider the exchange rate variability before making policies that affect the exchange rate. The flow of foreign investments into India impacts the exchange rate to appreciate as they are positively related. So, the government and regulatory bodies should take initiatives that encourage and increase foreign investments into India. Policies for economic reforms can be considered by economists and policymakers to control the exchange rate fluctuations and to maintain economic stability in the country. In addition, policymakers should control the import of non-essential items to lower the import bills for reducing the trade deficit.

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