

Analysis of India's Exchange Rate Under the New Economic Policy Regime

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Abstract

Exchange rate is a very important financial variable as it affects the decisions that are made by the foreign exchange investors, exporters, importers, bankers, financial institutions, business and policy makers in the developed and the developing countries. Exchange rate movement affects trade and capital flows. It is also important to understand the financial development and changes in economic policy. The study deals with analyzing the exchange rate behavior during the post reform period. The time period of the study is from April 1, 1994 to March 31, 2012. It looks into the major determinants of India's exchange rate in the long run. The findings from the study are that the exchange rate has been stable with the intermitted period of fluctuations. Exchange rate is determined by economic fundamentals such as the Economic Activity, Inflation, Bombay Stock Exchange Sensex, Rate of Interest, and Trade Deficit. The most significant variables are Bombay Stock Exchange Sensex and Interest Rate.

Keywords: exchange rate, economic fundamentals, econometric modeling, VAR model

JEL Classification: F31, C51, C52

Paper Submission Date : May 8, 2013 ; Paper sent back for Revision : June 24, 2013 ; Paper Acceptance Date : August 18, 2013
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An exchange rate is the value of a unit of foreign currency with respect to the home currency. It plays a very important role in the economy. The exchange rate movement also plays a very vital role in the insinuation of the trade in the economy and the capital flows. Thus, it is essential in comprehension of the financial developments and the modifications in the economic policies. It also has an effect on the judgments made by the financial institution investors (FII) and the people who make the policies for the economy. It also affects the judgments of the importers, banks, exporters, and individual businesses.

Exchange rate movements are either long and medium term or short term, that is, for very shot durations. The long-term variables are more associated with the balance of alterations. They are inflation, growth, interest rate, trade deficit, and some financial variables. The short-term variables are associated with a very short-term duration, which causes sudden changes. These sudden changes are because of the change in the policies with respect to the instability in the foreign exchange market or because of global announcements.

There are many critical factors which go into the determination of the exchange rate movements and some of them are inflation, index of industrial production, and so forth. One of the important functions of the RBI is to manage the exchange rate volatility so that it does not affect the long-run performance of the exchange rate. The aim of the RBI in exchange rate management is to reduce the volatility mirror along with managing solid economic fundamentals, to ensure that price steadiness is preserved, and to have a sufficient level of foreign exchange reserves.

India's Exchange Rate Developments

Currently, India's exchange rate regime can best be stated as an intermediate between freely floating and managed regimes. Before 1990, India followed a pegged exchange rate. It was controlled with restraints on transactions and on the use of instruments. From 1990 onwards, India experienced a lot of changes in the regulatory and institutional reforms. These changes resulted in a great development in the US \$/ Rupee exchange market. Today, the market accomplices have got a great deal of knowledge for managing the instruments of various currencies and also exchange rate risk.

Due to the balance of payment crisis in 1991, currency improvement methods were taken in tally with other structural reforms. A sharp decline of the exchange rate change, that is, 18% was taken on by the Reserve Bank of

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India (RBI) in two stages - that is on July 1 and July 3, 1991. This led to many fundamental changes in the exchange rate, which were suggested by the high level committee on balance of payments. This was pursued by opening of the Liberalized Exchange Rate Management System (LERMS) in March 1992. Furthermore, it also led to the implementation of a dual exchange rate system in India for the first time. By following the dual exchange rate system, it led to 11% depreciation of the transactions in the market, but it forced a tax on exports and remittances. According to Pyne and Roy (2008) :

Consequently, downward pressures had been building up and a regime change was overdue. Subsequently, in March 1993, the dual exchange rate system gave way to a unified exchange rate system, which along with removal of exchange restriction on imports through the abolition of foreign exchange budgeting are the initial steps towards current account convertibility. (p.12)

The last steps taken for the current account convertibility were taken in August 1994. This was done by broadening the liberalization of the invisible transactions and exchange control regulation. Thereafter, the exchange value was obtained by demand and supply of foreign exchange in the market. On the other hand, the RBI kept on overruling in order to contain volatility and affect the currency value. Up to mid-1997, the rupee showed an equitable stability. Thereafter, the Indian rupee experienced a minor attack from the East Asian currency crisis. The RBI in 1998 focused on exchange rate management to focus on levelling extreme volatility in the exchange rate and to retain systematic market conditions. During recent times, the rupee with respect to the dollar has depreciated except during the period from 2003 to 2005, and during 2007- 2008, when it appreciated. An important characteristic has been that there has been a decrease in the volatility in the exchange rate in the last few years. However, under the new policy of liberalization, there were many changes such as removal of the quota system, reduction of tariff rates, and liberalized foreign exchange allocation supporting capital inflows. This led to globalization in India. Due to these policies, there has been a large amount of inflow of foreign capital. There was an increase in the monetary base because the RBI was forced to intercede so that volatility remains low and that the exports enjoy a viable gain.

Review of Literature

Hutchison, Sengupta, and Singh (2010) investigated whether the discretionary and flexible approach of the Reserve Bank of India can be described by a Taylor-type rule. They estimated an exchange-rate-augmented Taylor rule for India over the period Quarter 1 of 1980 to Quarter 4 of 2008. They further investigated the monetary policy changes between the pre- and post-liberalization periods in order to capture the potential impact of macroeconomic structural changes on RBI's monetary policy conduct. Overall, the paper emphasized that the output gap seems to matter more to RBI than inflation. Goyal (2010) examined options for monetary policy arising from interactions between it and the Indian foreign exchange (FX) markets. Hourly, daily, and monthly data sets for FX markets and policy variables were used to empirically test (i) whether FX market intervention is able to influence levels, returns, and volatility, (ii) the influence of microstructure variables, (iii) whether markets anticipate policy, and (iv) the slope of the speculative market demand curve.

Aizenman and Crichton (2007) evaluated the impact of international reserves; terms of trade shocks and capital flows on the real exchange rate (REER). It was observed that international reserves cushion the impact of TOT shocks on the REER, and that this effect is important for developing but not for industrial countries. Reddy and Sebastin (2008) looked into the interactions between the foreign exchange market and the stock market of a country, as they are considered to be an important internal force of the markets in a financially liberalized environment. Dua and Ranjan (2011) made a thorough analysis of India's exchange rate story and discussed the structure of the foreign exchange market in India. They found that the exchange rate is one of the key indicators that affects the decision made by foreign exchange investors, exporters, importers, bankers, businesses, financial institutions, and policy makers in the developed as well as in the developing countries. They found that exchange rate fluctuations affect the value of international reserves, currency value of debt payments, and a cost to tourists in terms of the value of their currencies. Their study covered two main topics - namely, the various aspects of economic policy with respect to exchange rate and second, modelling and forecasting exchange rate.

Goyal (2010) also studied the causes of rupee appreciation and depreciation of the Indian exchange rate during the

time period from 1993-2004. He opined that the immediate cause for the exchange rate volatility in April 2004 was due to weakness in the dollar and large FII inflows due to IPOs of public sector units. Kar and Sarkar (2009) applied modern econometric methods to systematically determine the breakpoints in nominal rupee/US dollar exchange rate series. They used an adequate modelling exercise, incorporating ARCH/GARCH to study the predictability of returns of Indian Rupee/US Dollar exchange rate with due consideration to possible sources of misspecification of conditional mean, that is, serial correlation, seasonal effects, parameter instability, omitted time series variables, and any other remaining nonlinear dependences. Unnikrishnan and Mohan (2001) based on monthly data from January 1996 to March 2002 on exchange rate, net purchase by the Reserve Bank of India, data on open market operations in the debt market, and nominal effective exchange rate (NEER) developed a generalized autoregressive conditional heteroskedastic (GARCH) model for USD/INR exchange rate. Major conclusions of the paper were: **(i)** central bank intervention reduces volatility in the market; **(ii)** open market operations in the debt market in case of sterilized intervention reduces volatility in exchange rate and, **(iii)** NEER plays a dominant role on return and volatility. Besides, the results indicated that USD/INR exchange rate and NEER are co-integrated.

Results and Discussion

The objective of this section is to identify the exchange rate determination. The applied econometric methodology was used to guarantee a rigorous analysis. The data on Exchange Rate (EXR), Index Industrial Production (IIP), Foreign Exchange Reserves (FER), Bombay Stock Exchange (BSE), Trade Deficit (TD), Rate of Interest (ROI) and Wholesale Price Index (WPI) was taken from the Handbook of Statistics on Indian economy published by the RBI.

➤ **Unit Root Test:** To avoid spurious results, it is necessary to check the time series data for stationarity using unit root tests. Keeping this in mind, the unit root test had been carried out for each series in log form with the help of augmented Dickey Fuller test. The results of this test are presented below in the Table 1.

Table 1 : Unit Root Test with Trend and Intercept			
Variable	Level	1st Difference	Inference
TD	-4.704728	-----	Stationary at I(0)
LNROI	-6.503747	-19.34260	Stationary at I(1)
LNIIIP	-4.464436	-25.17648	Stationary at I(1)
LNBSE	-2.091846	-13.96497	Stationary at I(1)
LNEXR	-1.774328	-10.62750	Stationary at I(1)
LNWPI	-0.929292	-11.29372	Stationary at I(1)
LNFER	-2.755712	-20.49001	Stationary at I(1)
Critical values: 1%: -4.10, 5%: -3.48, 10%: -3.16			
Source: Based on authors' calculation			
The variables used in the analysis are Exchange Rate (LNEXR), Index of Industrial Production (LNIIIP), Foreign Exchange Reserves (LNFER), Bombay Stock Exchange (LNBSE), Rate of Interest (LNROI), Wholesale Price Index (LNWPI), and Trade Deficit (TD). For all the variables, we have taken the log form so that we could calculate the elasticities.			

If the variables are not stationary at level $I(0)$, we then take the difference and test it. The same process is carried on if the variables are not stationary at 1st difference, then we take the 2nd difference. The stationarity of the variable is identified by comparing the calculated value and the critical value. If the calculated value is greater than the critical value, we reject the null hypothesis and accept the alternative hypothesis. Here, the null hypothesis is the variable has a unit root. Except for Trade Deficit (TD), all the other variables were stationary at first difference.

➤ **Economic Relations:** The purpose of the study is to identify the major exchange rate determinants. Also, the study

aimed to identify whether the existing exchange rate - the managed exchange rate is a better exchange rate regime than a fixed or floating rate. This relationship can be found in the following equation.

➤ **Determinants of Exchange Rate:**

$$\text{Exchange rate} = f(\text{IIP}, \text{BSE}, \text{ROI}, \text{TD}, \text{FER}, \text{INF})$$

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Following are the results of the estimated equation:

$$\begin{aligned} D(\text{LNEXR}) = & 0.0019 - 0.0289 * D(\text{LN IIP}(-1)) + 0.0973 * D(\text{LNWPI}(-2)) \\ & (2.012) \quad (-2.25) \quad (1.01) \\ & - 0.0005 * D(\text{LNROI}(-1)) + (0.006 * \text{TD}(-3)) - 0.0197 * D(\text{LNFER}(-2)) \\ & (-3.04) \quad (1.40) \quad (-2.29) \\ & - 0.0501 * D(\text{LNBSE}) + 0.0436 \text{DUM} \\ & (-6.07) \end{aligned}$$

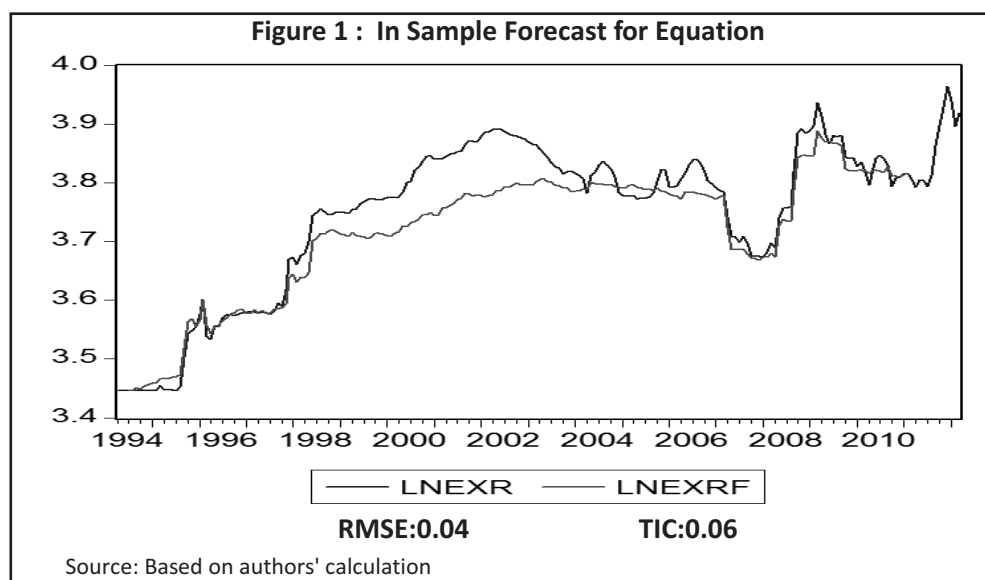
$$\text{ADJR}^2 = 0.678$$

$$\text{D-W stat} = 1.64$$

$$\text{F-Stat} = 57.78$$

Here, the dependent variable is the Exchange Rate (LNEXR), and the independent variables are Index of Industrial Production (LN IIP), Wholesale Price Index (LNWPI), Rate of Interest (LNROI), Trade Deficit (TD), Foreign Exchange Reserves (LNFER), and BSE Sensex (LNBSE). The analysis shows there is a substantial relationship between the dependent and the independent variables. Around 70% of the variation in the spread is being accounted for data regressors. The six instructive variables are important to explain the exchange rate. All the explanatory variables are behaving according to the theory. There is not much problem of auto correlation. This is proved by the Durbin – Watson statistic. Here, the D – W statistic is 1.64. The model is a good one based on the f statistic as it shows a value of 57.78.

From the results, it can be understood that BSE, ROI, IIP and FER are the important factors in determining the exchange rate. This is proved by the t - statistic, which is mentioned below every variable. These variables except BSE share a lag connection with the nominal exchange rate. From the analysis, it can be seen that by introducing a lag of one month, it gives a more substantial change in the economic activity than the current level of economic activity. It can be seen that a % change in BSE and ROI leads to 0.61% and 0.30% change in the Exchange Rate. The BSE has no lag and ,therefore, has an immediate effect on the Exchange Rate as it is the most important variable. Therefore, this implies that the higher the BSE, the more will be the capital flows into the country and thus, it will lead to appreciation in the exchange rate and this shows an inverse connection between the variables. Whereas, the ROI has a lag of 1



month and ,therefore, it will have an effect on the exchange rate after a month. On the other side, a % change in the IIP and FER will lead to roughly 0.23% change (of each of the variables) on the Exchange Rate. The IIP has a lag of 1 month and ,therefore, it will affect the exchange rate after a month, whereas the FER has a lag of 2 months and ,therefore, it will affect the exchange rate after two months. We also have a dummy variable, which accounts to capture the unexpected behaviour in the variable. Some of the periods were 1996-2 because of speculative activity, 1997-3 due to the Asian crisis, 1998-5 due to the Kargil war, 2000-9 due to the terrorist attack on the World Trade Center, New York, and so forth.

Two important statistics of prediction are the root mean square error (RMSE) and the Theil inequality coefficient (TIC).The analysis shows a RMSE of 0.045. It means that the forecast capability is good. The TIC should be between 0-1, and it tells about the predictive performance of the model. Here, the TIC (0.006) is close to zero. It means that the forecasted series is close to the actual series. The Figure 1 shows the actual and the estimated model. In order to see whether the constraints of the model are steady transversely of the other sub variables, the stability test was done.

Table 2 : Dynamics of Interdependence						
	D(LNIIP)	D(ROI)	D(LNBSE)	D(LNWPI)	TD	D(LNFER) D(LNEXR)
D(LNIIP)	1,2,4,5,6,7,8,10	3,7,9,10	4	4,8		6
D(LNROI)	3,4	1,2,3,4,7		5	1,3,10	1,5,6
D(LNBSE)	1,7	1,3,10		6,9	8	1,4,5
D(LNWPI)			7	1,9	1	1,6
TD		1,2,3,4,5,6			1,2,4,6,8,9,10	1 1,3,4,7,9
D(LNFER)	4,7,8	10			4,5	1,2,3 8
D(LNEXR)		1,3,6,8	1,5	1		1,2 1,5,7,8

Source: Based on authors' calculation

Here, all the variables are dependent variables, and the variables with lags are independent variables. The variables are Exchange Rate (LNEXR), Index of Industrial Production (LNIIP), Wholesale Price Index (LNWPI), Rate of Interest (LNROI), Trade Deficit (TD), Foreign Exchange Reserves (LNFER) and BSE Sensex (LNBSE).

➤ **VAR (Vector Auto Regression)** : The Table 2 explains how each variable is influenced by itself and by the other variables. The variable IIP is influenced by the lags 1, 2, 4, 5, 6, 7, 8, 10 of the same variable, whereas IIP is influenced by the lags 3 and 4 of ROI. The variable IIP is influenced by the lags 1, 7 of BSE. None of the lags of TD, WPI, and EXR have an influence on IIP. The variable ROI is influenced by the lags 3, 7, 9, 10 of IIP. ROI is influenced by the lags 1, 2, 3, 4, 7 of the same variable, whereas ROI is influenced by the lags 1,3,10 of BSE. The variable ROI is influenced by the lags 1, 2, 3, 4, 5, 6 of TD, whereas it is influenced by the lag 10 of FER. The variable is also influenced by the lags 1,3,6,8 of EXR. The only place the variable is not influenced is with the variable WPI. The variable BSE is not influenced by the lags of the variables ROI, TD, and FER. The variable BSE is also not influenced by the same variable. But the BSE is influenced by the lag 4 in case of the variable IIP, lag 7 in case of WPI and lags 1,5 of EXR.

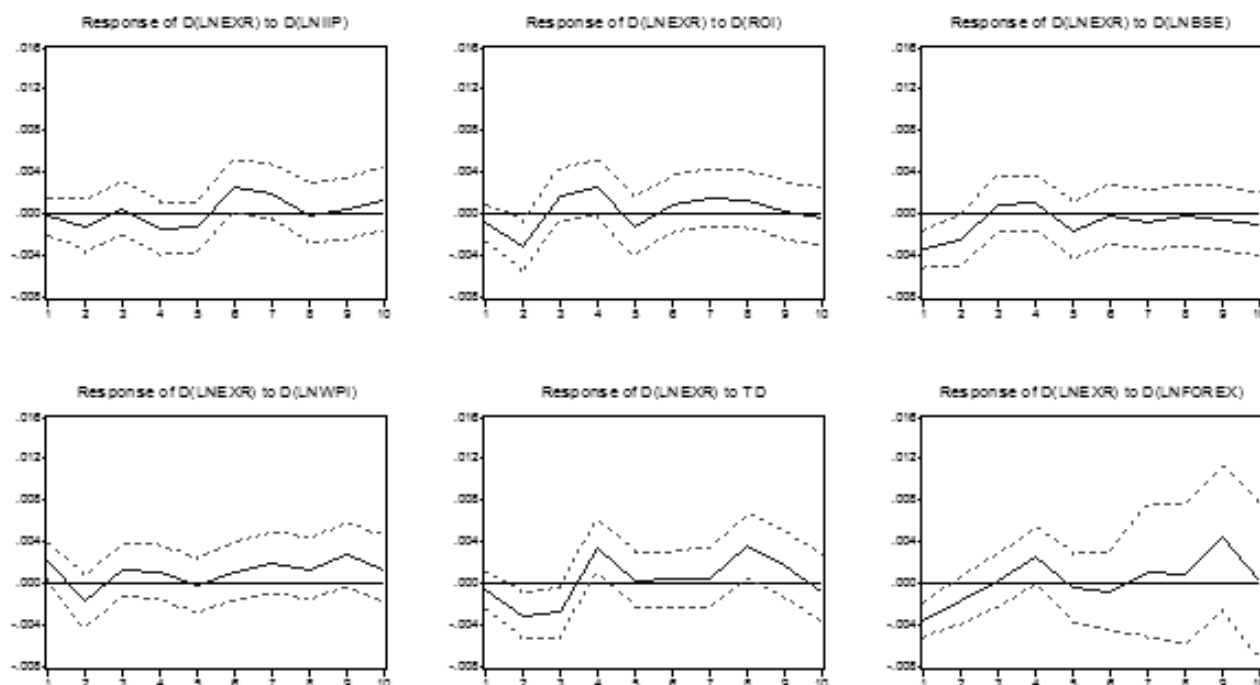
The variable WPI is influenced by the lags 4,8 of the variable IIP, lag 5 of the variable ROI, lags 6,9 of BSE, lags 1,9 of WPI, and lag 1 of the variable EXR. The variable WPI is not affected by the lags of TD and FER. The variable TD is influenced by the lags 1,3,10 of ROI, lags 8 of BSE, lag 1 of WPI, lags 1,2,4,6,8,9,10 of the same variable, and lags 4,5 of FER. The variable TD is not affected by the lags of the variables IIP and EXR. The variable FER is not affected by the lags of the variables IIP, ROI, BSE, and WPI. But the variable FER is effected by lag 1 of the variable TD, lags 1,2,3 of the same variable, and lags 1,2 of the variable EXR. The variable EXR is affected by lags 6 of the variable IIP, lags 1,5,6 of the variable ROI, lags 1,4,5 of the variable BSE, lags 1,6 of the variable WPI, lags 1,3,4,7,9 of the variable TD, lags 8 of the variable FER, and lags 1,5,7,8 of the same variable.

➤ **Impulse Response Function:** The impulse response analysis gives the i^{th} period response when the system is given a shock of one standard deviation. A shock given to variable X will affect the X^{th} variable directly. But this shock will also be channelled to the other independent variables. The function traces the response to 1 standard deviation shock

+/- 2 standard errors on both current and future values of the endogenous variable. With respect to the responses of exchange rate r to the Index of Industrial Production (IIP), the theory states that as the IIP of a country increases, the exchange rate appreciates. Therefore, IIP has an inverse relationship with the variable EXR. In the response of exchange rate to Cholesky one standard deviation of the Index of Industrial Production, when a positive shock was given to IIP, it was observed that it affected the exchange rate instantaneously. As observed from the Figure 2, we can say that the exchange rate fitters out in the future periods.

Figure 2: Exchange Rate Response to Shocks given to Various Variables

Response to Cholesky One S.D. Innovations $\pm$ 2 S.E.



Source: Based on authors' calculation

With respect to Exchange Rate (EXR) and Rate of Interest (ROI), as the ROI of a country increases, the exchange rate appreciates due to greater inflows of foreign capital to obtain higher returns. Therefore, ROI has an inverse relationship with EXR. Thus, when a positive shock was given to ROI, it was observed that it affected the exchange rate instantaneously. It can be observed from the Figure 2 that the fluctuations over the period are getting minimized and thereafter, fitter out in the future period. As per the Figure 2, with respect to the Exchange Rate and BSE Sensex (BSE), as the sensex of a country increases, the Exchange Rate appreciates as investors get better return on their investment. Therefore, the Sensex has an inverse relationship with the EXR. Regarding the response of the Exchange Rate to BSE Sensex - when a positive shock was given to the BSE Sensex - it was observed that the Exchange Rate is affected by four lag periods. In response to Exchange Rate (EXR) to Wholesale Price Index (WPI), if the WPI of a country increases, the Exchange Rate must depreciate as it causes the exports to become costly and imports become cheap. Therefore, WPI has a positive relationship with the EXR. Regarding the response of Exchange Rate to Cholesky one standard deviation of the WPI, when a positive shock was given to WPI, it was observed that Exchange Rate is affected by one lag period and thereafter, it appreciates.

With respect to the Exchange Rate (EXR) to Trade Deficit (TD), as the TD of an economy increases, the Exchange Rate depreciates. Therefore, TD has a positive relationship with EXR. With reference to Exchange Rate and Trade Deficit, when a positive shock was given to TD, it was observed that it takes a lag of three periods to cause an impact on the exchange rate. Thus, here, the Exchange Rate should have depreciated if the Trade Deficit increases, but rather,

Exchange Rate appreciated, and it later took three lag periods to actually revert to depreciation. This phenomenon is technically known as the J curve effect. With respect to the response of Exchange Rate (EXR) to Foreign Exchange Reserves (FER), the theory states that as the Forex of a country increases, the Exchange Rate appreciates because it brings in more confidence for the central bank to intervene in the forex reserves market. Therefore, FER has an inverse relationship with EXR. With regard to the response of Exchange Rate to Cholesky one standard deviation of the Foreign Exchange Reserves, when a positive shock was given to FER, it was observed that it took a lag of four periods to fall in line with the economic theory. In the Figure 2, EXR fitters out in the future periods.

Summary and Conclusion

The present study has made an endeavor to practically examine the important areas concerning India's exchange rate performance. This study also gives a picture of the major factors that affect the exchange rate determination. From the early 1990s, there have been many exchange rate developments. In the year 1991, the Indian rupee depreciated by 17%-18% with respect to the sterling, and with respect to the dollar, the rupee depreciated by 20%. In 1992, the Indian exchange rate management shifted towards a liberalized exchange rate management. It was in this year that the dollar became the intervening currency. In the following year, the reserves grew due to the large inflows and also the market related exchange rate was introduced. In 1997, due to the Asian crisis, the exchange rate depreciated and was followed by further depreciation in 1998 due to the Kargil war. There was a sudden depreciation in the exchange rate late in the year 2001 due to the terrorist attack on the World Trade Center. By then, the rupee with respect to the dollar traded at 47.1/\$. Since the foreign exchange market was driven by the rising global oil prices, it led to the rise in the interest rates in US in 2004, and it was during this year that the rupee hit a low of 45.3/\$. The rupee depreciated due to the recession in the US. Thereafter, the rupee has depreciated to all low of 55.45/\$ in 2012, and to an all time low of 68.85/\$ in August this year (2013).

The Indian economy has improved from 1991 onwards. The speculation in the exchange rate many a times is caused by external problems. In the equation of the econometric analysis, it was observed that the BSE Sensex was the most significant variable. It impacted the exchange rate the most. Therefore, it implies that there are a lot opportunities for capital inflow from other countries as they would get better returns on their investment. The greater is the capital inflow, it will lead to appreciation in the exchange rate. Furthermore, it has been observed in the present study that the BSE Sensex (BSE), Rate of Interest (ROI), Index of Industrial Production (IIP), and Foreign Exchange Reserves (FER) are the important factors in determining the Exchange Rate. From the analysis, it can be seen that introducing a lag of one month gives a substantial change in the economic activity (from the current level of economic activity). It was observed that a % change in the BSE Sensex and Rate of Interest leads to 0.61% and 0.30% change in the Exchange Rate. The BSE Sensex has no lag and ,therefore, has an immediate effect on the exchange rate as it is the most important variable. Therefore, this implies that the higher is the BSE Sensex, the more will be the capital flows into the country, and thus, this will lead to appreciation in the exchange rate, and this shows an inverse connection between the variables. Whereas, the Rate of Interest has a lag of one month and ,therefore, this has an effect on the Exchange Rate after a month. On the other side, a % change in the Index of Industrial Production (IIP) and Foreign Exchange Reserves (FER) will lead to roughly 0.23% change in the Exchange Rate. The Index of Industrial Production has a lag of one month and ,therefore, this will affect the exchange rate after a month, whereas the Foreign Exchange Reserves have a lag of two months and ,therefore, this will affect the exchange rate after two months. Thus, from the study, it can be stated that the Reserve Bank of India needs to take the macroeconomic variables into account. The Reserve Bank of India, if it interferes in the exchange rate any time, will have to consider these variables.

In the recent times, there has been a huge depreciation in the rupee. The RBI has brought in measures such as raising gold duty from 6% to 8% with gold being one the largest imports for the country. Furthermore, the RBI has given an order that there will be no credit purchase of gold. Also, the rupee has depreciated beyond what REER (real effective exchange rate) would suggest.

Policy Implications

In today's economic order of globalization, exchange rate assumes a crucial role as a determinant of the performance of the external sector which, in turn, has a considerable impact on the overall pace of economic activity. Any significant misalignment and volatility of the exchange rate arising from either internal or external factors will create a

crisis, which will, in turn, adversely disturb the macroeconomic balance, and jeopardize the country's economic performance. The East Asian currency crisis of 1997 has forcefully shown how bad the consequences can be. At the micro level, exchange rate variations, even under otherwise normal conditions, create considerable uncertainties and risks, which may adversely affect their performance.

It is now widely recognized that smoothly functioning foreign exchange markets together with appropriately coordinated monetary and fiscal policies are necessary for stable economic growth. Hence, there is a need to understand the factors that determine exchange rate movements in the short, medium, as well as long run. While the short run movements may be considerably affected by speculative activity together with the central bank's policies, the medium and long run movements are largely determined by changes in the so-called 'fundamentals'. These need to be identified along with the quantum of their influence on the exchange rate.

Given the structure of markets in developing countries and the nature of their links with the developed world, there are no neat theories to explain movements in exchange rates for these economies. In any case, the policy framework is not only different, but also not even uniform across countries. Each case is distinctly different in its own way. Clearly, exchange movements would have two components associated with the short and medium run. While the former would primarily be due to speculative factors, and get reflected in the daily observations, the latter would be due to fundamentals, which drive the exchange rate towards its equilibrium levels as observed in low frequency observations.

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