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Full Length Research Paper

OLS Modeling for Indian Rupee Fluctuations against US Dollar

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This study is an attempt to understand the dynamics of Indian Rupee fluctuations against US Dollar using yearly observations over the period of 13 years from 2001 to September 2013. In this paper, evolution of exchange rate mechanism from fixed to hybrid exchange rate system in context of India along with the journey of ` since independence has been explored. Further, an attempt has been made to identify the key variables that influence the Indian rupee fluctuations against US Dollar. Finally, Ordinary Least Square (OLS) modeling is done on the log computed variables to know the determinants of the rupee fluctuations against dollar.

Keywords: Exchange Rate, Mechanism, Appreciation, Depreciation, Rupee Fluctuation, OLS.

INTRODUCTION

Depreciation in rupee has become a big worry for the Indian Government because it has depreciated to an all time low with respect to the US Dollar. On 28th August 2013, the Indian rupee had gone down to 68.825 against the Dollar. Similarly rupee appreciation also causes concerns to imports of India. Exchange rates play a vital role in a country's level of trade, which is critical to almost every free market economy in the world. Therefore, exchange rates are among the most monitored, analyzed and manipulated economic measures by the government. This study aims at exploring the dynamics of exchange rate mechanism, rupee journey against dollar since independence, factors influencing the fluctuation of Indian Rupee and finally modeling the exchange rate through multivariate analysis (OLS).

Exchange Rate Mechanism

Each country has its own currency and when we convert currency of one country with that of another country, it is called conversion rate or exchange rate between the two countries. For example- 1$= `50 which means if we convert 1 $ in ` we will get Rs.50. The conversion rate fluctuates on timely basis based on various factors such as demand and supply of each currency, inflation rate in country, interest rate prevailing in the country etc. All economies that interact with international economy can be broadly classified into three categories on the basis of exchange rate policy of the country (Goyal, 2010).

Fixed Exchange Rate

These economies peg the value of their currency with some other prominent currency like US dollar. This system is simple and provides stability to the economy. This type of exchange rate regime is maintained by generally smaller economies like Nepal and Bhutan

(pegged to Indian Rupee) or several African nations. Rational behind such regime is that in case of small economy – if the exchange rate is market determined – the sudden influx or outflux of even relatively small amount of foreign capital will have large impact on exchange rate and cause instability to its economy. Notable exception is China which despite being large economy has its currency pegged to US dollar. But then when it comes to China, its irrational to talk about rationality.

Floating (or free) Exchange Rate

Bigger and developed economies like US, UK, Japan etc generally let market determine their exchange rate. In such economy exchange rate is determined by demand and supply of the currency in international foreign exchange market. In real world, there will be multilateral interactions and final exchange rate will be an equilibrium reached by all those interactions.

Hybrid system

Most midsized economy like India practices a mix of both these regimes. It allows for the exchange rate to float in a range which it deems comfortable. Once the market determined rate tries to breach this range, central bank (government) intervenes in the currency market and controls the exchange rate.

Rupee Appreciation and Depreciation

Appreciation in any currency means when we exchange that currency with another currency, we will get more foreign currency or we need to pay less home country currency. On the other hand depreciation in a currency means when we exchange that currency with another currency, we will get less foreign currency or we need to pay more home country currency. For example: Few months back, 1 $= ` 45 which means for each 1$, we need to pay ` 45.While in current situation, 1$= ` 60 which means for each 1$, we need to shell out ` 60. Thus we need to pay more ` compared to previous situation. Thus in this case, rupee has depreciated and $ has appreciated.

Journey since Independence

The Indian currency has witnessed a slippery journey since Independence. Many geopolitical and economic developments have affected its movement in the last 66 years (TOI, 2013)

a) When India got freedom on August 15, 1947, the value of the rupee was on a par with the American dollar. There were no foreign borrowings on India's balance sheet.
b) To finance welfare and development activities, especially with the introduction of the Five-Year Plan in 1951, the government started external borrowings. This required the devaluation of the rupee.
c) After independence, India had chosen to adopt a fixed rate currency regime. The rupee was pegged at 4.79 against a dollar between 1948 and 1966.
d) Two consecutive wars, one with China in 1962 and another one with Pakistan in 1965; resulted in a huge deficit on India's budget, forcing the government to devalue the currency to 7.57 against the dollar.
e) The rupee's link with the British currency was broken in 1971 and it was linked directly to the US dollar.
f) In 1975, value of the Indian rupee was pegged at 8.39 against a dollar.
g) In 1985, it was further devalued to 12 against a dollar.
h) In 1991, India faced a serious balance of payment crisis and was forced to sharply devalue its currency. The country was in the grip of high inflation, low growth and the foreign reserves were not even worth to meet three weeks of imports. Under these situations, the currency was devalued to 17.90 against a dollar.
i) 1993 was very important. This year currency was let free to flow with the market sentiments. The exchange rate was freed to be determined by the market, with provisions of intervention by the central bank under the situation of extreme volatility. This year, the currency was devalued to 31.37 against a dollar. The rupee traded in the range of 40-50 between 2000 and 2010.
j) It was mostly at around 45 against a dollar. It touched a high of 39 in 2007.
k) The Indian currency has gradually depreciated since the global 2008 economic crisis.
l) Liberalising the currency regime led to a sharp jump in foreign investment inflows and boosted the economic growth

Devaluation during 1966

Since 1951, despite government attempts to obtain a positive trade balance, India experienced a severe balance of payments deficits. Inflation caused Indian prices to go sky high. When the exchange rate is fixed and a country experiences high inflation relative to other countries, that country's goods become more expensive and foreign goods become cheaper. Therefore, inflation tends to increase imports and decrease exports. Since 1950, Indian continuously faced trade deficits. Another reason, which played important role in the 1966 devaluation, was war with Pakistan. The US and other

countries withdrew their aid, which further necessitated devaluation. To improve fiscal position, Government of India devalued Rupee by huge 57% against Dollar (Johri & Miller).

Devaluation during 1991

In 1991, India still had a fixed exchange rate system, where the rupee was hooked to basket of currencies of major trading partner countries. At the end of 1990, the Government of India found itself in serious economic trouble. The government was close to financial default and its foreign exchange reserves had dried up to the point that India could barely finance three weeks of imports. In July of 1991 the Indian government devalued the rupee by 19.5%. The government also changed its trade policy from its highly restrictive form to a system which allowed exporters to import 30% of the value of their exports (Saket, 2013).

Devaluation during 2013

The Indian rupee touched a lifetime low of 68.85 against the US dollar on August 28, 2013. The rupee plunged by 3.7 percent on the day in its biggest single-day percentage fall in more than two decades. Since January 2013, the rupee has lost more than 20 percent of its value, the biggest loser among the Asian currencies (Singh, 2013).

Chronology of India's Rupee Valuations (` per $)

India being a developing economy with high inflation, depreciation of the currency is quite natural. Depreciation of rupee is good, so long as it is not volatile. A random depreciation that we have seen in the last few months is bad and it has hurt the economy. Right from the beginning of year 2013, the value of rupee has been depreciating

Review of Literature

Various theoretical models are available to analyze exchange rate determination and behavior in the international finance literature. Most of the studies on exchange rate models prior to the 1970s were based on the fixed price assumption (Dua & Ranjan, 2010). With the advent of the floating exchange rate regime amongst major industrialized countries in the early 1970s, an important advance was made with the development of the monetary approach to exchange rate determination. With liberalization and development of foreign exchange and assets markets, variables such as capital flows, volatility in capital flows and forward premium have also became important in determining exchange rates. Furthermore, with the growing development of foreign exchange markets and a rise in the trading volume in these markets, the micro level dynamics in foreign exchange markets increasingly became important in determining exchange rates. Agents in the foreign exchange market have access to private information about fundamentals or liquidity, which is reflected in the buying/selling transactions they undertake, that are termed as order flows (Medeiros, 2005; Bjonnes, 2003). Microstructure theory evolved in order to capture the micro level dynamics in the foreign exchange market (Evans, 1999). Another variable that is important in determining exchange rates is central bank intervention in the foreign exchange market. Pros and Cons of currency appreciation and depreciation are studied as boon and bane for the economic growth. It also provides suggestions or steps needed to control as well as to overcome ill-effects of excessive fluctuations between rupee and dollar keeping in view current trends (Raithatha, 2012). (Mishra & Yadav, 2012) tried to find some stylized facts about the rupee-dollar exchange rates (ER) based on Hooper-Morton model by relating it with five very important macroeconomic variables namely; Money Supply (MS), Real Inflation Rate (RIR), Real Output (Y), Inflation Rate (IR) and Trade Balance (TB) for both domestic and foreign economy. The findings based on Vector Autoregressive (VAR) model confirm most of the stylized facts such that RIR and MS have prominent effects on ER. (Dua & Ranjan, 2011) reported that the Bayesian vector autoregressive models generally outperform their corresponding VAR variants. It is well known that exchange rate fluctuations are very difficult to predict using economic models, and that a random walk forecasts currency rates better than any economic model (Meese, 1991). ARCH and GARCH models and its categories have also been used by many authors to predict the time varying volatility of exchange rates (Dukich, Kim, & Lin, 2010) (Modelling Exchange Rate Volatility using GARCH Models: Empirical Evidence from Arab Countries, 2012; Samsudheen & Shanmugasundaram). However, the recent literature has identified a series of fundamentals/methodologies that claim to answer the question that whether currency rates are predictable? Overall, analysis of the literature and the data used by various authors suggests that the answer to the question: "Are currency rates predictable?" is, "It depends" on the choice of predictor, forecast horizon, sample period, model, and forecast evaluation method (Rossi, 2013).

Factors Affecting the ` Fluctuations against $

The value of any currency in an economy is hard to bet, to be stable for a long period of time as there are number of factor influencing its appreciation and the depreciation. The currency value of an economy influences the growth rate of GDP in an economy. Several other factors that have a direct influence on the over or the undervaluation of a currency are listed below:

Basic Law of Economics

As per the basic laws of economics if the demand for $ in India exceeds its supply then its worth will go up and that of the ` will come down in that respect. If the demand for the Indian rupee is more (to settle international payments) than its supply in the foreign exchange market, its value will appreciate and vice-versa. It may be that importers are the major entities who are in need of the dollar for making their payments. Another possibility here could be that the Foreign Institutional Investors are withdrawing their investments in the country and taking them elsewhere. Besides the basic law of economics, there are many other factors also which can cause a fluctuation in currency in international market. Some factors are discussed below-

Price of Crude Oil

India is a major importer of oil and the valuation of Indian money gets easily affected by the increase in the prices of the crude oil. It can further result in spreading inflation in an economy due to the over valuation of the Indian currency. The worth of crude oil has been a major nuisance for India since it has to bring in the majority of its requirement from outside the country. The demand for oil in India has been going up every year and this has led to the present situation. All over the world, the price of oil is given in dollars. This implies that as and when the demand for oil increases in India or there is an increase in oil prices in the global market, there also arises a need for more dollars to pay the suppliers. This also results in a situation where the worth of the ` decreases significantly in comparison to the dollar.

Forex Reserve

India's foreign exchange reserves is made up of Foreign currency assets (FCA) (US dollar, euro, pound sterling, Canadian dollar, Australian dollar and Japanese yen etc.), gold, special drawing rights (SDRs) of IMF and Reserve tranche position (RTP) in the International Monetary Fund (IMF). The level of forex reserve is expressed in US dollars. Hence India's forex reserve declines when US dollar appreciates against major international currencies and vice versa. RBI gains Foreign exchange reserves by buying foreign currency (via intervention in the foreign exchange market, Funding from the International Bank for Reconstruction and Development (IBRD), Asian Development Bank (ADB), International Development Association (IDA) etc., aid receipts and interest receipts.

Relative Inflation Rates

It is necessary to note that exchange rate is a relative price and hence the market weighs all the relevant factors in a relative term, (in relation to the counterpart countries). The underlying reasoning behind this conviction was that a relatively high rate of inflation reduces a country's competitiveness in international markets and weakens its ability to sell in foreign markets. This will weaken the expected demand for foreign currency (increase in supply of domestic currency and decrease in supply of foreign currency). But during 1981-85 period exchange rates of major currencies did not confirm the direction of relative inflation rates. The rise of the dollar persistently for such a long period discredited this principle.

Interest Rates

An important factor for movements in exchange rates in recent years has been difference in interest rates; i.e. interest differential between major countries. In this respect the growing integration of the financial markets of major currencies, the revolution in telecommunication facilities, the growth of specialized asset managing agencies, the deregulation of financial markets by major countries, the emergence of foreign exchange trading etc. having accelerated the potential for exchange rates volatility.

Trade Balance

If a country is exporting more than its imports from other countries, then this would result in higher demand for that exchange, resulting appreciation of that currency against others. One of the main reasons behind the Indian government's inability to arrest the fall of the national currency is imbalance between export and import. A negative trade balance occurs when imports are more than the exports of the country and vice-versa. The trade balance is generally measured by the current account. In

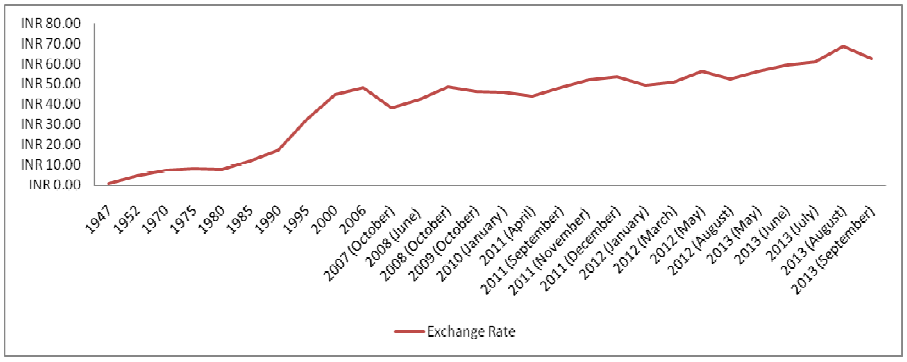

Figure 1. Exchange Rate (` per $)

Figure 2. Rupee Value in past 3 years (open, high,low, close)

Table 2. depicts the analysis of variance of predicting variables where the p-value is 0.015 which is significant at 5% level of significance.

Table 1: Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.974[a]	0.948	0.871	0.0235996
a. Predictors: (Constant), Interest Rate (%), Foreign Institutional Investment, Trade Balance, Forex Reserve, Inflation (%), Money supply				

the fiscal year 2012-13, India's current account deficit (CAD) was measured at 4.8 per cent of the GDP.

Foreign Institutional Investment

Recently ArcelorMittal and Posco decided to pull out from their projects in India. Posco did not go ahead with a steel plant worth ` 30,000 crore that was supposed to be built in Karnataka and ArcelorMittal withdrew from setting up a steel plant in Odisha that was supposed to cost around 52,000 crore. There were lot of delays and problems related to acquiring land for the project. In fact in 2012-13 the Indian companies have spent more outside India compared to FIIs in India.

Money Supply

Similar to how the local *fruit-wala* decides on the price at which to sell his fruits at to his customers based on the supply and demand of fruits, the Rupee's intrinsic value is largely a function of how many Rupees there are in circulation. In layman's terms, the less Rupees there are in circulation, the higher the value of the Rupee.

The money supply of Rupees can change due to the

Table 3. shows the coefficients of the independent variables in OLS model.

Table 2: ANOVA[b]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	0.041	6	0.007	12.265	.015a
	Residual	0.002	4	0.001		
	Total	0.043	10			
a. Predictors: (Constant), Interest Rate (%), Foreign Institutional Investment, Trade Balance, Forex Reserve, Inflation (%), Money supply						

Table 3: Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.05	1.799		5.586	0.005
	Forex Reserve	0.121	0.092	1.279	1.306	0.262
	Foreign Institutional Investment	-0.02	0.013	-0.361	-1.541	0.198
	Money supply	-0.595	0.217	-5.943	-2.749	0.051
	Trade Balance	-7.29E-05	0	-3.029	-4.759	0.009
	Inflation	0.056	0.021	2.409	2.625	0.058
	Interest Rate	-0.685	0.214	-1.391	-3.206	0.033
a. Dependent Variable: Exchange Rate						

trade balance, which is nothing more than how much a country imports versus exports. When a country sells more goods and services to overseas markets than it buys from them, then it has a trade surplus. A trade surplus increases the value of the Rupee because it brings in more foreign currency into India than the amount of Rupees that are paid for imports.

Capital flows and the stock market of India

It is important to note that in spite of suffering recession, an economy can grow if the capital inflow is constant or continuously rising. In India even if the GDP rate is less, the currency can still get overvalued due to excessive capital inflows made by the FII's in the Indian economy.

Global Currency trends

Like many other currencies Indian rupee have also tied its knot with some of the big economies of the world including the names of UK, US, Japan and Canada. The depreciation or appreciation in the currency any of these, especially in the US dollar, influences the valuation of the Indian currency in one way or the other.

RBI Intervention

The valuation of the Indian currency highly depends on RBI that manages the 'balance of payments', slight modification in which can define the over or the under valuation of the Indian currency.

Political Factors

Several other factors that affect the currency stability are some political factors like change in the government set up, introduction of new export and import policies, tax rates and many more.

Conclusively, there are many factors that arise from the economic structure of Indian economy and affect the fluctuation of the Indian currency that in turn affects the economic growth rate of the economy.

RESEARCH METHODOLOGY

Need of the Study

The persistent decline in rupee is a cause of concern. Depreciation leads to imports becoming costlier which is a worry for India as it meets most of its oil demand via

imports. Apart from oil, prices of other imported commodities like metals, gold etc will also rise pushing overall inflation higher. Even if prices of global oil and commodities decline, the Indian consumers might not benefit as depreciation will negate the impact. The depreciating rupee will add further pressure on the overall domestic inflation and since India is structurally an importintensive country, as reflected in the high and persistent current account deficits month after month, the domestic costs will rise on account of rupee depreciation. Exchange rate risk also drives away foreign investors which in turn depreciates the local currency. Indian Rupee is currently caught in this vicious cycle; it will have to find a stable level to regain investors' confidence.

The exchange rate is a very important monetary policy tool for emerging economies like India. Exchange rate affects trading relationships between two nations. The exchange rate of the currency determines the real return of the portfolio that holds the bulk of its investment. The exchange rate influences purchasing power of income and capital gains derived from returns, income factors such as interest rates, inflation and even capital gains from domestic securities. The movements of exchange rates also influence FDI through relative wage channels, relative wealth channels, and imperfect capital market arguments.

Objective of the Study

This empirical study is based on Rupee-Dollar relationship in terms of Rupee appreciation i.e. dollar depreciation and rupee depreciation i.e. dollar appreciation. The main goal of this paper is to provide an answer to the question: Does anything forecast exchange rates, and if so, which variables? This study aims at finding out the crucial factors of the economy that cause impact on Indian rupee fluctuation against US dollar.

There are several factors affecting the exchange rate like the inflation, interest rates, trade balance, FII, money supply (M3) in economy, Foreign Exchange Reserve and political factors etc. From these factors we have identified six independent variables and exchange rate (`/$) as dependent variable.

1. Forex Reserve (Rs Bilion)
2. Foreign Institutional Investment (Rs Bilion)
3. Money Supply (Rs Bilion)
4. Trade Balance (Rs Billion)
5. Inflation(%)
6. Interest Rate (%)

Research Approach

Yearly data for the six Independent variables mentioned in previous section was considered for the period 2001 – 2013. Also data for the dependant variable "Rupee Exchange Rate against Dollar (ER)" was considered for the same period. The data was obtained from RBI database on Indian economy. Further the data for the study period was processed through excel by taking natural logarithm of the variable for converting the data in normal distribution at primary level and regression analysis is done with the help of SPSS (statistical analysis package). Contribution of each independent variable individually and their collective impact on the dependant variable was observed.

Empirical Findings and Analysis

The results of the OLS modeling are summarized in the following tables. Table 1 presents the summary of model application stating that there is 97.4% correlation between the dependent and independent variables. Table also reveals that 94.8% of dependent variable is explained by the six identified independent variables. Only 5.2% of currency rate is because of the other factors influencing the dependent variable. Thus, the model seems to be a good fit for the currency rate of ` against US dollar.

Thus, the predictor equation becomes as follows-

$$ER = 10.05 + 0.121FR - 0.02FII - 0.595MS - (7.29E-05)TB + 0.056INF - 0.685INT + e_t$$

Since the p-values for foreign exchange reserve and foreign institutional investment are insignificant, they can dropped from the model, leading to the following equation:

$$ER = 10.05 - 0.595MS - (7.29E-05)TB + 0.056INF - 0.685INT + e_t$$

CONCLUSION

Depreciation and appreciation in rupee is not a permanent phenomenon but it is due to various reasons. An attempt has been made in this study to list out those factors which influence the fluctuation in Indian rupee against dollar. Here six factors have been identified to be specific to rupee fluctuation and are modeled with multivariate regression analysis. The result of analysis shows that these variables can explain the exchange rate dynamics to the extent of 94.8%. Since there are various internal as well as external reasons behind rupee appreciation and depreciation to a large extent, It takes time to bring back the situation to the normal state. The

RBI and other Government agencies have to play their role to tackle this situation. However, the exchange rate fluctuations modeling through various other econometric techniques based on the different aspects of currency rates remain the area for further research.

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