What Drives Forward Premia in Indian FOREX Market?

Anil Kumar Sharma and Anujit Mitra*

Abstract

This paper explores the behavior of the Forward Premia for US$ vis-à-vis INR during the five-year period of September 2000 to September 2005. Indian Forex market experienced a peculiar phenomenon in the years 2003 and 2004 where the forward premia on US$ spot (cash) vis-à-vis Indian rupee became negative. This phenomenon was somewhat uncommon to Indian forex market wherein Indian rupee was *always* on discount to US$ in the past. The paper tested hypothesis of uncovered interest rate parity in the context of Indian Market. The paper also tries to find out the factors that drive the forward premia in the Indian forex market during this period. It is observed that demand and supply factors viz. FII flows and current account balance played a dominant role in determining forward premia on US$ vis-à-vis INR rather than the usual Interest rate differential between Indian and US economy.

Keywords: Forward Premia, Uncovered Interest Rate Parity

Introduction

Indian Forex market experienced a peculiar phenomenon in the years 2003 and 2004 where the forward premia on US dollar spot (cash) vis-à-vis Indian rupee became negative. This phenomenon was somewhat uncommon to Indian forex market wherein Indian rupee was *always* on discount to US dollar in the past. Earlier, weak rupee was in tune with the strength of US dollar vis-à-vis Indian rupee and also in conformity with the theory which says that currency of the country where inflation rate/interest rate is more than that of the other country, its currency should be at discount vis-à-vis other country's currency. However, years 2003, 2004 experienced an Indian rupee gaining strength against US dollar despite of India having higher inflation rate / interest rate vis-à-vis US economy. This generates a question as to what drives forward premia in Indian forex Market. This also raises question on how deep is Indian forex market, especially the forward market. With Indian rupee still not been fully convertible on capital account except for certain transactions carried out by Foreign Institutional Investors, within certain limits, and libralisation on Investment front by way of Investment abroad by

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Indian Individuals/companies wherein they can freely convert their foreign currency/rupee assets into Indian/foreign currency assets by way of investment in Indian/foreign capital market, Indian rupee is *still somewhat protected* from vagaries of the International forex market. However, with convertibility of Indian rupee on current account, India's increasing share in world exports (i.e. 0.84 percent in 2004 as against only 0.52 percent in 1990), liberlisation on Investment abroad by Indian Individuals and Indian companies as well as almost full convertibility of Indian rupee as regard transactions carried out by Non-resident Indians, exchange rate of Indian rupee is *somewhat more flexible now*. Still the share of Indian Rupee in the Forex Market was only 0.15% global turnover in the year 2004. This was even less in the earlier years, as indicated by the Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity by Bank for International Settlements (refer Table 1). With US dollar still dominating the Invoicing pattern of India's exports, this paper concentrates on forward premia on US dollar vis-à-vis Indian rupee only. As the market decides forward premia in advance after taking into account all the information available in the market at that time. It also raises question on whether Indian forex market satisfies the hypothesis of uncovered interest rate parity or not.

During the last twenty-five years, the majority of studies have rejected the hypothesis of uncovered interest rate parity, which states that the (nominal) expected return to speculation in the forward foreign exchange market conditioned on available information is zero. These empirical studies have regressed ex post rates of depreciation on a constant and the forward premium, and have rejected the null hypothesis that the slope coefficient is one. In particular, a robust result in these studies is that this slope is negative, and significantly different from one. This phenomenon is known as the “forward premium puzzle” and implies that, contrary to the theory, high domestic interest rates relative to those in the foreign country, predict a future appreciation of the home currency. Different explanations have been given to this issue. Firstly, rejection of the null hypothesis can be related to the existence of a rational risk premium in the foreign exchange market. And secondly, other authors have claimed the existence of a “peso problem”, or even the existence of irrational market participants.

To understand the behavior of forward premia in respect on Indian Forex market, an exploratory analysis is carried out using data available in *Database on Indian Economy*

(culled out from Central Database Management System (CDBMS) of Reserve Bank of India's Data Warehouse) and other data series available in Telerate. Authors have tried to test the hypothesis of uncovered interest rate parity in the context of Indian Market in Section I of the Paper. Section II discusses the various theoretical explanations that are supposed to determine the forex premia in any market. The paper also tries to find out the factors that drive the forward premia in the Indian forex market in Section III. Section IV concludes the paper.

Section I

The closed or covered Interest Rate Parity (IRP) hypothesis states that the forward exchange rate, relative to the current exchange rate, covers the difference between current interest rates in domestic and foreign countries. Open or uncovered IRP assumes that the expected future exchange rate covers this difference. In general, there must be no possibility to make easy money from investing domestically or abroad.

Uncovered interest rate parity

$$R_{INR} - R_{\$} = (E^{e}_{t+1\ INR/\$} - Et_{INR/\$}) / Et_{INR/\$} \qquad (1)$$

Equation (1) says that nominal interest rate differential between rupee and dollar deposits should be equal to the expected rate of depreciation of the rupee.

Deviations from IRP

$$R_{INR} - R_{\$} = (E^{e}_{t+1} - E_t)/E_t + \sigma_t \qquad (2)$$

Equation (2) says that interest rate differential depends on the expected rate of depreciation and the risk of holding rupee denominated assets (σ).

Covered interest rate parity

$$R_{INR} - R_{\$} = (Ft - Et)/Et \qquad (3)$$

Equation (3) says that nominal interest rate differential between the rupee and the dollar should be equal to the forward premium on the dollar (forward discount on the rupee).

Internationally, using IRPs to forecast Exchange rate (E)

- evidence shows that interest rate differentials predict appreciations rather than depreciations

– forward premiums predict appreciations rather than depreciations

In Indian context, authors have tried to test the hypothesis of Uncovered Interest rate Parity. It may be mentioned here that Indian rupee not being fully convertible so far, conversion of rupee denominated assets into dollar denominated assets is partially possible in the case of banks who can hold both rupee as well as foreign currency deposits and can transmit their influence on interest rates as well as on forward premia. *Similarly, with liberlisation of investment in stock market in India by Foreign Institutional Investors (FIIs), FIIs can hold financial assets in Indian Market which can be converted into dollar denominated assets and vice versa.* Recently, Indian Individuals/companies have also been permitted to invest in shares of foreign companies, having a minimum of 10 percent of the share capital of a company listed in a recognized stock exchange in India, enabling them to convert their rupee denominated assets into foreign currency denominated assets. This is a step closer to full convertibility of rupee. As all these measure do have impact on exchange rate of rupee as well as forward premia of US dollar vis-à-vis Indian rupee. These measures are worth noticing for players active in Indian forex market.

Empirical work on the relation between the forward premiums in the foreign exchange market to the expected change in the spot exchange rate has been an area of active research for the last twenty years. In particular, an important building block of this relationship has been the Uncovered Interest Rate Parity (UIP), which states that the (nominal) expected return to speculation in the forward foreign exchange market conditioned on available information is zero:

$$E_t [s_{t+\delta t} - s_t] = f_t - s_t \qquad (4)$$

where s_t is the logarithm of the spot exchange rate S_t, f_t is the logarithm of the forward rate F_t contracted at t and matures at $t + \delta t$. As a consequence, the (log) forward exchange rate is an unbiased predictor of the δt -periods ahead (log) spot exchange rate.

For this reason, UIP is also known as “Unbiasedness Hypothesis”.

Although a main criticism made to UIP is that it pays no attention to issues of risk aversion and inter-temporal allocation of wealth, Hansen and Hodrick (1983) have shown that equation (1) with an additional constant term is consistent with a model of rational

maximizing behavior. The conditions needed are that the spot and forward exchange rates and the stochastic discount factor have a lognormal distribution with constant conditional second moments. This proposition is known as “Modified Unbiasedness Hypothesis" (Hodrick (1987), Engel (1996) and Wang and Jones (2002)).

Assuming rational expectations (RE) in foreign exchange markets:

$$s_{t+\delta t} - s_t = E_t [s_{t+\delta t} - s_t] + \mu_{t+\delta t,\delta t} \qquad (5)$$

where $\mu_{t+\delta t,\delta t}$ is a rational expectation error with zero mean and uncorrelated with any variable in the time t.

Combining equations (4) and (5)

$$s_{t+\delta t} - s_t = f_t - s_t + \mu_{t+\delta t,\delta t}$$

which has motivated the following OLS regression, as in Geweke and Feige (1979), as the usual starting point to test UIP:

$$s_{t+\delta t} - s_t = \beta_0 + \beta_1 (f_t - s_t) + \mu_{t+\delta t,\delta t} \qquad (6)$$

as a test of $\beta_0 = 0$ and $\beta_1 = 1$.

However, the RE assumption implies that errors are not autocorrelated as long the sampling interval is equal or larger than δ_t. For this reason, different authors, as Frenkel (1977) among others, have sampled data to produce a data set with non-overlapping residuals with the corresponding waste of degrees of freedom.

On the other hand, Hansen and Hodrick (1980) show how to use overlapping data in order to increase to the sample size, which will be reflected in corresponding gains in the asymptotic power of tests. Using Hansen’s Generalized Method of Moments, they obtain asymptotic standard errors that take into account the serial correlation induced into the regression error when the prediction horizon is higher than the sampling interval of the data. In the same way, standard errors robust to conditional heteroscedasticity can also be computed.

Nonetheless, some points with respect to the single equation approach have to be emphasized. Firstly, the asymptotic covariance matrix is very sensitive to the selection of the bandwidth and the kernel chosen in its estimation. Secondly, the construction of the covariance matrix is infeasible if we want to use high-frequency data in order to test UIP, given that the degree of overlapping tends to infinity.

In order to test the UIP in the case of India, authors have used monthly interval data on forward premia and exchange rate to avoid abovementioned problems. Accordingly, let

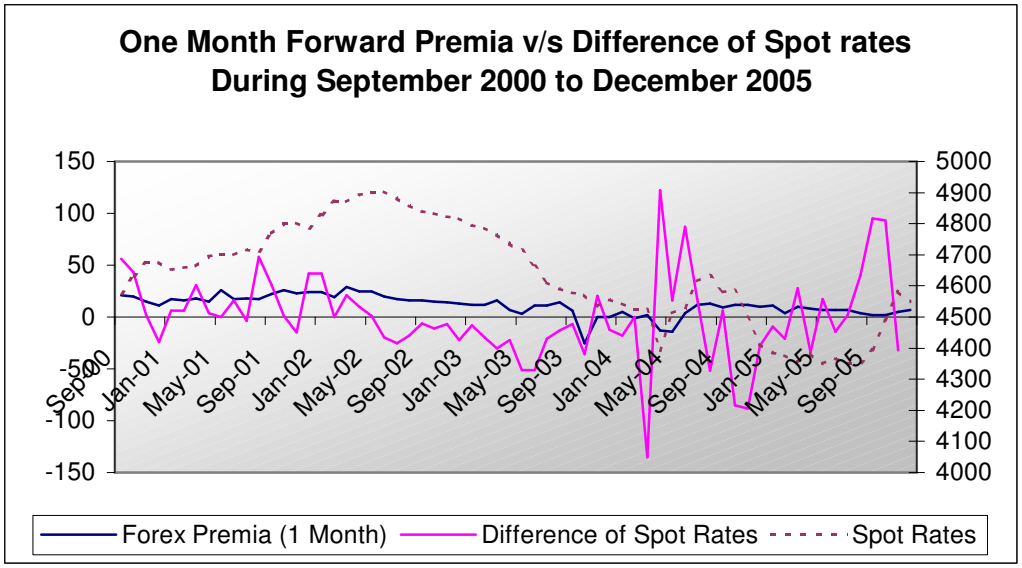
$s_{t+\delta t}$ =log (spot exchange rate of US$ vis-à-vis Indian rupee at time t+δt), δt = 1 month

f_t = log (one month forward exchange rate of US$ vis-à-vis Indian rupee).

To test UIP for Indian forex market:

$$s_{t+\delta t} - s_t = \beta_0 + \beta_1 (f_t - s_t) + \mu_{t+\delta t,\delta t} \qquad \text{using (6)}$$

If UIP holds good, i.e. $\beta_0 = 0$ and $\beta_1 = 1$, we estimate error terms and work out its variance-covariance matrix.



Graph 1

From Graph 1 above, it is clear that spot rate of Indian rupee vis-à-vis US dollar started appreciating in as early as June 2002 on a regular basis, however, one month forward premia became negative for the first time only in October 2003. To stem the appreciation of Indian rupee, RBI has to absorb almost US $ 10 billion from the market in November, December 2003 and January 2004 (refer Table 2). Subsequently, movement in the spot rate of Indian rupee were of very high range and RBI has to intervene in the spot as well as forward market and within one month its forex reserves increased from US$ 1,12,959 million (March 2004) to US$ 1,18,490 million in April 2004 (i.e. approximately US$ 5.5 billion) in a month. Despite these bouts of heavy intervention in the market, spot rate of Indian rupee started appreciating again in the month of August 2004 and has been continuously appreciating since October 2004 onwards reaching Rs. 43.49/US$ in May 2005 starting from Rs. 49.03/US$ in June 2002. This has happened in spite of RBI

intervention resulting in increase of forex reserves from US$ 58.7 billion at the end of June 2002 to US$ 138.9 billion at the end of May 2005. Though forward premia on US$ vis-à-vis Indian rupee has become positive since June 2004 onwards, movements in spot rate of Indian rupee are still erratic. The question remains how long RBI can keep on intervening in the forex market to keep the rupee appreciation in check. With stock of foreign currency assets held by RBI, in its books, reaching Rs. 5,75, 864 crore as at the end of June 2005 from Rs. 2,67, 333 crore as at the end of June 2002, domestic assets held by RBI have fallen drastically from Rs. 1,86, 227 crore as at the end of June 2002 to only Rs. 1,06, 953 crore as at the end of June 2005 (refer RBI Annual Report: 2004-05) limiting its intervention power over the years in case of rupee appreciation. While carrying out regression as suggested in equation (6) above, it can be observed from the results presented below that UIP hypothesis do not hold good for Indian market as the slope coefficient is significantly different from one and is negative. The negative slope coefficient means market is expecting a study appreciation of Indian rupee vis-à-vis US dollar irrespective of the positive forward premia, managed through intervention so far, and inspite of higher domestic interest rate in Indian market as compared with US market. Further, the relationship with spot exchange rate and forward premia in Indian Market is found to be very weak. This means future spot rate of US dollar vis-à-vis Indian rupee is driven by some other factors in addition to forward premia. The regression equation in Indian context takes the following form

$s_{t+\delta t} - s_t = 0.00005 - 0.0583 * (f_t - s_t)$

with the following results

Regression Statistics	
Multiple R	0.0130
R Square	0.0002
Adjusted R Square	-0.0162
Standard Error	0.0094
Observations	63

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.0000	0.0000	0.0103	0.9194
Residual	61	0.0054	0.0001		
Total	62	0.0054			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*

Intercept	0.0001	0.0018	0.0280	0.9778	-0.0036	0.0037
ft - st	-0.0583	0.5734	-0.1016	0.9194	-1.2049	1.0883

Question then arises is what does forward premia in Indian forex market represent and what factors are accounted for by the market players while determining the forward premia itself. Authors endeavored to analyze these factors in Section II in general and in section III in respect of Indian forex market in particular.

Section II

Forward Market for foreign exchange is extremely important particularly for importers and exporters. This is so because international trades result in exposure in foreign currencies. Forward Market helps the traders in hedging the risks of this inevitable exposure in foreign currency. On the other side there are players in foreign exchange market who offer the forward rates for the foreign currency. A well-developed market helps in getting the better rates for the traders promoting international trade and consequently the general economic development.

Offering forward rates always involve trying to forecast the future. It may require knowledge about how the price of the underlying product is determined in the market. One also needs to be aware about the factors influencing the price of the product. Countries are free to decide the type of exchange rate arrangements, which could be described to vary in different degrees from fixed to flexible exchange rate. It is practically impossible to strictly follow either a completely fixed or flexible exchange rate. International Monetary Fund publishes an annual report listing the different regimen followed by its member countries. There are many countries that are following 'pegged exchange rate' mechanism whereby their domestic currencies are fully pegged with some other major foreign currency like USD. Forecasting the exchange rate and thereby working out the forward rates for currencies following different regimes would be different.

From the perspective of the economists there are three classes of explanatory variables, namely, price level, interest rates and the balance of payments to explain the behavior of the exchange rate. The Purchasing Price Parity or PPP hypothesis tries to explain how the price levels affect the exchange rates. It says the relative exchange rate $S = kP/P^*$, where P is the price level in the domestic economy and P* is that in the other country. k is a constant parameter. Taking differences after taking logarithms gives us $\Delta s = \Delta p - \Delta p^*$

giving us the idea how the forward rates could be influenced by the change in the level of prices in the two economies. However, it is noted that over a short or medium term, PPP hypothesis is conclusively rejected. Though, it cannot be said that the price levels have no impact on exchange rate movement or the forward rates.

In the earlier section we have already talked about the influence of interest rates on the exchange rates. Both of the two major Interest Rate Parity hypotheses, Covered Interest Rate Parity (CIP) and Uncovered Interest Rate Parity (UIP) have drawn lot of attention of the researchers, but UIP is more interesting in our context because it involves the variable expected future spot rate unlike CIP.

That the trade imbalances would have a bearing on the behavior of exchange rates has been recognized very early. However, the earliest models to relate the current account to the exchange rate followed the Marshallian tradition of treating the exchange rate as a relative price to clear the market with the "elasticities approach". The limitations of this approach have led to the emergence of "absorption approach" in the 1950s. Among the series of subsequent models, the Mundell – Fleming model is most referred. The Mundell-Fleming Model adds a balance of payments equilibrium condition to the IS-LM Model. This extends the closed economy IS-LM framework to examine the interplay between monetary policy and exchange rate policy. In particular, the model emphasizes the differences between fixed and floating exchange rates.

It is very apparent that the forward rate is to come out from the expectations on the future exchange rates, which is expected to get influenced by the sets of variables mentioned above as well as all of the "news". This news could indicate change in the economic conditions or even political stability. The prices of the crude oil in the international market also found to impact the forex market. The forward premia is particularly sensitive to any news having financial bearing and reacts or over-reacts instantly. Coming back to the Indian context where currently some sort of *managed float* approach is followed, the intervention by the regulator may also play important role at least over short to medium term. Over the years, internationally, the central banks are found to intervene through the Forward Market in conjunction with the spot market for making larger impact.

In the next section we look at the behavior of forward premia on US dollar vis-à-vis Indian rupee.

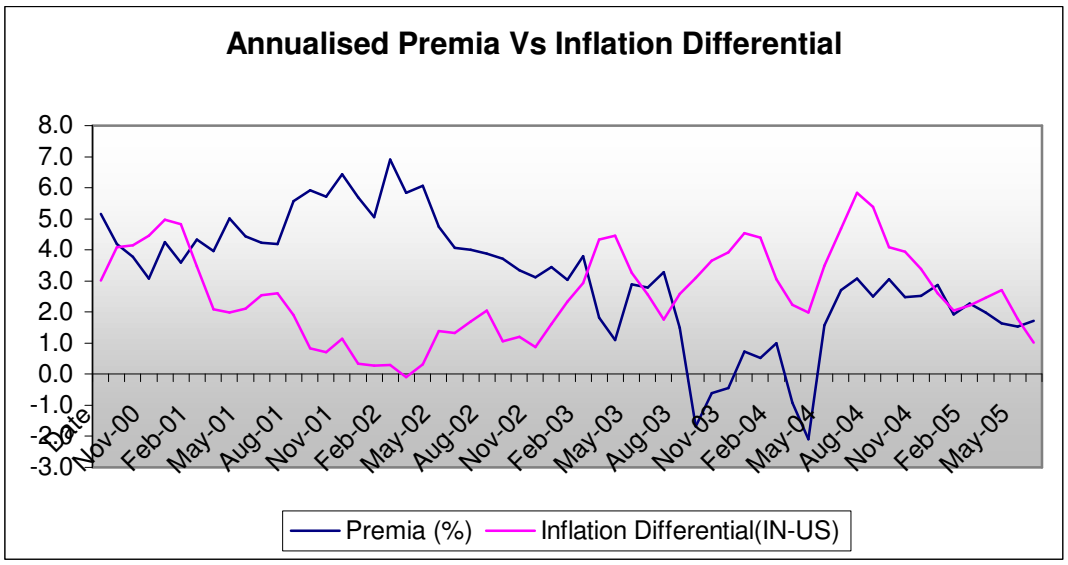
Section III

As observed in Section I above, UIP hypothesis do not hold good for Indian market, as the slope coefficient is significantly different from one. Further, there are other factors, which also influence the forward market in India. Authors have tried to identify in this section the factors that affect Forward Premia in Indian FOREX Market i.e. "What Derives Forward Premia in Indian FOREX Market?"

- Is it Inflation-Differential?
- Is it Interest-Rate Differential?
- Is it FII flows?
- Is it the current account balance in BoP?

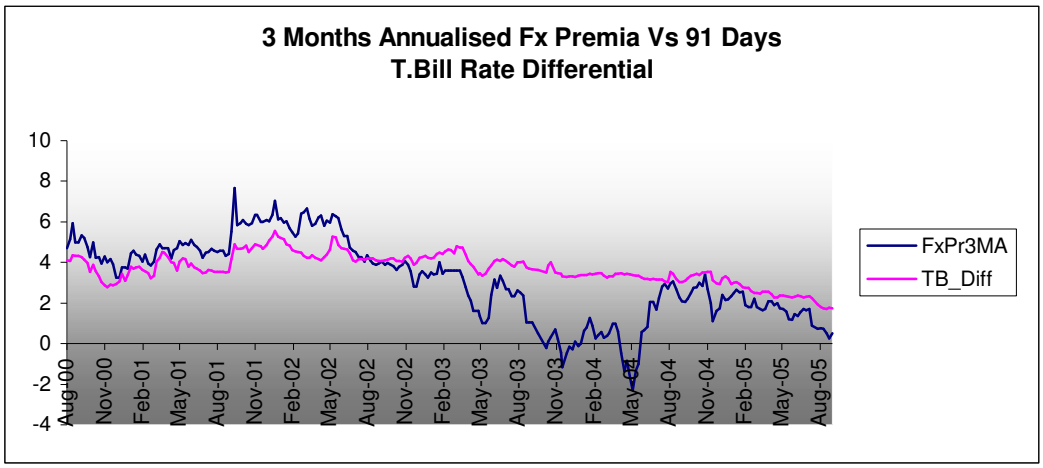
To answer this question, an attempt is made to carry -out some exploratory exercise based on Forward Premia - annualized (INR vis-à-vis US$), Inflation differential between Indian and US economy (i.e. WPI for India – CPI for US economy) (Graph 2), Interest Rate differential between 91 Day Treasury Bills in India and US (Graph 3); Interest Rate differential between MIBOR - one month and LIBOR-one month (Graph 4), FIIs inflows and Current Account Balance (Graph 5).

Graph 2 below indicates that forward premia has a *weak relationship* with Inflation-differential in US and Indian Economy.



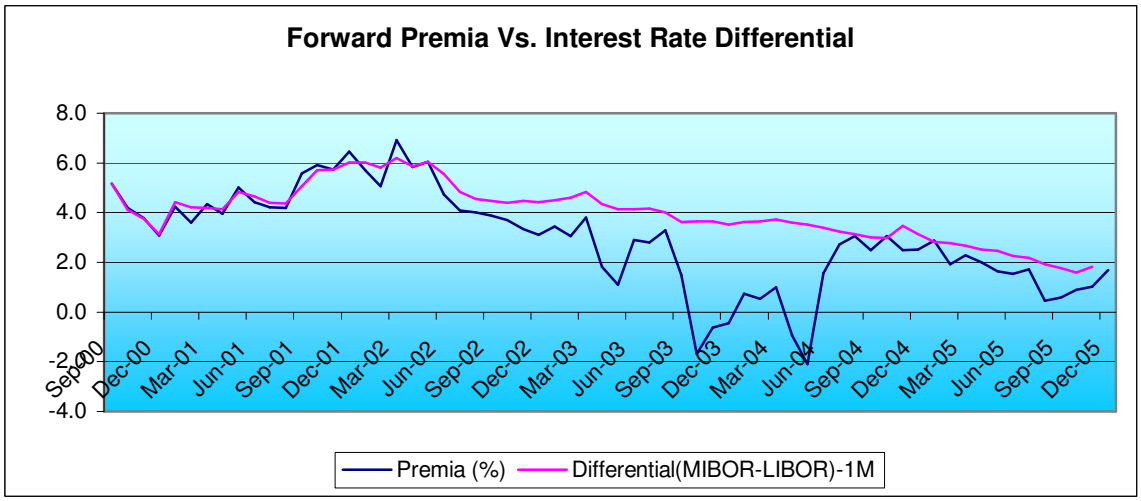
Graph - 2

Graph 3 below indicates the relationship between 3 months forward premia (annualized) and interest rate differential in Govt. of India and US T Bills is also *not strong*.



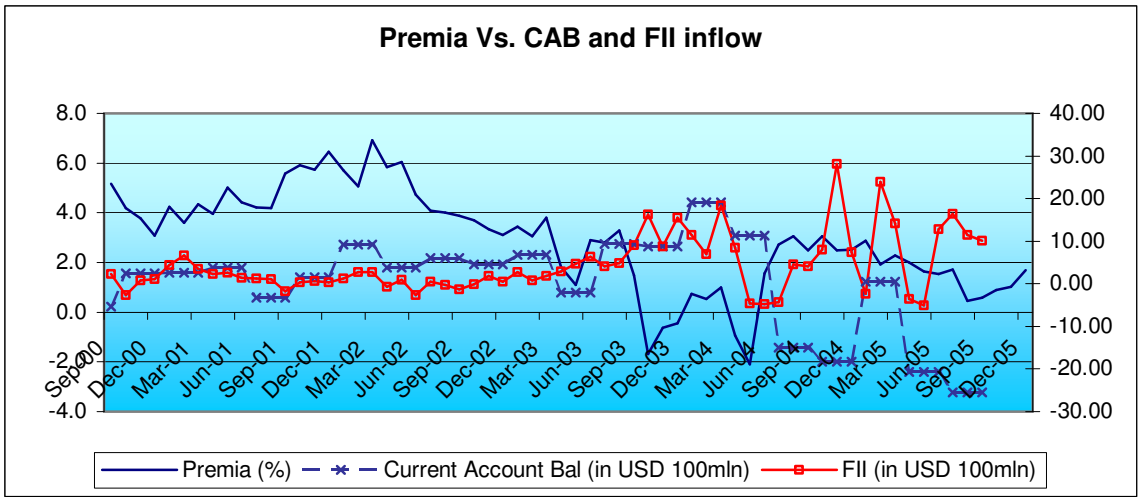
Graph - 3

Graph 4 below indicates that relationship between forward premia - 1 month (annualized) and interest rate differential between one month MIBOR and 1 month LIBOR, is stronger than the above two.



Graph - 4

However, there are other factors (supply side and demand side) viz. fresh flows by Foreign Institutional Investors (FIIs) and Current Account Balance play important part in determining the forward premia as can be seen from the respective regression equation and its analysis given below. In Graph 5 below the Premia is shown with the Current Account Balance (USD 100 million) and FII net investment (in USD 100 million).



Graph 5

When we performed the regression of one month Forward Premia for USD vis-à-vis INR (Annualised) Vs. Inflation Differential, Interest Rate Differential (one month MIBOR – one month LIBOR), FII Portfolio Investment (net flows) and India's Current Account Balance (CAB), it is observed that the coefficient for Inflation differential is not statistically significant, hence dropped from final analysis. Since, the information on current account balances is available to the market with a lag, introduction of lagged value of current account balance (1 quarter lag) showed improvement. Further, BoP current account quarterly balance is distributed equally for intervening months for regression analysis, due to non-availability of monthly CAB data.

Equation:

Forward Premia (Y) = f (Interest rate differential (X1), Current Account Balance –lagged (X2), FIIs Net flows (X3))

$$\mathbf{Y} = -2.3166 + 1.4393\ \mathbf{X1} - 0.1039\ \mathbf{X2} - 0.0917\ \mathbf{X3}$$

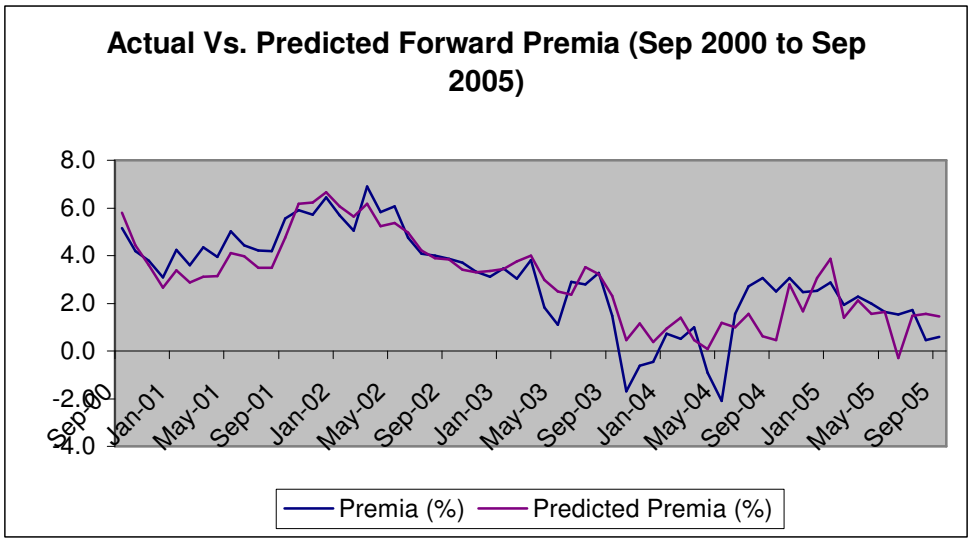
Regression Statistics	
Multiple R	0.8772
R Square	0.7695
Adjusted R Square	0.7574
Standard Error	0.9870
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	185.3581	61.7860	63.4292	0.0000
Residual	57	55.5234	0.9741		
Total	60	240.8815			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-2.3166	0.5822	-3.9788	0.0002	-3.4825	-1.1507
X1	1.4393	0.1316	10.9339	0.0000	1.1757	1.7028
X2	-0.1039	0.0145	-7.1897	0.0000	-0.1328	-0.0750
X3	-0.0917	0.0212	-4.3220	0.0001	-0.1341	-0.0492

Durbin-Watson D 1.084



Graph 6

Further to check the influence of RBI intervention on forward premia, RBI's Intervention (Net Purchase of USD) has also been tried as regressor and it was found that the variable is not statistically significant indicating that RBI intervention in forex market does not make significant impact in determination of forward premia by market player and it only helps in smoothing the volatility in forex premia. Similarly inclusion of Trade Balance as regressor in place of Current Account Balance has not resulted in improvements.

Though the regression above shows a reasonable fit with expected signs, in the actual and estimated premia plot in Graph 6 some change in pattern is observed over the period. This motivated the authors to break the period of observation into two parts i.e. September 2000 to March 2003 and April 2003 to September 2005 and explore the behavior separately.

For the September 2000 to March 2003 period the regression gives the following result:

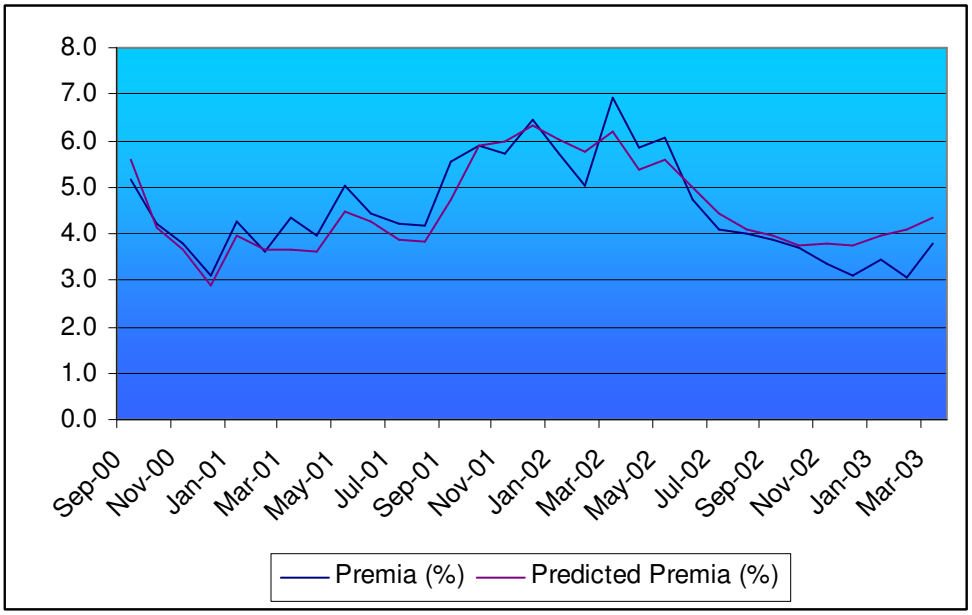
Regression Statistics	
Multiple R	0.9019
R Square	0.8135
Adjusted R Square	0.7928
Standard Error	0.4800
Observations	31

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	27.1278	9.0426	39.2534	0.0000
Residual	27	6.2199	0.2304		
Total	30	33.3477			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1.3441	0.5754	-2.3357	0.0272	-2.5248	-0.1634
X1	1.2402	0.1164	10.6567	0.0000	1.0014	1.4790
X2	-0.0610	0.0198	-3.0746	0.0048	-0.1017	-0.0203
X3	-0.0076	0.0452	-0.1678	0.8680	-0.1004	0.0852

Actual Vs. Predicted Forward Premia



Graph 7

For the period April 2003 to September 2005 period the regression gives the following result:

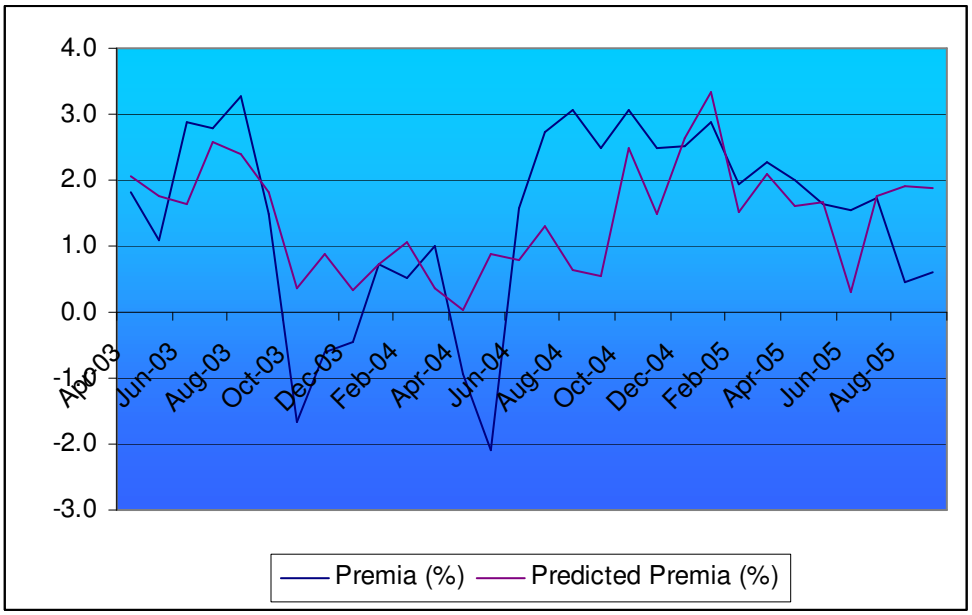
Regression Statistics	
Multiple R	0.5765
R Square	0.3324
Adjusted R Square	0.2554
Standard Error	1.2429
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	19.9961	6.6654	4.3149	0.0135
Residual	26	40.1626	1.5447		
Total	29	60.1587			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.5304	1.3627	-0.3892	0.7003	-3.3314	2.2707
X1	0.7686	0.4251	1.8081	0.0822	-0.1052	1.6424
X2	-0.0842	0.0240	-3.5074	0.0017	-0.1336	-0.0349
X3	-0.0682	0.0309	-2.2041	0.0366	-0.1318	-0.0046

Actual Vs. Predicted Forward Premia



Graph 8

As observed there is a marked difference in the regression results in the two periods. Also, the Durbin Watson D statistics, for the regression run for the full study period, indicates the possible presence of first order autocorrelation. One way to deal with the autocorrelation is to include the lagged value of the dependent variable as a regressor. However, it is felt that the past Forward Premia might have less influence on the current forward premia compared to the observed change in the exchange rate in the immediately preceding period. It was indeed found out that introducing the lagged forward premia was not improving the regression. Therefore, the authors introduced another variable X4: Annualised observed change in exchange rate of USD vis-à-vis INR. This variable captures the immediate trend in the exchange rate. Further, this also goes well with self-fulfilling nature as observed during the times of volatility in any financial market. The regression results based on the four variables for the period of October 2000 to September 2005 are as follows:

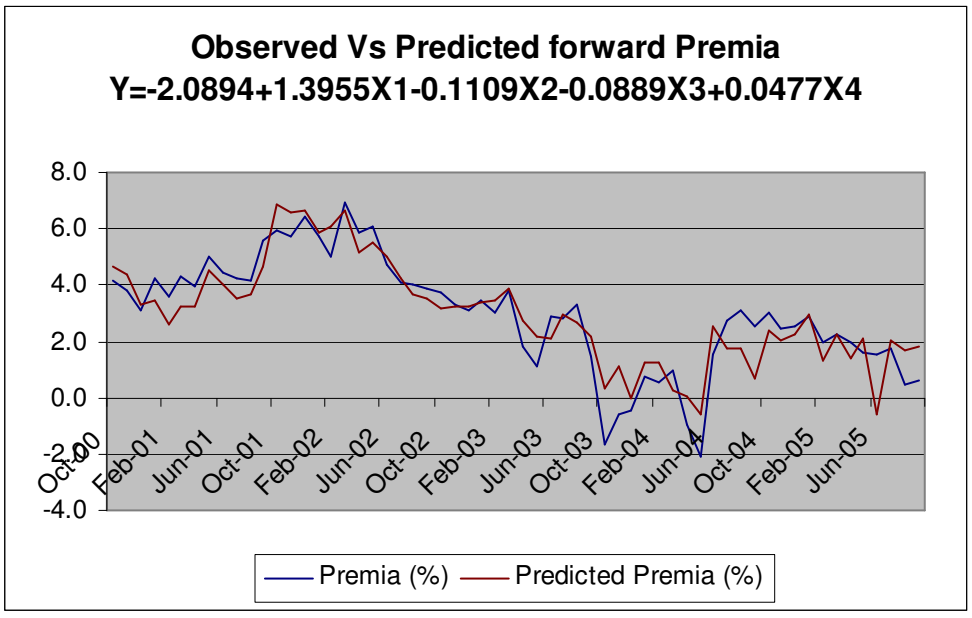
Regression Statistics	
Multiple R	0.9075
R Square	0.8236
Adjusted R Square	0.8108
Standard Error	0.8702
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	194.4922	48.6231	64.2144	0.0000
Residual	55	41.6459	0.7572		
Total	59	236.1381			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-2.0894	0.5210	-4.0107	0.0002	-3.1334	-1.0454
X1	1.3955	0.1186	11.7658	0.0000	1.1578	1.6331
X2	-0.1109	0.0130	-8.5095	0.0000	-0.1371	-0.0848
X3	-0.0889	0.0187	-4.7451	0.0000	-0.1264	-0.0513
X4	0.0477	0.0113	4.2146	0.0001	0.0250	0.0704

Durbin-Watson D 1.144



Graph 9

It is observed that the incorporation of the 4th variable has improved the fitness in terms of the Adjusted R Square (0.75 to 0.81) and other parameters. More importantly, it is observed that the fit is good uniformly and in particular much better in the second half of the study period, which experienced volatile movements in forward premia. It is also observed that the first order autocorrelation has come down though its presence cannot

still be ruled out. This leaves further scope for exploratory analysis in this area especially in respect of Indian forex market, which is still emerging.

Section IV

Conclusion: In Section I, we have seen that the UIP hypothesis does not hold good for Indian market. It has been explored that individually no single factor is able to explain the behavior of the Forex Premia in Indian forex market. From the analysis carried out above, we could see that in specific time window one of the factors may have dominated in determining the movement of the Forex Premia. The authors have also explored the movement of the forex premia by dividing the study period in two parts and observed that in the first part (September 2000 to March 2003) of the study period the coefficient of the Interest Rate Differential was much higher than the second part (April 2003 to September 2005). The role of Foreign Institutional Investment in driving the Forward Premia is observed to be more dominant in second part than the first. This vindicates the perception that the Premia is more and more being influenced by demand and supply factors (i.e. FI inflow) rather than the Interest Rate Differential in recent times. Though these two variables along with the Interest rate differentials were able to explain the behavior of the Premia in the first part of the study period, the relationships have weakened considerably in recent times.

In a longer time horizon, differential between interest rates (i.e. LIBOR-MIBOR differential) together with Foreign Institutional Investment in Indian market, Current Account Balance and the change in the observed Exchange rate are largely able to explain the behavior of the Forex Premia in Indian forex market. Authors therefore conclude that forex premia of US$ vis-à-vis Indian rupee is driven to a large extent by the Interest rate differential in the Inter Bank market of the two economy coupled with capital receipts and excess of current accounts payments on accounts of imports in relation to exports as well as the change in the Exchange rate of USD vis-à-vis Indian Rupees.

Table 1

Currency distribution of reported foreign exchange market turnover[1]

Percentage shares of average daily turnover in April

Currency	**1989**	**1992**	**1995**	**1998**	**2001**	**2004**
US dollar	90	82.0	83.3	87.3	90.3	88.7
Euro	.	.	.	.	37.6	37.2
Deutsche mark[2]	27	39.6	36.1	30.1	.	.
French franc	2	3.8	7.9	5.1	.	.
ECU and other EMS currencies	4	11.8	15.7	17.3	.	.
Japanese yen	27	23.4	24.1	20.2	22.7	20.3
Pound sterling	15	13.6	9.4	11.0	13.2	16.9
Swiss franc	10	8.4	7.3	7.1	6.1	6.1
Australian dollar	2	2.5	2.7	3.1	4.2	5.5
Canadian dollar	1	3.3	3.4	3.6	4.5	4.2
Swedish krona[3]	…	1.3	0.6	0.4	2.6	2.3
Hong Kong dollar[3]	…	1.1	0.9	1.3	2.3	1.9
Norwegian krone[3]	…	0.3	0.2	0.4	1.5	1.4
Korean won[3]	…	…	…	0.2	0.8	1.2
Mexican peso[3]	…	…	…	0.6	0.9	1.1
New Zealand dollar[3]	…	0.2	0.2	0.3	0.6	1.0
Singapore dollar[3]	…	0.3	0.3	1.2	1.1	1.0
Danish krone[3]	…	0.5	0.6	0.4	1.2	0.9
South African rand[3]	…	0.3	0.2	0.5	1.0	0.8
Polish zloty[3]	…	…	…	0.1	0.5	0.4
Taiwan dollar[3]	…	…	…	0.1	0.3	0.4
Indian rupee[3]	**…**	**…**	**…**	**0.1**	**0.2**	**0.3**
Brazilian real[3]	…	…	…	0.4	0.4	0.2
Czech koruna[3]	…	…	…	0.3	0.2	0.2
Thai baht[3]	…	…	…	0.2	0.2	0.2
Hungarian forint[3]	…	…	…	0.0	0.0	0.2
Russian rouble[3]	…	…	…	0.3	0.4	0.7
Chilean peso[3]	…	…	…	0.1	0.2	0.1
Malaysian ringgit[3]	…	…	…	0.0	0.1	0.1
Other currencies	22	7.7	7.1	8.2	6.5	6.1
All currencies	**200**	**200.0**	**200.0**	**200.0**	**200.0**	**200.0**

[1] Because two currencies are involved in each transaction, the sum of the percentage shares of individual currencies totals 200% instead of 100%. The figures relate to reported "net-net" turnover, ie they are adjusted for both local and cross-border double-counting, except for 1989 data, which are available only on a "gross-gross" basis. [2] Data for April 1989 exclude domestic trading involving the Deutsche mark in Germany. [3] For 1992-98, the data cover local home currency trading only.

Source: Triennial Central Bank Survey 2004, BIS

Table 2

Reserve Banks Sale and Purchase of USD (in Million)

Month	Sales in US Dollar	Purchase in US Dollar	Net in US Dollar
2000:09 (SEP)	1015.09	728	-287.09
2000:10 (OCT)	1004.5	510.5	-494
2000:11 (NOV)	4392.5	8078.61	3686.11
2000:12 (DEC)	2204.5	2049.36	-155.14
2001:01 (JAN)	1334.7	2166.25	831.55
2001:02 (FEB)	456.5	1080.44	623.94
2001:03 (MAR)	1138.68	1745	606.32
2001:04 (APR)	1626.75	1608.5	-18.25
2001:05 (MAY)	613.5	1082.25	468.75
2001:06 (JUN)	1169.23	1205.5	36.27
2001:07 (JUL)	1130.66	859	-271.66
2001:08 (AUG)	1052	1733.75	681.75
2001:09 (SEP)	2326.11	1432	-894.11
2001:10 (OCT)	1043.42	1280.75	237.33
2001:11 (NOV)	1435	2977.05	1542.05
2001:12 (DEC)	1341.17	2381.6	1040.43
2002:01 (JAN)	1390.5	2781.7	1391.2
2002:02 (FEB)	1202.5	1769.25	566.75
2002:03 (MAR)	1428.04	3710.55	2282.51
2002:04 (APR)	1605.5	2082	476.5
2002:05 (MAY)	1146.5	1232.5	86
2002:06 (JUN)	571.25	812	240.75
2002:07 (JUL)	685	2514.05	1829.05
2002:08 (AUG)	1459	2637.75	1178.75
2002:09 (SEP)	1956.37	2921.5	965.13
2002:10 (OCT)	1422.5	2593.5	1171
2002:11 (NOV)	972	3086.5	2114.5
2002:12 (DEC)	1551.52	3230.5	1678.98
2003:01 (JAN)	1046	2830.5	1784.5
2003:02 (FEB)	1171	3505.5	2334.5
2003:03 (MAR)	1339.08	3188.5	1849.42
2003:04 (APR)	1511	2942.5	1431.5
2003:05 (MAY)	1636	3978	2342
2003:06 (JUN)	982.08	1878.5	896.42
2003:07 (JUL)	2950	6095.5	3145.5
2003:08 (AUG)	1360	3711.5	2351.5
2003:09 (SEP)	4229.42	6574	2344.58

2003:10 (OCT)	5227.72	6821	1593.28
2003:11 (NOV)	580	4029	3449
2003:12 (DEC)	484.4	3372.5	2888.1
2004:01 (JAN)	1028	4321.5	3293.5
2004:02 (FEB)	2163	5519.5	3356.5
2004:03 (MAR)	2789	6170.5	3381.5
2004:04 (APR)	3332	10758.5	7426.5
2004:05 (MAY)	3439.5	3219.5	-220
2004:06 (JUN)	1382.95	969.5	-413.45
2004:07 (JUL)	1179.5		-1,179.50
2004:08 (AUG)	880.5	5	-875.5
2004:09 (SEP)	124	143	19
2004:10 (OCT)	104	5	-99
2004:11 (NOV)		3791.5	3791.5
2004:12 (DEC)	108.22	1501.5	1393.28
2005:01 (JAN)			0
2005:02 (FEB)		4974	4974
2005:03 (MAR)		6030	6030
2005:04 (APR)			0
2005:05 (MAY)			0
2005:06 (JUN)	103.64		-103.64
2005:07 (JUL)		2473	2473
2005:08 (AUG)	451	2003	1552
2005:09 (SEP)			0
2005:10 (OCT)			0

References

Baillie, R.T., R. E. Lippens, and P. C. McMahon (1983): "Testing Rational Expectations and Efficiency in the Foreign Exchange Market", Econometrica, 51, 553-564

Bekaert, G. and R. Hodrick (2001): "Expectations Hypotheses Tests", Journal of Finance, 56, 4, 1357-1393.

Cochrane, J. (2001): Asset Pricing, Princeton, N.J., Princeton University Press.

Database on Indian Economy (https://cdbmsi.reservebank.org.in/)

Fama E. (1984): "Forward and Spot Exchange Rates", Journal of Monetary Economics, 14, 319-338.

Flood, R.P and A. K. Rose (2002): "Uncovered Interest Parity in Crisis", IMF Staff Papers, 49, 2, 252-266.

Frenkel, J. A. (1977): "The Forward Exchange Rate, Expectations, and the Demand for Money: The German Hyperinflation", American Economic Review, 67, 653-670.

Geweke, J. and E. Feige (1979): "Some Joint Tests of the Efficiency of Markets for Forward Foreign Exchange", Review of Economic Statistics, 61, 334-341.

Hakkio, C. S. (1981): "Expectations and the Forward Exchange Rate", International Economic Review, 22, 663-678.

Hansen L.P. and R. Hodrick (1980): "Forward Exchange Rates as Optimal Predictors of Future Spot "Rates: An Econometric Analysis", Journal of Political Economy, 88, 5, 829-853.

Hansen L.P. and R. Hodrick (1983): "Risk Averse Speculation in the Forward Foreign Exchange Market: An Econometric Analysis of Linear Models" in Exchange Rates and International Macroeconomics, ed. by J.A. Frenkel. Chicago: University of Chicago Press for National Bureau of Economic Research, 1983.

Hodrick, R. (1987): The empirical evidence on the efficiency of forward and futures foreign exchange markets, Harwood Academic Publishers, Chur, Switzerland

Horvath M.T.K and M. W. Watson (1995): "Testing for Cointegration When Some of the Cointegrating Vectors are Prespecified", Econometric Theory, 11, 5, pp. 952-984.

Lewis K. (1989): "Changing Beliefs and Systematic Rational Forecast Errors with Evidence from Foreign Exchange", American Economic Review, 79, 621-36.

Mark N.C. and Y. Wu (1998): "Rethinking Deviations from Uncovered Interest Rate Parity: The Role of Covariance Risk and Noise", Economic Journal, 108, 1686-706.

Phillips P.C. B. (1991): "Error Correction and Long Run Equilibrium in Continuous Time", Econometrica 59, 967-980.

RBI Annual Report, 2004-05.

Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity by Bank for International Settlements (BIS), 2004.

Wang P. and T. Jones (2002): "Testing for Efficiency and Rationality in Foreign Exchange Markets - A Review of the Literature and Research on Foreign Exchange Market Efficiency and Rationality with Comments", Journal of International Money and Finance, 21, 223-239