CURRENCY FUTURES IMPACT ON THE VOLATILITY OF EXCHANGE RATE

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ABSTRACT

This article attempts to study the impact of currency futures trading on the volatility of the spot exchange rates where the underlying in the futures contract is the USD-INR exchange rate. Currency futures were introduced in year 2008 on the Indian stock exchange to hedge the risks arising out of the fluctuations in exchange rate and to contain the volatility of the exchange rates. The study has employed USD-INR exchange rate data for 10 year period starting from March 2000 to Dec 2010. Using GARCH (1,1) framework, the study reports an increase in volatility coefficient of the spot exchange rate of USD-INR. Thus, it can be inferred on the basis of the empirical evidence that currency futures trading has increased the volatility of the exchange rate of USD-INR.

KEYWORDS: Currency Futures, GARCH, Volatility.

INTRODUCTION

A currency future, also known as FX future, is a futures contract to exchange one currency for another at a specified date in the future at a price that is fixed on the purchase date. A futures contract is priced in terms of INR per unit of other currency. Currency future contracts allow investors to hedge against foreign exchange risk. With increased volatility in exchange rate and to mitigate the risk arising out of excess volatility, currency futures were introduced in India.
Currency future is a form of financial derivative contract where the underlying is the currency. Derivatives were introduced in India in year 2000 with the introduction of index futures on BSE. Since then derivatives trading has outperformed the trading in the cash market segment. Currency futures are the recent entrants to the family of derivatives.

Currency futures were introduced on the Indian stock exchanges in year 2008 and currency options in year 2010. First, currency futures on USD-INR were introduced for trading and subsequently the Indian rupee was allowed to trade against other currencies such as Euro, Pound Sterling and the Japanese yen. Currency options are currently available on US Dollars only.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Contracts</th>
<th>Turnover in Cr. Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-2012</td>
<td>70,13,71,974</td>
<td>33,78,488.92</td>
</tr>
<tr>
<td>2010-2011</td>
<td>71,21,81,928</td>
<td>32,79,002.13</td>
</tr>
<tr>
<td>2009-2010</td>
<td>37,86,06,983</td>
<td>17,82,608.04</td>
</tr>
<tr>
<td>2008-2009</td>
<td>3,26,72,768</td>
<td>1,62,272.43</td>
</tr>
</tbody>
</table>

Source: nseindia.com

Over the span of 4 years, trading in currency futures contract has increased by around 22 times. Derivatives were introduced on the Indian stock exchanges to contain the volatility of the Indian stock market to integrate the Indian markets with the international markets and also to provide investors with the more innovative risk management tools. The impact of derivatives on volatility is a much debated issue. There have been no conclusive evidence regarding the impact of derivatives trading on volatility. Many studies have been made on the same issue but provided mixed results. Because of low transaction costs and leverage effect, derivatives are assumed to attract speculative trading, thus, destabilizing the volatility of the spot market. On the other side, derivatives are assumed to decrease the spot market volatility by increasing the informational efficiency of the spot market and because of low transactions costs, speculators migrate from spot market to futures market thus stabilizing the cash market.

At the time of introduction of currency futures in India, it was thought that the currency futures market in India would make a notable contribution towards improving currency risk management. Many studies have been made pertaining to various international markets to study the impact of currency futures on the spot market volatility but they produced mixed results. In several cases, the volatility is found to be reduced following the introduction of currency futures, though empirical evidence to the contrary also exists. So, there is no clear evidence to regarding the impact of futures contracts on volatility of the underlying commodity. In the light of the above, it will be interesting to observe and analyze the effect of introduction of currency futures
on spot market exchange rate. The aim of this paper is to analyse the impact of introduction of USD-INR futures contract on the volatility of their spot exchange rates.

REVIEW OF LITERATURE

Despite the popular opinion that increased volatility in numerous financial markets was enhanced by trading in derivatives, the empirical evidence regarding this issue is far from conclusive. Some studies made on the same have been briefed below:

Chatrath, Ramchander and Song (1996) explicitly examined the relationship between level of currency futures trading and the volatility in the spot rates of the British pound, Canadian dollar, Japanese yen, Swiss franc and Deutsche mark. The researchers provide strong evidence on the causality between futures trading volume exchange rate volatility, as it is found out that the trading activity in futures has a positive impact on conditional volatility in the exchange rate changes, with a weaker feedback from the exchange rate fluctuations to the futures volatility. Moreover, futures trading activity is found to decline on the day following increased volatility in spot exchange rates.

Bessembinder and Seguin (1992) examined whether greater S&P 500 futures-trading activity is associated with greater equity volatility. Their evidence indicated that equity volatility is positively related to spot-trading activity and to contemporaneous futures-trading shocks. Moreover, they argue that equity volatility is actually mitigated when the background futures activity is high. These findings contrast significantly with other empirical studies that suggest positive relation between futures trading and spot market variability.

Gulen and Mayhew (2000), in a study of 25 countries, found different results in different countries. They reported that futures trading is associated with increased volatility in the US and Japan. In some countries, there has been no robust, significant effect, and in many others, volatility has been lower after futures have been introduced. Thus results varied from place to place.

Darrat, Rahman and Zhong (2002) found that index futures trading have not increased the volatility in the spot market. And also derivatives trading has led to the development of the spot market.

Ricardo Pereira (2004) attempted to forecast Portuguese Stock Market volatility using different measures of volatility and compared them through the use of both symmetric and asymmetric error statistics. He found smooth superiority of ARCH class models, principally when using RMSE and MME.

Sung, Taek and Park (2004) studied the effect of the introduction of index futures trading in the Korean markets on spot price volatility and market efficiency of the underlying KOSPI 200 stocks relative to the carefully matched non-KOSPI 200 stocks; they found evidence that market volatility has not been affected by futures trading, while market efficiency has improved.

Bhargava and Malhotra (2007) focused on trading in futures on four currencies over the time period of 1982-2000. The authors found evidence that day traders and speculators destabilize the
market for futures. Furthermore it is inconclusive whether hedgers stabilize or destabilize the market. Exchange rate movements affect expected future cash flow by changing the home currency value of foreign cash inflows and outflows and the terms of trade and competition. Hence, the usage of currency derivatives for hedging the unexpected movement of currency becomes more important and essential and its importance is heightened.

Hakim Kanasro, Chandan Rohra, Mumtaz Junejo (2009) examined the presence of volatility at the Karachi Stock Exchange (KSE) by analyzing two Indexes namely KSE-100 Index and All shares index through the use of GARCH family models introduced by Engle (1982), Bollerslev (1986) and Nelson (1991). The empirical results have confirmed the presence of high volatility at Karachi Stock Exchange throughout the study period.

Hojatallah Goudarzi & C. S. Ramanarayanan (2010) examined the volatility of the Indian stock markets and its related stylized facts using ARCH models. The BSE 500 stock index has been used to study the volatility in the Indian stock market over a 10 years period. Two commonly used symmetric volatility models, ARCH and GARCH have been used. The adequacy of selected model has been tested using ARCH-LM test and LB statistics. The study has concluded that GARCH (1, 1) model best explains the volatility of the Indian stock market and its stylized facts including volatility clustering, fat tails and mean reverting satisfactorily.

Johan de Beer (2009) studied the impact of introduction of single stock futures on spot market volatility. The listed shares of thirty-eight South African companies have been evaluated in terms of a possible volatility effect due to the initial trading of their respective single stock futures contracts. GARCH (1, 1) model has been used to establish a volatility structure (pattern of behavior) per company. Results, in general, showed a reduction in the level and changes in the structure of spot market volatility post single stock futures.

DATA & RESEARCH METHODOLOGY

For the present analysis, we have concentrated on the USD-INR currency futures only from 2001 to 2011. This paper will be using the secondary data which has been collected from official website of Reserve Bank of India. The data has been analysed using eviews 5 software.

The study uses GARCH(1,1) technique to capture the impact of currency futures on volatility which is the most popular model out of GARCH class models.

GARCH (1, 1)

The GARCH specification, firstly proposed by Bollerslev (1986), formulates the serial dependence of volatility and incorporates the past observations into the future volatility (Bollerslev et al. 1994)

The GARCH(1,1) model is presented as follows:

\[ R_t = c + R_{t-1} + \varepsilon_t \]

\[ \varepsilon_t = \sqrt{h_t} \]

\[ h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j} \]
\[ \sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \]

News about volatility from the previous period can be measured as the lag of the squared residual from the mean equation (ARCH term). Also, the estimate of \( \beta \) (GARCH term) shows the persistence of volatility to a shock or, alternatively, the impact of old news on volatility.

In order to find the impact of currency futures on volatility, the whole study period has been divided into two parts:

Pre currency derivatives period: 1\textsuperscript{st} April 2000 – 29\textsuperscript{th} August 2008

Post currency derivatives period: 30\textsuperscript{th} Aug 2008 - 31\textsuperscript{st} Dec 2010

To study the impact on volatility following the onset of derivatives trading, a dummy variable has been introduced in the conditional variance equation with the dummy variable (Dummy) taking on the value zero in pre derivatives period, and one in the post derivatives period.

Thus, the GARCH (1,1) equation becomes:

\[ \sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \gamma Dummy \]

If \( \gamma \), the coefficient of the dummy variable, is statistically significant, then it can be said that existence of derivative trading has had an impact on spot market volatility. Further, the sign of \( \gamma \) indicates the direction of change in the spot market volatility. If the coefficient is negative, it can be said that the volatility has reduced post introduction of derivatives and vice versa if the coefficient is positive.

**ANALYSIS OF DATA**

**FIG 1. DESCRIPTIVE STATISTICS OF USD INR EXCHANGE RATE**

- Series: RETUSD
- Sample: 1 2901
- Observations: 2900
- Mean: 7.00e-05
- Median: 0.000000
- Maximum: 0.024903
- Minimum: -0.030065
- Std. Dev.: 0.003854
- Skewness: -0.028043
- Kurtosis: 11.01409
- Jarque-Bera: 7760.986
- Probability: 0.000000
The descriptive statistics of USD-INR exhibits a deviation from normality which has been confirmed using JB test statistic. The stationary of the exchange rate series has also been checked using ADF test with null hypothesis of non stationarity which rejects the null of stationarity at 5% level of significance.

Thus, the non stationary series has been converted into stationary series by taking logarithmic differences using the following equation:

\[ r_t = \log (p_t - p_{t-1}) \]

Where

\[ r_t \] = continuously compounded logarithmic return
\[ p_t \] = exchange rate at day t and
\[ p_{t-1} \] = exchange rate at day t-1

A look at Fig 2 reveals some typical characteristics about the exchange rate series. The exchange rate series exhibit a changing variance, volatility clustering and mean reversion. These characteristics cannot be captured using linear models. Hence, non linear models have been used. Also variance seems to have increased in the later part of the graph.

Using box Jenkins methodology, mean equation has been formulated as AR(3) MA(3) model. The residuals of the linear model have been tested for any correlation using LJUNG Q statistics which reveal autocorrelation among the error terms. The correlogram of squared returns for 20 lags has been given in Table 1 in Appendix.

Further the residuals have been tested for ARCH effects using ARCH LM test using null hypothesis of o heteroskedasticity. The result for ARCH LM test have been presented below in table 2.
After confirming for the ARCH effects, GARCH (1,1) equation has been formulated using dummy variable. The result for GARCH (1,1) equation has been presented in table 3 below.

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>RESID(-1)^2</th>
<th>GARCH(-1)</th>
<th>SERIES01</th>
</tr>
</thead>
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<tr>
<td>F-statistic</td>
<td>47.48479</td>
<td>0.305209</td>
<td>0.746400</td>
<td>1.23E-06</td>
</tr>
<tr>
<td>Prob. F(12,2871)</td>
<td>0.00000</td>
<td>0.024979</td>
<td>0.015093</td>
<td>4.43E-07</td>
</tr>
<tr>
<td>Obs*R-squared</td>
<td>477.6056</td>
<td>12.21867</td>
<td>49.45179</td>
<td>2.788402</td>
</tr>
<tr>
<td>Prob. Chi-Square(12)</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0053</td>
</tr>
</tbody>
</table>

The coefficient of dummy variable is positive and is significant at 5% level as reported by low p values in the last column of the table 3. This indicates that currency futures introduction has increased the volatility of the spot exchange rate. This can also be seen in fig 1, where the variance of the exchange rate seems to have increased in the later years.

**CONCLUSION**

This paper has attempted to find the impact of currency futures on the volatility of exchange rate. Currency futures were introduced with the belief that they will help in hedging the exposures of exchange rate to unfavorable movements in exchange rate. No clear evidence of the impact of futures trading on the volatility of underlying has been obtained yet. So this study attempted to fill the gap in the existing literature. The study employs 10 years data from 2001 to 2010 on USD-INR exchange rate. The study found that the volatility of exchange rates has increased after the introduction of currency futures.
BIBLIOGRAPHY & REFERENCES


http://www.tarj.in
APPENDIX

TABLE 1. CORRELOGRAM OF SQUARED RESIDUALS
Q-STATISTIC PROBABILITIES

<table>
<thead>
<tr>
<th>Autocorrelation</th>
<th>Partial Correlation</th>
<th>AC</th>
<th>PAC</th>
<th>Q-Stat</th>
<th>Prob</th>
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<tbody>
<tr>
<td>**</td>
<td></td>
<td>1</td>
<td>0.272</td>
<td>0.272</td>
<td>214.25</td>
</tr>
<tr>
<td>**</td>
<td></td>
<td>2</td>
<td>0.231</td>
<td>0.170</td>
<td>369.56</td>
</tr>
<tr>
<td>**</td>
<td></td>
<td>3</td>
<td>0.231</td>
<td>0.147</td>
<td>523.97</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>4</td>
<td>0.174</td>
<td>0.063</td>
<td>611.51</td>
</tr>
<tr>
<td>**</td>
<td></td>
<td>5</td>
<td>0.239</td>
<td>0.145</td>
<td>776.72</td>
</tr>
<tr>
<td>**</td>
<td></td>
<td>6</td>
<td>0.222</td>
<td>0.099</td>
<td>919.90</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>7</td>
<td>0.160</td>
<td>0.020</td>
<td>993.83</td>
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<tr>
<td>*</td>
<td></td>
<td>8</td>
<td>0.186</td>
<td>0.061</td>
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<tr>
<td>*</td>
<td></td>
<td>9</td>
<td>0.152</td>
<td>0.023</td>
<td>1162.1</td>
</tr>
<tr>
<td>**</td>
<td></td>
<td>10</td>
<td>0.199</td>
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</tr>
<tr>
<td>*</td>
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<td>11</td>
<td>0.144</td>
<td>-0.003</td>
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</tr>
<tr>
<td>*</td>
<td></td>
<td>12</td>
<td>0.157</td>
<td>0.039</td>
<td>1409.2</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>13</td>
<td>0.176</td>
<td>0.054</td>
<td>1499.0</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>14</td>
<td>0.166</td>
<td>0.044</td>
<td>1579.1</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>15</td>
<td>0.150</td>
<td>0.014</td>
<td>1644.8</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>16</td>
<td>0.184</td>
<td>0.062</td>
<td>1743.6</td>
</tr>
<tr>
<td>**</td>
<td></td>
<td>17</td>
<td>0.198</td>
<td>0.078</td>
<td>1857.4</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>18</td>
<td>0.172</td>
<td>0.024</td>
<td>1943.5</td>
</tr>
<tr>
<td>*</td>
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<td>19</td>
<td>0.157</td>
<td>0.012</td>
<td>2015.4</td>
</tr>
<tr>
<td>*</td>
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<td>20</td>
<td>0.137</td>
<td>-0.006</td>
<td>2069.9</td>
</tr>
</tbody>
</table>
CONTRACT SPECIFICATION FOR US DOLLARS – INDIAN RUPEE (USDINR) CURRENCY FUTURES

Contract specification: USD INR Currency Derivatives

Underlying Rate of exchange between one USD and INR

Exchange of trading National Stock Exchange of India Limited

Security descriptor FUTCUR USDINR

Contract size USD 1000