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- Garg, Bhavet (2011): Towards a New Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

EXCHANGE RATE VOLATILITY IN INDIAN FOREIGN EXCHANGE MARKET WITH SPECIAL REFERENCE TO THE UNITED STATES DOLLAR

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ABSTRACT

Foreign exchange market is one of the biggest traded markets across the world. In Indian foreign exchange market, the transactions are done through banks. Various organizations in India are international player, however they have to bear the exchange rate risk of volatility in the international trade as the exchange rate against United States Dollar has raised five folds during last four decades. Foreign Exchange market in India has become extremely dynamic after 1990s. At present currency market is the most volatile & liquid in all financial market in the world. An exchange rate fluctuation in the United States Dollar in respect to Indian National Rupee portrays rapid and pointed changes. The paper empirically analyzes volatile behavior of United States Dollar in respect to Indian National Rupee. It observes exchange rate volatility using daily exchange rate from 2008 to 2015 of United States Dollar and Indian National Rupee.

KEYWORDS

foreign exchange market, currency market, volatility, usd & inr.

INTRODUCTION

Volatility is one of the most usual measures of risk of a financial asset. It presents a measure for the extent of uncertainty of the financial asset prices and also signifies the variation of the returns from financial asset from their mean returns. Volatility is one of the main measures of risk for a sole financial asset investment; however, for a portfolio of financial assets the volatility depends on the extent of correlation between the returns of the financial assets.

The dispersion of returns is termed as volatility. Volatility is one of the significant factors of risks. The foreign exchange rates may perhaps exhibit higher volatility because of numerous causes like variation from basics, unnecessary speculative foreign exchange transactions, changes in macroeconomic factors, news from home and foreign country.

Foreign exchange rates extreme movements might adversely affect the sections of financial markets, may also affect the indicators of monetary policy which may lead to financial instability. Foreign trade and authentic foreign investments may have unfavorable impact due to undue movements in foreign exchange rate. Particularly if the connection between the spot-futures arbitrage is broken then, not considering the returns form underlying but by observing the fluctuations in exchange rate the investments could then be probably channelized.

Fixed or floating exchange rates are perhaps the main imperative exchange rate systems. Fixed exchange rates are hypothetically does not vary. For an enduring term they stay fixed. On the contrary, floating rates vary with the time. It is not easy to forecast a future floating exchange rate.

Volatility signifies the extent to which a variable say currency exchange rate varies eventually. Intensity of volatility depends on the degree of change in the variable and frequency of changes in the variable. If the degree of a change in the variable is very big or it changes very frequently then, the variable is highly volatile and vice-versa.

In view of the fact that fixed exchange rates does not vary we may say that they are not volatile. On the other hand, floating exchange rates have got the liberty to vary; hence, they are more volatile in nature.

REVIEW OF THE LITERATURE

Figlewaski (1981) argued that speculation in the derivatives market is transmitted to the underlying spot markets. The speculation produces a net loss with some speculators gaining (and others loosing), thereby destabilize the market. Uninformed speculative traders increase price volatility by interjecting noise to a market with limited liquidity. The inflow and existence of the speculators in the derivatives market produces estabilization forces, which creates undesirable bubbles.

Stein (1987) developed a model in which prices are determined by the interaction between hedgers and informed speculators. In this model, opening a futures market has two effects; (1) the futures market improves risk sharing and therefore reduces price volatility, and (2) if the speculators observe a noisy but informative signal, the hedgers react to the noise in the speculative trades, producing an increase in volatility.

Kumar and Seppi (1992) and Jarrow (1992) studied the impact of currency derivatives on spot market volatility and found that speculative trading executed by big players in the derivatives market increases the volatility in the spot exchange rate. Hence, currency futures trading increases the spot market volatility.

In addition to the critique by Meese and Rogoff (1983 a, b), another puzzle quickly emerges, pertaining to the volatility of exchange rates. Marston (1989) notes that the volatility of currencies visibly increases in the '70s, after the end of the fixed exchange rates system of Bretton Woods, while the volatility of the underlying economic factors remains largely unchanged. While he comes to the conclusion that exchange rate returns are excessively volatile in regard to fundamentals, Flood and Rose (1993) conclude that macroeconomic factors can provide only little help in explaining or predicting exchange rate changes. In addition, Schwert (1989) finds some (weak) evidence that equity return volatility helps to explain future macroeconomic volatility, rather than the opposite.

Subsequently, research moves away from economic factors to explain volatility and focuses almost entirely on the new ARCH-type of models and their extensions. To model volatility based mainly on the information contained in the historical volatility, Engle (1982) develops the autoregressive conditional heteroscedasticity (ARCH) model, which is later extended into the generalized ARCH (GARCH) model by Bollerslev (1986). From there on, a multitude of models with different specifications have been constructed in order to take into account the features observed in the financial markets. Bollerslev et al. (1992) and Palm (1996) provide an extensive overview over the earlier family of GARCH models, while Bauwens et al. (2006) look in particular at the multivariate extensions of the GARCH model.

As it has often been observed that financial assets behave differently in market downturns than they do in market upturns, with a notable increase in volatility and correlation during downturns, Patton (2006) tests for asymmetric exchange rate interdependence between the German mark and the yen. Using an extension of the BEKK model, he finds that the mark/dollar and the yen/dollar exchange rates are more correlated when simultaneously depreciating against the dollar than when they are appreciating against the latter. Additionally, in line with the findings of van Dijk et al. (2011), Patton (2006) reports strong evidence for a structural break in the conditional copula with the physical introduction of the euro in January 1999.

Bodart and Reding (2001) show that exchange rates have a significant effect on expected industry stock returns and on their volatility, though the magnitude of this effect is quite small. The study also concludes that the importance of the exchange rate spillovers is influenced by the exchange rate regime, the magnitude, and the direction of exchange rate shocks.

In parallel to the studies examining the influence of macroeconomic variables on the returns of exchange rates, researchers have also paid close attention to the volatility of exchange rates. In one of the first studies on volatilities, Ederington and Lee (1993) find that the scheduled U.S. macroeconomic news announcements are responsible for most of the observed time-of-day and day-of-the-week volatility patterns observed in the foreign exchange market. In a more detailed analysis with a larger set of macroeconomic variables, Andersen and Bollerslev (1998b) confirm the strong announcement effects on the return volatility. The higher volatility observed on certain days of the week is mainly due to a clustering of news releases on such days. Besides the impact of U.S. news announcements,

Andersen and Bollerslev (1998b) also document a number of German variables that have a significant impact on the German mark - U.S. dollar exchange rate. Chaboud et al. (2004) find macroeconomic announcements to be immediately followed by higher trading volume and volatility and both remain elevated for a period of time after the announcement.

In 2013, M. Thenmozhi and Abhijeet Chandra in their research titled, "India Volatility Index (India VIX) and Risk Management in the Indian Stock", have examined the asymmetric relationship between the India Volatility Index (India VIX)3 and stock market returns, and demonstrated that Nifty returns were negatively related to the changes in the India VIX levels; in the case of high upward movements in the market, the returns on the two indices tend to move independently. When the market takes a sharp downward turn, the relationship was not as significant for higher quantiles. This property of the India VIX made it ideal as a risk management tool whereby derivative products based on the volatility index can be used for portfolio insurance against bad declines.

EXCHANGE RATE VOLATILITY

The rise and fall in an exchange rate is termed as exchange rate volatility. It can be calculated on an hourly, daily, weekly, monthly or yearly basis. Volatility offers a thought of a range the exchange rate can vary within a particular period assuming that change in an exchange rate follow a normal distribution. The standard deviation of fluctuations of foreign exchange rates is used to measure volatility of an exchange rate in absolute terms.

Exchange rate volatility is a measure of the propensity for foreign currencies to appreciate or depreciate in rate, thus affecting the profitability of foreign currency transactions. It is the extent of the amount that these currency rates vary and the rate of recurrence of those fluctuations. There are various states of affairs at a time where foreign exchange rate volatility makes the impact, like commercial transactions between parties from different nations and global investments. It is not easy to evade this volatility in such conditions; however, by exercising the futures the users may lock in foreign exchange rates and can tone down the effects of foreign exchange rate volatility. Thus, volatility has an effect on any commercial organization whose business transactions engage two or more nations.

Figure 1.1 demonstrates the charts of the annual volatility for the USD/INR using daily data. It is apparent that volatility is not stable. Volatility is, however, statistically continual.

This means that volatility shows a trend. If it is volatile at present, then it should go on to be volatile.

In the below graph clustering can be seen. Trader cannot make money if volatility is not present. Thus it can be understood that, volatility measures variability, or dispersion about a central tendency — it is a measure of the extent of fluctuations in currency prices. Volatility also has many nuances that make it difficult to examine and execute.

VOLATILITY DYNAMICS

One of the assumptions in *Black & Scholes Option Pricing Model* is that volatility is constant.

However, an established fact about volatility is that when the foreign exchange rate increases (decreases) volatility generally decreases (increases); thus we may conclude that there is an inverse relationship between volatility and the foreign exchange rate. This may be viewed in the Figure 1.2 [depicting USD/INR Foreign Exchange rate versus the historical annual volatility since April 2008].

Second characteristic of volatility is that it is mean reverting. It means that foreign exchange rates ultimately move back towards the mean or average exchange rate. It can be said that, currency exchange rate is mean reverting if currency exchange rate is likely to go down (go up) after striking a upper limit (lowest limit).

VOLATILITY DEFINED

Volatility is a gauge to measure unsteadiness. A volatile material will have a propensity to vary its structure effortlessly. In the currency markets, volatility means that the foreign exchange rate will vary over time. Volatility may also be defined as the deviation of a foreign exchange income.

Volatility signifies the array of a return's fluctuation. If the value of volatility comes to be large, it shows that range in the fluctuation in returns is wide. It means that the foreign exchange rate will fluctuate significantly in a particular period of time. Thus, in a foreign exchange rate returns, volatility is the variation of returns from their arithmetic mean.

For instance, if the foreign exchange data is normally distributed, presuming the arithmetic mean of foreign exchange returns to be zero, then 5% volatility signifies that in a time period of one-year foreign exchange returns will be within [-0.05; +0.05] with 68.3% probability (1σ); within [-0.1; +0.1], with 95.4% probability (2σ), and within [-0.15; +0.15], with 99.7% probability (3σ).

FIGURE 1.1: ANNUAL VOLATILITY OF THE USD/INR SINCE APRIL 2008 USING DAILY DATA

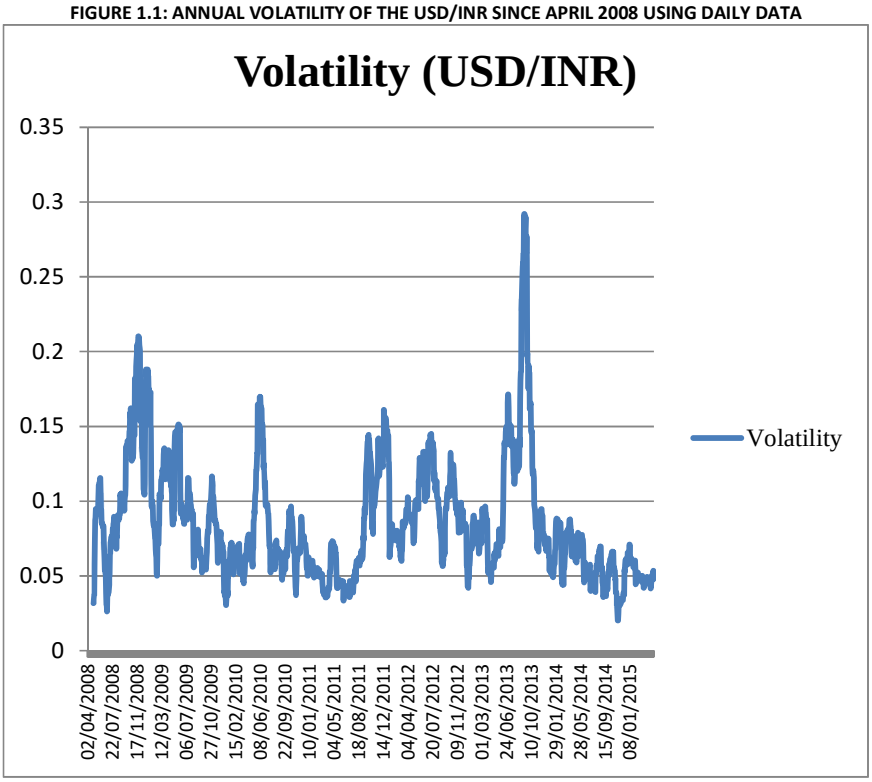
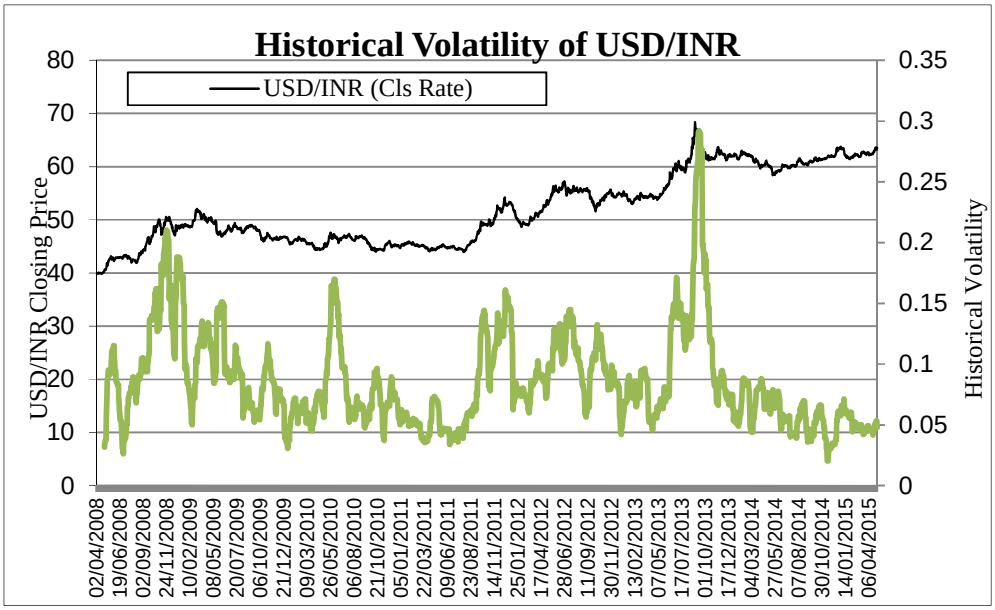


FIGURE 1.2: USD/INR FOREIGN EXCHANGE RATE VERSUS THE HISTORICAL ANNUAL VOLATILITY SINCE APRIL 2008 USING DAILY DATA



THE VARIANCE RATE OF RETURN (σ^2)

Volatility is the amount of variability in the returns of the underlying asset. Risk reflects the chance that the actual return on an investment may be very different than the expected return. One way to measure risk is to calculate the variance (**σ^2**) and standard deviation **(σ)** of the distribution of returns.

Currency risk is the probability that currency returns will be not as expected. The higher the probability, the bigger will be the risk. If a currency risk is large, then it should likely compensate to the foreign exchange trader with a greater return; otherwise, the trader would not at all presume the risk if the probability of a larger return was zero. The dispersions of foreign exchange rate returns can generally be characterized by the normal distribution curve.

Statistical methods like variance and standard deviation are used to quantify risk. Since the higher fluctuations in currency rate signifies a greater dispersion and lower fluctuations in currency rate signifies a smaller dispersion, it refers that currency rate of highly risky currency fluctuates more extensively than for less risky currency. Thus, variance (σ2) and standard deviation (σ) are absolute measure of dispersion, and, coefficient of variation is a relative measure of dispersion, i.e., risk. The degree of fluctuation in foreign exchange rate can be measured by considering the actual historical exchange rates. These values are used to measure the variance in exchange rate or the standard deviation of exchange rate. Variance is measured by computing the deviation between a particular currency exchange rate from its arithmetic mean rate. Variance is measured by the following equation:

$$\sigma^2 = \frac{\Sigma(X-\mu)^2}{N} \qquad (1.1)$$

$$\sigma = \left[\sqrt{\frac{\Sigma(X-\mu)^2}{N}}\right] \qquad (1.2)$$

Where,
σ^2 = Variance
σ = Standard Deviation
X = value of foreign exchange rate
μ = Arithmetic mean of foreign exchange rate
N = Number of observed foreign exchange rates

ESTIMATION OF HISTORICAL VOLATILITY

Let daily foreign exchange rate movements are determined in a foreign exchange market. Then the natural log (ln) of the ratio (Rt) of a foreign exchange rate (S) from the current day (t) to the previous day (t-1) is worked out:

$$R_t = ln\left[\frac{S_t}{S_{t-1}}\right] \qquad (1.3)$$

Then mean of daily fluctuations over a definite time period is computed and afterwards work out mean for them (R_m):

$$R_m = \frac{\Sigma R_t}{n} \qquad (1.4)$$

The historical volatility (σ) is the "average variance" from the mean (the "standard deviation"), and is estimated as:

$$\sigma = \sqrt{\frac{\Sigma (R_t - R_m)^2}{n-1}} \qquad (1.5)$$

To get annualize volatility we need to balance this approximation with an annualisation factor *m* (number of intervals per annum)

$$\sigma_{annual} = \sigma \sqrt{m} \qquad (1.6)$$

For daily data m = 252; for weekly data m = 52; and for monthly data m = 12.

CONCLUSION

Equation (1.5) is the standard deviation of the sampled data of foreign exchange rate R_t. Table 1.1 illustrates historical volatility estimation. It demonstrates daily exchange rates of USD/INR in sequence for 1 month (March 2015) i.e., 21 exchange trading days. The mean for the log relatives R_m is 0.00061256 and the standard deviation is 0.002796457. Annualized historical volatility is 4.43923786%.

This paper investigates exchange–rate volatility for the Indian foreign exchange market with respect to the USD/INR. From the outcome of estimation for volatility of the exchange rates under consideration, it is apparent that the exchange rates between USD/INR are extremely volatile in nature. Volatility clustering is clearly evident in all the phases and among all the exchange rates.

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ANNEXURE

TABLE

TABLE 1.1: HISTORICAL VOLATILITY FOR USD/INR DURING MARCH 2015

Date	USD/INR (Closing Exchange Rate)	R_t	R_t^2
27/02/2015	61.7908		
02/03/2015	61.8248	0.00055009	0.00000030
03/03/2015	61.8387	0.00022480	0.00000005
04/03/2015	61.8543	0.00025224	0.00000006
05/03/2015	62.2015	0.00559750	0.00003133
09/03/2015	62.616	0.00664172	0.00004411
10/03/2015	62.6983	0.00131350	0.00000173
11/03/2015	62.745	0.00074456	0.00000055
12/03/2015	62.5665	-0.00284890	0.00000812
13/03/2015	62.6733	0.00170553	0.00000291
16/03/2015	62.8215	0.00236185	0.00000558
17/03/2015	62.692	-0.00206352	0.00000426
18/03/2015	62.672	-0.00031907	0.00000010
19/03/2015	62.4208	-0.00401622	0.00001613
20/03/2015	62.4923	0.00114480	0.00000131
23/03/2015	62.2879	-0.00327616	0.00001073
24/03/2015	62.1988	-0.00143148	0.00000205
25/03/2015	62.3419	0.00229804	0.00000528
26/03/2015	62.6728	0.00529379	0.00002802
27/03/2015	62.6069	-0.00105205	0.00000111
30/03/2015	62.6305	0.00037688	0.00000014
31/03/2015	62.5908	-0.00063408	0.00000040
	Mean	0.00061256	0.00000782
	Std Dev	0.002796457	
	Annual Volatility σ	4.43923786	

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