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Crash Risk in Indian Currency Futures

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ABSTRACT

This research tries to examine the foreign exchange market risk with foreign currency derivative instrument. In past the currency markets of various countries have been explored by various researchers. Though a lot of studies have been already conducted for derivative instruments in foreign context but in India very few studies has been done till now. They too are restricted to examining the Indian equity markets. The analysis of the exchange rate data for crash risk revealed a mixed skewness. But more prominent is the positive skewness which makes them asymmetrically distributed. Though the positive skewness suggests no crash risk in Indian currency market but this asymmetrical distribution implies that information dissemination process is inefficient in the Indian currency market. Further analysis of crash risk using skewness data shows its absence for the currency pairs i.e. dollar-rupee.

Keywords: crash risk, OLS, derivatives, skewness, currency futures etc.

• INTRODUCTION

Economic risks have always been a prominent feature of the global market. The exposures affect the business in different ways increasing the uncertainties for them. It is vital for the companies to anticipate and manage, eliminate, or at least reduce the exposures and risks, they are exposed to. As firms operate cross borders and in diverse countries, they may trade commodities in different currencies. This gives rise to the globalization and international trade. It is almost impossible to forecast how much or in what direction two particular currencies will move over

time. Currency crisis increases the uncertainty and volatility of the currency exchange market which directly affects the international corporations.

One of the questions arises that why do the firms need to manage currency risk? The answer to this question is based on three types of exposure which a company might have to face if it is operating internationally. The first type of exposure is transaction exposure which is a result of foreign currency denominated contracts of exports, imports or international financing transactions with a defined maturity (Jacque, 1996). The second type is translation exposure which occurs due to direct investment and consolidation of foreign subsidiaries financial statement. Bennett (1997) defines translation exposure as the risk of difference in the values of domestic currency of assets and liabilities due to translation at foreign exchange rate in future. The third exposure is the economic exposure which is defined as the percentage change in economic value of the firm resulting from 1% change in the exchange rate. All the companies exposed to all or any of the mentioned exposures tries to minimize it as much as possible. These all together possibly form a reason to treat currencies as a new asset class. They follow distinctive fundamentals unlike other classes of assets like equity or bond.

Loderer and Pichler (2000) analyzed the currency risk management process of Swiss Industrial Corporation and found that company is unable to measure their currency risk exposure. The reason simply was that firm thought it to be not that relevantas they used on-balance-sheet instruments like profit/loss from forex operations to take shieldfrom currency fluctuations.

The currency risk is an in builtfeature of international business. Fortunately, a number ofderivative instruments including futures, options, swaps contractsetc.are available to manage such risks. Acquaintance with these tools is though necessary, but still not enough. The management of these risks will be effective only if the coordination is done at enterprise level.

The currencies are always exposed to certain risk like depreciation as suggested by M Obstfeld (1995). This results in the crash risk. It has been studied by various researchers like Brunnermeier, Nagel and Pederson (2009),Ames, Bagnarosa, and Peters (2015)with reference to different economies in the world.The major puzzle addressed is uncovered interest rate parity

(UIP). Itsays that the carry gains due to difference in interest rates of low interest rate currency and high interest rate currency is offset by depreciation in the high interest rate currency

- ***Crash Risk***

The international trade gave rise to the theory of interest rate parity. It equates the difference between foreign interest rate and domestic interest rate with the difference in spot and future exchange rates. This parity condition says that

$$I_h = I_f + \partial_{exch} \ldots\ldots\ldots eq1$$

Where

I_h= the home country interest rate

I_f=the foreign country interest rate

∂_{exch} = the expected adjustment of the exchange rates.

It also states that investors are rational and neutral towards risk; therefore, the future exchange rate adjusts itself to the current interest-rate differential. Interest rate parity exists in two different forms: ***uncovered interest rate parity (UIP)*** **and** ***covered interest rate parity (CIP).*** UIP is without a forward contract to hedge exchange rate risk and CIP uses a forward contract to *cover* exchange rate risk.

This study focuses on the crash risk raised due to UIP. UIP postulates that if funds freely flow across freenation borders' and investors attitude is neutral towards risk, then the expected rates of return to substitutable resources denominated in different currencies should be equal after the adjustment of expected depreciation. In equations,

$$\mathbf{S_t - S_{t-1} = i_f - i_h \ldots\ldots\ldots\ldots eq2}$$

$\mathbf{S_t - S_{t-}1}$**=**expected changes in spot exchange rate and

$\mathbf{i_f - i_h}$**=** the interest differentials of two countries.

The basis of UIP is interest arbitrage. It means that if domestic interest rate is less than the expected returns on a similar asset in foreign country, investors tend to borrow indomestic

market and invest in the foreign market. This process adjusts the two interest rates-until both returns reach the same level.

• LITERATURE REVIEW

Rapp and Sharma (1999) explored the performance of the foreign exchange market forG-7 countries. The analysis found that the market is performing well across countries but it's within countries performance is not up to the mark as empirical results are highly mixed. Coleman (1990), analysed the eighteen foreign currencies and found co-integration. Ahmad *et al.* (2012) examined the within and cross-country market performance of 12 Asia-Pacific foreign exchange markets. The research concludes that foreign exchange markets are generally performing well within-country and across-country perspectives. The present study is in line with the findings of Pilbeam and Olmo (2011).

Gali (2020)Under uncovered interest parity (UIP), the size of the effect on the real exchange rate of an anticipated change in real interest rate differentials is invariant to the horizon at which the change is expected. Empirical evidence using US, euro area and UK data points to a substantial deviation from that invariance prediction: expectations of interest rate differentials in the near (distant) future are shown to have much larger (smaller) effects on the real exchange rate than is implied by UIP. Some possible explanations are discussed.

Brunnermeier, Nagel and Pederson (2009)in their study on the crash risk of currencies shared some new views on the major currency puzzles. The major issue taken into consideration is UIP, which hypothesized that the carry gain which arises due to interest rate difference (between low interest rate currency and high interest rate currency) gets compensated by an adequate reduction in the high interest rate currency. The study suggests that high interest rate currencies are exposed to depreciation which may lead to crash risk.

Jurek (2008) studied the violations of uncovered interest rate parity in G10 currencies and found that there are significant excess returns. The data on out-of-the-money foreign exchange options has been used to compute returns to crash-hedged portfolios. It also suggested that the high returns to carry trades are not due to peso problems. A comparative evaluation of the returns on

hedged and un-hedged trades indicated a crash risk premia accounts for around one-third of the excess return to currency carry trades.

Chinn and Meredith (2004) analyzed the data from 1980-2000 for different periods for 6 major currencies and found that four of the estimated coefficients had the wrong sign and were significantly different from the expected coefficient. The study also found that the estimates from the arbitrage equations have a tendency to be highly imprecise, so if the null of unity as well as zero coefficient couldn't be rejected. A variety of reasons could be there for this biasness existing at horizons less than a year and more than a few hours. These reasons majorly fall into three categories: risk premium, estimate errors, and non-linearity. Meredith and Chinn (1998) and Chinn (2006) analyzed and found panel estimates for UIP at five and ten-year horizons for four countries' and obtained coefficients near to the expected ones.

Lothian and Wu (2003) found that UIP does not hold up well empirically in many researches. The failures of UIP have been attributed to the sample used for the study (1980s) and the noise brought by small UIP deviations. It suggested that traditional regressions have positive slope estimates over the whole sample period but it becomes negative when the sample is dominated by the period of the 1980s. The negative estimates during this sample period could be failure of expectations to adjust quickly to the changes in monetary policy of the United Kingdom and the United States. The study also argued that large interest rate differentials have significantly stronger forecasting powers for currency movements than small interest rate differentials.

- ***Objective***

The objective of the study has been formulated on the basis of gap found in the literature review.

- To study the currency crash risk in Indian currency futures market.

• RESEARCH METHODOLOGY

The analysis of this objective starts with uncovered interest rate parity. UIP is more difficult to test as compared to its other form with an existing forward rate. This could be due to reason that

the expectations of future exchange rates are indirectly observable (Isard 1996). Hence, UIP workswith the hypothesis that the present forward rate isequal to the expected exchange rate along with a forecast error defined as:

$$f_t = E_{(t+1)} + e_{(t+1)} \qquad \textbf{eq1}$$

Where,

f_t=current forward rate at time t and

$E_{(t+1)}$= expected exchange rate one period ahead of t

$e_{(t+1)}$ = error term at one period ahead of t

So, the equation for UIP becomes

$$S_{(t+1)}-S_t=r_t-r_t^* + \varepsilon_{(t+1)} \qquad \textbf{eq2}$$

$S_{(t+1)}-S_t$= spot exchange rate differential at time t+1 and t

$r_t-r_t^*$= difference between risk free rate of interest of domestic and foreign currency

The researchers test the validity of the UIP by calculating the parameter values of **α** and β in the equation below:

$$S_{(t+1)}-S_t=\alpha_0+\beta_1(r_t-r_t^*) + \varepsilon_{(t+1)} \qquad \textbf{eq 3}$$

Assuming rational expectations and risk-neutrality amongst investors, the value of alpha coefficient should be zero (α=0). This means the absence of a constant risk premium. The beta is expected to be one (β=1); this suggests a perfect depreciating relationship according to UIP. The investors have captured excess returns in the foreign exchange market through carry trades returns due to failure of UIP. However, the study restricts itself to the testing of UIP and check if crash risk is there or not.

The equation (3) has been used as the base model for UIP; the forward premium regression is included in the scope of this paper. The results of the regression analysis will give a comparison for the other models and emphasize their specific contributions towards statistical analysis of UIRP.

- ***Data***

To test UIP empirically, the data on daily exchange rate for pair of currency rupee –dollar has been taken from the official website of National Stock exchange. The data for risk free rate of

return for India is the return on 91 days T-bills rate (on daily basis). The data for risk free interest rate for foreign currencies 91 days T-bill. To measure the crash risk, the skewness of the exchange rate has been calculated from daily data on monthly basis.

B. Study Period

The period of study is from October 2008 to March 2013. The period has been chosen as the currency derivatives trading commenced from October 2008.

C. Methodology

As mentioned above, the UIP empirically has been tested in the form of equation 3. So, in order to proceed with the OLS regression for estimation of alpha and beta parameters, the data series i.e. exchange rate difference and the interest rate difference have been checked for stationary and autocorrelation.

D. Research Hypothesis

The hypothesis related to the above-mentioned objective are:

The proposition for UIP and crash risk:

- H_{0a}: *The Indian currency derivatives market do not follow uncovered interest rate parity theorem.*
- H_{0b}: *There is no significant crash risk in Indian currency market.*

• ANALYSIS AND RESULTS

Uncovered Interest Rate Parity and Crash Risk

As mentioned earlier that to test the UIP, economists assess empirically estimating the parameter values of α and β in the form:

$$S_{(t+1)}-S_t=\alpha_0+\beta_1(r_t-r_t^*) + \varepsilon_{(t+1)}$$

UIP expects an inverse relationship between the interest-rate differential and exchange rate. To hold this relation true, the alpha coefficient should be zero (α=0) the beta is expected to be one (β=1). This relation empirically has been tested below for currency pair rupee-euro.

The time series data has been checked for autocorrelation and stationary, both the series i.e. exchange rate and interest rate difference were tested for both. The results are summarized below

which suggest that the series is free from auto correlation through Durbin Watson (DW) statistics and is stationary (using Augmented Dickey Fuller statistics).

The DW statistics 2.000001, 1.995727, 1.998120 and 2.034232 lie in decision area of du<d<4-du. The decision area says do not reject the null hypothesis of no autocorrelation, positive or negative. It satisfies the condition for no autocorrelation. Similarly, the test for stationary through Augmented Dickey Fuller found both the series are stationary at first difference form. The results are summarized in table 1.

The results of table 2 clearly indicate that both the time series i.e. exchange rate and interest rate difference are stationary at first difference form so OLS (Least Square) method of regression can be applied to estimate the alpha and beta coefficients. The alpha value is near to zero and beta is negative which is in line with previous findings of violation of UIP. However the coefficients are insignificant and the f-statistics is also insignificant. It means that exchange rate difference is not only depending on interest rate difference series but also some other important variable. It means the null hypothesis cannot be rejected. UIP is not followed in Indian currency derivatives market.

Now after UIP the next step is to verify for crash risk. It has been done by measuring the skewness of the daily exchange rate data. The mean skewness is positive which again suggests the absence of crash risk. The positive value of average skewness again suggests the absence of crash risk.(table 3)

Table 1: Stationary test for Interest rate difference series and Exchange Rate Series

Currency Pair	***Variable***	***Stationary at***	***ADF stat***	***Prob****	***DW stat***	***Akaike info criterion***	***Schwarz criterion***
Rupee-Dollar	*Interest rate series*	*First Difference*	*-35.23164*	*0.0000*	*2.000001*	*16.18617*	*16.19443*
	Exchange Rate Series	*First Difference*	*-33.50840*	*0.0000*	*1.995727*	*1.365350*	*1.373607*

Table 2. Ordinary Least Square

Currency Pair	Variable	Coefficient	Std. Error	t-Statistic	Prob.
Rupee-Dollar	INTERESTDIFF	*-1.50E-05*	*1.72E-05*	*-0.870381*	*0.3843*
	C	*0.002093*	*0.013587*	*0.154026*	*0.8776*
	R-squared	*0.601011*	*F-statistic*		*0.757562*
	Adjusted R-squared	*0.581095*	*Prob*		*0.384261*

	Table 3:Descriptive Statistics				
		Mean	Std. Deviation	Skewness	
		Statistic	Statistic	Statistic	Std. Error
Rupee-Euro	Exchange rate	*7.064930E*	*8.4000731*	***.350***	*.069*

• CONCLUSION

The analysis of the exchange rate data for crash risk revealed a mixed skewness. But more prominent is the positive skewness which makes them asymmetrically distributed. The result for currency pairs rupee-dollar got the positive value of skewness which indicated absence of crash risk. However, the absence of crash risk can't be equalized with the puzzle of uncovered interest rate theory (UIP). UIP expects an inverse relationship between the interest rate differential and exchange rate differential. Here though crash risk is absent but the inverse relationship is also not confirmed. The analysis through OLS regression confirms that UIP is not followed in Indian currency market which negates the chances of crash risk. But the positive skewness and this asymmetrical distribution in Indian currency market implies that information dissemination process is inefficient in the Indian currency market.

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