PRICE DISCOVERY IN CURRENCY MARKETS

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ABSTRACT

Since the introduction of currency futures in India, volume of currency futures trading in the Indian bourses has risen significantly. Indian currency market accounts for around 1% of the total world forex transactions, which stand at about $4 trillion on a daily basis. Currency futures market offer lot of advantages like hedging, price discovery, high liquidity, Counter-party guarantee, low transactions costs, standardized contracts, lower margins and electronic settlement. While there is some doubt about the usefulness of currency futures market for price discovery. The topic of price discovery efficiency in currency futures market has been researched and debated to some extent over the last few years. This paper also examines price discovery efficiency in currency futures market by using intraday data from august 2008 to august 2013. Data is taken from NSE website. Data is analyzed by using Error Correction Model (ECM) and Granger Causality test. Empirical findings of this paper reveal that the spot currency market plays a dominant role, and serve effective price discovery role in the future currency market. Reverse causality also exist in currency spot and futures market.

Keywords: *Currency Futures, Price Discovery, ECM, Granger Causality*

1. Introduction

Financial deleveraging and abrupt reversal of foreign capital flows due to the systemic risk emanated from various international incidences has exaggerated the quantum of currency exposure in India and propelled it to an alarming state which need to be addressed carefully. In order to counter the evil effects of currency exposure on the Indian economy, market regulators in India introduced derivatives trading and initiated the trading of currency futures in INR-USD pair of currency in August 2008 at National Stock Exchange. Aftermath Bombay Stock Exchange (BSE) and Multi Commodity Exchange (MCX-SX) also started trading of currency futures in INR-USD pair of currency in October 2008. Futures on three additional currency pairs, namely INR: EURO, INR: GBP and INR: JPY were introduced at NSE and MCX-SX in February 2010. United Stock Exchange also started trading in these four currency futures from September 2010. The launch of currency futures was taken as a major step in the development of Indian Forex market. Currency futures market had provided a mechanism to alleviate currency exposure and strengthen the microstructure of Indian forex market. Hence its turnover and trading volume has increased to a large extent. Apart from alleviating currency exposure, currency futures

market also perform other important functions as price discovery and contribution to the market efficiency. Price discovery is the process through which closely related markets attempt to reach the equilibrium price. The price discovery literature assumes that prices for an asset in different markets share a common efficient price which represents the fundamental value of an asset. In the long run the prices in different markets converge to the efficient price, but in the short run they might deviate from it due to trading frictions. In current scenario, where trading volume in the future market has increased significantly, price discovery in the spot market and future market becomes an interesting subject. The dynamics of the spot and futures markets, particularly price discovery efficiency and causality in the markets for commodities, stock indexes, and foreign exchange (FX) had been the subject of numerous studies (see, for instance, Kawaller, Koch and Koch (1987), Stoll and Whaley (1990), Chan (1992), Abhyankar (1995), Tse (1995), Brooks, Rew and Ritson (2001) and Darrat, Rahman and Zhong (2002). All these studies had provided different results. Some studies found that spot market is more efficient, some other found future market is efficient in price discovery. Some researchers come across with bilateral causality in spot and future market; some other studies locate that no market is efficient in price discovery. Maximum of these studies were done on equity and commodity futures markets. Only a few had worked on currency futures. This paper makes a contribution in this literature by focusing on price discovery efficiency of currency futures market taking data from the introduction of currency futures in India (29 august 2008) to till now (30th September 2013). The remaining parts of this paper are organized as follows. The next section provides a brief review of the related literature. Section 3 documents the sources of data and methodologies that we have employed. Section 4 discusses and evaluates the empirical results. The last section offers the conclusion.

2. Literature Review

In efficient markets "being smart is no advantage". In efficient markets, there is no possibility for systematically exploitation of excess returns. Neither the smartest investors nor people who have no understanding of investment strategies at all can achieve better investment performance than the market average, because every bit of superior information is already captured in actual asset prices. If one is willing to accept this premise of efficient market theory, he/she will follow that asset price fluctuations are unpredictable because they will be fully determined by the impact of new information – called "news". In perfectly efficient futures and spot markets, new information is reflected in both markets, simultaneously (Raju, M.T. and Karande, Kiran 2003). In perfectly efficient futures and spot markets, informed investors are indifferent between trading in futures and spot market. In the developed economies viz. U.S.A. and U.K., markets are found to be efficient but reverse holds in case of the emerging markets like India, Taiwan, and Bangladesh etc. If one market reacts faster to information and the other market is slow to react, due to market frictions such as transactions costs or market microstructure effects, a lead-lag relation in returns is observed. The market that provides greater liquidity, lower transaction costs, and less restriction, is likely to play a more important role in price discovery (Karmakar, Madhusudan, 2009). A better understanding of the dynamic relation of spot and futures prices and its relation to the basis provides to these "agents" the ability to use hedging in a more efficient way. Price discovery efficiency has been considered as the predominant feature of the efficient futures market (Telser (1981), Garbade and Sibler (1983)). For these reasons, research devoted towards the relationship between futures and spot markets has been voluminous (Chan, Chan and Karolyi, 1991), Madhusudan Karmakar, 2009), Chen and Gau (2010), (Chatrath, A. et. al., 1996) Tse, Xiang, and Fung (2006). Using different methodologies, these studies found confounding results. Some studies found spot market is more efficient in price discovery and some other found that futures market is more efficient. Lyons (2001) in his research paper said that in foreign exchange market, size of currency futures market is relatively small compared with the over the counter spot market. So it is doubtful that a significant share of price determination occurs in currency futures market. Using euro and Japanese yen, Tse, Xiang, and Fung in 2006 determine that the electronic trading platforms are more conducive to price discovery than the floor trading. According to their results, on the electronic platforms, the futures prices lead the spot prices in the case of euro, but not for the Japanese yen, whereas the floor-traded futures markets contribute very little to the price discovery of either currency. Qing-fu, LIU, Jin-qing, ZHANG (2006) finds the long run equilibrium relationships and significant bidirectional information flows between spot and futures market in china, with futures being dominant. Rosenberg and Traub (2007) found that despite the dominance of the foreign exchange spot market in terms of total trading volume, currency futures market had more information share than spot market averaging between 80 and 90 percent based on the methodology used by Hasbrouck (1995) and Gonzalo and Granger (1995). The currencies they examined are the Deutsche Mark, the British Pound, the Japanese Yen and the Swiss Franc. In 2009, Cabrera, Wang and Yang in their research paper report that information found in the spot market leads the futures market for the euro and lags for the yen. Chen and Gau (2010) also studied price discovery for the Japanese yen and the euro around the release of major U.S. macroeconomic announcements and found that the spot market provides a greater contribution to the price discovery than the futures does, and that news releases regarding gross domestic product (GDP), employment, and durable goods have a positive impact on the price discovery of the foreign exchange futures rates.

3. Methodology and Data Description

Main objective of this paper is to examine the price discovery efficiency between future and spot market in currency segment. This study is diagnostic cum causal in nature. To examine the

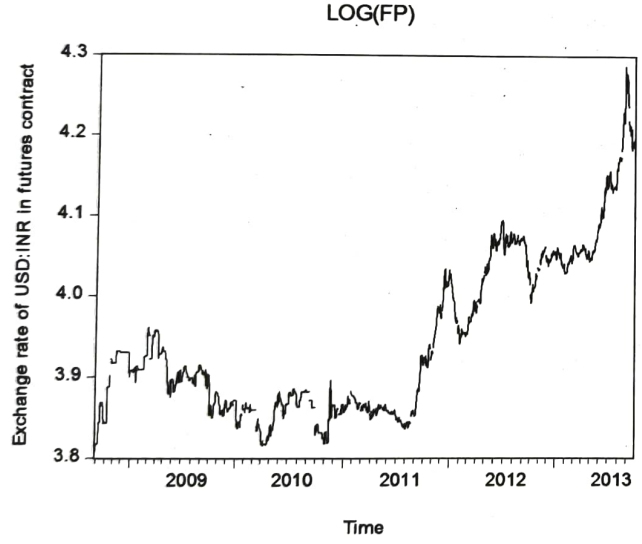
price discovery efficiency in currency segment, the daily data on USD: INR currency pair is obtained from National Stock Exchange (NSE) website. The data span over a period of almost 5 years and 1 month i.e. 29th August 2008 to 30th September 2013. Price discovery is analyzed by using error correction model and granger causality test.

4. Empirical Results and Discussion

The empirical analysis reported here is based on two-stage estimation. In the first stage, Cointegrating relationship among the variables is identified. If cointegrating relationship is identified, the Error correction model includes residuals (lagged one period) taken from the OLS (Ordinary Least Square) applied on future and spot price series to identify price discovery. Before we test for cointegration relation in spot and futures exchange rates of USD: INR currency pair, it is necessary to check the nature of data by using graph and descriptive statistics.

4.1 Graph and Descriptive Statistics:

Figure 1: Graph of Exchange Rate in Spot and Future Market



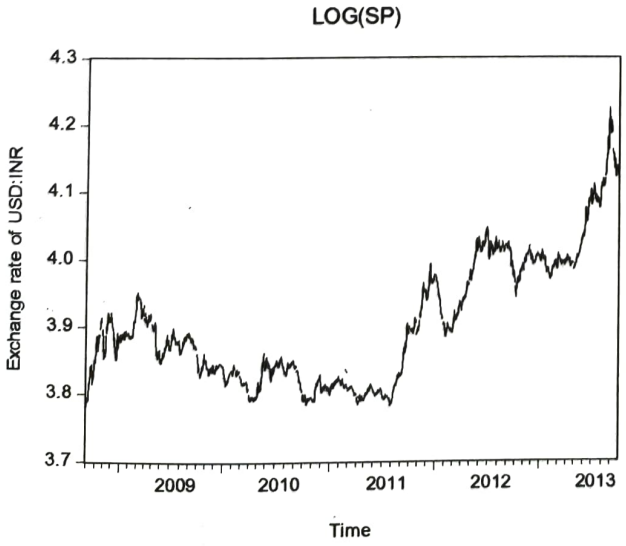


Table 1: Descriptive Statistics

Descriptive Statistics	LOG(SP)	LOG(FP)
Mean	3.90459	3.94408
Median	3.88599	3.90892
Maximum	4.2248	4.28772
Minimum	3.77941	3.80777
Std. Dev.	0.0925	0.09923
Skewness	0.80672	0.8752
Kurtosis	2.99835	2.93762
Jarque-Bera	132.33	155.947
Probability	0	0
Sum	4763.59	4811.78
Sum Sq. Dev.	10.4292	12.0023
Observations	1220	1220

Note: SP=change Rate in Spot Market, FP= Exchange Rate in Future Market

Figure 1: shows that exchange rates of USD: INR currency pair follows an increasing trend in the long run with small fluctuations in the short run. By looking on the graph of spot and futures exchange rates, reveal that both spot and futures exchange rates series are non stationary. Table I reports summary statistics for log future exchange rates and log spot exchange rates of USD: INR Currencies pair under consideration. As expected, both log spot and log future series have similar mean, median, maximum, minimum, standard deviation measures. As mean and standard deviation of future and spot price are same so investor is indifferent between investing in any market. Skewness and kurtosis measures of the future and spot series are near about 0 and 3 respectively but not exact so both future and spot price series are not normally distributed. Jarque Bera test probability value also rejects the null hypothesis of normality in both spot and future exchange rates series at 1% level of significance.

4.2 Stationarity and Cointegration Tests

To examine whether USDINR futures and spot exchange rates are cointegrated, an initial step is to analyze whether each log exchange rates series is integrated [I(1)] or stationary [I(0)]. An I(1) time series is said to have a unit root and any shock in this series is permanent. To identify whether our series are I(1) or I(0), we conduct Augmented Dickey Fuller (ADF) and Phillips-Perron (P-P) unit root test. Table No. 2 shows the results of Unit root test. Augmented Dickey Fuller test T statistics and P values indicate that both future and spot exchange rates series can't reject the null hypothesis at 1%, 5% level of significance so they have unit root at level. It means that both future and spot exchange rates series of USDINR are non stationary at level. Phillips Perron unit root test also support this result. After it we check the unit root at

level, trend and intercept. Both augmented dickey fuller and Phillips Perron test result shows that series also have unit root at level, trend and intercept. Then we check the unit root at 1st difference. Both Augmented Dickey Fuller and Phillips Perron unit root test reject the null hypothesis at 1% level of significance. So it is confirmed that both future and spot exchange rates series are integrated at order 1. For identifying whether movement between the non stationary log spot exchange rates series and log futures exchange rates series are stationary or not, we use OLS (Ordinary Least Square) method as equation (1) and make residual series.

$$S_t = a_i + b_i * F_t + \epsilon_t - - - - - - - - (i)$$

Where S_t = log of spot exchange rates

F_t = log of future exchange rates

$å_t$ = Residual or Error term

Residual series is checked for stationarity at level by using Augmented Dickey Fuller test and Philips Perron test. Both test results (probability value of both test is zero) reject the null hypothesis of unit root at 1% significance level. This shows that future and spot currency market has a cointegrating relationship. Cointegrating relationship between future and spot market is also checked by performing cointegration test. Table No. 3 shows the result of co-integration. Cointegration test also shows that there is a cointegrating relationship between spot and future market.

4.3 Price Discovery

After knowing about the existence of Cointegration in spot and future exchange rates series of USDINR currency pair, this paper used Error correction model for identifying the price discovery between future and spot exchange rates series. The error correction (EC) term coefficient also called the speed of adjustment is significant in both equations (equation with $ÄS_t$ being the dependent variable, equation with $ÄY_t$ being the dependent variable) with correct signs, suggesting a bidirectional error correction. If the EC term (t statistics) in the spot equation (or the equation with $ÄS_t$ being the dependent variable) is greater in absolute term than that of the futures equation (equation with $ÄY_t$ being the dependent variable), indicates that when the cointegrated series is in disequilibrium in the short run, it is the spot price that makes greater adjustment in order to reestablish the equilibrium. In other words, the future price leads the spot price in price discovery. Table no. 4 discusses the error correction model result. t statistics in future equation is higher than spot equation in absolute term. Hence USDINR spot market leads the future market in price discovery. Hence future price make greater adjustment to reestablish equilibrium and spot price perform the price discovery function. This paper also checks the price discovery by applying Granger Causality Test. Table no. 5 reveals the granger causality result. Both the null hypothesis that spot price doesn't cause future price and future price doesn't cause spot price are rejected. So bidirectional causality was found which implies that both futures and cash market contributes to the price movement in other series.

Table 2: Results of ADF and PP Tests for Unit Root on Price Series

Variable	Augmented dickey fuller test						Phillips Perron test					
	Level		Level + trend and intercept		1st difference		Level		Level + trend and intercept		1st difference	
	t-statistics	Prob.value	t-statistics	Prob.value	t-statistics	Prob.value	t-statistics	Prob.value	t-statistics	Prob.value	t-statistics	Prob.value
Log(SP)	-0.2907	0.9238	-1.1827	0.9126	-34.5911	.0000	-0.4026	0.9063	-1.3071	0.8856	-34.6273	.0000
Log(FP)	-0.2314	0.9319	-1.3292	0.8800	-26.7003	.0000	-0.2314	0.9319	-1.2703	0.8943	-34.9094	.0000

Note: Test critical values for level and 1st difference at 1%, 5%, 10% level of significance are -3.4355, -2.8637, -2.5679 respectively, Test critical values for level + trend and intercept at 1%, 5%, 10% level of significance are -3.9656, -3.4135, -3.1288 respectively

Table 3: Co integration Test Result

Hypothesized Number of Cointegrating Equations	Eigen value	Trace statistics	Critical value at 5% level of significance	Probability value**
None*	0.024783	30.51767	15.49471	0.0001
At the most 1	2.21E-05	0.026887	3.841466	0.8697

Note: Trace test statistics indicates 1 cointegrating equation at the 0.05 level, *denotes rejection of hypothesis at the 0.05 level, ** MacKinnon-Haug-Michelis (1999) P-values

Table 4: Error correction model results

Equation	Spot Equation $\ddot{A}S_t = a_1 + a_2 * R(-1) + \mu_t$	Future Equation $\ddot{A}Y_t = b_1 + b_2 * R(-1) + u_t$
Error correction term (T statistics)	-4.3341	4.7698
Error correction term (Probability value)	.0000	.0000

Note: Where $\ddot{A}S_t$ = change in exchange rate in spot market, calculated as $(\log S_t - \log S_{t-1})/\log S_t$,

$\ddot{A}Y_t$ = change in exchange rate in futures market, calculated as $(\log Y_t - \log Y_{t-1})/\log Y_t$,

R (-1) = Residual series resulting from equation 1 at lag 1,

μ_t and u_t = Residual or Error term in spot equation and future equation respectively,

a_1 and b_1 = Constant in spot equation and future equation respectively,

a_2 and b_2 = coefficient of Error correction term in spot equation and future equation respectively

Table 5: Granger Causality Test Results

Null Hypothesis	Observations	F-Statistics	Probability Value
Spot exchange rate does not granger cause future exchange rate	1217	3.73425	0.0242
future exchange rate does not granger cause Spot exchange rate		44.4956	2.E-19

5. Conclusion

Innovation of currency futures have redefined and revolutionized the landscape of financial industry and earned a well deserved and extremely significant place among all the financial derivatives products in India. Previous researches indicate that currency futures were the least used instrument in currency derivatives instruments. In India currency futures are getting popularity and used for hedging and trading purpose after its introduction. The present study has investigated the price discovery efficiency in currency spot and futures market. Empirical findings divulge that the spot currency market plays a dominant role and serve effective price discovery in the future currency market. Reverse causality also exist in currency spot and futures market. Price discovery efficiency helps investors in making efficient strategies for hedging and speculating in futures. From the policy perspective, the price discovery is important for policy makers as it helps them to formulate policy. Interconnectedness of these markets also assists policy makers in stabilization of financial markets. The present study calls for government intervention to check the dynamics of both spot and future forex markets in India.

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