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AN EMPIRICAL EVIDENCE OF THE CASUAL NEXUS BETWEEN INDIAN FOREIGN CURRENCY FUTURES AND SPOT MARKETS

Guntur Anjana Raju

Professor, Department of Commerce, Faculty of Commerce and Management Studies; Goa-University, Goa

Jambotkar Mrunali Manohar

Student of Department of Commerce, Faculty of Commerce and Management Studies; Goa-University, Goa

ABSTRACT

The study empirically analyses the interdependence and price discovery mechanism between the spot and futures prices of Indian Foreign Exchange Market. Using the closing prices of four major currency pairs for a period ranging from August 2008 to February 2018 for USD/INR and from February 2010 to February 2018 for other currency pairs (EURO/INR, GBP/INR and YEN/INR), the study employs Johansen Co-integration test, error correction estimates and granger causality test to identify the leading market and to predict the information efficiency among these two markets. The empirical results evidenced co-integrating relationship between spot and futures prices of USD/INR, EURO/INR and YEN/INR. The results of causality test signifies that spot and futures returns of USD/INR and GBP/INR shows bidirectional or two way causality relationship flow concluding that the both markets leads or influences to each other.

Key words: Foreign Exchange Market, Spot and Futures prices, Granger Causality Test, Price discovery

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INTRODUCTION

Each country uses its own currency to undertake domestic as well as global transactions. The foreign exchange market facilitates exchange of currencies among such countries to promote international trade and commerce all over the world. To raise the standards of Indian foreign exchange market internationally and to hedge against risk in unfavourable changes in forex rate, currency futures trading in India started in the year 2008. Since the emergence of currency futures, the interdependence and price discovery between the spot and futures currency market have been an area of intense investigation. Numerous theoretical and empirical studies were carried out in developed markets to investigate such a lead lag relationship among the spot and future currencies market but studies in emerging markets are carried out few. The lead lag relationship provides an idea on the linkages among the two markets. The information efficiency among the markets determines the strength of price discovery mechanism and reflects the leading and lagging market. Such a feedback relationship will support the decision criteria for hedgers, speculators, Banks, Multinationals, Regulators and other policy decision makers.

REVIEW OF LITERATURE

This section reveals theoretical as well as empirical reviews on temporal relationship between spot and futures prices relating to nature of underlying asset such as Commodity, Equity, Interest rate, Currency etc. There exists an extensive literature in both the equity and commodity segment either for an index or for an underlying stocks or commodities of financial market segment. Several studies by (Min & Najand, 1999), (Stoll & Whaley, 1990), (Pizzi, Economopoulos, & O'Neill, 1998), (Pizzi et al., 1998), (Stoll & Whaley, 1990), (Srinivasan, 2009), (Ullah & Shah, 2013), (Athanasios, 2010), (Mallikarjunappa & Afsal, 2010), (Judge & Reancharoen, 2014)(Peri, Baldi, & Vandone, 2013), (Chhajed & Mehta, 2013), (Sehgal, Rajput, & Dua, 2012), (Tobergte & Curtis, 2013), (Nirmala, 2015), (Sridhar, Sumathy, Sudha, & A, 2016), (Hernandez & Torero, 2010) investigated the lead lag relationship among spot and futures prices of equities and commodities.

(Rosenberg & Traub, 2006), Compared price estimation and information transparency power between the spot and futures market through the application of price discovery models by

Hasbrouck (1995) and Gonzalo and granger (1995). Although the spot market was dominant in total trading volume, the results shows that even the futures currencies market played a significant role in price formation on account of strong transparency as compared to interdealer spot trading.

(Sharma, 2011), examined the influence of currency futures on spot market volatility of Indian foreign exchange market. The study considers USD/INR Currency pair from 2008 to 2010 and the results of granger causality analyses revealed bidirectional causality between spot market volatility and trading activity in exchange rate futures.

(Ersan, 2012), explored the interaction between foreign currency spot and futures prices contract traded in Turkish derivatives exchange from January 2007 to December 2011.The estimation of long and short run equilibrium relationship among the spot and futures currency market is realized through co-integration test, VECM and granger causality analyses which evidence a strong stable association among the spot and futures currency markets. Their findings suggest a significant hedging opportunities and arbitrage profits on account of strong information linkages among the two markets.

(Raghavendra & Velmurugan, 2013), critically examined the efficiency of Indian Forex Market by assessing the lead lag relationship between the spot and futures currencies market. The causality relationship among the spot and futures currency pair of GBP/INR traded in MCX-SX Currency Exchange for a period ranging from February 2010 to December 2012 was examined through the application of Granger causality test. The results concludes one way causality relationship between futures and spot prices indicating currency futures market as a leading and more influencing market in prices discovery.

(Wei, Lu, & Lin, 2015), investigates the price discovery mechanism of Floor and electronic traded futures Market in Euro FX and Japanese Yen and spot market of currency. Various econometric models such as VECM and common factors models derived from it (Hasbrouck 1995, Information Share Model and the Gonzalo and Granger 1995, Permanent- transitory Model) were used to measure price discovery. An empirical evidence suggested an efficient price discovery in electronic trading as compared to floor trading.

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The above background points out the comprehensive research to assess the reflection of price information in the spot and futures currency's market in both domestic as well as international context. The existing theories provide diverse findings with different methodologies, time frame and variables considered under the study. The present study is an attempt to explore this limited explored area and to add value to the existing literature through application of various econometric techniques such as co-integration, error correction mechanism and granger causality test to examine the dynamic linkages between the price changes in spot and futures Indian foreign exchange market.

OBJECTIVES AND METHODOLOGY

OBJECTIVES

- To examine the relationship between Spot and Future Currency Market of India.

HYPOTHESIS

The Null hypotheses formulated to study the significant relationship among the variables are:

1. The data series under consideration are non stationary.
2. There is no long run and short run equilibrium relationship between the spot and futures prices of USD/INR, EURO/INR, YEN/INR and GBP/INR.
3. There is no Causality relationship between the spot and futures prices of USD/INR, EURO/INR, YEN/INR and GBP/INR.

Trading in currency derivatives in Indian context came into effect in the year 2008 for USD/INR and in 2010 for all other three currency pairs. Due to this fact, the data period selected for both the spot and futures returns of USD/INR is from August 2008 to February 2018 and for other currency pairs (EURO/INR, YEN/INR and GBP/INR) was from February 2010 to February 2018. The present study is based on secondary data of Currency Futures prices collected from NSE Website (www.nseindia.com) and currency spot market data was gathered from Reserve Bank of India website (www.rbi.org.in). For Normality of time series data, all price series are converted into its natural logarithms form.

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The objective of research is to represent detailed description of data set & methodology that are used to analyze& provide solution to the research. It includes description of data that are used for analysis. Further it continues with application of key econometric models through E-views such as Unit Root test (Augmented Dickey Fuller test) to determine stationarity properties of all data series, Johansen's Co-integration test to examine the co-integrating movements among two markets in the long run, Vector Error correction Model(VECM) to describe Price discovery Mechanism to reach market equilibrium and finally Granger causality test to estimate lead lag relationship among the spot and futures currency markets.

EMPIRICAL ANALYSIS

Table 1 Summary Statistics for the spot and futures return of Currency pairs traded in India

	Spot Return				Futures Return			
	USD/INR	**EURO/INR**	**GBP/INR**	**JPY/INR**	**USD/INR**	**EURO/INR**	**GBP/INR**	**JPY/INR**
Mean	0.000171	0.000106	0.000101	6.650000	0.000169	0.000171	0.000103	6.56000
Standard Deviation	0.005283	0.006359	0.006311	0.007996	0.005029	0.00675	0.006203	0.008014
Skewness	0.218888	0.351522	-0.510293	0.103166	0.231553	3.491143	-0.734804	0.26946
Kurtosis	7.820181	5.724383	11.31335	5.427063	7.299737	67.95275	14.00898	8.29682
Jarque-Bera	0.389798	634.9718	5626.882	475.8928	0.384369	342298	9894.283	2250.582
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	2273	1925	1925	1925	2273	1925	1925	1925

Descriptive Statistics describes the features of time series data that has been considered for the study. It is observed from the **Table 1** that average values of both the spot and futures returns of JPY/INR is highest as compared to all other currency pairs traded in India. Standard deviation value indicates that INR shows most fluctuations in its return with respect to JPY whereas least fluctuations are indicated with respect to USD. The measures of skewness suggest that all the

variables are skewed positively except GBP/INR, which is negatively skewed. The kurtosis figures depicted that both the spot and futures return series of all the four currency pairs follows a leptokurtic behavior as both their values are more than three. The results of Jarque-Bera test indicates that data series of spot and futures returns of all the currency pairs are not normally distributed.

Table 2: Unit Root Test (ADF) for the spot and futures return of Currency pairs traded in India

Null Hypothesis: Futures and Spot prices has a unit root						
Variable	**Particulars**	**t-Statistic**	**Test critical values**			**P-value**
			1% Level	**5% Level**	**10%Level**	
USD/INR	Forward	-34.72991	-3.433033	-2.862612	-2.567386	0.0000**
	Spot	-47.66455	-3.433032	-2.862611	-2.567386	0.0001**
GBP/INR	Forward	-31.97263	-3.433519	-2.862826	-2.567501	0.0000**
	Spot	-42.44959	-3.433517	-2.862826	-2.567501	0.0000**
EURO/INR	Forward	-41.17118	-3.433517	-2.862826	-2.567501	0.0000**
	Spot	-41.64012	-3.433517	-2.862826	-2.567501	0.0000**
YEN/INR	Forward	-41.17118	-3.433517	-2.862826	-2.567501	0.0000**
	Spot	-43.88783	-3.433517	-2.862826	-2.567501	0.0001**
**indicates rejection of null hypotheses at 5% level						

Source: Compilation by Author

Before proceeding for co-integration analyses it is required to check the level of integration among the variables. Therefore the study examines stationarity properties among the spot and futures prices of all currency pairs (USD/INR, EURO/INR, GBP/INR and YEN/INR). The results of Augmented Dickey Fuller(ADF) test reveals rejection of the formulated null hypothesis that there is a unit root test in the series as the observed values of T-Statistics of USD/INR, EURO/INR, GBP/INR and YEN/INR is greater than the critical values at 5% significance level. So the Unit Root test concludes that the log series of all the spot and futures currency pairs are stationary and follows I (I) order of integration criteria.

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Table 3: Co-integration Test for the spot and futures return of Currency pairs traded in India

Table 3(a) Co-integration Test for USD				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.138884	340.7309	15.49471	0.0001*
At most 1	0.000642	1.457195	3.841466	0.2274
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Table 3(b) Co-integration Test for EURO				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.027190	55.72056	15.49471	0.0000*
At most 1	0.001169	2.268243	3.841466	0.1320
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Table 3(c) Co-integration Test for GBP				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None	0.001301	3.397158	15.49471	0.9460
At most 1	0.000450	0.872683	3.841466	0.3502
Trace test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Table 3(d) Co-integration Test for JPY				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.121340	28.70309	15.49471	0.0003*
At most 1 *	0.003910	0.450555	3.841466	0.5021
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

After considering the necessary precondition of non stationarity of original data series, the analyses proceed to the fundamental co-integrating methodology to determine long run association among the spot and futures currency prices. Co-integration test states that when two non stationarity series are combined then their linear combination may provide for stationarity. The present study uses trace statistics to check the co-integrating vectors between the spot and futures prices of USD/INR, EURO/INR, GBP/INR and YEN/INR. In case of USD/INR, EURO/INR, YEN/INR it is observed that the spot and future prices of the series are co-integrated as the null hypothesis of no co-integrating relationship among these currency pairs is rejected, concluding that the above variables exhibit long run association among both the spot and futures currency prices. The analyses imply that both spot and futures currency market reflects information arrived by discrepancies in exchange rate among these two markets. It means in short run both the markets reacts dis-appropriately to such an information but exhibit an equilibrium relationship in the long run provided markets are information efficient and innovative. So it means that price variations in one market reflect price variations in another

market inorder to bring long run equilibrium among the two markets. A co-integration result showsan acceptance of null hypothesis of no co-integration relationship in case of GBP/INR at 5% significance level and confirms no long run relationship among the spot and futures market of GBP/INR currency pair.

Once the Co-integration outcome has been observed than to examine the leading market and equilibrium adjustment power, we proceed to VECM Model. Thus to detect and further to verify the relationship in the short-run and also to identify the progress of error correction in the short-run to arrive at equilibrium, the VECM model has been used.

Table 4: Vector Error Correction Model (VECM) for the spot and futures return of Currency pairs traded in India

	USD/INR	
Currency Variables	**Ln Futures**	**Ln Spot**
C	-2.28E-06 [-9.6324]	-0.0457 [-1.7718]
Co-integrating Equation$_{t-1}$	-0.3734 [-4.1259]	1.9293 [26.1582]
Ln Futures USD$_{t-1}$	-0.2433 [-3.2882]	-0.8547 [-14.1733]
Ln Futures USD$_{t-2}$	-0.0791 [-1.9095]	-0.2919 [-8.6516]
Ln Spot USD$_{t-1}$	-0.4154 [-6.3837]	0.2431 [4.5840]
Ln Spot USD$_{t-2}$	-0.3051 [-9.6324]	-0.0457 [-1.7718]
	GBP/INR	
C	2.63E-06 [-8.9744]	-0.0871 [-3.2635]
Co-integrating Equation$_{t-1}$	-0.6058 [-6.6672]	1.6175 [21.7547]
Ln Futures GBP$_{t-1}$	-0.0814 [-1.1099]	-0.6783 [-11.3098]
Ln Futures GBP$_{t-2}$	-0.0318 [-0.7573]	-0.2165 [-6.3082]
Ln Spot GBP$_{t-1}$	-0.4617 [-7.2318]	0.0864 [1.6543]
Ln Spot GBP$_{t-2}$	2.63E-06 [0.0164]	1.96E-06 [0.0149]
	YEN/INR	
C	5.83E-06 [0.0279]	6.22E-06 [0.0342]
Co-integrating Equation$_{t-1}$	-0.6277 [-6.9864]	1.3934 [17.8469]

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Ln Futures YEN$_{t-1}$	-0.1394 [-1.9528]	-0.5832 [-9.4052]
Ln Futures YEN$_{t-2}$	-0.0488 [-1.1871]	-0.1688 [-4.7246]
Ln Spot YEN$_{t-1}$	-0.5112 [-7.8264]	-0.0174 [-0.3064]
Ln Spot YEN$_{t-2}$	-0.2824 [-7.9773]	-0.1225 [-3.9824]

Notes: The first values in the table indicates coefficient and in [] indicates t-statistics.

In all the above instances from **Table 4** the error correction coefficient is smaller in the case of currency futures (USD, GBP and YEN) as compare to currency spot. It indicates that currency a future takes more time to make an adjustment to reach at equilibrium and currency spot takes less time. Similarly in the case of one and two lags of independent variables are seen to be significant which means that the flow of information can be takes place from both the markets (From currency spot to currency futures and from currency futures to currency spot).

Table 5: VAR Modelfor the spot and futures return of EURO/INR Currency pair traded in India

	Coefficient	Std. Error	t-Statistics	Prob.
C(1)	0.0950	0.0308	3.0851	0.0020**
C(2)	0.0029	0.0335	0.0859	0.9315
C(3)	-0.0478	0.0355	-1.3480	0.1777
C(4)	-0.0157	0.0328	-0.4789	0.6320
C(5)	0.00016	0.00015	1.0511	0.2933
C(6)	0.5136	0.0265	19.3376	0.0000**
C(7)	0.1236	0.0289	4.2773	0.0000**
C(8)	-0.3319	0.0306	-10.8341	0.0000**
C(9)	-0.0917	0.0282	-3.2457	0.0012**
C(10)	3.88E-05	0.00013	0.2927	0.7697

**indicates rejection of null hypotheses at 5% level

Equations

Ln Futures EURO= C(1)*Ln Futures EURO(-1) + C(2)*Ln Futures EURO(-2)+ C(3)*Ln Spot EURO(-1)+ C(4)*Ln Spot EURO(-2)+C(5)

Ln Spot EURO= C(6)*Ln Futures EURO(-1) + C(7)*Ln Futures EURO(-2)+ C(8)*Ln Spot EURO(-1)+ C(9)*Ln Spot EURO(-2)+C(10)

In the above **Table 5** (represent the Auto regression between the selected Currency spot and futures variables) ** denotes the significant criteria which means we reject the Null hypothesis and accept the Alternative hypothesis at 0.05 level. Thus the significant result in the tables has indicated with **, which means that one and two lags of the variables have an short run influence on the current prices of the other variables as shown in the above tables. Otherwise without** values in the tables states that lags do not produce the short run influence on the other variables

Table 6: Granger Causality Test for the spot and futures return of Currency pairs traded in India

Variable	Null Hypothesis	F-Statistic	Prob*
USD/INR	LN Spot price does not granger cause to LN Future	4.31728	0.0134**
	LN Future does not granger cause to LN Spot	580.952	2E-204**
GBP/INR	LN Spot price does not granger cause to LN Future	4.14041	0.0161**
	LN Future does not granger cause to LN Spot	235.708	2.E-92**
EURO/INR	LN Spot price does not granger cause to LN Future	0.31442	0.7303
	LN Future does not granger cause to LN Spot	128.343	5.E-53**
YEN/INR	LN Spot price does not granger cause to LN Future	0.61753	0.5394
	LN Future does not granger cause to LN Spot	229.197	5.E-90**
** indicates rejection of null hypotheses at 5% level			

Source: Compilation by Author

Granger causality is a technique supports on prediction of causality & discovering the relationship between two variables. It seeks to determine whether past values of a variable helps to predict changes in another variable. The null hypothesis has been tested on the basis of the P-

value. If the P-value is less than 5% level of significance than the null hypothesis is rejected and there will be a significant casual relation among the variables considered under the study

The Granger's causality test is applied to check the direction of causation existing among the spot and futures return of currency pairs (USD/INR, EURO/INR, GBP/INR and YEN/INR). The null hypothesis has been tested on the basis of the P-value. The findings reveal that the null hypothesis of no causality relation has been accepted in case of both EURO/INR and YEN/INR currency pairs, concluding that there exists an Independent causality running among these variables i.e. both future and spot prices of EURO/INR and YEN/INR are independent in their characters. Any change in spot return of EURO/INR and YEN/INR cannot be used to predict the futures returns of these currency pairs and vice-versa. Further unidirectional causality flow from futures prices to spot prices of EURO/INR and YEN/INR has been noted in the above table. And finally the two way causality flow also present in the case of futures and spot prices of USD/INR and GBP/INR. It means both the currency futures and spot markets can be used for prediction each other prices.

CONCLUSION

The study empirically analyzed the association between spot and futures currency market to assess transparency and information efficiency among these markets. The analyses confirmed the existence of co-integrating relationship between spot and futures currency pairs of USD/INR, EURO/INR and YEN/INR. The error correction coefficient suggests that currency Futures (USD, GBP and YEN) takes more time to make an adjustment to reach at equilibrium as compared to currency spot market. The findings of the Granger Causality results exhibited that spot and futures returns of USD/INR and GBP/INR showed bidirectional or two way causality relationship. The price movement in spot and futures markets of GBP/INR and USD/INR brings price changes in each other. Thus the spot and futures prices of GBP/INR and USD/INR play a very leading and dominant role in the price discovery function. The results also revealed that

there is a one way causality flow from futures to spot market of EURO/INR and YEN/INR.So in this case only futures prices can be used as a price discovery of spot of these markets.The outcome of the study will support the decision criteria for hedgers, speculators, Banks, Multinationals, Regulators and other policy decision makers.

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