

LINKAGE BETWEEN EURO FUTURES AND SPOT MARKET: EMPIRICAL EVIDENCE FROM INDIA

-Amandeep Kaur, Research Scholar, Delhi Technological University, Rohini, Delhi

-Narinder Pal Singh, Professor, Cambrian College of Applied Arts and Technology, Ontario, Canada.

ABSTRACT

Expanding trade between India and European Union countries leads to increased EUR/INR transactions which make the currency market more volatile and riskier to trade. Traders and investors who are exposed to currency fluctuations try to hedge their risks by investing in euro futures contracts. In this study, we assess EUR-INR spot and futures prices from January 2010 – December 2019 using Grangers causality, Johansen's cointegration, and VECM techniques. Stationarity of employed dataset is confirmed using ADF test. Existence of long run equilibrium between euro-rupee futures and spot market and at least one cointegrating vector is confirmed using Johansen's cointegration. The Granger causality results signify one-way causality between the price series where, futures prices lead spot prices. The ECT is considered to be significant. Thus, we conclude that the euro futures market at National Stock Exchange (NSE) is efficient and performs price discovery function. Traders, retail investors, policy makers and mutual fund managers who diversify their investments can advance from this study.

Keywords: *Euro Futures, Error Correction, Cointegration, Causality, Currency Derivatives*

INTRODUCTION

Currency Derivatives initiated on August 29, 2008 at the National Stock Exchange (NSE), India with US dollar - Indian Rupee (USD/INR) being the first traded currency pair. Currency derivatives were introduced to limit the instability of the spot market and amplify the price discovery mechanism (Gupta, 2017). In harmony with international application of currency derivatives in trading, National Stock Exchange of India gave its nod for trading in currency derivatives denominated in Euro (EUR) in February 2010 (Sahu, 2012). While deciding futures prices market respondents compare present futures contract prices with spot value that is presumed to be at the maturity of futures contract (Bose, 2007).

Currency futures carry out the purpose of transferring risk and price discovery mechanism. The mechanism of price discovery is referred to as using futures contract prices to price the spot market transactions. Quintessence of price discovery lays on the reality if additional data appears initially in spot market or in futures market (Unlu and Ersoy, 2012). Price discovery has an important role to play for market investors, hedgers and speculators.

United States being the largest destination for Indian exports, much of the existing literature focuses on the currency derivatives denominated in US dollar. Some of these studies are Goyal and Mittal (2014), Kharbanda and Singh (2017), Singh and Tandon (2018), Yadav and Sharma (2019), Unlu and Ersoy (2012). For instance, Vadivel, Veeramani and Raghutla (2020) report that USD/INR exchange rate pass-through provides heterogeneous data that change whole price index in India. Nath and Pacheco (2018) find one-month USD/INR futures and forwards are unbiased estimates of spot prices. However, there is dearth of studies on Euro-Indian rupee futures market. European Union being one of the biggest economy and sizeable trading block in the World categorizes as first for international investments. EU bags the rank of second largest destination for Indian exports encompassing over 14% of the total exports. Goods traded between India and European Union has gone up by 72% in last decade. Resultantly, European Union has become India's one of the largest trading partners accounting for 11.1% of total Indian trade in 2019. European Union has adopted Euro as its official currency for the 19 countries of the Eurozone as well as non-euro member countries namely Sweden, Poland, Romania, Hungary, Croatia, Bulgaria and Czech Republic. It is also being held as an international reserve currency in other nations including India.

A couple of studies on EUR/INR futures market can be discerned from the literature. These are Sahu (2012), Kumar et al. (2017) and Kumar Poornima and Sudarsan (2017). However, Sahu (2012) analyses the effect of EUR/INR futures trading on EUR/INR spot rate instability while Kumar, Poornima and

Sudarsan (2017) studies both USD/INR and EUR/INR markets. Kumar et al. (2017) finds that EUR/INR spot prices Granger causes EUR/INR futures prices, but not conversely. Such conclusions raise the question of price discovery mechanism in EUR/INR futures market while the same is taking place in EUR/INR spot market. However, they further report that the INR-EURO spot has imperceptibly diminished since the launch of currency futures in Indian market. Thus, it leads to some further questions. Whether equilibrium in both short and long run exists in EUR/INR spot and futures markets? Does EUR/INR Futures market lead or lag EUR/INR spot market? Is EUR/INR futures market informationally efficient and performs the functions of risk management and price discovery? The present study intends to scrutinize answers to these questions.

With this backdrop, where USD/INR currency pair has been given thought to frame relation between spot and futures while there is a very shallow pool of literature on association between EUR/INR spot market and futures market, and strategic importance of the India's trade with EU, we are motivated to take up this study. The focus of the study is to assess the linkage among euro futures and spot markets and to investigate the mechanism of price discovery in the Indian euro currency futures market. The rest of the paper has been bifurcated in four sections. Section two portrays the review of literature. Section three gives an overview of the data and methodology employed for analysis. Section four demonstrates empirical results and discussion. Section five gives a brief account of the conclusion, research implications and opportunities for future research.

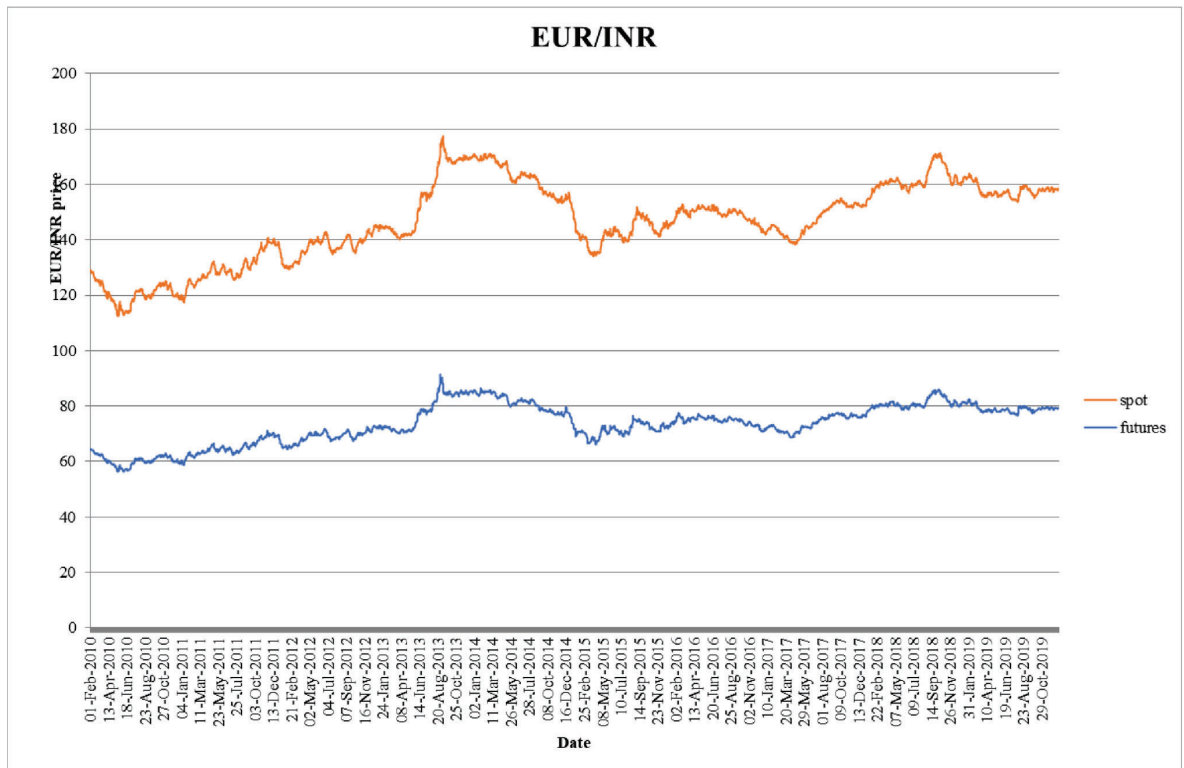


Fig 1: EUR/INR spot prices and futures contract values

LITERATURE REVIEW AND OBJECTIVES OF RESEARCH

Table 1 presents a brief of some important studies available in the literature. It can be gleaned from Table 1 that there exists two-way causality among futures and spot price series (Turkington and Walsh, 1999), (Floros, 2009), (Unlu and Ersoy, 2012), (Zhou, Dong and Wang, 2014), which is in contradiction to results of (Floros and Vougas, 2007), (Sahu, 2012). Further, it surfaces from the literature that a vast pool of studies is available on USD and a few studies are focused on Euro. European Union comes under India's one of the topmost trading partners making Euro one of the widely traded currencies in India. It was in the year 2010 EUR/INR futures were allowed to be traded (Gupta, 2017). This study is one of its kinds and investigates the linkage among Euro futures prices and spot prices. The intents of this study are as per the following:

- To inspect cointegration between euro/rupee spot and futures markets.
- To assess causality among euro/rupee spot and futures markets.
- To analyze the price discovery mechanism of euro/rupee futures markets

Table 1: Brief of Literature Review.

Year	Author(s)	Objective	Methodology	Findings
1999	Turkington and Walsh	To investigate the high-recurrence causal connection between Australian share price futures and All-Ordinaries	ADF, ARMA, VAR	There exists bi-directional causality. Price discovery is moderate which proposes absence of favored market for informed trading in this climate.
2003	Bandivadekar and Ghosh	To assess the impact of futures on spot market unpredictability listed in S&P CNX and BSE	GARCH	Sensex volatility declined due to market effects while S&P CNX volatility declined due to market and futures effect.
2006	Tse, Fung and Xiang	To ascertain price discovery mechanism in currency (Japanese, Euro, and Yen) futures and spot markets.	Hasbrouck information share model, Gonzalo and Granger permanent-transitory model	The outcome portrays electronic trading stages encouraging price discovery than floor trading. Futures market traders may educe information from spot prices.
2007	Floros and Vougas	To explicate price discovery mechanism of futures market over the crisis (1999 to 2001)	Bivariate GARCH	Futures market has been identified with price discovery mechanism than spot market.
2009	Floros	To ascertain price discovery mechanism, causality and lead-lag association among the prices of South African futures and cash.	Johansen's Cointegration, VECM, Granger Causality, Error correction model with TGARCH errors.	Bi-directional causality exists.
2011	Rastogi	To ascertain how exchange traded currency derivatives impacts spot exchange unpredictability.	ARCH-LM, GARCH (1,1)	Spot market found to be weak-form efficient
2012	Sahu	To contemplate the effect of EUR/INR futures trading on EUR/INR spot rate unpredictability	ADF, GARCH	No impact of EUR/INR futures introduction on spot rates
2012	García, Gaytán, and Wolfskill.	To provide evidence as to acknowledge or dismiss the Efficient Markets Hypothesis.	ADF	Findings reports autocorrelation among currency spot prices and thereby rejecting Efficient Markets Hypothesis (EMH) in its weak form.

2012	Unlu and Ersoy	To examine association among Turkish Lira-US dollar spot rate and Turkish Lira-US dollar futures contract traded in Turkish derivatives exchange.	Cointegration test, Error Correction Test	Long run association among foreign currency spot & futures market. Two-way causality exists in the short run and long run.
2014	Zhou, Dong and Wang	To examine volatility spillover impact among futures and spot market in Chinese stock market	VAR, TVP-VAR	Bi-directional volatility spillovers exists between CSI spot and futures markets. Changes in futures volatility decreases fluctuations in spot market volatility.
2014	Goyal and Mittal	To examine the consequences of currency futures on exchange rate unpredictability.	GARCH (1,1)	USD/INR volatility has increased after the introduction of currency futures in India.
2017	Kumar Poornima and Sudarsan	To measure, compare and test the volatility causation between Indian futures and spot market.	ADF, PP, GARCH, E-GARCH, T-GARCH and Granger Causality	USD/INR and EUR/INR spot return granger causes USD/INR and EUR/INR futures return, but converse does not exist. However, Bi-directional causality exists in INR-GBP. Volatility of GBP/INR spot and EUR/INR spot has been moderately decreased since the introduction of currency futures in India.
2017	Martinez and Tse	To examine the effect of Tick-size reduction on market quality and informed trading for EUR, JPY and MXN futures contract	Probability of Informed Trading (PIN), Barclay and Hendershott model, Hasbrouck model	Spreads are significantly reduced, indicating lower transaction costs. Price variance reduced after tick size reduction, supporting increased market quality.
2017	Kharbanda and Singh	To examine lead-lag association among futures and spot market in India	ADF, PP, KPSS, Johansen's cointegration test, VECM	Futures market lead spot market for the USD, EUR, JPY and GBP
2018	Kharbanda and Singh	To comprehend price discovery mechanisms and interconnection among futures and spot markets.	ADF, PP, KPSS, Johansen's cointegration, VECM	Spot prices follow futures prices to accomplish equilibrium, Indian FX market is informationally inefficient.
2018	Singh and Tandon	To analyze the efficiency of US dollar at NSE India	Runs test, ADF, Johansen Cointegration, Granger Causality	Presence of bi-directional causality and cointegration between USD spot and futures.

2018	Nath and Pacheco	To examine effectiveness and volatility of USD/INR.	GARCH, EGARCH, CCC – DCC GARCH (1,1)	USD/INR Futures and forward rates are unprejudiced appraisals of spot rates. Volatility has increased after the introduction of futures
2019	Yadav and Sharma	To survey the impact of arbitrage opportunities on currency futures market in India	Johansen's cointegration, VEC Granger Causality/Block Exogeneity Wald test	Short run arbitrage opportunities in the currency futures market lead to long run equilibrium in the spot market.
2020	Vadivel, Veeramani and Raghutla	To examine time varying characteristics of USD/INR pass through and Wholesale price index	Flexible least square approach	Both export-import of products and services assume fundamental job in USD/INR and wholesale price index fluctuations, also USD/INR pass-through provides heterogeneous data that change WPI in India.

DATA AND METHODOLOGY

Data

The dataset comprises of 2383 data points each of euro spot and euro futures prices. EUR/INR spot and futures prices are gathered from Reserve Bank of India and National Stock Exchange of India website respectively spanning from January 2010 to December 2019. The collected values are the daily closing prices of the spot and futures market. All computations are done using R studio and MS – excel.

Methodology

This segment encompasses the research techniques and tools that have been utilized in this study. Augmented Dickey-Fuller (ADF) test confirms the stationarity in time series. For cointegration among two time series, we used Johansen cointegration. To analyze strength and direction of causality among Euro spot and futures, we used the Vector Error Correction Model (VECM) and Granger causality.

1. Augmented dickey fuller test (adf)

Generally, in practice the majority of the time series are non-stationary at their level form, which can be made stationary on first differencing.

$$\Delta x_t = x_t - x_{t-1} \quad (1)$$

Where, Δx_t is the first order difference. Time series made stationary using first order differencing can be called as “Integrated of order one” denoted by I (1) (Baumöhl, and Lyócsa, 2009). Stationarity test can be done using ADF test which helps to detect the unit root presence in a general time series (Xiao and Phillips, 1998).

2. Johansen cointegration test

Cointegration test examines stability in the long run between two markets (Babatunde and Adefabi, 2005). This study employs Johansen cointegration which computes trace and maximum eigenvalue test statistic. Null hypothesis of no co-integration between

Euro spot and futures price series against the alternative of cointegration has been examined for both the tests. Johansen's cointegration test is an improvement over Engle – Granger cointegration. It dodges the issue of picking a reliant variable and issues which arise when errors are carried from one stage then on to another. Also, it can detect multiple cointegration vectors. The cointegration test is assessed by the rank of the matrix Π .

$$\Delta X_t = \Pi X_{t-1} + \epsilon_t \tag{2}$$

The following equation represents the kth order VAR model of Johansen's test.

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \epsilon_t \tag{3}$$

Where $\Delta Y_t = Y_t - Y_{t-1}$ denotes difference operator,

Π denotes coefficient matrix for the first lag,

Γ_i are the matrices for the differenced lag, and

ϵ_t is the noise term.

Johansen's cointegration employs two approaches namely, trace, λ_{trace} and max eigenvalue, λ_{max} which is a likelihood ratio for which test statistic can be computed using following mathematical equations respectively:

$$\text{LR}(\theta, \theta+1) = -T \ln(1 - \lambda_{\theta+1}) \tag{4}$$

$$\text{LR}(\theta, n) = -T \sum_{i=\theta+1}^n \ln(1 - \lambda_i) \tag{5}$$

Where $\text{LR}(\theta, \theta+1)$ is likelihood ratio of maximum eigenvalue test statistic for null hypothesis rank $(\Pi) = \theta$ versus the alternate hypothesis of rank $(\Pi) = \theta+1$. For trace test, $\text{LR}(\theta, n)$ is the likelihood ratio for null hypothesis rank $(\Pi) = \theta$ versus the alternate hypothesis of rank $(\Pi) \leq n$.

3. Vector error correction model (vecm)

VECM can be applied to non – stationary series which are cointegrated. The upside of the Error Correction Model lies in its quality of catching both the short run and long run equilibration among two time series (Bekhet and Yusop, 2009). If series are found to be non – cointegrated, we can directly proceed to Grangers causality test and hence VECM is not required. A significant negative Error correction term denotes short term fluctuations among series will result in a long run stable relationship (Asari et al, 2011). VECM is estimated using following equations:

$$\Delta X_t = \beta_{X0} + \sum_{i=1}^n \beta_{Xi} \Delta X_{t-i} + \sum_{i=0}^n \delta_{Xi} \Delta Y_{t-i} + \varphi_x Z_{t-1} + \mu_{Yt} \tag{6}$$

$$\Delta Y_t = \beta_{Y0} + \sum_{i=1}^n \beta_{Yi} \Delta X_{t-i} + \sum_{i=0}^n \delta_{Yi} \Delta Y_{t-i} + \varphi_Y Z_{t-1} + \mu_{Xt} \tag{7}$$

Where X is spot prices and Y is futures prices, β_{X0} and β_{Y0} are intercepts, Z_{t-1} is error correction term and β_{Xi} , β_{Yi} , β_{Xi} and β_{Yi} are short run coefficients.

4. Granger causality

Granger causality is applied on stationary time series. Granger causality is used to inspect one-way causality, two – way causality and synchronous adjustments between spot prices and futures contracts (Ajayi, Friedman and Mehdian, 1998). It estimates the lead-lag association among Euro futures and spot price series. Mathematical equations of Grangers causality are as follows: -

$$X_t = \theta_0 + \sum_{i=1}^n \theta_i X_{t-i} + \sum_{j=1}^n \gamma_j Y_{t-j} + \epsilon_t \tag{8}$$

$$Y_t = \beta_0 + \sum_{i=1}^n \beta_i X_{t-i} + \sum_{j=1}^n \alpha_j Y_{t-j} + \epsilon_t \tag{9}$$

Where X and Y are spot price and futures prices respectively, θ_0 and β_0 are constants and ϵ_t and ϵ_t are error terms. Granger causality has been utilized to examine the causality among

Euro futures and spot prices. For mathematical equation (8), if the null hypothesis is rejected, we conclude that Y_t Granger causes X_t . Similarly, causality for mathematical equation (9) is tested.

RESULTS AND DISCUSSION

Augmented dickey fuller (adf) results

ADF test is applied on euro futures and spot prices. The findings are tabulated in Table 2 from which it can be inferred that euro futures and spot prices contain unit root at level form as p-value is greater than 5% significance level. Further, the series are integrated of order one at which p-value is less than the significance level of 5%. Hence, it can be said series are stationary at first order integration.

Table 2: ADF test results.

VARIABLE		DICKEY-FULLER TEST STATISTIC	P-VALUE
Futures Price series	Level form	-2.0151	0.5719
	Difference of degree 1	-13.127	0.01
Spot Price series	Level form	-2.0028	0.5771
	Difference of degree 1	-13.365	0.01

Note: Critical values for ADF test are -2.89 & -3.45 at 1% and 5% level of significance.

Johansen cointegration results

Johansen Cointegration test is delicate to lag length. Optimal lag selection can be done using Akaike's Information Criterion (AIC). Low AIC value is considered better, number of chosen lags for Euro is 8. The alternate hypothesis stands accepted rejecting the null as p-value is less than 0.05 at $r = 0$ which implies there is cointegration among futures and spot prices (see Table 3). The null hypothesis stating there is at most one cointegrating vector among the two-time series is accepted as p-value is greater than 0.05. Resultantly, we can say there is at most one cointegrating vector between futures and spot prices. Hence futures and spot prices of Euro are linked in the long run and would always converge.

Table 3: Eigen and Trace test statistic at vectors 0 and 1.

Null hypothesis	Eigen value	Trace test		Maximum eigen value test	
		Statistics	P-value	Statistics	Statistics
$R = 0$ (none)	0.153328	397.6239 (15.49471)	0.0001	394.9663 (14.26460)	0.0001

R≤1 (at most 1)	0.001119	2.657635 (3.841466)	0.1031	2.657635 (3.841466)	0.1031
-----------------	----------	------------------------	--------	------------------------	--------

figures in parenthesis () represent critical values at the significance level of 5%.

Vector error correction model results

The results of Johansen cointegration imply the existence of long-run association between futures and spot price (see Table 3) which has been applied to ascertain the short-run properties of the futures and spot series. For a stable long-run association between spot market and futures market, the error correction term (ECT) must be significantly negative. It also indicates the speed of adjustment and signifies any changes in the short run relationship will ascent to a stable long run relationship. Spot prices at lag 1, 2, 4 and 5 are significant implying that there is short run causality of its own lag on spot prices, the Error correction term (ECT) signifying about 28% of disequilibrium is corrected whereas futures prices at different lags are insignificant which infers long run causality on futures derived from spot market. Hence, it is inferred that futures market prices makes less adjustment than the spot market prices to reach equilibrium. This is similar to the findings of Kharbanda and Singh (2017).

Table 4: VECM result for EUR/INR spot and futures.

VARIABLES	SPOT	FUTURES
ECT	-0.2809(0.0152) ***	-0.0214(0.0166)
INTERCEPT	0.0501(0.0084) ***	0.0105(0.0092)
SPOT – 1	0.0995(0.0202) ***	-0.0048(0.0222)
FUTURES – 1	-0.2308(0.0241) ***	0.0445(0.0264)
SPOT – 2	0.0453(0.0197) *	-0.0285(0.0216)
FUTURES – 2	-0.1613(0.0238) ***	-0.0454(0.0261)
SPOT – 3	0.0236(0.0192)	0.0156(0.0210)
FUTURES – 3	-0.1238(0.0234) ***	-0.0411(0.0256)
SPOT – 4	0.0766(0.0191) ***	-0.0129(0.0209)
FUTURES – 4	-0.1267(0.0229) ***	0.0195(0.0250)
SPOT – 5	0.0520(0.0190) **	0.0071(0.0208)
FUTURES – 5	-0.1670(0.0225) ***	0.0289(0.0247)
SPOT – 6	0.0164(0.0187)	0.0121(0.0205)
FUTURES – 6	-0.1936(0.0223) ***	-0.0112(0.0245)
SPOT – 7	0.0110(0.0184)	-0.0042(0.0202)
FUTURES – 7	-0.0602(0.0221) **	-0.0146(0.0242)
SPOT – 8	-0.0127(0.0183)	-0.0448(0.0200) *

FUTURES – 8	-0.0383(0.0215)	-0.0303(0.0235)
SPOT – 9	-0.0242(0.0182)	0.0191(0.0200)
FUTURES – 9	0.0278(0.0212)	-0.0420(0.0232)
F – STATISTIC	40.15	1.973

Significance Codes: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05

Granger causality

Granger causality is sensitive to lag length selection which is chosen using AIC criterion. Number of lags chosen is 1. We accept null hypothesis (H01) stating EUR spot does not Granger cause EUR futures thereby, rejecting the alternate hypothesis as p – value turns out to be smaller than the significance level of 0.05. We can infer there exists one-way causality in EUR/INR currency pair, where the futures leads the spot prices. However, the results of our study are in contradiction to Kumar, Poornima and Sudarsan (2017) which states euro has one-way causality where spot market leads futures market.

Table 5: Granger causality test result for EUR/INR.

CURRENCY	NULL HYPOTHESIS	P - VALUE
Euro	EUR Spot prices does not Granger cause EUR futures prices	0.4002
	EUR Futures prices does not Granger cause EUR spot prices	0.01236*

* implies rejection of null hypothesis

CONCLUDING REMARKS

This study focuses on the Euro being the world’s second most traded currency. National Stock Exchange of India gave its nod for trading in currency derivatives denominated in euro in February 2010. To analyze the causal relationship secondary data has been compiled spanning from January 2010 to December 2019 from the websites of RBI and NSE, India. The dataset comprises of spot and futures market daily closing prices. EUR/INR spot and futures prices are not stationary in their level form and hence have been converted to stationary series on first order differencing by applying ADF test. Further, the

long run equilibrium between the two is assessed by Johansen’s cointegration which computes trace and Eigenvalue test statistics. Null hypothesis at vector 0 is rejected and accepted at vector 1. From this, we can infer that there is at least one cointegrating vector and the presence of long run equilibrium between spot and futures prices of EUR/INR.

Further from the results of VECM, we can say spot prices at lag 1, 2, 4 and 5 are significant implying there is short run causality of its own lag on spot prices and Futures prices at different lags are insignificant which infers long run causality on futures market is derived from spot market.

Granger causality is sensitive to lag length which is computed using AIC. The findings of the study shows the existence of one – way causal relation between futures and spot prices, futures contract prices lead spot prices and vice versa does not exist. Thus, we can conclude the existence of equilibrium in the long run between the two markets with futures market taking a lead role in price discovery mechanism.

The findings of this study can assist various participants of foreign trade in India and similar economies. The results are useful to government

officials, importers, exporters, investors, MNCs and many more. The exporters and importers can take positions in EUR/INR futures contracts and hedge against forex risk. Retail investors and mutual fund managers who diversify their investments can be benefitted from this study. This study may also be beneficial to policy makers in taking a rational decision. This study could, therefore, be further extended by employing other currency derivatives traded in India, examining price discovery, lead-lag relationship and market efficiency.

References

1. Ajayi R.A., Friedman J. and Mehdian S.M. (1998). On the relationship between stock returns and exchange rates: tests of granger causality. *Global Finance Journal*, 9(2): 241-251.
2. Asari F.F.A.H., Baharuddin N.S., Jusoh N., Mohamad Z., Shamsudin N., Jusoff K. (2011). A Vector Error Correction Model (VECM) Approach in Explaining the Relationship Between Interest Rate and Inflation Towards Exchange Rate Volatility in Malaysia. *World Applied Sciences Journal* 12 (Special Issue on Bolstering Economic Sustainability): 49-56.
3. Babatunde M.A. and Adefabi R.A. (2005). Long Run Relationship between Education and Economic Growth in Nigeria: Evidence from the Johansen's Cointegration Approach. *Regional Conference on Education in West Africa: Constraints and Opportunities* Dakar, Senegal.
4. Baumöhl E. and Lyócsa S. (2009). Stationarity of time series and the problem of spurious regression. *MPRA Paper No. 27926*.
5. Bandivadekar S., and S. Ghosh. (2003). Derivatives and Volatility on Indian Stock Markets. *Reserve Bank of India Occasional Papers*, Vol. 24(3): 187-201.
6. Bekhet H.A., Yusop N.Y.M. (2009). Assessing the Relationship between Oil Prices, Energy Consumption and Macroeconomic Performance in Malaysia: Co-integration and Vector Error Correction Model (VECM) Approach. *International business research*, Vol. 2(3): 152-175.
7. Bose S. (2007). Commodity Futures Market in India: A Study of Trends in the Notional Multi-Commodity Indices. *ICRA Bulletin*, Vol. 3(3): 125-158.
8. Floros C. (2009). Price Discovery in South African stock index futures market. *International Research Journal of Finance and Economics*, Issue 34: 148-159.
9. Floros C., Vougas D.V. (2007). Lead-Lag relationship between Futures and spot market in Greece: 1991-2001. *International Research Journal of Finance and Economics*, Issue 7: 168-174.
10. García B.Q., Gaytán J.C.T., and Wolfskill L.A. (2012). The role of technical analysis in the foreign exchange market, *Global Journal of Business Research*, Vol 6(3).

11. Goyal N. and Mittal A. (2014). Currency futures impact on the volatility of exchange rate, *Asian Journal of Multidimensional Research*, Vol. 3(4)
12. Gupta R. (2017). EURO/INR futures and exchange rate volatility. *International Journal of Academic Research and Development*, Volume 2(4): 268-270.
13. Kharbanda V., Singh A. (2017). Lead-lag relationship between futures and spot FX market in India. *International Journal of Managerial finance*, Vol. 13(5): 560-577.
14. Kharbanda V., Singh A. (2018). Futures Market efficiency and effectiveness of hedge in Indian Currency market. *International Journal of Emerging Markets*, Vol. 13(6): 2001-2027.
15. Kumar T.K.D., Poornima B.G. and Sudarsan P.K. (2017). Effectiveness of currency futures market in India: An empirical investigation. *IIM Kozhikode Society & Management Review*, Vol. 6(2):196 – 203.
16. Martinez V., and Tse Y. (2019). The impact of Tick-size reductions in foreign exchange futures markets. *Finance Research Letters*, Vol. 28, 32 – 38.
17. Nath G. and Pacheco M. (2018). Currency futures market in India: an empirical analysis of market efficiency and volatility. *Macroeconomics and Finance in Emerging Market Economies*, 11(1), 47-84.
18. Rastogi S. (2011). Impact of currency futures on spot market volatility: An Empirical study. *The Indian Journal of Management*, Vol. 4(2): 3-8.
19. Sahu D. (2012). Dynamics of Currency Futures Trading and Underlying Exchange rate Volatility in India. *Research Journal of Finance and Accounting*, 3(7): 15-23.
20. Singh N.P. and Tandon A. (2018). Is Currency Futures Market at NSE India Informationally Efficient? *Jaipuria International Journal of Management Research*, Vol. 4(1): 21-27.
21. Tse Y., Xiang J., and Fung J.K.W. (2006). Price Discovery in the Foreign Exchange Futures Market. *The Journal of Futures market*, Vol. 26(11): 1131 – 1143.
22. Turkington J., and Walsh D. (1999). Price Discovery and Causality in the Australian Share Price Index Futures Market. *Australian Journal of Management*, 24(2): 97-113.
23. Unlu U., and Ersoy E. (2012). The causal relationship between foreign currency futures and spot market: evidence from Turkey. *Investment Management and Financial Innovations*, Volume 9(2): 208 – 212.
24. Vadivel A., Veeramani S., and Raghutla C. (2020). Exchange rate (USD/INR) pass-through and wholesale price index: A flexible least square approach. *Journal of Public Affairs*, e2087.
25. Xiao Z., Phillips P.C.B. (1998). An ADF coefficient test for a unit root in ARMA models of unknown order with empirical applications to the US economy. *Econometrics Journal*, Vol. 1: 27–43.
26. Yadav A.C. and Sharma M. (2019). Impact of arbitrage opportunities on currency futures market in India. *International Journal of 360 Management Review*, Vol. 7(1).
27. Zhou Z., Dong H. and Wang S. (2014). Intraday Volatility spillovers between Index futures and spot market: Evidence from China. *2nd International Conference on Information Technology and Quantitative Management*.