



Testing The Cointegration Of Foreign Exchange Market In India

* Yuvaraj. D ** Dr. J. Gayathri

* Lecturer in Management Studies, Sri Balaji Chockalingam Engineering College, ACS Nagar, Arni

** Assistant Professor, Department of Commerce & Financial Studies, Bharathidasan University, Trichy

ABSTRACT

The main objective of this paper is to examine the non stationary and cointegration of foreign exchange market. The closing spot prices of daily data consisting of USD/INR, EUR/INR, JPY/INR and GBP/INR for the period of 1st Jan 2002 to 31st Dec 2011 was analyzed using Augmented Dickey Fuller Test, Johansen Co Integration Test and Granger Causality Test. The results confirm that there is no stationary and no cointegration among Foreign Exchange Market in India.

Keywords : Cointegration, Stationary, Foreign Exchange Market, Spot Prices.

Introduction

Foreign Exchange Market

The evolution of India's foreign exchange market may be viewed in line with the shifts in India's exchange rate policies over the last few decades from a par value system to a basket-peg and further to a managed float exchange rate system. During the period from 1947 to 1971, India followed the par value system of exchange rate. Initially the rupee's external par value was fixed at 4.15 grains of fine gold. Since the sterling-dollar exchange rate was kept stable by the US monetary authority, the exchange rates of rupee in terms of gold as well as the dollar and other currencies were indirectly kept stable. The devaluation of rupee in September 1949 and June 1966 in terms of gold resulted in the reduction of the par value of rupee in terms of gold to 2.88 and 1.83 grains of fine gold, respectively. The exchange rate of the rupee remained unchanged between 1966 and 1971.

The foreign exchange market India is growing very rapidly. In the year 2008-2009 annual turnover of the market is more than \$400 billion. Comparing this with the monthly trading volume of about 120 billion US dollars for all cash, derivatives and debt instruments put together in the country, and the sheer size of the foreign exchange market becomes clear. The foreign exchange market in India started in earnest less than three decades ago when in 1978 the government allowed banks to trade foreign exchange among them during the day.

Review Of Literature

The paper by Sashikanth & Reddy Dareddy, (2009), in their paper "Testing the Efficiency of Indian Foreign Exchange Markets: An Empirical Study" This paper investigates the efficiency of foreign exchange (spot) markets, in India. The study period is from Jan 1999 June 2009. As a result of study conclude that the foreign exchange (spot) markets in India conform to both weak form & semi-strong form efficiency.

Abdullah M. Norman and Minhaz U. Ahmed (2008), in their paper "Efficiency of the foreign exchange markets in South Asian Countries" examined the weak form efficiency of the foreign exchange markets in seven SAARC countries using

monthly return series for each of these markets over a period of 21 years (1985-2005). The test statistics in all cases show that the nominal exchange rates of these countries contain unit root.

The paper "An Analysis of The Efficiency of The Foreign Exchange Market in Kenya" by Sifunjo E. Kisaka, Ngugi W. Rose & Pokhariyal Ganesh (2008), analysed the weak form using Run Tests, Unit Root Tests and the Ljung-Box Q-statistics. Evidence on the efficiency of the foreign exchange market in Kenya is not conclusive. ADF test and the Serial Correlation Tests (Ljung-Box Q-statistics) strongly suggested that the foreign exchange market is not efficient.

Michael Kuhl, (2007) in his paper "Cointegration in The Foreign Exchange Market and Market Efficiency since the Introduction of The Euro: Evidence Based On Bivariate Cointegration Analyses" examined the market efficiency. Descriptive tests, Unit Root test, and bivariate cointegration analysis are used to analyse this study. The results conclude the co integration between pairs of daily foreign exchange rates.

The paper by Guneratne B Wickremasinghe (2004), entitled "Efficiency of Foreign Exchange Markets: A Developing Country Perspective" tests efficiency of the foreign exchange market in Sri Lanka. Weak-form efficiency is examined using unit root tests while semi-strong form efficiency is tested using Granger causality tests and Variance Decomposition Analysis. Results indicate that the Sri Lankan foreign exchange market is consistent with the weak-form and semi-strong form efficiency.

The earlier studies were related to the testing of foreign exchange market's efficiency. Augmented Dickey Fuller test, Phillips Perron test, Auto correlation test, Runs Test, were used to measure the weak form efficiency and Johansen co integration test, Engle Granger 2 step test, Granger Causality test were used to test the Cointegration. The present study is focused on testing the Cointegration of Foreign Exchange Market in India. Augmented Dickey Fuller test, Johansen Cointegration test and Granger Causality models were used to examine co integration of Foreign Exchange Market in India. Few studies have been carried out in India to test the co integration of Foreign Exchange market rates.

Research Design Of The Study

Statement of the Problem

Last two decades the exchange rates were fluctuated on periodically and also the rates may or may not be reliant with other exchange rates. The burning issue of declining rupee value against US Dollar, Euro and Yen is considered as prime importance. Under these circumstances it is necessary to study the Co integration of Foreign Exchange Market. Moreover there is no unified or centrally cleared market for the majority of Foreign exchange trades, and there is very little cross-border regulation.

Need of the Study

Foreign Exchange rates are considered to be one of the important economic variables for a country. The study has been conducted to test the cointegration of foreign exchange market in various developed and developing countries. However in Indian perspective only few researches have been carried out in this area. Therefore, the study on the Cointegration of the foreign exchange market would enable the market participants to forecast the exchange rate movement.

The following are the objectives of the study

- To examine the stationary in the spot prices of sample exchange rates.
- To analyze the co integration of sample exchange rates.
- To summarize the findings, suggestions and conclusion.

Following hypothesis were tested in this study

- NH 1: Closing spot prices of USD, EUR, GBP and JPY/INR are non stationary.
- NH 2: There is no co integration in Sample exchange rates.

Data

The daily closing spot exchange rates for this study was collected from the websites www.exchangerate.com and www.oanda.com. For the present study the following four pairs of exchange rates are considered as samples which were in the top list with respect to volume traded. Mid rates of sample exchange rates were taken in to consideration for analysis purpose for the period of 01st Jan 2002 - 20th Dec 2011. These sample exchange rates are: - 'United States Dollar/Indian Rupee, Euro/Indian Rupee, Great Britain Pound/Indian Rupee and Japanese Yen/Indian Rupee'.

Tools used for analysis

A. Augmented Dicky-Fuller Test: Augmented Dicky-Fuller Test can decide whether the time-series is difference stationary or trend stationary, a necessary property for random walk process, it is not able to detect the serial correlation of error terms.

B. Johansen Co integration Test: Johansen Co integration test is used to find out the long term relationship between the samples. This test does not require all variables to be in the same order of integration, and hence this test is much more convenient than the EngleGranger test for unit roots which is based on the DickeyFuller test.

C. Granger Causality Test: Granger Causality Test is a statistical concept of causality that is based on prediction. This test is used to find out the Short term interdependence between the samples.

Data Analysis & Interpretation

Analysis of Augmented dickey Fuller Test

Table 1 : Augmented Dickey fuller (ADF) Test results for USD, EUR, JPY and GBP/INR

Exchange rate pairs	Level		First differences	
	Intercept	1% Sig value	Intercept	1% Sig value
USD/INR	-1.183439	-3.432464	-20.22156	-3.432465
EUR/INR	-1.811989	-3.432464	-54.50923	-3.432465
GBP/INR	-2.720746	-3.432464	-42.33884	-3.432465
JPY/INR	0.620693	-3.432464	-52.80376	-3.432465

Source: computed from E views

Table 1 exhibits the empirical results of Augmented Dickey Fuller Test for the USD/INR, EUR/INR, JPY/INR and GBP/INR. The Test statistical value for the Augmented Dickey-Fuller Test statistics is not more than the critical value at 1% level of significance, then the null hypothesis H01 "Closing spot prices of USD, EUR, GBP and JPY/INR are non stationary" was accepted. The first difference of Test statistical value for the Augmented Dickey-Fuller Test is more than the critical value at 1% level of significance. The exchange rates are stationary at first differences both for intercept. The USD/INR, EUR/INR, JPY/INR and GBP/INR exchange rate under consideration is non-stationary in their level and become stationary when they are first differenced.

Analysis of Johansen Co integration Test

Table 2 : Johansen Co integration test for USD/INR, EUR/INR, JPY/INR and GBP/INR

A. Johansen Co integration test Trace Statistic Results for sample Exchange Rates

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	5 Percent Critical Value	Probability**
None	0.002492	19.27487	47.85613	0.9942
At most 1	0.001532	10.17359	29.79707	0.9776
At most 2	0.001253	4.581287	15.49471	0.8516
At most 3	2.30E-06	0.008406	3.841466	0.9266

Trace test indices no co integration at both 5% and 1% levels

B. Johansen Co integration test Max Eigen value Results for sample Exchange Rates.

Hypothesized No. of CE(s)	Eigen value	Max-Eigen value Statistic	5 Percent Critical Value	Probability**
None	0.002492	9.101281	27.58434	0.9941
At most 1	0.001532	5.592303	21.13162	0.9897
At most 2	0.001253	4.572881	14.26460	0.7945
At most 3	2.30E-06	0.008406	3.841466	0.9266

Source: computed from E views, Max-Eigen value test indicates no cointegration at both 5% and 1% levels, *(**) denotes rejection of the hypothesis at the 5% (1%) level

Johansen Co-integration Test was conducted to check the long run equilibrium relationship between the variables. The Co-integration between exchange rate pairs was tested with unrestricted co-integration trace statistics and Max- Eigen value. Trace value and Max- Eigen values are lower than critical value at the 5% level of significance. There is no co-movement relationship between Foreign exchange rates. Trace statistic and Max-Eigen Statistic values are 19.274, 10.173, 4.581 & 0.008 and 9.101, 5.592, 4.572 & 0.008 which were lower than the critical value i.e. 47.856, 29.797, 15.494 & 3.841 and 27.584, 21.131, 14.264 & 3.841. Hence the null hypothesis H04 'There is no co integration in Sample exchange rates' should be accepted for at most 1, 2 & 3 and none. The result of Johansen co integration test says there is no long term co integration among sample exchange rates.

Analysis of Granger Causality Test

Table 3:1. Granger Causality test results for USD/INR, EUR/INR, JPY/INR and GBP/INR

Exchange Rate Pairs	Obs	F-Statistic	Prob
JPY_INR does not Granger Cause USD_INR	3648	2.56262	0.02537
USD_INR does not Granger Cause JPY_INR		3.70345*	0.00240
GBP_INR does not Granger Cause USD_INR	3648	3.90113*	0.00158
USD_INR does not Granger Cause GBP_INR		2.93936	0.01185
EUR_INR does not Granger Cause USD_INR	3648	3.90889*	0.00155
USD_INR does not Granger Cause EUR_INR		0.47001	0.79886
GBP_INR does not Granger Cause JPY_INR	3648	3.56907*	0.00320
JPY_INR does not Granger Cause GBP_INR		4.85141*	0.00020
EUR_INR does not Granger Cause JPY_INR	3648	2.72978	0.01815
JPY_INR does not Granger Cause EUR_INR		1.67227	0.13772
EUR_INR does not Granger Cause GBP_INR	3648	5.23132*	8.6E-05
GBP_INR does not Granger Cause EUR_INR		3.09669	0.00858

Source: computed from E views, *rejected the null hypothesis "F-Statistic" with the critical value of 3.60 at 1% significance

Table reveals the Granger Causality results for examining the short run relationship between Foreign exchange rates. The rule is if F statistic value exceeds the critical F value at the chosen level of significance, and then the null hypothesis is rejected.

Similarly the F statistics value for foreign exchange rate is 3.703, 3.901, 3.908, 3.569, 4.851 & 5.231 which exceed the critical F value (3.60) at 1% significance level. On the other end another six exchange rate pairs did not exceed the F-Critical value (3.60) at 1% significant level. Hence, the null hypothesis, partially H02 'There is no co integration in Sample exchange rates' is accepted. In this analysis, only six different combinations of the exchange rate pairs have short term interdependence. Granger Causality test result says that there is no short term independence among USD/INR, EUR/INR, JPY/INR and GBP/INR exchange rates.

Findings

Augmented Dickey Fuller (ADF) indicates there is non stationarity in USD/INR, EUR/INR, JPY/INR and GBP/INR. The test result shows that the exchange rates of our country contain unit root. It can be concluded that there is a healthy presence of stationary when it is first differenced.

The Co-integration between Exchange Rate Pairs was tested with unrestricted Co-Integration Trace Statistics and Max-Eigen Value. Trace Statistics and Max-Eigen Values were lower than critical value. This result shows that there no was Co-Integration between Foreign Exchange Rates at the hypothesis of at most 1, 2 & 3 and none. That means there was no long term relationship between the Foreign Exchange Rates.

The Bi-directional Granger Causality between the Foreign Exchange Rates reveals that there was no co integration between the Foreign Exchange Rates. That means that there

was no short term interdependence between the Foreign Exchange Rates.

Conclusion

The present study investigated the efficiency of Foreign Exchange Rate in India. This study attempted to test the Co Integration between the Sample Exchange Rates. The daily data consisted of closing Spot Rates for the period of 10 years from 1st Jan 2002 to 31st Dec 2011. USD/INR, EUR/INR, GBP/INR and JPY/INR were chosen as samples. Augmented Dickey Fuller Test, Johansen Test & Granger Causality Tests were used to test the co integration among the Exchange Rates. The Augmented Dickey-Fuller Test confirmed that all the Exchange Rate Pairs were weak form efficient which means that Past Exchange Rates cannot be used to predict Future Exchange Rates and Co Integration Tests confirmed that there was no long term relationship and short term independence between Exchange Rates. Some of the currency pairs were co integrated in short term independent. It can be finally concluded that the Foreign Exchange Market is efficient and there is no co integration between the sample exchange rates and every exchange rate pairs were moving on their own path and doesn't depending on any other exchange rate.

Scope for Further Research

The interesting areas are left for further researchers. The future study can focus on the Semi Strong Form and Strong Efficiency of Indian Foreign Exchange Market. The study with similar objectives could be made from time to time. It can also focus on analyzing Futures and Option Market. Further, researchers can test all the Exchange Rates that are traded in foreign exchange market in India. Researchers can use the high frequency of data in further research.

REFERENCES

- Abullah M. Noman and Minhaz U. Ahmed "Efficiency of the Foreign Exchange Markets in South Asian Countries" (2008), <http://orp.aiub.edu/WorkingPaper/WorkingPaper.aspx?> | Apte (2009), 'International Financial Management', Tata McGraw Hill Publishing Company Ltd, NewDelhi, 5th ed | Brigham & Houston (2001) "Fundamentals of Financial Management", South Western Publishers, PP 755-756 | Dareddy, Sashikanth Reddy "Testing the Efficiency of Indian Foreign Exchange Markets: An Empirical Study" (2008-09), www.ssrn.com | Gurusamy.S, (2008) 'Essentials of Financial Services' Tata McGraw Hill Publishing company Ltd, NewDelhi, | Guneratne B Wickremasinghe, "Efficiency of Foreign Exchange Markets: A Developing Country Perspective" (2004), www.ssrn.com | Sifunjo E. Kisaka, Ngugi W. Rose, Pokhariyal Ganesh, "An Analysis of the Efficiency of the Foreign Exchange Market In Kenya", Economics Bulletin, Vol. 14, No. 2 (2008), | Kothari.C.R (1995), 'Research Methodology Methods and Techniques' Wishwa Prakashan publishers. | Michael Kuhl, (2007) "Cointegration in The Foreign Exchange Market and Market Efficiency since the Introduction of The Euro: Evidence Based on Bivariate Cointegration Analyses" www.jstor.com | Swarna D.Dutt and Dipak Ghosh, "A Note On The Foreign Exchange Market Efficiency Hypothesis" Journal of Economics and Finance, Vol 23, No.2, (1999), PP 157 -161 | <http://www.ExchangeRate.com/> | <http://www.oanda.com/>