DYNAMICS OF FOREIGN EXCHANGE RATES

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ABSTRACT

There are many fundamental factors which determine the foreign exchange rates. These can be determined by either peg system of the central bank or by demand and supply forces at the currency markets. This creates an interesting question about the determination of forex due to the currency assets co-movements. The present study is an attempt to analyse the co-movements of the six major currencies, with five foreign exchanges and understand the theory behind this co-integration. The study concluded that markets being efficient react to a particular event and cause the markets to co-move. Furthermore, the study intended to examine the effect of volatility of one currency pair on the other, which was found to be significant. Hence, it can be said that also the volatility in foreign exchange can affect the movements of other exchange rate.

Keywords: Foreign Exchange Rate, Co-integration, VAR, VEC, GARCH, EMH, Volatility

JEL Classification: G120, G140, G170

INTRODUCTION

Recently, the determination of foreign exchange rate, have been seen as a residual of the theory to control inflation of the country. The focus of the apex bank has been to control inflation, by using monetary policy tools, where they affect directly the CPI figures. But when intruding in the analysis of the determination of exchange rate, important factors like trade of the currency in FOREX markets also play important role in such purpose. These lead to unlocking the facts of these markets, where microstructures are seen to be important determinants.

In fact, the Global changes in the environment of Foreign Exchange Markets, are figuring that management of foreign exchange mechanism is important, in order to maintain the financial stability in the economy. This is evidenced from the China's move towards the devaluation of its currency in order to meet the export crunch and hence to restore the financial stability.

The review of literature has helped in understanding the fundamentals of foreign exchange market. Messe and Rogoff (1983) explained that random walk forecast for determining the exchange rate is better to the fundamental theories. It is not saying that one can outcast the fundamental theories, but instead, market analysis of the models, would give better results. Also, the forecasting could be observed in shorter time period (MacDonald and Taylor, 1994). In addition, the prices of the speculative assets would never co-move, as co-movement would oppose the weak form of market. This means that co-integration will exist only when the prices of one asset could predict the prices of other.

The fundamental models have been strongly analysed and used for determining exchange rate (Dornbusch, 1976). Even these have been used to locate the bilateral relationship with other currency pairs. But, there have been no evidence which can show the forecasting power of one currency over the other, or in other words, does the long run co-movements of currency pairs, determine each other? Still there is no lucid picture of this relationship. Is FOREX market efficient, where movements are due to the available movement of some market information? Also, the purpose of this study is to identify the variances caused in the foreign exchange rate, due to the fluctuations caused in the other currency pairs. This helps in understanding the logic behind the international capital asset pricing model, where the investment returns are measured by the risk of fluctuating currencies. Also, in the literature, there are evidences, which showed the correlations in the forex market, which helped in knowing the long run relationships. There are dubious views on the co-integration of currency pairs, which can be used to forecast the exchange rate or determine it.

For this purpose, the study used Foreign exchange as the main variable. The ups and downs of the market and the fluctuations in the rates were used to find out the relationship between them. This would help in knowing the excess co-movements between the currencies. This discussion opens the door to multivariate modeling where not only the volatilities but also the correlations were investigated. There are now a large number of multivariate ARCH models to choose from. These turn out often to be difficult to estimate and to have large numbers of parameters. Research is continuing to examine new classes of multivariate models that are more convenient for fitting large covariance matrices. This is relevant for systems of equations such as vector autoregressions and for portfolio problems where possibly thousands of assets are to be analyzed. The analysis of ARCH and GARCH models and their many extensions provides a statistical stage on which many theories of asset pricing and portfolio analysis can be exhibited and tested. The study could also make use of policy framework factors which could help in strengthening the fact of co-movement. The biggest limitation of the study was the data insufficiency of microstructure of FOREX markets.

Conceptual Framework

Foreign exchange is the exchange of currencies in order to trade across the national borders. It is a medium of exchange between the nations for the purchase of goods and services. It emerged as a concept where Gold Standard System was followed to enhance the trade among the nations. But the Gold Standard System was not providing flexibility in trade, where huge valuations of different currencies were not resulting in desired benefits to many nations. Therefore, in Bretton Wood Conference, Gold Standard System was replaced by the common currency Dollar, which is used to measure the worth of currency of each country.

Various economies use different methods for determining their currency, which are Fixed Rate and Floating Rate method. Fixed Rate is pegged rate by the central banks of the countries, which they use to trade their currency. On the other hand floating rate is the market rate, where the forces of demand and supply of currency, determine the rate of the currency (Engel and West, 2005). Apart from the trade between the nations, currency valuations have become point of discussion because of many factors. From the point of view of the economy, it is important for maintaining the financial stability of the country, as it influences inflation and interest rate of the economy, as both of these are closely related (Kaur et al, 2014). On the other hand, from the viewpoint of an investor, it is an investment alternative, where the returns are judged by the performance of the currency at the currency market. Currency markets emerged as the very volatile markets, which work round the clock, and hence help in determining the rates of the currency. The forces of demand and supply of specific currency play a significant role in this.

Factors affecting the currency markets

There are many factors which can be seen to be a reason for the fluctuations in the currency markets. These are specific to the country and its economic environment. Therefore, the present study has identified some common factors, which can create fluctuation in currency market, resulting in determining the exchange rate and hence resulting in financial stability. These are:

1. Economic Data of the nation which include data of GDP, CPI, Industrial Production, unemployment figures, which directly influence the value of the currency (Allen and Taylor, 1990). These are positively correlated with the value of the currency and hence are most likely to be affected vis-à-vis the currencies of other nations.

2. Interest Rates: Returns on government securities directly impact the exchange rate of country. If there is an increase in interest rates, then demand investment in such country rises, tending the capital flow to increase, resulting in the appreciation of the currency and vice-versa.

3. Balance of Payments: Current Account and Capital Accounts are the major components of the Balance of Payments of the economy. These accounts contain major transactions related to trade flows and capital flows. The surplus and deficit in BOP measures influences the exchange rate of the country.

4. News: Any outbreak of certain event, which entails the effect on the individual as well as global economy, influences the exchange rate movements also. This can include the changes in the government policies, a natural calamity or economic crises.

5. Investors Psychology: This is the most important determinant of exchange rate. It is because of the fact that demand and supply forces are derived by the intention of the investor. It is the behavior of the individual how he reacts to a certain declaration, news, data and takes a decision. If this can be determined and located, most of volatility in FOREX markets can be hedged.

Co-integration in FOREX Markets

Co-integration is the condition, when the factors are correlated and cause a stochastic drift towards each other (Baillie and Bollerslev, 1989). In forex markets, usually one can observe the correlation from the charts and patterns, but cannot specifically explain that they are co-integrated. The reason to this is co-integration necessarily do not exist all the time. It is just a stochastic drift which is caused a leash by other factor. The cointegration exists only in certain time periods. It means that if there is some news outbreak, which can act as leash and cause a stochastic trend between two currencies, we can say that the market is co-integrated. Here the importance of Efficient Market Hypothesis can be seen that, market being efficient, creates a stochastic trend in the resultant exchange rates. This proves that Forex market does not move randomly. We can say that FOREX markets approve the existence of efficient market hypothesis.

EMH and FOREX Market: A reason for co-movement of currency pairs

The outbreak of the news and investors reacting to that news, makes the market efficient. This means that market absorbs all the information, which comes. Furthermore, usually it is seen that currency pairs are correlated. This correlation is because of the common characteristics which these currency markets share. This means that fundamental model of each currency, which can be seen from equation [1], representing balance of payments approach, will cause the currencies to be correlated.

$$ca + ka = 0 \text{ ---------------------[1]}$$

Where, ca= current account, ka = capital account of balance of payments.

Furthermore, a stochastic drift can only be observed during specific time zones (Kuhl, 2008). These stochastic drift are nothing else but the co-movement between the currency pairs. The reason for this co-movement has been explained by asset approach, where these are treated as 'same assets' and hence they co-move (Hakkio and Rush, 1989 and Baffes, 1994). The present study is a unique attempt to validate the EMH, by testing the co-movements in the currency market in various time periods.

Now, this means that this stochastic drift is a function of some event. The Swiss National Bank's decision to create a floor on the EURCHF at 1.20 generated a "leash" that made several pairs share a stochastic drift. For example the EURUSD and the CHFUSD are now cointegrated due to this fact Figure 1.

Figure 1: Co-integration between the EUR/USD and USD/CHF

Source: http://mechanicalforex.com/2014/11/cointegration-in-the-forex-market.html

Volatility in Foreign Exchange Market

FOREX markets work round the clock and are considered to be highly volatile. These markets are high risk prone markets, where hedging of the currencies, help in drawing returns from the market. Due to this volatility, usually the short term relationship is observed in the currency pairs. In fact, one can say there is a stochastic drift in the movements, but for a shorter duration of time. The present study wants to analyse the effect of volatility on the movements of the currency, as the short run movements in the market, determine the long term movements.

REVIEW OF LITERATURE

Foreign Exchange Rate is seen to be an important indicator of the country's economic progress. In addition to this, it is considered to be one of fruitful investment alternatives, which gives high returns, provided with the volatility. This is a big point of discussion that how these markets help in yielding high returns. There are numerous studies which have proposed the better ways of knowing the FOREX markets and hence enabling trade in them. One of the major theories, apart from fundamental framework, is the Efficient Market Hypothesis, which claims the understanding of the FOREX markets. Fama (1984) explains the FOREX markets react to the information which comes in the markets, provided there is no time varying risk premium. This means that the demand and supply forces in the markets behave if there is no risk in the market. The developments in statistical analysis was introduced by Johansen and Juselius (1990), which enabled the testing of the efficient market hypothesis, by maximum likelihood method, showed that foreign exchange rates move in tandem. The co-integration analysis is used to locate the long run relationship between the variables (Granger, 1986). The analysis of market efficiency in forex market was first done by MacDonald and Talyor (1994), Hakkio and Rush (1989), and Baillie and Bollerslev (1989). MacDonald and Taylor (1994) used Engle/Granger approach and found no co-integration in French Franc/USD and Deutsche Mark/USD. Further, Shen and Wang

(1990) also proposed that the use of Engle and Granger (1987) was a useful tool to test the EMH. The study of Zivot (2000) provided the evidence that foreign exchange market efficiency does not existed in JPY, CAD and USD, using co-integration analysis.

Authors namely Copeland (1991), Diebold et al (1994) rejected the hypothesis of co-integration for the time period before 1990s. An important point was highlighted by Sephton and Larsen (1991) and Barkoulas and Baum (1997), that co-integration largely depends on the chosen period of observation. Makovsky (2014) used the panel data co-integration method to test the validity of EMH of FOREX market and found that regulation and liberalization of financial services impacts the foreign exchange markets, and tends them to co-move.

The explanation to this co-integration has been very well given by Hakkio and Rush (1989), who say if the countries pegs its exchange rate or manages it by changing its economic policies, then the currencies are not different assets, hence they are same assets. This means assets are different on the basis of their determination and policy framework (Baffes, 1994). The resultant of the co-integration analysis is that, that two currencies can be treated as similar assets. Furthermore, the work of Kuhl (2008) explains the importance of co-integration in investment risk management, when currency assets can be considered similar when three currencies are taken. The gap which was identified by the literature review was that nowhere, there is evidence of existence of co-integration in the event of subprime crises, for currencies with direct quote of EURO with six major currencies altogether. The understanding of co-integration relationship has been verified with the existence of Efficient Market Hypothesis and not Random Walk Theory.

Also, in addition to the co-integration analysis, which can help in understanding the movements of foreign exchange rates, the volatility analysis can also serve the purpose. As it is known that foreign exchange markets are highly volatile, as they trade in futures, the volatility in one exchange rate currency pair may impact the movement in the other currency pair. There are evidences in the literature about the factors that influence the exchange rate volatility which are classified as macro-economic factors (Hartman, 1972; Choi and Prasad, 1995; Mark, 2009). Even the volatility clustering and persistence have been identified as the characteristics of volatility in exchange rate (Taylor, 1987; Fiser and Roman (2010). But nowhere, to the best of my knowledge there is the evidence of volatility effect of one foreign exchange on other. The present study tries to fill this gap, for the purpose to know the factors which can lead to determination of foreign exchange.

OBJECTIVES OF THE STUDY

Following are the objectives of the study-

- To check the stationarity of the data series.
- To know the existence of the co-integration during various time frames.

- To examine the forecasting power of sample foreign exchange rates for each other, if co-integrated.
- To validate the Efficient Market Hypothesis, using co-integration analysis.
- To examine the effect of volatility of foreign exchange of sample countries.

Variable

We have taken only one variable for the research through which we will check the volatility of the sample countries and the co integration among the sample countries also.

The variables are: EUR_AUD, EUR_GBP, EUR_USD, EUR_CAD, EUR_JPY.

RESEARCH METHODOLOGY

About the study: The study was causal in nature and secondary data was used in the study. The population of the study was of all Foreign exchange dynamics of the world. The sample size of the study included most actively traded currencies like U.S. Dollar, Great Britain Pound, Australian Dollar, Canadian Dollar, and Japanese Yen. An individual country was the sampling units. A non probability purposive sampling technique was used in the study.

Tools Used For Data Collection: The data set comprises of the daily time series of implied volatilities derived from the daily fluctuations in the foreign exchange in the International Money Market (IMM) of the OANDA.COM for 10 years from January 2005 to December 2015. We included most actively traded currencies; US Dollar (USD), Australian Dollar (AUD), Japanese yen (JPY), Great Britain pound (GBP), and Canadian dollar (CAD). The implied volatilities of these futures options are obtained from the OANDA.COM.

Data Analysis: Data was analyzed by using following methods:

1. Unit root test was applied to check the stationarity.

2. Johansen and Juselius (1990) Co-integration Test was used.

2. VAR and VEC Models were used to know the forecasting power of one currency over the other.

3. ADF Unit Root Test was used to test the stationarity, of the residuals of VAR and VEC models.

4. Garch Model was used to check the sudden changes in variance and the data series.

RESULTS AND DISCUSSION

Unit Root Test

The present study is an attempt to understand the long term relationship between the currency pairs. This relationship will help in measuring the risk of the currency markets. Furthermore, analyzing the stochastic trends in the movements of the sample currencies will help in knowing the reasons behind these moves. It was reviewed in the literature that these stochastic trends were observed only in the times of some political instability, asset prices fluctuations or market instability (Barberis, Shleifer et al, 2005). This will also help in understanding the equilibrium price relationship between the currency pairs.

For this purpose, co-integrating vectors were identified using three different time periods, which were classified as Before Event (2005-2007), During the event (2005-2015), and After the event (2009-2015), where 2008 was taken as the event window. Event was the US Sub Prime crises. The reason for taking this crises was The US Dollar, being one of the prime currencies.

It is known that regression with non stationary series, results in spurious regression. But when the series are I(0), or integrated of same order, they contain a stochastic trend. This makes possible that two series share the same common trend, so that the regression of one on the other will not be necessarily spurious.

The authors run the regression model on time series data of EUR_AUD, EUR_JPY, EUR_CAD, EUR_GBP, EUR_USD individually, which can be seen as follows in model [1]:

LEUR_AUD= β_1 + β_2 LEUR_JPY + β_3 LEUR_CAD + β_4 LEUR_GBP + β_5 LEUR_USD + u_t………………..[1]

Where in equation [1], L denotes logarithm β_2, β_3 , β_4 , β_5 are the elasticites of EUR_JPY, EUR_CAD, EUR_GBP, EUR_USD with respect to EUR_AUD.

The above equation helps in understanding that the stochastic trends are cancelled by linear combination in the two series. This makes clear that the regression is meaningful and hence some co-integration exists between the variables.

Furthermore, the unit root tests also provide the order of integration of the time series variables. The stationarity of the data set indicates that the variances in the data series are constant. This is the basic presumption of OLS modelling. This means, when data is tested with Augmented Dickey Fuller, the results indicate the integration order of the series. If the series are I(1), this means data is stationary at first difference. Further, if data is I(0), it means data is stationary. The complete model with deterministic terms such as intercepts and trends is shown in equation (2). The results in Table I present that the series are integrated at one order. The p-values shown in () parenthesis in Table I, are insignificant a 5% level of significance, explaining that time series of the sample variables are not stationary at I(0). These were further tested at differenced value, where these were found to be significant. Hence we can conclude that all the data series at stationary at same order i.i. I(1). Also, this can be judged by analysing the t-stats given in [1] parenthesis, where it is lesser to all the critical values, explaining the existence of the unt root in the series.

$$\Delta y_t = \alpha + \pi + \delta y_{\underset{i=1}{t-1}} + \Delta\beta_i Y_{t-1} + \varepsilon_t \text{.....................[2]}$$

Table I: ADF Unit Root Test Statistics

S. No	Variables	Critical values	Test statistic	Result
1.	Eur_aud	1% = -3.431795 5% = -2.862064 10% = -2.567092	[-1.6780] (0.442)	Variable is stationary I(1)
2.	Eur_cad	1% = -3.431795 5% = -2.862064 10% = -2.567092	[-2.7326] (0.068)	Variable is stationary I(1)
3.	Eur_gbp	1% = -3.431795 5% = -2.862064 10% = -2.567092	[-1.5506] (0.507)	Variable is stationary I(1)
4.	Eur_jpy	1% = -3.431795 5% = -2.862064 10% = -2.567092	[-1.4371] (0.565)	Variable is stationary I(1)
5.	Eur_usd	1% = -3.431795 5% = -2.862064 10% = -2.567092	[-1.5578] (0.504)	Variable is stationary I(1)

Note: *p-values in ( ) & t-statistics in [ ]*

CO INTEGRATION TEST

Johansen and Juselius's (1990) Tests for Co integrating Relationships provides tests of hypotheses about the number of co integrating relationships/equations. When there are three stochastically trending variables in the co integrated regression, Johansen and Juselius's method tests three hypotheses about the co integrating relationships:

$H_0$1: There are no co integrating relationships; the regression is spurious.
$H_0$2: There is at most one co integrating relationship.
$H_0$3: There are at most two co integrating relationships.

The number of such hypotheses tested corresponds directly to the number of co-integrating variables. The Johansen and Juselius (1990) strategy is to ask whether one estimated co integrating relationship is a multiple of another or is a linear combination of some others. Also, the results are enumerated from the two statistics, namely trace and max eigen. These both have equal relevance and results of both can be used to analyse the relationship, but Max Eigen values should be preferred (Banerjee et al, 1993). The relevance of the hypothesis depends on the number of co-integrating vectors in the equation. This helps in identifying the co-integrating vectors in long term relationship. Table II show the results computed before the event window.

Table II: Co-integration Results of Time Frame (2005-2007)

Hypothesized		**Trace**	**0.05**		**Max-Eigen**	**0.05**	
No. of CE(s)	**Eigen Value**	**Statistic**	**Critical Value**	**Prob.****	**Statistic**	**Critical Value**	**Prob.****
None	0.018640	49.70450	69.81889	0.6506	20.50989	33.87687	0.7204
At most 1	0.017223	29.19461	47.85613	0.7590	18.93707	27.58434	0.4194
At most 2	0.007055	10.25754	29.79707	0.9763	7.717699	21.13162	0.9202
At most 3	0.002271	2.539846	15.49471	0.9838	2.478629	14.26460	0.9752
At most 4	5.62E-05	0.061218	3.841466	0.8046	0.061218	3.841466	0.8046

Trace test indicates no cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates no cointegrating eqn(s) at the 0.05 level
* *denotes rejection of the hypothesis at the 0.05 level

Table III: Co-integration Results of Time Frame (2009-2015)

Hypothesized		**Trace**	**0.05**		**Max-Eigen**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****	**Statistic**	**Critical Value**	**Prob.****
None	0.012243	61.58927	69.81889	0.1898	31.41303	33.87687	0.0957
At most 1	0.006567	30.17624	47.85613	0.7099	16.80187	27.58434	0.5970
At most 2	0.003719	13.37437	29.79707	0.8738	9.501680	21.13162	0.7900
At most 3	0.001502	3.872688	15.49471	0.9135	3.831850	14.26460	0.8766
At most 4	1.60E-05	0.040839	3.841466	0.8398	0.040839	3.841466	0.8398

Trace test indicates no cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates no cointegrating eqn(s) at the 0.05 level
* *denotes rejection of the hypothesis at the 0.05 level

The results in Table II and III show that there is no long term relationship between the variables. As the first hypothesis states that none of the variables are co-integrated, is not rejected, in both the Trace and Max- Eigen stats. Further the second and subsequent hypotheses are also not rejected, which means that the one or more variables are not co-integrated. This was seen to be an empirical analysis of the various facts, which determined the asset prices in currency market. The developing nations were seen to be the most enduring hubs for the investors, because of the larger part of the demand were from this market. The investments in the sample currencies were dynamic, which were determined by the fundamental reasons. Also, here we can observe the presence of Random Walk by the investors, where they are behaving on the basis of the past performance of the markets. Further, in order to identify the number of cointegrating vectors, we have run the VAR model.

VAR (Vector Auto Regressive) model identifies the number of cointegrated vectors, in the form of two or more variables, where dependent variables are revealed as lagged ones on the right hand side of the equation. It can be seen as below:

$y_t = A_1 y_{t-1} + \cdots + A_1 y_{t-p} + Bx_t + \varepsilon_t$--------------------------[3]

Where, y_t is k vector of endogenous variable (EUR_AUD, EUR_CAD, EUR_JPY, EUR_USD, EUR_GBP), x_t is a d vector of exogenous variable and ε_t is a vector of innovations that may be contemporaneously correlated with each other but are uncorrelated with their own lagged values and uncorrelated with all the right hand side variables.

Table IV: VAR Model Statistics

	EUR_AUD	**EUR_CAD**	**EUR_GBP**	**EUR_JPY**	**EUR_USD**
EUR_AUD(-1)	1.208922	0.051732	0.068646	0.043085	0.067166
	(0.03423)	(0.03474)	(0.02395)	(0.04046)	(0.03352)
	[35.3162]	[1.48897]	[2.86665]	[1.06498]	[2.00396]
EUR_AUD(-2)	-0.221548	-0.047380	-0.069474	-0.037257	-0.069695
	(0.03418)	(0.03470)	(0.02391)	(0.04040)	(0.03347)
	[-6.48095]	[-1.36559]	[-2.90522]	[-0.92219]	[-2.08224]
EUR_CAD(-1)	-0.023408	1.106094	-0.057981	-0.069962	-0.057674
	(0.03750)	(0.03806)	(0.02623)	(0.04432)	(0.03672)
	[-0.62420]	[29.0601]	[-2.21016]	[-1.57855]	[-1.57070]
EUR_CAD(-2)	0.017620	-0.114571	0.050789	0.066134	0.055671
	(0.03747)	(0.03803)	(0.02621)	(0.04428)	(0.03669)
	[0.47021]	[-3.01250]	[1.93755]	[1.49337]	[1.51735]

EUR_GBP(-1)	-0.059358	-0.065441	1.173137	-0.034915	-0.022576
	(0.04656)	(0.04725)	(0.03257)	(0.05502)	(0.04558)
	[-1.27501]	[-1.38494]	[36.0218]	[-0.63458]	[-0.49528]
EUR_GBP(-2)	0.046919	0.055635	-0.193809	0.031994	0.030304
	(0.04682)	(0.04752)	(0.03275)	(0.05533)	(0.04584)
	[1.00220]	[1.17085]	[-5.91783]	[0.57825]	[0.66110]
EUR_JPY(-1)	-0.101863	-0.008160	0.041304	1.164971	0.033838
	(0.02838)	(0.02880)	(0.01985)	(0.03354)	(0.02778)
	[-3.58963]	[-0.28332]	[2.08071]	[34.7370]	[1.21786]
EUR_JPY(-2)	0.097304	0.004878	-0.047119	-0.166376	-0.027630
	(0.02848)	(0.02891)	(0.01993)	(0.03366)	(0.02789)
	[3.41606]	[0.16873]	[-2.36472]	[-4.94234]	[-0.99067]
EUR_USD(-1)	0.089774	0.108957	-0.007567	0.001386	1.165270
	(0.04001)	(0.04061)	(0.02799)	(0.04729)	(0.03918)
	[2.24366]	[2.68294]	[-0.27036]	[0.02930]	[29.7436]
EUR_USD(-2)	-0.081646	-0.103042	0.018920	-0.000891	-0.172839
	(0.03989)	(0.04049)	(0.02791)	(0.04715)	(0.03906)
	[-2.04666]	[-2.54495]	[0.67798]	[-0.01891]	[-4.42502]
C	-0.000983	-0.000549	-0.000499	7.01E-05	-0.000796
	(0.00036)	(0.00036)	(0.00025)	(0.00042)	(0.00035)
	[-2.74802]	[-1.51271]	[-1.99456]	[0.16591]	[-2.27370]
R-squared	0.979126	0.993938	0.980198	0.997328	0.996355
Adj. R-squared	0.978933	0.993882	0.980015	0.997304	0.996321
Sum sq. resids	0.012501	0.012878	0.006117	0.017460	0.011984
S.E. equation	0.003399	0.003450	0.002378	0.004017	0.003328
F-statistic	5075.186	17740.93	5355.821	40392.49	29577.56
Log likelihood	4667.529	4651.299	5058.088	4484.929	4690.585
Akaike AIC	-8.520639	-8.490941	-9.235294	-8.186513	-8.562827
Schwarz SC	-8.470352	-8.440654	-9.185007	-8.136226	-8.512540
Mean dependent	-0.052588	-0.102053	-0.032373	0.064367	-0.048602
S.D. dependent	0.023418	0.044106	0.016820	0.077362	0.054873
Determinant resid covariance (dof adj.)		5.50E-26			
Determinant resid covariance		5.23E-26			
Log likelihood		24058.83			
Akaike information criterion		-43.92283			
Schwarz criterion		-43.67140			

The results in Table IV explain the co-integrating vectors, with endogenous variables. These results explain the regression statistics of each endogenous variable. Here, determinant residual covariance is k vector of residuals. As seen AIC and Schwarz criteria are very low, which indicate the model fitness. It can be said that the movements in the currency pairs are due to the movements in the other currency pairs. These are explaining the unidirectional causal relationship, running from one endogenous variable to other. As we can see, only, EUR_CAD and EUR_JPY are not affected by other sample currency pair. Hence, we can say that there is no cointegrating equation from 2005-2007 and for the period 2009-2015, as there was no major event observed during the 2005-2007 period and was observed the recovery during 2009-2015. But, there are three co-integrating vectors, which are disturbing this relationship. The changes in EUR_USD, EUR_GBP and EUR_AUD are playing significant role in currency markets, to bring shocks in the market, as people follow past performances to forecast the future performance of the currency assets. These vectors can be used for forecasting the future relationships between the exchange rates for shorter duration of time (Hylleberg and Engle, 1990).

Impulse Response

An impulse response function traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. A shock to the i-th variable directly affects the i-th variable, and is also transmitted to all of the endogenous variables through the dynamic structure of the VAR. Figure 2 shows the multiple impulse Response Graphs in which it can be concluded that a change in ε_t (red lines) will immediately change the value of different currency pairs. The impulse response function measures the effect of one standard deviation currency fluctuation shock on other currency pair. It can be observed that deviation shocks are determining the movements of other currency pairs.

Figure 2: Impulse Responses of VAR model

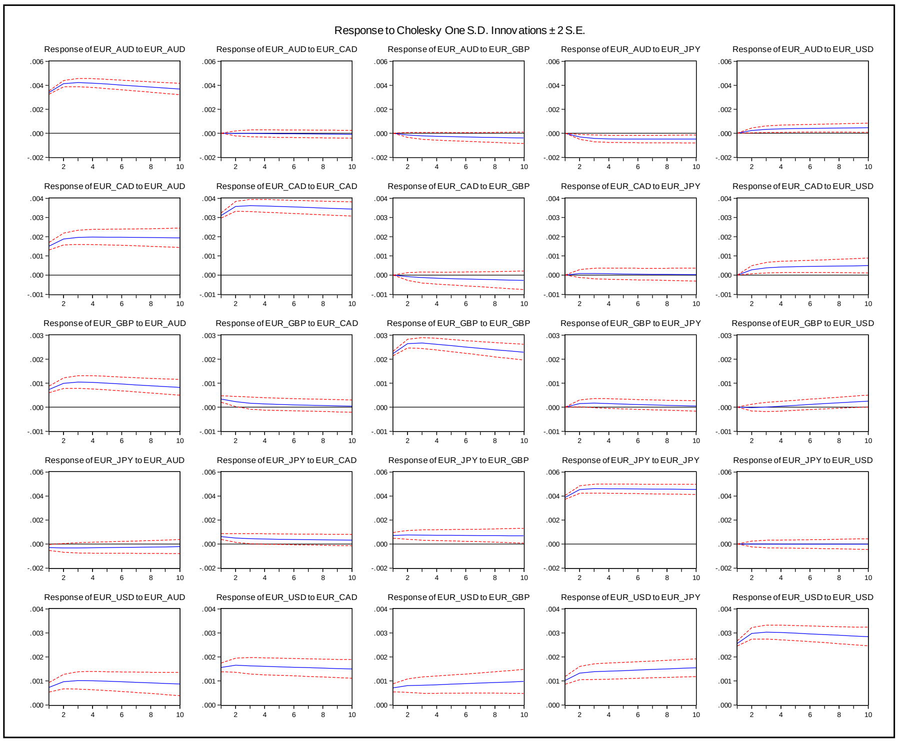


Table V: Co-integration Results of Time Frame (2005-2015)

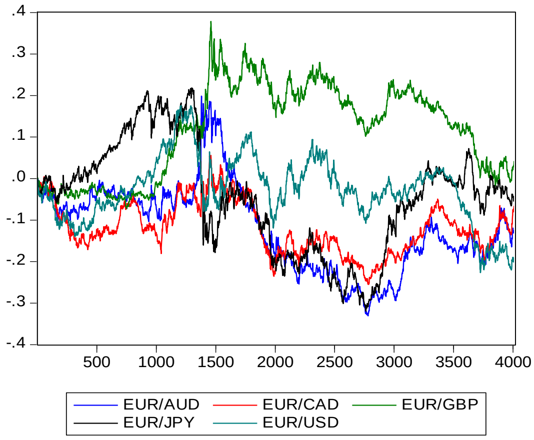
Hypothesized		Trace	0.05		Max-Eigen	0.05	
No. of CE(s)	**Eigen Value**	**Statistic**	**Critical Value**	**Prob.****	**Statistic**	**Critical Value**	**Prob.****
None *	0.010878	80.50858	79.34145	0.0407	43.86964	37.16359	0.0074
At most 1	0.005382	36.63894	55.24578	0.6877	21.64650	30.81507	0.4234
At most 2	0.002344	14.99243	35.01090	0.9431	9.412484	24.25202	0.9327
At most 3	0.001389	5.579950	18.39771	0.8996	5.574523	17.14769	0.8559
At most 4	1.35E-06	0.005427	3.841466	0.9406	0.005427	3.841466	0.9406

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* *denotes rejection of the hypothesis at the 0.05 level

Figure 3: Co-integration of Currency Pairs



The results in Table V show the existence of the co-integrating equations among the sample major exchange rates. Both the Trace statistics and Max Eigen show that there is one co-integrating equation, when the null hypothesis, of none of the variables are co-integrated, is rejected. On the other hand the subsequent hypotheses are not rejected, which means the existence of the co-integration equation. The reasons identified were that there was a common setback in the global economies. This setback was the US subprime crises, where it affected all the major economies in the same manner. This lead to low employment, high rates of inflation, high interest rate differentials, and high current account deficits, which ultimately influenced the foreign exchange rates of the economies (UN Report, 2008). Further the exchange rate was tumbled because of global imbalances. The process of devaluation of the currencies and pegging of the exchange rate specifically influenced the global markets. China also devalued its currency for improving its exports, which led to global turmoil among the major currencies.

It was observed that Exchange Rate EUR_AUD played a major in bringing the stochastic trend in the other major sample exchange rates. The reasons are strong favorable conditions in Australian economy. There were favorable interest rates, which fostered money in the markets. Also the consumer spending growth helped the economy to be stable in times of global crises (Belkas, 2007).

VECM Modeling

A vector error correction (VEC) model is a restricted VAR that has co-integration restrictions built into the specification, so that it is designed for use with non-stationary series that are known to be co-integrated. The VEC specification restricts the long-run behavior of the endogenous variables to converge to their co-integrating relationships while allowing a wide range of short-run dynamics. The co-integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. Also, Hoffman and Rasche (2002) found the error-correction model provided forecast improvements.

Vector Error Correction Mechanism

$$\Delta y_{1,t} = \gamma_1(y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{1,t} \quad \text{-- [4]}$$

$$\Delta y_{2,t} = \gamma_2(y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{2,t} \quad \text{-- [5]}$$

Equations [4] and [5] represent the error correction mechanism in the co-integration equation. This helps to know the process which eliminates the disequilibrium position in the long run relationship. The coefficients γ_1 and γ_2 determine the speed of adjustment.

In the present study, VECM model of each variable has been obtained after selecting a suitable lag, by following Lag selection Criteria. These models explain the existence of the error correction mechanism, which is facilitating the equilibrium exchange rate. It was found that EUR_AUD and EUR_CAD are the vectors, which are enabling the position of equilibrium. This can be seen from the Table VI, where the t-stats are significant at 5% level of significance. This also implies the existence of long term relationship with the estimates of VECM model.

D(EUR_AUD) = C(1)*(EUR_AUD(-1) + 16.8074036356*EUR_CAD(-1) - 5.18771924311*EUR_GBP(-1) - 8.75999639716*EUR_JPY(-1) + 4.57892788396*EUR_USD(-1) + 2.44445011184) + C(2) *D(EUR_AUD(-1)) + C(3)*D(EUR_AUD(-2)) + C(4)*D(EUR_CAD(-1)) + C(5)*D(EUR_CAD(-2)) + C(6)*D(EUR_GBP(-1)) + C(7)*D(EUR_GBP(-2)) + C(8)*D(EUR_JPY(-1)) + C(9)*D(EUR_JPY(-2)) + C(10) *D(EUR_USD(-1)) + C(11)*D(EUR_USD(-2)) + C(12)---------------------[6]

D(EUR_CAD) = C(13)*(EUR_AUD(-1) + 16.8074036356*EUR_CAD(-1) - 5.18771924311*EUR_GBP(-1) - 8.75999639716*EUR_JPY(-1) + 4.57892788396*EUR_USD(-1) + 2.44445011184) + C(14) *D(EUR_AUD(-1)) + C(15)*D(EUR_AUD(-2)) + C(16)*D(EUR_CAD(-1)) + C(17)*D(EUR_CAD(-2)) + C(18)*D(EUR_GBP(-1)) + C(19) *D(EUR_GBP(-2)) + C(20)*D(EUR_JPY(-1)) + C(21)*D(EUR_JPY(-2)) + C(22)*D(EUR_USD(-1)) + C(23)*D(EUR_USD(-2)) + C(24)----------------[7]

D(EUR_GBP) = C(25)*(EUR_AUD(-1) + 16.8074036356*EUR_CAD(-1) - 5.18771924311*EUR_GBP(-1) - 8.75999639716*EUR_JPY(-1) + 4.57892788396*EUR_USD(-1) + 2.44445011184) + C(26) *D(EUR_AUD(-1)) + C(27)*D(EUR_AUD(-2)) + C(28)*D(EUR_CAD(-1)) + C(29)*D(EUR_CAD(-2)) + C(30)*D(EUR_GBP(-1)) + C(31) *D(EUR_GBP(-2)) + C(32)*D(EUR_JPY(-1)) + C(33)*D(EUR_JPY(-2)) + C(34)*D(EUR_USD(-1)) + C(35)*D(EUR_USD(-2)) + C(36)--------------------[8]

D(EUR_JPY) = C(37)*(EUR_AUD(-1) + 16.8074036356*EUR_CAD(-1) -
5.18771924311*EUR_GBP(-1) - 8.75999639716*EUR_JPY(-1) +
4.57892788396*EUR_USD(-1) + 2.44445011184) + C(38)
*D(EUR_AUD(-1)) + C(39)*D(EUR_AUD(-2)) + C(40)*D(EUR_CAD(-1))
+ C(41)*D(EUR_CAD(-2)) + C(42)*D(EUR_GBP(-1)) + C(43)
*D(EUR_GBP(-2)) + C(44)*D(EUR_JPY(-1)) + C(45)*D(EUR_JPY(-2)) +
C(46)*D(EUR_USD(-1)) + C(47)*D(EUR_USD(-2)) + C(48)---------------------------------------[9]

D(EUR_USD) = C(49)*(EUR_AUD(-1) + 16.8074036356*EUR_CAD(-1) -
5.18771924311*EUR_GBP(-1) - 8.75999639716*EUR_JPY(-1) +
4.57892788396*EUR_USD(-1) + 2.44445011184) + C(50)
*D(EUR_AUD(-1)) + C(51)*D(EUR_AUD(-2)) + C(52)*D(EUR_CAD(-1))
+ C(53)*D(EUR_CAD(-2)) + C(54)*D(EUR_GBP(-1)) + C(55)
*D(EUR_GBP(-2)) + C(56)*D(EUR_JPY(-1)) + C(57)*D(EUR_JPY(-2)) +
C(58)*D(EUR_USD(-1)) + C(59)*D(EUR_USD(-2)) + C(60)---------------------------------------[10]

Table VI: VEC Statistics

Equations	Coefficient	Adj. R Square	F Stats	Prob.	T-Stats	Prob.	Durbin Watson
[6]	-0.000301	0.086621	34.49432	0.000000	-3.906368	0.0001	2.000051
[7]	-0.000192	0.084674	34.73975	0.000000	-3.026286	0.0025	1.996832
[8]	7.94E-05	0.158253	69.57046	0.000000	1.215567	0.2242	1.980121
[9]	3.01E-05	0.060864	24.63748	0.000000	0.353251	0.7239	1.997804
[10]	-7.87E-05	0.084902	34.83897	0.000000	-1.125080	0.2606	2.000233

The results in table VI describe the OLS models of VEC models, where p-values of t-stats help to know the error correction mechanism between the variables in the co-integrating equation. This helps in understanding the long run co-movements determine the prices of other currency pairs. It can be observed that equations EUR_AUD and EUR_CAD are getting influenced by the other sample currency pairs, whereas, in equations [8]-[10], this relationship cannot be observed. Equation [7] explains that EUR_AUD and EUR_GBP is significantly influencing the movement of EUR_CAD.

We can observe the equilibrium price determination mechanism from equations [6]-[10]. In these equations we can see foreign exchange rate can be in equilibrium when the error becomes zero. The OLS model explains EUR_AUD + 16.8074036356*EUR_CAD(-1) - 5.18771924311*EUR_GBP(-1) - 8.75999639716*EUR_JPY(-1) + 4.57892788396*EUR_USD(-1) + 2.44445011184) = zero. This means that in order to be in equilibrium, EUR_CAD, EUR_GBP, EUR_JPY, EUR_USD and EUR_AUD will increase or decrease in order to determine an equilibrium rate for EUR_AUD, EUR_GBP, EUR_CAD, EUR_JPY and EUR_USD. This means that currency pairs play a major role in determining and forecasting each other.

Results explain that each of the currency pairs, are significantly explaining the other currency pair, where EUR_AUD and EUR_USD are playing a major role.

Residuals Analysis

Table VII: Unit Root Analysis

S. No	Variables	Critical values	Test statistic	Result
1.	U	1% = -3.431795 5% = -2.862064 10% = -2.567092	[-63.365] (0.00)	Variable is stationary I(0)

The existence of co-integration between the foreign exchange rates, using Johansen tests, confirms the first necessary condition for long –term market efficiency.

One of the objectives of the present research was to analyse that Does the variances in a foreign exchange is influencing the variances in another? This was cleared by using Generalized Auto Regressive Conditional Heteroskedasticity analysis.

GARCH MODEL

One of the main objectives was to identify the sudden changes in variance in the data series of EUR_AUD, EUR_CAD, EUR_GBP, EUR_JPY and EUR_USD. This means understanding the volatility effect of one FOREX on another, GARCH is the appropriate tool which can help in achieving the objective of the study. For all the series studied descriptive statistics were obtain including a test for auto correlation to know the possibility of ARCH. Based on statistics decided to use ARCH (1) model. The study applied GARCH (1, 1) model

Development of ARCH and GARCH model

Equation [11] shows the mean model of GARCH:

Mean model is EUR_USD = C (1) +C (2)*EUR_AUD (-1) + C (3)*EUR_CAD (-1) + C(4)* EUR_GBP(-1) +C(5) * EUR_JPY(-1)-------------------------------[11]

Where, EUR_USD = Dependent variable, C (1) = Constant, c (2) = Coefficient

Independent variables = EUR_AUD, EUR_CAD, EUR_GBP, EUR_JPY

Variance Equation

Equations [12], [13] and [14] show three different variance equations.

Variance equation is h_t=c (3) +c (4)*h_t-1+c (5)*e^2t-1 -------------------[12]

Where, h_t = EUR_USD volatility , c(1) = constant, h_t = previous day's residual (lag of h_t) of EUR_USD – (GARCH term), h_t = current period volatility and h_t-1 is previous period volatility.

For driving mean equation the least square was applied and found there is no relationship between EUR_USD and EUR_AUD, EUR_CAD, EUR_GBP, EUR_JPY respectively.

Variance Equation

Residual derived from mean equation used in fuming variance equation

Variance equation is h_t=c (3) +c (4)*h_t-1+c (5)*e^2t-1----------------------------[13]

Where, h_t = EUR_USD volatility, C (1) = constant, h_t = previous day's residual (lag of h_t) of EUR_USD – (GARCH term), h_t = current period volatility and h_t-1 is previous period volatility.

(A) ML - ARCH (Marquardt) - Normal Distribution

First of all GARCH (1, 1) applied with normal Gaussian method which resulted into the following equation:

GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*EUR_AUD + C(7)*EUR_CAD + C(8)*EUR_GBP + C(9)*EUR_JPY-------------------------------------[14]

TEST TABLE (NORMAL DISTRIBUTION)

Dependent Variable: EUR_USD(-1)

Method: ML - ARCH (Marquardt) - Normal distribution

Date: 01/07/16 Time: 10:24

Sample (adjusted): 2 4016

Included observations: 4015 after adjustments

Convergence achieved after 39 iterations

Variance backcast: ON

EUR_USD(-1) = C(1) + C(2) * EUR_AUD(-1) +C(3) *EUR_CAD(-1) +
C(4) * EUR_GBP(-1) + C(5) *EUR_JPY(-1)

GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1) + C(9)
*EUR_AUD + C(10)*EUR_CAD + C(11)*EUR_GBP + C(12)
*EUR_JPY

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.042992	0.002682	-16.02780	0.0000
C(2)	-0.299723	0.010753	-27.87378	0.0000
C(3)	0.354842	0.021679	16.36771	0.0000

C(4)	0.485756	0.008450	57.48306	0.0000
C(5)	0.363220	0.008199	44.30210	0.0000
	Variance Equation			
C	0.002286	0.000222	10.30112	0.0000
RESID(-1)^2	1.250568	0.130221	9.603433	0.0000
GARCH(-1)	-0.856362	0.031589	-27.10930	0.0000
EUR_AUD	0.002169	0.000938	2.311898	0.0208
EUR_CAD	0.003206	0.001445	2.218886	0.0265
EUR_GBP	-0.002825	0.000687	-4.111704	0.0000
EUR_JPY	0.001431	0.000606	2.360324	0.0183
R-squared	0.468318	Mean dependent var		-0.027421
Adjusted R-squared	0.466857	S.D. dependent var		0.078563
S.E. of regression	0.057364	Akaike info criterion		-3.988398
Sum squared resid	13.17251	Schwarz criterion		-3.969575
Log likelihood	8018.709	Durbin-Watson stat		0.002889

INTERPRETATION

The equation revealed that the ARCH term GARCH term were significant with coefficient value of RESID(-1)^2(1.250568), GARCH(-1) (-0.856362) significant at 0% respectively hence it is concluded that the internal shocks are affecting EUR_USD since the other coefficient values of EUR_AUD(0.002169), EUR_CAD(0.003206), EUR_GBP(-0.002825) and EUR_JPY(0.001431) are also significant and affecting the foreign exchange. The model further predicated the high value of likelihood and minimum value of (AIC) Akaike info criterion, shows the model fitness.

(B) ML - ARCH (Marquardt) - Student's t distribution

Student's distribution is a one of the alternative GARCH (1,1) applied with student's distribution Gaussian method which resulted into the following equation [15]:

GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*EUR_AUD + C(7)*EUR_CAD + C(8)*EUR_GBP + C(9)*EUR_JPY---------------------------[15]

TEST TABLE (STUDENT'S T DISTRIBUTION)

Dependent Variable: EUR_USD(-1)

Method: ML - ARCH (Marquardt) - Student's t distribution
Date: 01/07/16   Time: 10:29
Sample (adjusted): 2 4016
Included observations: 4015 after adjustments
Convergence achieved after 22 iterations
Variance backcast: ON
EUR_USD(-1) = C(1) + C(2) * EUR_AUD(-1) +C(3) *EUR_CAD(-1) +
C(4) * EUR_GBP(-1) + C(5) *EUR_JPY(-1)
GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1) + C(9)
*EUR_AUD + C(10)*EUR_CAD + C(11)*EUR_GBP + C(12)
*EUR_JPY

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.045656	0.002460	-18.55868	0.0000
C(2)	-0.283452	0.012522	-22.63579	0.0000
C(3)	0.321137	0.022489	14.27985	0.0000
C(4)	0.504233	0.007899	63.83630	0.0000
C(5)	0.378851	0.007741	48.94195	0.0000
	Variance Equation			
C	0.002138	0.000155	13.78273	0.0000
RESID(-1)^2	1.401468	0.275116	5.094088	0.0000
GARCH(-1)	-0.792054	0.053450	-14.81870	0.0000
EUR_AUD	0.001968	0.000878	2.241065	0.0250
EUR_CAD	0.003265	0.001171	2.787102	0.0053
EUR_GBP	-0.003155	0.000384	-8.208579	0.0000
EUR_JPY	0.000982	0.000627	1.566606	0.1172
T-DIST. DOF	20.03501	17.66060	1.134447	0.2566

R-squared	0.467829	Mean dependent var	-0.027421
Adjusted R-squared	0.466233	S.D. dependent var	0.078563
S.E. of regression	0.057398	Akaike info criterion	-4.007388
Sum squared resid	13.18463	Schwarz criterion	-3.986996

Log likelihood	8057.831	Durbin-Watson stat	0.002916

INTERPRETATION

The equation revealed that the ARCH term GARCH term were significant with coefficient value of RESID (-1)^2(1.401468), GARCH(-1) (-0.792054) significant at 0% respectively hence it is concluded that the internal shocks are affecting EUR_USD. Since the other coefficient values of EUR_AUD(0.001968) , EUR_CAD(0.003265), EUR_GBP(-0.003155) EUR_JPY(0.000982)are significant and affecting the FOREIGN EXCHANGE as well except EUR_JPY(0.000982)which was not significant at 5%. The model further predicted the high value of likelihood and minimum value of (AIC) Akaike info criterio show that the model is highly fit.

(C) ML - ARCH (Marquardt) – Generalized error distribution (GED)

Generalized error distribution (GED) is one of the alternative method of GARCH (1,1) applied with Generalized error distribution (GED) Gaussian method which resulted into the following equation:

GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*EUR-AUD + C(7)*EUR-CAD + C(8)*EUR-GBP + C(9)*EUR-JPY

TEST TABLE (GENERALIZED ERROR DISTRIBUTION)

Dependent Variable: EUR_USD(-1)
Method: ML - ARCH (Marquardt) - Generalized error distribution (GED)
Date: 01/07/16 Time: 16:17
Sample (adjusted): 2 4016
Included observations: 4015 after adjustments
Convergence achieved after 169 iterations
Variance backcast: ON
EUR_USD(-1) = C(1) + C(2) * EUR_AUD(-1) +C(3) *EUR_CAD(-1) +
C(4) * EUR_GBP(-1) + C(5) *EUR_JPY(-1)
GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.052439	0.000248	-211.7423	0.0000
C(2)	-0.269020	0.001851	-145.3742	0.0000
C(3)	0.242802	0.003349	72.50733	0.0000
C(4)	0.505800	0.001230	411.0863	0.0000
C(5)	0.401334	0.001752	229.0109	0.0000
	Variance Equation			
C	2.99E-05	8.20E-07	36.51416	0.0000

RESID(-1)^2	0.607317	0.013155	46.16656	0.0000
GARCH(-1)	-0.128073	0.011775	-10.87672	0.0000
GED PARAMETER	9.768732	0.311591	31.35110	0.0000
R-squared	0.464071	Mean dependent var		-0.027421
Adjusted R-squared	0.463001	S.D. dependent var		0.078563
S.E. of regression	0.057571	Akaike info criterion		-5.076409
Sum squared resid	13.27772	Schwarz criterion		-5.062292
Log likelihood	10199.89	Durbin-Watson stat		0.002977

INTERPRETATION

The equation revealed that the ARCH term GARCH term were significant with coefficient value of RESID(-1)^2(0.607317), GARCH(-1) (-0.128073) significant at 0% respectively hence it is concluded that the internal shocks are affecting EUR-USD. Since the other coefficient values of EUR-AUD(-0.269020), EUR-CAD(0.242802), EUR-GBP(0.505800), EUR-JPY(0.401334) are also significant and affecting the EUR-USD. It can be seen that the volatility measured by using three different types of GARCH models, explain the existence of the impact of volatility of other forex on EUR_USD. EUR_USD was taken as the dependent variable because it is the highest tradable currency in the forex markets.

IMPLICATIONS

The study helps in understanding the nature of the FOREX markets. It helps in understanding the relationship between various foreign currencies, which determine each other, sometimes.

Also it makes clear that the volatility of one foreign exchange impacts the volatility of the other. It is a useful contribution in knowing that can forex markets be predicted using other currency pairs? The most important idea for the study, it can help the investors in hedging risk in FOREX markets, if they the relationship between the currency pairs. It facilitates the understanding of the EMH theory of risk management, which can be fruitful to investors and academicians for research purposes.

SUGGESTIONS

- In order to understand the equilibrium price determination process, the study can also include the macroeconomic indicators, which can be analysed using VEC models.
- More specific models of GARCH can be framed, which would help in knowing the effect of volatility of other currency pairs.
- The study can make use of Futures of FOREX market, in order to forecast it.
- Other major events, like Russia-Spain Crises can be taken, where more examples of EMH validity can be presented.
- Currency pairs of other emerging economies can also be studied.

CONCLUSION

The present study is an attempt to answer some basic questions for understanding the Foreign Exchange functioning and its determination. Apart from the theoretical framework, the study has tried to explore a new corner for determining the exchange rates at FOREX markets. This is looking at the co-movements between the currency pairs, where it was found that currency pairs/foreign exchange were co-integrated only in times of some serious fluctuation in the market or the economy. The study included six major currency pairs, with EURO a dominant currency, namely, EUR_USD, EUR_CAD, EUR_JPY, EUR_GBP, and EUR_AUD. The study identified one of major events, which occurred during the time frame of 2005-2015, which was US sub prime crises. This event was used as just an example in order to validate the existence of EMH, which says, information is absorbed by the markt as it comes. This means, the reason for the cointegration of the currency market is EMH, that sub prime crises occurred, the currency markets started moving in tandem. Also, it was observed that the major currency, which was causing this co-movement was EUR_AUD, as the results explained that, probability of VEC models, were significant at 5% level of significance. The reasons were identified to the Australian economy performance during the time frame 2007-2008. This helped in explaining that, yet provided the events in the economy, foreign exchanges can determine the moves of other foreign exchanges. Also, these can be forecasted, on the basis of the relationship they share.

Furthermore, the study also tried to know the effect of volatility of one FOREX on other FOREX. It used GARCH (1,1) model, where EUR_USD was taken as major foreign exchange. It was found that, yes, the volatility of one FOREX impacts the other. This made clear that even FOREX fluctuates, it is not only because of the fundamental models, but also the movements of other Foreign exchange rates. The study was a serious attempt to analyse the relationship between the froegin exchange rates using econometric modeling.

REFERENCES

- Allen, H. and Taylor, M. P. (1990). Charts, Noise and Fundamentals in the London Foreign Exchange Market. *The Economic Journal*, *100* (400, Conference Papers), 49–59.
- Baffes, J. (1994). Does Comovement among Exchange Rates imply Market Efficiency? *Economics Letters*, *44* (3), 273–280.
- Baillie, R. T. and Bollerslev, T. (1989). Common Stochastic Trends in a System of Exchange Rates. *The Journal of Finance*, *44* (1), 167–181.
- Banerjee, A., Dolado, J. J., Galbraith JW, Hendry D F 1993. Cointegration, Error Correction and the Econometric Analysis of Non-stationary Data. New Yortk: Oxford University Press
- Barberis, N., Shleifer, A. and Wurgler, J. (2005). Co-movement. *Journal of Finanial Economics*, *75,* 283–317.
- Barkoulas, J. and Baum, C. F. (1997). A Re-examination of the fragility of Evidence from Cointegration-Based Tests of Foreign Exchange Market Efficiency. *Applied Financial Economics, 7*, 635–643.

- Belkas, T. (2007, December 31). **AUD/USD 2008 Outlook. Retrieved from** https://www.dailyfx.com/story/currency/aud_fundamentals/2007/12/31/AUD_USD_2008_Outlook_1199120466582.html.
- Choi, J. J., & Prasad, A. M. (1995). Exchange Risk Sensitivity and its Determinants: A firm and Industry Analysis of US Multinationals. *Financial Management, 24*(3), 77-88.
- Copeland, L. S. (1991). Cointegration Tests with Daily Exchange Rate Data. *Oxford Bulletin of Economics and Statistics, 53,*185–198.
- Diebold, F. X., J. Gardeazabal and K. Yilmaz (1994). On Cointegration and Exchange Rate Dynamics. *The Journal of Finance, 49,*727–735.
- Dornbusch, R. (1976). The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy. *Scandinavian Journal of Economics*, *78* (2), 255–275.
- Engel, C. and K. D. West (2005). Exchange Rates and Fundamentals. *Journal of Political Economy*, *113* (3), 485–517.
- Engle, R. F., and Granger, C.W. J. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica, 55,* 251-276.
- Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, *25* (2), 383–417.
- Fama, E.F., (1984). Forward and spot exchange rates. Journal of Monetary Economics, 14(3), 319-338.
- Fiser, R., & Roman, H. (2010). Central Bank Communication and Exchange Rate Volatility: A GARCH Analysis. *Macroeconomics and Finance in Emerging Market Economies, 3*(2), 25-31.
- Granger, C.W.J. (1986). Developments in the Study of Cointegrated Economic Variables. *Oxford Bulletin of Economics and Statistics, 48,* (3), 213-28.
- Hakkio, C. S. and Rush, M. (1989). Market Efficiency and Cointegration: An Application to the Sterling and Deutschmark Exchange Markets. *Journal of International Money and Finance*, *8,* 75–88.
- Hartman, R. (1972). The Effects of Price and Cost Uncertainty on Investment. *Journal of Economic Theory, 5*(10), 258-266.
- Hoffman, D.L. & Rasche, R.H. (1996). Assessing Forecast Performance in a Co-integrated System. *Journal of Applied Econometrics, 11*, 495-517.
- Anderson, R. G., Hoffman, D. L., & Rasche, R. H. (2002). A vector error-correction forecasting model of the US economy. Journal of Macroeconomics, 24(4), 569-598.
- Hylleberg, S., Engle, R. F., Granger, C. W. J. and Yoo, B. S. (1990). Seasonal cointegration. *Journal of Econometrics*, *44*, 215—238.
- Johansen, S. and K. Juselius (1990). Maximum Likelihood Estimation and Inference on Cointegration - with Application to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52 (2): 169–210.
- Kaur, J.**,** Verma, M., Agrawal, N., Narang, K. (2014). Relationship between RBI Liquidity Decisions and Household Expenditures. *Indian Journal of Accounting*, *46*(1), 87-95.

- Kuhl, M. (2008). Strong comovements of exchange rates: Theoritical and empirial cases when currencies become the same asset. Retrieved from http://econstor.eu/bitstream/10419/31989/1/585596816.pdf
- MacDonald, R., and Taylor, M. P. (1994). The monetary model of the exchange rate: Longrun relationships, short-run dynamics and how to beat a random walk. *Journal of International Money and Finance, 13* (3), 276-90.
- Makovsky, P. (2014). Modern Approaches to efficient market hypothesis of FOREX – the central European case. Procedia Economics and Finance, *14,* 397 – 406.
- Mark, N. (2009). Changing Monetary Policy Rules, Learning, and Real Exchange Rate Dynamics. *Journal of Money, Credit, and Banking, 41*, 1047-1070.
- Meese, R. A. and K. Rogoff (1983). Empirical Exchange Rate Models of the Seventies. *Journal of International Economics*, 14: 3–24.
- Sephton, P. S. and H. K. Larsen (1991). Tests of Exchange Market Efficiency: Fragile Evidence from Cointegration Tests. *Journal of International Money and Finance, 10,* 561– 570.
- Shen, C.-H. and Wang, L.-R. (1990). Examining the Validity of a Test of Futures Market Stock Efficiency: A Comment. *Journal of Futures Markets, 10,*195-196.
- Taylor, S. J. (1987). Forecasting the Volatility of Currency Exchange Rates. *International Journal of Forecasting, 3,* 159 – 70.
- World Economic Situation and Prospects 2006, United Nations: New York.
- Zivot, E., (2000). Cointegration and forward and spot exchange rate regressions. *Journal of International Money and Finance, 19*(6), 785-812.