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REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESIS (ES)

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

LIMITATIONS

SCOPE FOR FURTHER RESEARCH

REFERENCES

APPENDIX/ANNEXURE

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- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.

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ONLINE RESOURCES

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ESTIMATION OF DAILY EXCHANGE RATE VOLATILITY: A COMPARATIVE STUDY OF INDIAN CURRENCY WITH TOP TRADABLE CURRENCIES OF THE WORLD

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ABSTRACT

The increasing volatility of exchange rates after the fall of Britton Woods's agreements has been a constant source of concern for trade for every nation. Since the adoption of a floating exchange-rate regime in 1973, the effects of exchange-rate volatility on the volume of international trade have been the subjects of both theoretical and empirical investigations. Since international trade is the main focus of concern to rate anything including the determination of currency value and other macro-economic variables. The demand and supply of international currencies depend on the process international trade will fix the rate of currency and every day it will differs. The fluctuation of exchange rate volatility which is incurred by this result not only exerts pressure on trade but also in charting the policy and safeguards the currency values. Since Indian currency has been in constant depreciation and also devalued two times has opened the face of concern for study. Hence this paper highlighted the worth of the currency in respect of fluctuation in one year period of time with that of other top tradable currencies of the world. In this paper the volatility has been measured by taking the top tradable currencies of the world with that of the Indian currency. GARCH model is used with the help of Excel and daily rates have been taken to evaluate and long run volatility measures have been evaluated by GARCH method.

KEYWORDS

Exchange rate volatility, top tradable currencies, long run varience.

INTRODUCTION

Business is the core source of development of any nation. Finance which follows the tradable activity can measure economy of the nation. At the same time if trade depreciates the total business collapse and it influence the currency rates of that particular nation. Here exchange rate play very important role. Exchange rate volatility refers to the demand of one currency with respect to other and leads to tendency for foreign currencies to appreciate or depreciate in value, thus affecting the profitability of foreign exchange trades. The volatility is the measurement of the amount that these rates change and the frequency of those changes. Exchange-rate risk increases transaction costs and reduces the gains to international trade. There are many circumstances when exchange rate volatility comes into play, including business dealings between parties in two different countries and international investments. Although this volatility is difficult to avoid in such circumstances, the use of futures to lock in exchange rates can mitigate the effects of price change. Volatility can occur in any security that rises or falls in value. The term is most often used in conjunction with the stock market, but foreign currencies can be volatile as well. When exchange rates are floating exchange rates, as opposed to fixed exchange rates, they are likely to go up and down in value depending upon the strength of the economies involved. As a result, volatility is something that affects any business undertaking involving two different countries.

In this paper the work has been constructed on the basis of GARCH model where the currencies are compared by estimating exchange rate volatility. Top tradable currencies have been taken into consideration as per the rating of world bank. Top currencies such as US dollar, Briton Pound, Japanese yen, Swiss franc and Australian Dollar have been taken for the studies. European Euro has been kept apart considering that it is the common currencies of many European nations.

TOP TRADABLE CURRENCIES OF THE WORLD

- **US dollar (The Almighty Dollar):** Created in 1913 by the Federal Reserve Act, the Federal Reserve System (also called the Fed) is the central banking body of the U.S. The system is itself headed by a chairman and board of governors, with most of the focus being placed on the branch known as the Federal Open Market Committee (FOMC). The FOMC supervises open market operations as well as monetary policy or interest rates.
- **European Euro (EUR) (The Dollar's Nemesis):** Headquartered in Frankfurt, Germany, the European Central Bank is the central bank of the 17 member countries of the Eurozone. In similar fashion to the United States' FOMC, the ECB has a main body responsible for making monetary policy decisions, the Executive Council, which is composed of five members and headed by a president. The remaining policy heads are chosen with consideration that four of the remaining seats are reserved for the four largest economies in the system, which include Germany, France, Italy and Spain. This is to ensure that the largest economies are always represented in the case of a change in administration. The council meets approximately 10 times a year.
- **Briton Pound (The Queen's Currency):** As the main governing body in the United Kingdom, the Bank of England serves as the monetary equivalent of the Federal Reserve System. In the same fashion, the governing body establishes a committee headed by the governor of the bank. Made up of nine members, the committee includes four external participants (appointed by the Chancellor of Exchequer), a chief economist, director of market operations, committee chief economist and two deputy governors.
- **Japanese yen (Technically Complex, Fundamentally Simple):** Established as far back as 1882, the Bank of Japan serves as the central bank to the world's second largest economy. It governs monetary policy as well as currency issuance, money market operations and data/economic analysis. The main Monetary Policy Board tends to work toward economic stability, constantly exchanging views with the reigning administration, while simultaneously working toward its own independence and transparency. Meeting 12-14 times a year, the governor leads a team of nine policy members, including two appointed deputy governors.

- **Swiss franc (A Banker's Currency):** Different from all other major central banks, the Swiss National Bank is viewed as a governing body with private and public ownership. This belief stems from the fact that the Swiss National Bank is technically a corporation under special regulation. As a result, a little over half of the governing body is owned by the sovereign states of Switzerland. It is this arrangement that emphasizes the economic and financial stability policies dictated by the governing board of the SNB. Smaller than most governing bodies, monetary policy decisions are created by three major bank heads who meet on a quarterly basis.
- **Australian Dollar (Always a Carry Favourite):** Offering one of the higher interest rates in the major global markets, the Reserve Bank of Australia has always upheld price stability and economic strength as cornerstones of its long-term plan. Headed by the governor, the bank's board is made up of six members-at-large, in addition to a deputy governor and a secretary of the Treasury.

LITERATURE REVIEW

Blinder (1996) offers a good definition blending four characteristics which encompasses the three classical functions of money (a medium of exchange, a unit of account, and store of value): an international currency accounting for a preponderant share of the official reserves of central banks; a currency used "hand-to-hand" in foreign countries; a currency in which a disproportionate share of international trade is denominated; and a dominant currency in international financial markets. This paper mainly focuses on the currency volatility in exchange rate.

Exchange rate regime of any country is one of the major macroeconomic factors which determine the worth of nation's economy. The countries, which follow floating exchange rate regime, are supposed to face more volatility in exchange rates which results in more variability of cash flows for the firms. There are various determinants of exchange rates starting from Differentials in Inflation, Differentials in Interest Rates, Current-Account Deficits, Public Debt, Balance of Payments, and Relative strength of other currencies, Terms of Trade, Political Stability & Government Intervention and Economic Performance in the macroeconomic level and performance of firms and its subsidiaries in relation to international trade or in short Sensitivity of firms in the microeconomic level.

In micro economic scenario, the sensitivity of firms' cash flows to the fluctuations in exchange rate is known as *Foreign Exchange Exposure*. This exposure could be conventionally classified into three categories as mentioned by Eun and Resnick. First, *Transaction Exposure* which is defined as the sensitivity of "realized" domestic currency values of the firm's contractual cash flows denominated in foreign currencies to unexpected exchange rates. Second, *Economic Exposure* can be defined as the extent to which the value of the firm would be affected by unanticipated changes in exchange rates. Any anticipated changes in exchange rates would have been already discounted and reflected in the firm's value. Third, *Translation exposure* refers to the potential that the firm's consolidated financial statements can be affected by changes in exchange rates.

In macro-economic scenario, the status of a national currency is usually enforced by a set of legal restrictions. However, the use of currencies as international medium of exchange is largely determined by the "invisible hand". Recent work shows multiple reserve currencies can coexist because of multiple equilibria in the use of an international currency (Krugman 1984). Matsuyama et al. (1993), in the framework of random matching games for a two-country model of the world economy, also find multiple equilibria. In one equilibrium, the two national currencies circulate only locally; in another, one currency becomes an international currency. There is also an equilibrium in which both currencies are accepted internationally. The different roles of an international currency confer varied benefits (Cohen 2012). The use of a currency in foreign-exchange trading, trade invoicing, or for official intervention purposes generates some measure of gain at the microeconomic level. Cohen further adds that only the store-of-value role, which by definition implies some level of foreign accumulation, will generate any amount of seigniorage or macroeconomic flexibility for the issuing country.

Cohen (2012) argues that a currency's role in trade impacts the reserve preferences of the foreign central banks. The currency composition of the central banks' reserves generally reflects the currency choice of the international commercial relationship. The currency denomination of trade plays a vital part in determining which among several investment currencies will emerge as a favoured reserved currency. Frankel (2011) summarizes why most empirical studies of international currency choice have usually focused on the currency composition of foreign exchange reserves as the main indicator of the international use of currencies. Chinn & Frankel (2007, 2008) identify output and trade, financial markets, confidence in the value of the currency, network externality as critical factors that determine the status of international reserve currency. Lee (2010) uses the following demand function to estimate economic determinants of international currency.

The exchange rate in a given economy often plays a prominent role than the interest rate in the transmission mechanism of monetary policy (Vitale, 2003). Especially for developing countries, it has been assumed that depreciation is an appropriate macroeconomic fundamental to support the export sector.

GARCH and Exchange rates: Generalized autoregressive conditional heteroskedastic (GARCH) models have received ample attention in recent years, especially with regard to financial applications. This class of models, introduced by Bollerslev (1986), has been used to forecast fluctuations in commodities, securities and exchange rates. The aim of this paper is to assess the volatility of the top tradable currencies with that of Indian currency. It is well established that the volatility of asset prices displays considerable persistence hence large movements in prices values to be followed by large moves producing positive correlation in square returns. Thus current and past volatility can be used to predict future volatility.

OBJECTIVES

1. To estimate daily exchange rate volatility.
2. To estimate the fluctuation of top tradable currencies with Indian currency.

RESEARCH METHODOLOGY

The study has been conducted on the top currencies of the world against Indian Rupee. The study is both qualitative and quantitative. Top currencies has been taken for the study which are as follows.

1. US dollar,
2. Briton Pound,
3. Japanese yen,
4. Swiss franc and
5. Australian Dollar

DATA SOURCES AND COLLECTION

Secondary data has been used. The sources includes many reports including world bank report and IMF report, research bulletins and other accessible sources.

ESTIMATING EXCHANGE RATE VOLATILITY – THE MODEL

The methods of measuring volatility have evolved over time to reflect new advances in econometric techniques. There has not yet emerged a clearly dominant approximation for uncertainty. The volatility variable may be constructed as the standard deviation of a rate of change, or the level, of a variable; a moving standard deviation, or a within-period one (Mohsen & Hegerty, 2007). The most popular model for estimating volatility however is the GARCH (1,1) Model proposed by Bollerslev in 1986. The GARCH model has been used to characterize patterns of volatility in U.S. dollar foreign exchange markets (Baillie and Bollerslev 1989 and 1991) and in the European Monetary System (Neely,1999)

The variance rate (σ_n^2) is calculated from a long-run average rate, V_L as defined in the equation;

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2$$

This equation can also be written as

$$\sigma_n^2 = \omega + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2$$

Where ω is set equal to γV_L

When $\alpha + \beta < 1$, the variance process displays mean reversion to the unconditional expectation of σn^2, $\omega / (1-\alpha - \beta)$. That is, forecasts of volatility in the distant future will be equal to the unconditional expectation of σn^2, $\omega/ (1-\alpha - \beta)$. The parameters are as follows:

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- σ_n = Defined as the Volatility of exchange rate at day "n" estimated at the end of day "n-1
- σ_n^2 = Defined as the variance rate
- Un = Defined as the percentage change in the exchange rate between the end of day "n-1"and the end of day "n" between Rs and USD
- V_L = Long - run average variance rate
- ω, γ, α and β = Constant

ESTIMATING VOLATILITY

$\sigma_n^2 = 0.000000576 + 0848016\, u_{n-1}^2 + .138794\, \sigma_{n-1}^2$

From $\gamma + \alpha + \beta = 1$

Therefore $\gamma = 1 - (\alpha + \beta) = 0.013190$

Further, $\omega = \gamma V_L$, Therefore, $V_L = 0.000000576/0.013190 = 0.0000436694$

Thus, the long run average variance implied by the model is 0.0000436694. This corresponds to volatility of $\sqrt{0.0000436694} = .0066 = 0.66\%$ per day. Therefore, the Long-term volatility equals 0.66% per day.

The Long-term volatility of the year equals $0.66 * \sqrt{313} = 11.67\%$

The rest of the calculations are done by using Excel and the following results are shown for 5 top currencies in below table 1, 2, 3, 4 and 5.

FINDINGS AND ANALYSIS

- The trading days are different, where 2009 to 2014 has greater than previous years ranging from 290s to 315s because Saturdays are added as working days. But the weighted average is taken for calculations.
- When the long run variance is zero the fluctuation of rupees is very little.
- When the long run variance is little means it doesn't indicates that the rupee value is appreciated or depreciates but ranged from the rise and fall for shorter values. For example the fluctuation existed if the rupee value rises for 2 to 5 rupees or decreases for 2 to 5 rupees.
- When omega results in zero and Gamma value is negative the long run variance is zero.

US DOLLAR/INDIAN RUPEE

- 1995, 1997, 199, 2001, 2002, 2003 showed very little fluctuation in the currency rates hence volatility showed zero. It showed the fluctuation of Rs.2 or Rs.3 only raise and fall. The Gamma value of these years were negative as well resulting negligible long run variance
- 2004 was the year where rupee appreciated from Rs.45 of 2003 to Rs.43 in 2004. But lot of fluctuations was showed in this year in appreciation.
- 2008 was the year which showed much fluctuation because of recession.
- 2014 the fluctuation is minimised when compared to previous year even though the Rupee price gone more than expected which is up to Rs. 63.67 per dollar.

BRITISH POUND/INDIAN RUPEE

- British pond showed lot of fluctuation from 1995 to 2014.
- 2008 was the year which showed much fluctuation because of recession. In this year with US dollar pound also showed lot of fluctuation. In 2007 it was Rs.87 per pound and Rs.78 per pound in 2008. Since the decrease in trade with this currency the rupee value appreciated in 2008 but showed lot of fluctuation.

JAPANESE YEN/INDIAN RUPEE

- Even though the Japanese yen is lesser than the rupee value, the fluctuation is shown much in these currencies
- Year 2004 showed fluctuation in the currency value of yen where yes appreciated but remained constant with few variations. Hence long run variance is 9.86%
- 2009 was the year which shown more fluctuation because of depreciation of US dollar and also it saw a period of increase in the value of yen.

SWISS FRANC/INDIAN RUPEE

- 2009 was the year which shown more fluctuation because of depreciation of US dollar and also it saw a period of increase in the value of Swiss franc.
- 1999 and 2011 showed second level of fluctuation of 21.78% and 27.29%
- 2002 and 2014 showed less fluctuation which resulting in the fall of Swiss franc worth to Indian rupee when compared to previous year

AUSTRALIAN DOLLAR/INDIAN RUPEE

- Australian Dollar has also showed more fluctuation and this is the only currency which has constant rate of raise in its worth with that of Indian rupee.
- Year 1996, 1998, 2004, 2008 and 2013 has showed more fluctuation where 1997, 2002, 2005 and 2014 showed less fluctuation.

CONCLUSION

The international trade became complicated from 1973 till present. The worth of Indian rupee appreciated in small quantum and depreciated in large quantum. In this paper the volatility has been calculated from 1995 to 2014 where we have found that the volatility fluctuation over a period of year. When there is small variation the volatility is negligible but when there is large variation the volatility is high. In all 5 cases the volatility has shown high when the rupee value appreciated and also volatility has shown low when the rupee value remained constant. From the study it has been found that Japanese yen and Australian dollar has shown more volatility when compared to US dollar, Briton pound and Swiss Franc. And also in both Australian Dollar and Japanese yen high variation resulted in Appreciation of Indian rupee value. Hence from the study it can be conclude that Appreciation of Indian Rupee resulted in High long run variance which interprets as high exchange rate volatility.

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16. http://www.investing.com/currencies/usd-inr-historical-data

ANNEXURE

<div align="center">TABLE 1: US DOLLAR</div>

USD/INR - US Dollar Indian Rupee		1995	1996	1997	1998	1999	2000	2001	2002	2003
(Trading) Days per Year		260	261	260	260	260	260	260	260	261
Unconditional Variance		1.29E-05	2.01E-05	5.71E-06	1.31E-05	1.64E-06	3.14E-06	1.31E-06	4.19E-07	2.11E-06
Unconditional Variance ann.		0.003341	0.005246	0.001485	0.003405	0.000427	0.000815	0.00034	0.000109	0.000551
Unconditional Volatility ann.		0.057802	0.07243	0.038532	0.058353	0.02067	0.028557	0.018452	0.010441	0.023476
Estimated Omega		0	2.5E-07	0	5.1E-07	0	1.28E-07	0	0	0
	Alpha	0.544153	0.844155	0.888768	0.844155	0.781821	0.844155	0.729138	0.844155	0.874165
	Beta	1.294361	0.138794	0.180498	0.138793	0.328225	0.138793	0.463115	0.138793	0.161572
Log-Likelihood		3080.222	2646.931	3148.985	2736.455	3255.649	3073.5	3262.288	3514.042	3134.104
Gamma		-0.83851	0.017051	-0.06927	0.017052	-0.11005	0.017052	-0.19225	0.017052	-0.03574
Alpha + Beta + Gamma		1	1	1	1	1	1	1	1	1
Long-run variance		0.00%	6.18%	0.00%	8.82%	0.00%	4.41%	0.00%	0.00%	0.00%

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
262	260	260	261	262	292	306	311	314	313	313
4.09E-05	2.55E-05	2.51E-05	2.65E-05	9.24E-05	7.12E-05	3.66E-05	2.78E-05	3.14E-05	6.4E-05	1.85E-05
0.010725	0.006634	0.006514	0.006905	0.024202	0.020782	0.0112	0.008646	0.00987	0.02003	0.005799
0.103559	0.081449	0.08071	0.083094	0.155571	0.144161	0.10583	0.092982	0.099347	0.141527	0.076148
1.47E-06	1.2E-06	1.08E-06	1.05E-06	4.31E-07	1.98E-06	1.38E-06	1.21E-06	4.27E-06	1.42E-06	9.09E-07
0.844155	0.844155	0.844155	0.844155	0.869543	0.864356	0.844155	0.844155	0.863139	0.860717	0.844155
0.138793	0.138793	0.138793	0.138793	0.129734	0.103457	0.138793	0.138793	0	0.115405	0.138793
2368.153	2462.333	2475.421	2475.41	2226.46	2511.109	2809.154	2935.93	2922.139	2771.939	3070.685
0.017052	0.017052	0.017052	0.017052	0.000723	0.032187	0.017052	0.017052	0.136861	0.023878	0.017052
1	1	1	1	1	1	1	1	1	1	1
15.02%	13.55%	12.84%	12.66%	39.51%	13.42	15.76%	14.68%	9.90%	13.66%	11.67%

<div align="center">TABLE 2: BRITISH POUND</div>

GBP/INR - British Pound Indian Rupee		1995	1996	1997	1998	1999	2000	2001	2002	2003
(Trading) Days per Year		260	261	260	260	260	260	259	260	260
Unconditional Variance		4.41E-05	3.67E-05	3.14E-05	3.33E-05	2.08E-05	3.32E-05	2.67E-05	1.77E-05	2.7E-05
Unconditional Variance ann.		0.011461	0.009585	0.008162	0.008647	0.005404	0.008627	0.006928	0.004599	0.007028
Unconditional Volatility ann.		0.107056	0.097904	0.090346	0.092991	0.073515	0.092881	0.083233	0.067819	0.083834
Estimated Omega		2.04E-06	9.86E-07	4.17E-06	2.58E-06	1.15E-06	1.19E-06	1.2E-06	7.96E-07	1.19E-06
	Alpha	0.844155	0.847752	0.867533	0.872067	0.844155	0.852083	0.854152	0.847443	0.844155
	Beta	0.138793	0.138793	0	0.044537	0.138793	0.13939	0.137057	0.138793	0.138793
Log-Likelihood		2332.975	2424.78	2416.881	2416.56	2503.185	2401.763	2425.612	2560.379	2448.186
Gamma		0.017052	0.013455	0.132467	0.083396	0.017052	0.008527	0.008791	0.013764	0.017052
Alpha + Beta + Gamma		1	1	1	1	1	1	1	1	1
Long-run variance		17.64%	13.83%	9.05%	8.96%	13.22%	19.05%	18.82%	12.26%	13.46%

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
262	260	260	261	262	292	306	311	314	313	313
4.09E-05	2.55E-05	2.51E-05	2.65E-05	9.24E-05	7.12E-05	3.66E-05	2.78E-05	3.14E-05	6.4E-05	1.85E-05
0.010725	0.006634	0.006514	0.006905	0.024202	0.020782	0.0112	0.008646	0.00987	0.02003	0.005799
0.103559	0.081449	0.08071	0.083094	0.155571	0.144161	0.10583	0.092982	0.099347	0.141527	0.076148
1.47E-06	1.2E-06	1.08E-06	1.05E-06	4.31E-07	1.98E-06	1.38E-06	1.21E-06	4.27E-06	1.42E-06	9.09E-07
0.844155	0.844155	0.844155	0.844155	0.869543	0.864356	0.844155	0.844155	0.863139	0.860717	0.844155
0.138793	0.138793	0.138793	0.138793	0.129734	0.103457	0.138793	0.138793	0	0.115405	0.138793
2368.153	2462.333	2475.421	2475.41	2226.46	2511.109	2809.154	2935.93	2922.139	2771.939	3070.685
0.017052	0.017052	0.017052	0.017052	0.000723	0.032187	0.017052	0.017052	0.136861	0.023878	0.017052
1	1	1	1	1	1	1	1	1	1	1
15.02%	13.55%	12.84%	12.66%	39.51%	13.42	15.76%	14.68%	9.90%	13.66%	12.92%

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TABLE 3: JAPANESE YEN

JPY/INR - Japanese Yen Indian Rupee

		1995	1996	1997	1998	1999	2000	2001	2002	2003
(Trading) Days per Year		260	261	260	260	260	260	260	260	260
Unconditional Variance		9.36E-05	4.65E-05	6.16E-05	0.00012	7.27E-05	4.17E-05	4.38E-05	3.8E-05	2.74E-05
Unconditional Variance ann.		0.024325	0.012136	0.016022	0.031235	0.018896	0.010843	0.011381	0.009882	0.007116
Unconditional Volatility ann.		0.155966	0.110163	0.126577	0.176733	0.137462	0.104128	0.10668	0.09941	0.084359
Estimated Omega		8.14E-06	2.04E-06	2.74E-06	1.94E-05	4.33E-06	2.04E-06	2.04E-06	2.04E-06	2.87E-06
	Alpha	0.868	0.844155	0.851649	0.618937	0.846923	0.844155	0.844155	0.844155	0.868083
	Beta	0.049187	0.138793	0.127228	0.248441	0.128056	0.138793	0.138793	0.138793	0.028815
Log-Likelihood		2140.203	2345.472	2238.637	2098.678	2195.858	2336.794	2324.881	2351.489	2453.441
Gamma		0.082813	0.017052	0.021123	0.132623	0.025021	0.017052	0.017052	0.017052	0.103101
Alpha + Beta + Gamma		1	1	1	1	1	1	1	1	1
Long-run variance		15.99%	17.68%	18.37%	19.48%	21.22%	17.64%	17.64%	17.64%	8.51%

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
262	260	260	261	262	292	306	311	314	313	313
3.8E-05	2.46E-05	2.62E-05	5.54E-05	0.000173	0.000117	7.43E-05	4.52E-05	6.02E-05	0.000105	3.53E-05
0.009952	0.006387	0.006811	0.014453	0.04537	0.034116	0.022738	0.014048	0.018897	0.032975	0.011049
0.099757	0.079922	0.082527	0.120222	0.213003	0.184705	0.150791	0.118525	0.137467	0.18159	0.105114
2.54E-06	1.23E-06	1.25E-06	1.45E-06	2.42E-06	3.34E-06	3.37E-06	2.04E-06	2.47E-06	4.08E-06	2.62E-06
0.870668	0.844155	0.844155	0.848896	0.868463	0.891827	0.844155	0.844155	0.85961	0.844155	0.86095
0.060783	0.138793	0.138793	0.140043	0.116985	0.096706	0.138793	0.138793	0.12026	0.138793	0.069989
2394.808	2467.045	2457.023	2289.938	2066.756	2339.615	2617.881	2779.632	2714.137	2567.462	2895.561
0.068549	0.017052	0.017052	0.011061	0.014552	0.011467	0.017052	0.017052	0.020131	0.017052	0.069061
1	1	1	1	1	1	1	1	1	1	1
9.86%	13.68%	13.80%	18.48%	20.88%	29.16%	24.60%	19.29%	19.61%	27.37%	10.90%

TABLE 4: SWISS FRANC

CHF/INR - Swiss Franc Indian Rupee

		1995	1996	1997	1998	1999	2000	2001	2002	2003
(Trading) Days per Year		260	261	260	260	260	260	260	260	260
Unconditional Variance		0.0001	5.02E-05	5.26E-05	5.34E-05	4.59E-05	5.58E-05	5.49E-05	3.74E-05	5.59E-05
Unconditional Variance ann.		0.026125	0.013114	0.013683	0.013896	0.011936	0.014507	0.014278	0.009711	0.014525
Unconditional Volatility ann.		0.161632	0.114516	0.116974	0.117881	0.109251	0.120443	0.119492	0.098545	0.12052
Estimated Omega		1.08E-05	2.04E-06	3.85E-06	3.14E-06	1.79E-06	3.61E-06	2.77E-06	2.8E-06	1.53E-06
	Alpha	0.82124	0.844155	0.847141	0.852217	0.862842	0.85529	0.856718	0.871825	0.871539
	Beta	0.075771	0.138793	0.11013	0.116298	0.127365	0.103436	0.116936	0.051132	0.115226
Log-Likelihood		2123.16	2319.489	2274.259	2277.913	2308.233	2257.183	2270.456	2379.609	2257.17
Gamma		0.102989	0.017052	0.04273	0.031485	0.009793	0.041274	0.026347	0.077043	0.013235
Alpha + Beta + Gamma		1	1	1	1	1	1	1	1	1
Long-run variance		16.54%	17.68%	15.30%	16.11%	21.78%	15.09%	16.54%	9.72%	17.34%

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
262	260	260	261	262	292	306	311	314	313	314
6.01E-05	3.51E-05	3.12E-05	3.02E-05	0.000111	7.04E-05	4.34E-05	9.32E-05	3.46E-05	6.65E-05	2.76E-05
0.015742	0.009133	0.008112	0.007883	0.029079	0.02056	0.013288	0.02899	0.01086	0.020818	0.008666
0.125468	0.095568	0.090064	0.088784	0.170526	0.143389	0.115274	0.170266	0.104209	0.144283	0.093094
1.72E-06	1.78E-06	1.34E-06	1.12E-06	4.36E-06	1.92E-06	1.73E-06	4.08E-06	4.37E-06	1.42E-06	3.6E-06
0.871098	0.845269	0.844155	0.852962	0.854345	0.859747	0.846181	0.844155	0.872286	0.853891	0.863253
0.113088	0.138528	0.138793	0.138686	0.10879	0.13941	0.138624	0.138793	0.004173	0.130717	0.004516
2265.581	2371.347	2418.526	2424.73	2128.741	2504.461	2742.044	2587.584	2892.206	2774.185	2957.391
0.015813	0.016203	0.017052	0.008352	0.036864	0.000843	0.015196	0.017052	0.123541	0.015392	0.132231
1	1	1	1	1	1	1	1	1	1	1
16.86%	16.91%	14.29%	18.75%	17.60%	81.60%	18.68%	27.29%	10.54%	16.98%	9.25%

TABLE 5: AUSTRALIAN DOLLAR

AUD/INR - Australian Dollar Indian Rupee										
		1995	1996	1997	1998	1999	2000	2001	2002	2003
(Trading) Days per Year		260	260	260	260	260	260	260	260	260
Unconditional Variance		3.89E-05	3.7E-05	3.89E-05	7.58E-05	3.49E-05	6.04E-05	7.01E-05	3.24E-05	4.13E-05
Unconditional Variance ann.		0.010116	0.009609	0.010101	0.019709	0.009063	0.015692	0.018219	0.008437	0.010742
Unconditional Volatility ann.		0.100577	0.098027	0.100506	0.140389	0.095201	0.125269	0.134978	0.09185	0.103646
Estimated Omega		2.04E-06	1.06E-06	2.11E-06	3.32E-06	1.72E-06	4.75E-06	3.45E-06	2.02E-06	1.69E-06
	Alpha	0.844155	0.851891	0.862507	0.844155	0.849324	0.842598	0.856651	0.867352	0.855261
	Beta	0.138793	0.141419	0.078539	0.138793	0.136929	0.109537	0.115382	0.068135	0.126673
Log-Likelihood		2363.328	2401.286	2392.283	2196.716	2370.195	2237.035	2208.813	2426.668	2333.211
Gamma		0.017052	0.00669	0.058954	0.017052	0.013747	0.047865	0.027967	0.064513	0.018065
Alpha + Beta + Gamma		1	1	1	1	1	1	1	1	1
Long-run variance		17.64%	20.28%	9.64%	22.51%	18.02%	16.06%	17.92%	9.02%	15.60%

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
262	260	260	261	262	292	306	311	314	313	313
7.18E-05	3.08E-05	3.05E-05	6.11E-05	0.000291	9.99E-05	4.66E-05	4.85E-05	3.74E-05	6.63E-05	2.76E-05
0.018809	0.007997	0.007919	0.015948	0.076114	0.029169	0.014245	0.015074	0.011733	0.020749	0.00864
0.137144	0.089423	0.088991	0.126285	0.275887	0.170789	0.119351	0.122778	0.10832	0.144045	0.092953
1.91E-06	3.89E-06	1.11E-06	2.04E-06	2.23E-06	3.57E-06	2.04E-06	1.84E-06	2.04E-06	2.79E-06	3.97E-06
0.863433	0.873466	0.844155	0.844155	0.832439	0.844155	0.844155	0.844155	0.844155	0.845832	0.857341
0.126658	0	0.138793	0.138793	0.160328	0.138793	0.138793	0.138793	0.138793	0.138366	0
2221.683	2421.556	2433.223	2273.645	2028.306	2418.858	2737.27	2782.142	2855.494	2731.374	2945.049
0.009909	0.126534	0.017052	0.017052	0.007233	0.017052	0.017052	0.017052	0.017052	0.015802	0.142659
1	1	1	1	1	1	1	1	1	1	1
22.47%	8.94%	13.02%	17.68%	28.44%	24.73%	19.14%	18.33%	19.39%	23.52%	9.33%

FIG 1: MULTIPLE GRAPHS – TIME SERIES OF FIVE TOP TRADABLE CURRENCY
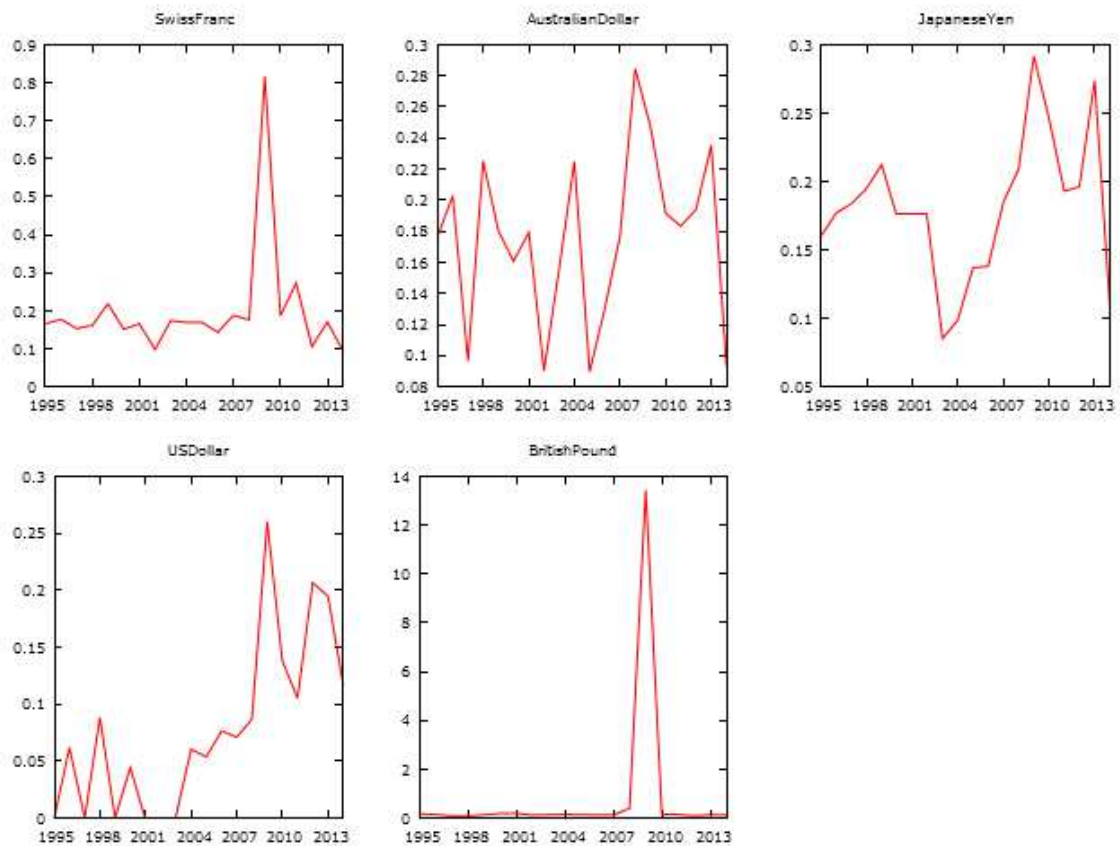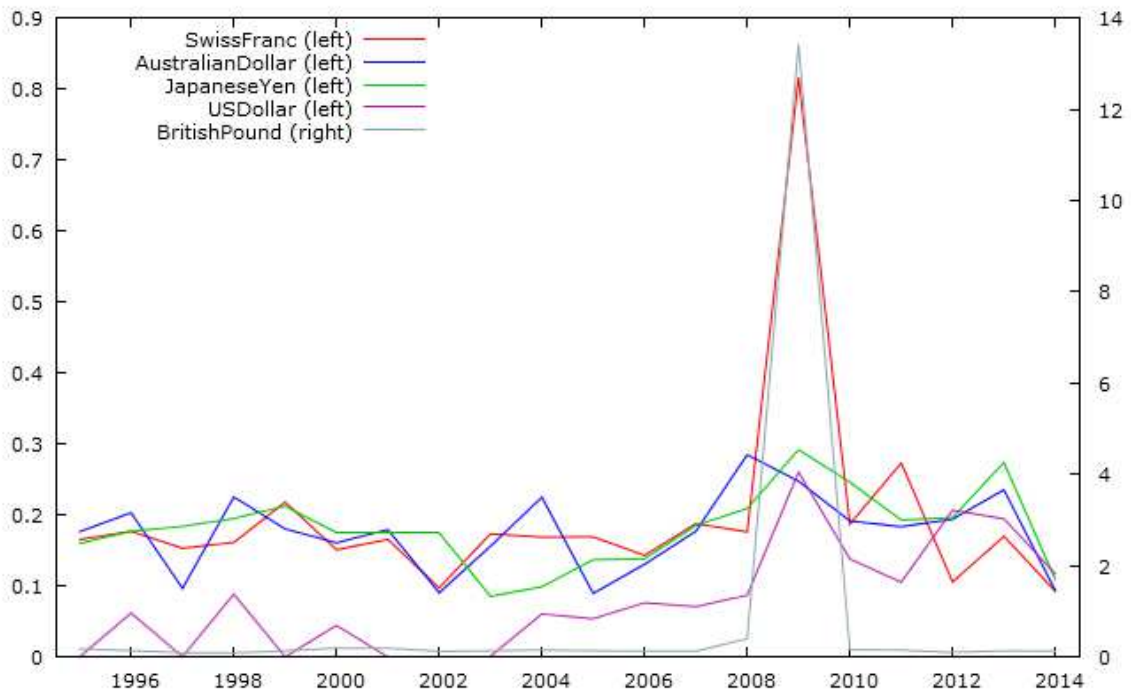
FIG 2: MULTIPLE GRAPHS – TIME SERIES OF FIVE TOP TRADABLE CURRENCY

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