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Using the GARCH framework to aid in decision making for businesses with Forex Exposures

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ABSTRACT

The increased volatility that has been witnessed over the past few years has posed a problem to SMEs. The authors of this paper would wish to prepare a framework that can help solve this problem by giving SMEs a guideline for making payments and to hedge their exposures. Earlier literature has already covered the prediction of spot prices of the forex rates. The authors wish to use this for decision-making the model used for this is the eGARCH model used on the R software. Using monthly and daily predictions the authors have developed a framework that can be used for decision making and hedging. This model is limited to working in normal times and not stressed situations.

Keywords: *Forex, Forecasting, eGARCH, Risk Management, Hedging, Small and Medium Enterprises*

1. INTRODUCTION

The Forex market is a market that suffers from large-scale information asymmetry. The main motivation behind the idea of our model is the number of companies and the number of portfolios which have foreign exposure in our country and the huge uncertainty regarding the outflow and inflow of payments. Various reports have indicated that there has been widespread growth in the uncertainty of the Forex markets. Fifteen to Twenty percent of the market has the framework to properly predict the exchange rate movements and the rest of the market speculates. As speculation can at times lead to larger losses this becomes a problem that does require immediate redressal.

Previous research models have mainly looked at using various Linear and non-linear models to predict future volatility. The methods used include the ARIMA, GARCH, ANN, ANFIS, SVR to name a few. None of the papers have highlighted how possibly this future volatility prediction can be used. These papers have been highlighted in the later sections.

Due to the unavailability of such a model in the real-life market, there is a lot of uncertainty regarding when is the ideal date to make the foreign payments to minimize the losses due to exchange rates. Our model which we have created using the GARCH model will help many of these companies to check when the average increase or decrease in the exchange rate is on a particular day of a month less/more than the average increase or decrease in the monthly average change in percentage and hence we can use this data to reduce the losses occurring due to fluctuations in exchange rates and book profits for the company.

This will help various companies in multiple sectors which make foreign payments often. the businesses can also use this model to the foreign exposures of the business and accordingly hedge the exposures and it can also determine the optimal hedge ratio for the firm. This model can also be used to determine the market trend of backwardation or contango. However, each of the uses of this model must be done keeping in mind the limitations of this model has in the next section.

2. LITERATURE REVIEW

Our ever-increasing dependence on the exchange rates made one thing clear that it is crucial to determine what makes up this exchange rate. Using various statistical models, we began using these techniques to predict the exchange rates, and considering the impact that these exchange rates have on the global markets, they proved to be a gamechanger.

An in-depth study was conducted to determine the macroeconomic variables of the exchange rate of the Indian Rupee against the US Dollar. The volatility of macroeconomic variables' relation with exchange rate volatility was studied in this project. In conclusion, the author found strong indirect correlations with the interest rates along with a mild indirect correlation with the GDP Growth Rate. The paper has also highlighted the fact during its period of study (2009-11), India received high inflows of forex which increased its volatility even though the domestic conditions looked stable.(Mirchandani, 2013).

The central authorities in a country would like to predict the variations in the exchange rate and implement appropriate counter-measures. On conducting the analysis, the relative stock of both money and debt that the government holds may have a direct relationship with the variations in the exchange rate. Central banks' stock of currencies can also be a significant variable in determining volatility. An aggressive borrowing policy by the Government might cause a severe depreciation in the currency (Saeed, Awan, Sial, & Sher, 2012).

Earlier research projects conducted in the field of Forex have highlighted that the investment horizon in the world can be affected by the Exchange Rates which in turn get determined by a set of variables that may either be arbitrary or relative to the country. Using a multiple-regression framework the authors have established a relation of the THB/USD rate having a strong correlation with the Terms of Trade and International reserves which do make sense considering that Thailand is an export-based country attracting foreign investments. The authors have also established that the variables may vary from country to country. (Bouraoui & Phisuthtiwatcharavong, 2015)

The wave of Globalisation has also presented us with a new problem. As the trading volumes in the foreign exchange market have increased, so has the volatility of the markets. There have been various variations in the models that were used and the notable works in this field have been stated below.

A comparative analysis between the ARIMA, GARCH, and the ANN models using the historical data of the Iranian Rial against the US Dollar. The data used for this project was historical. Due to the ability of the ANN and ANFIS models to be able to determine the non-linear relations between both the currency rates it proved to be the superior model among the various models employed (Fahimifard, Houmayounifar, Sabouhi, & Moghaddamnia, 2009).

In this prediction project, authors have used the Bullion Gold prices and the stock market variables of turkey to predict the fluctuations in the Turkish Lira against the US Dollar. Also taken into consideration are the Consumer Price Index and the Producer Price Index to explain the Turkish Lira Exchange rates against the US Dollar. The model consisted of 4 layers having the architecture of 5,10,20,1 with two hidden layers. The model was highly accurate having a Mean Square Error about 0.000267. (Erdogan & Goksu, 2014)

The standard back-propagation can sometimes be an extremely tedious process thus the author of this paper has used a scaled conjugate gradient algorithm along with a standard back-propagation algorithm in the ANN to predict the exchange rates. The period of study was 35 weeks and the model had a structure of 6,6,1. This sort of tool can be extremely crucial in the forex markets to predict the prices which would in turn determine the hedging strategies of that firm (Kamruzzaman & Sarker, 2004).

Using a 51-country study, the paper compared the discriminant score of the countries to see if the chosen variables were able to compare the fluctuations in the exchange rates. The variables include the investment service ratio, price index ratio and the ratio of imports to exports. Making use of this method the authors devised an early-warning system for a sudden fall in the exchange rates. This method of study can also be very useful in proving the relationship between the variables and the exchange rates (Folks & Stansell, 1975).

In the forex markets forecasting is only one part of the problem the other being solved by the risk management in this sphere. Using various metrics such as Value at Risk and also measuring the tail-end losses we can determine the risk profile of the country. Implementing the debt profile along with the exposures in the forex markets the possible losses made by the company can be hedged (Papiaonnou, 2006).

The GARCH Model and its variations have been used to predict the volatility of stock prices and currency exchange rates since a long time in order to determine the spot prices to determine the scale of wealth maximization. (Chong, Ahmad, & Abdullah, 1999). In order to capture the skewness of the returns an eGARCH model has often been used in order to predict the exchange rates as they tend to be negatively skewed. This has been done for the TZS/USD spot rates (Epaphra, 2016) and the BDT/USD spot rates (Alam & Rahman, 2012).

3. METHODOLOGY

The authors of this paper are aiming to develop a framework which can suggest the optimal days to make payments or receive their dues. In order to do this the authors of this paper have developed the below mentioned framework. First, the authors have predicted the monthly average values of a particular currency (in this case the USD/INR spot rates). Then, the authors have predicted the daily values of the same currency during the month by using another model. After this, the authors have observed all the daily values and

focus on the days where the value of the exchange rate is lower than the monthly average value of that month. The authors would then suggest to use the daily standard deviation to construct a range of values. The days during which the company finds the range suitable the payments should be made on those days.

Since the authors of the papers wish to use the historical data to determine future exposures of any company, the authors have used two different data sets in order to predict the optimum date to make payments or receive their dues. For this study the authors of this paper have chosen the USD/INR spot rates. The data chosen for this are daily observations over 200-day period. The second data set is monthly averages of daily observations from June 2005 to April 2021. After choosing the data series the authors have used the Augmented Dickey-Fuller test to determine if the data set is stationary. Since the sets are non-stationary log-natural differencing has been used. For the development of the model the authors have used the R software.

The authors of this paper will be using the eGARCH model to predict the spot rates. The underlying model of the GARCH model is an ARIMA (0,1,1) which is a standard MA for the monthly model and an ARIMA (0,1,0) for the daily model. The underlying curve used is a skewed Student's T-distribution rather than a normal Distribution due to the presence of fat tails. The justification for the same is explained in the form of graphs whose observations are summarized below.

In Graph 1.1 we have the QQ plot with black line describing the predicted values and the blue circles show the actual values showing the accuracy of the model. The ACF of the model is explained in graph 1.2 and through this graph we have come to the conclusion to us the ARMA model (0,1). Graph 1.3 is the News-Impact curve showing that positive news has a greater impact on our model than the negative news. Graph 1.4 shows the distribution of the data points which is skewed and has fatter tails. It also shows that the Skewed Student-T distribution is a better distribution to use over the normal distribution. As explained in the monthly GARCH model, graph 2.1 shows the efficacy rate of the model. Graph 2.2 shows that there is no serial auto-correlation justifying the use of a ARMA (0,0) model. For the daily model the positive news once again has a greater impact on the model and graph 2.4 justifies the use of skewed student T-distribution.

4. ANALYSIS AND FINDINGS

The results of both the GARCH models are explained in the form of tables in the end of this section. The predicted means and the volatilities of both the tables are summarised below in the form of tables.

Monthly GARCH -Table 1.1

Month	May	June	July	August	September
Volatilities	1.611%	1.625%	1.638%	1.65%	1.662%
Average Ceiling	75.67195	75.68238	75.69215	75.7025	75.71301
Average Floor	73.2724644	73.2620383	73.2523569	73.2434203	73.2344836

The users of the papers must not that according to the Model used by the authors of the paper this is the highest possible average and the lowest possible averages of the exchange rates. Care must be taken while choosing the day for payments, if the spot price on a particular day is higher than the ceiling than the payment should be shifted to a later date as the spot rates are mean-reverting and will eventually come down to meet the average point. Care should also be taken if the spot rates go below the floor average as that would indicate increased volatility in the market and at the same time it would be due to adverse situation in the market, which the market would eventually adjust to.

Daily GARCH - Table 1.2

Day	2nd May	3rd May	4th May	5th May
Spot High	74.4460284	74.4783006	74.3719562	74.5686459
Spot Low	73.6003716	73.5680994	73.6744438	73.4777541

If a firm has to make decision in the past regarding a date for the future the authors of the paper would like to suggest the following method. Using the Ceiling and Floor rates generated one can determine the average rate for the month which can be termed as the decision price. For the month of May, it would be 74.4722. In the above illustrated table, the predicted Spot High price exceeds the decision price on 3rd and 5th May, hence payment on these days should be avoided while any sort of receipt should be preferred. Ideally the firm could be choosing to make the payment on either 2nd May or 4th May. In order to make a decision between these two days one must consider the volatility. If the firm is ready to take on greater volatility in order to reach a smaller price or to avoid the risk of higher volatility and to go for a slightly higher price.

The authors of this paper would also like to stress on the fact that these models are solely built for regular conditions and not for extreme scenarios. The Daily GARCH Model would also need to be fed with new data in order to be able to catch the latest trends. The model does not follow a regime switching policy, that is the model assumes that periods of high volatility will be followed by periods of high volatility and vice-versa. These assumptions must be kept in mind while following this model along with the standard GARCH assumptions.

5. LIMITATIONS

The biggest limitation that is faced by this model is that it uses historical data which means that it only incorporates historical shocks and does not include the shocks that are possible in the future. At the same time the authors of this paper would also like the users of this paper note that this model can only be used during the normal market conditions and it cannot be used during the times of crises as the data may not follow the same pattern which it has been following during normal market conditions. The model also does operate at the 95 percent confidence level and is not a 100 percent accurate and there is also a possibility for the changes in

data to greater or smaller than the predicted value. The model also assumes linear relations between the time lags and thus the relation may not be as strong as that of non-linear models.

6. RECOMMENDATIONS FOR FUTURE RESEARCH

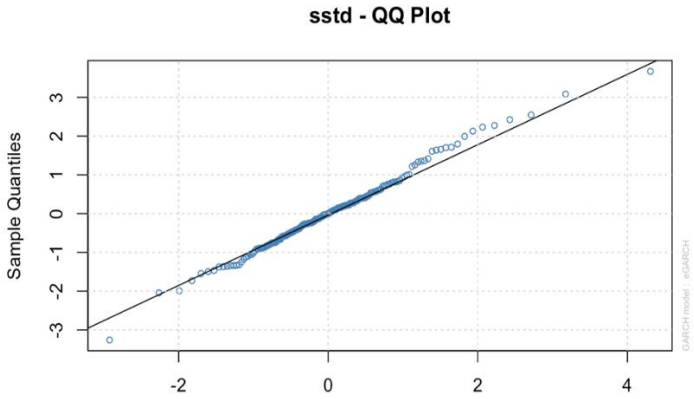
The authors of this research paper would strongly recommend future research projects to make use of the non-linear models to aid in the business decision making process. Due to the ability to make non-linear relations it tends to have greater accuracy over the linear models as the market variables due tend to have a non-linear relation. As the volatility increase the probability of crises occurring also does increase at the same time exponentially. Future projects can look at helping businesses hedge or reduce their losses during the times of crises as the demand for such models would be significant.

7. CONCLUSION

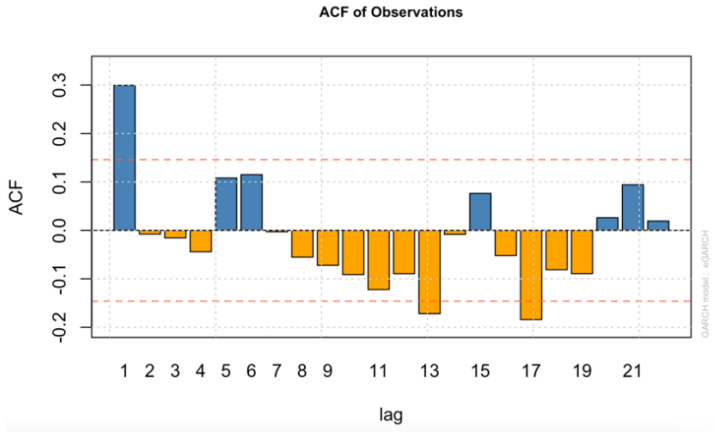
The authors of this paper would like to conclude by saying that volatility for the exchange rates is extremely volatile and small enterprises in India find it difficult to predict these in order to book an accounting profit. The research objective which was to aid businesses in determining which days optimal for making payments and receiving their dues has been met. The businesses can also use this model to earn a fixed profit by determining a decision price arbitrarily. The authors of the paper would like to reduce the uncertainty surrounding the decision making by way of this model and would also like to ensure that the decision making made around the forex exposures are made on the basis of this framework.

Graphs:

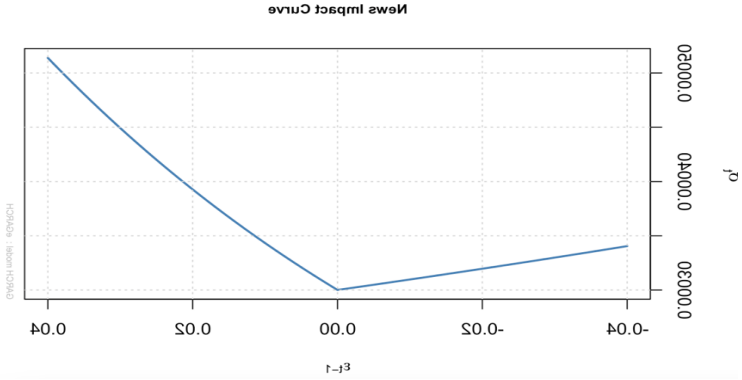
Monthly GARCH



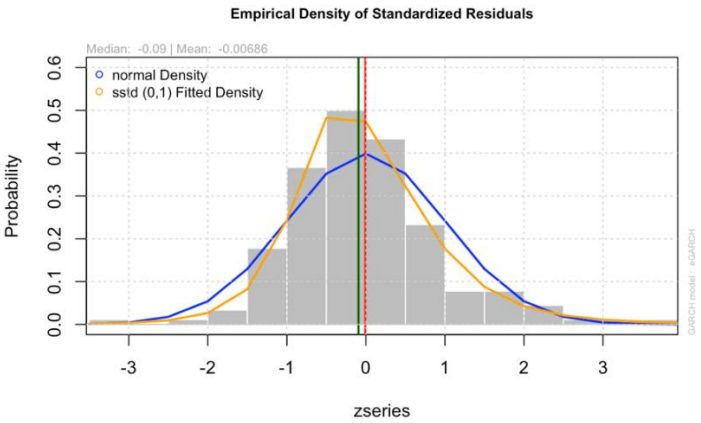
Graph 1.1



Graph 1.2

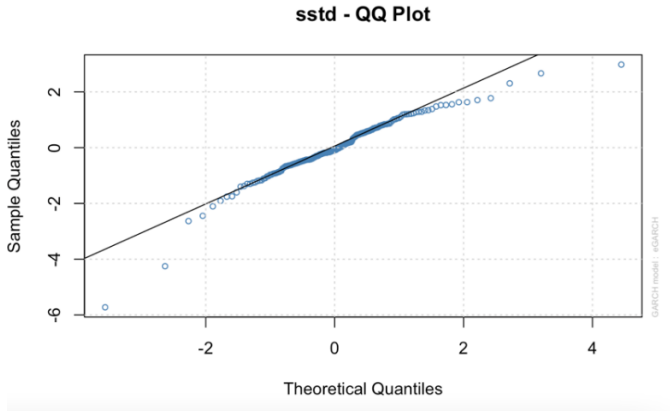


Graph 1.3

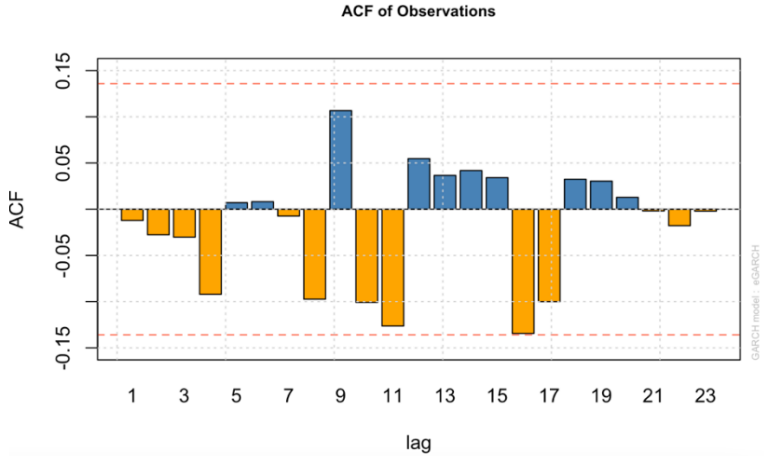


Graph 1.4

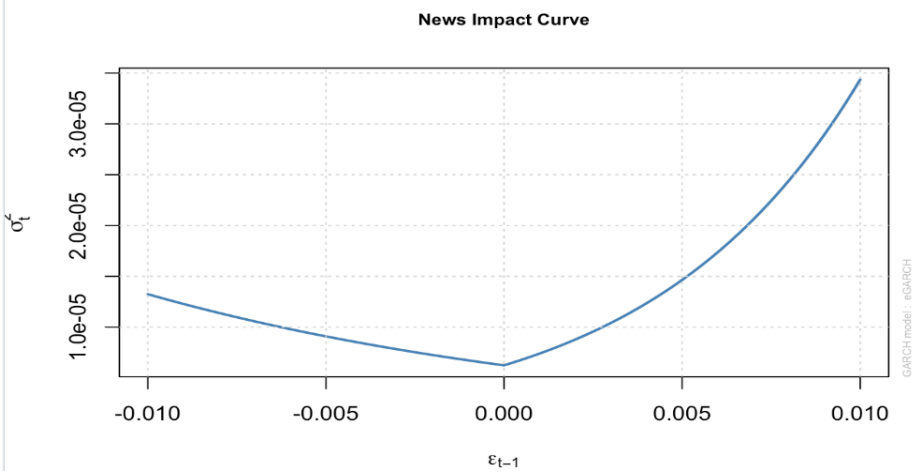
Daily GARCH



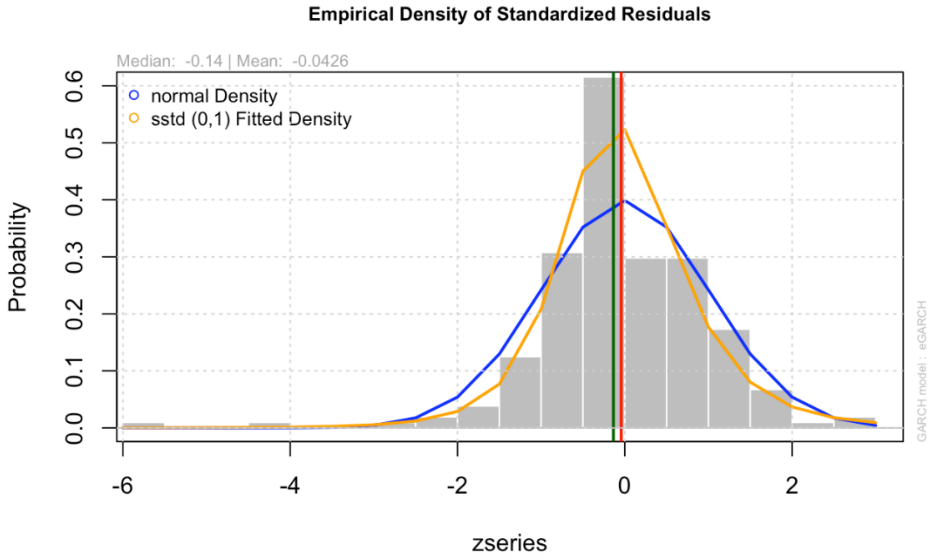
Graph 2.1



Graph 2.2



Graph 2.3



Graph 2.4

REFERENCES

[1] Mirchandani, A. (2013). Analysis of Macroeconomic Determinants of Exchange Rate Volatility in India. *International Journal of Economics and Financial Issues* , 172-179.

[2] Saeed, A., Awan, R. U., Sial, D. M., & Sher, F. (2012). AN ECONOMETRIC ANALYSIS OF DETERMINANTS OF EXCHANGE RATE IN PAKISTAN . *International Journal of Business and Social Sciences*, 184-196.

[3] Bouraoui, T., & Phisuthtiwatcharavong, A. (2015). On the Determinants of the THB/USD RAte. *Procedia Economics and FInanace*, 137-145.

[4] Bouraoui, T., & Phisuthtiwatcharavong, A. (2015). On the determinants of THB/USD Rate. *Procedia Economics and Finance*, 137-145.

[5] Fahimifard, S., Houmayounifar, M., Sabouhi, M., & Moghaddamnia, A. (2009). Comparision of ANN,ANFIS, ARIMA and GARCH Techniques to Exchange rate forecasting. *Journal of Applied Sciences*, 3641-3651.

[6] Goksu, O. E. (2014). Forecasting Euro and Turkish Lira Exchange Rates with Artificial Neural networks. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 307-316.

[7] Erdogan, O., & Goksu, A. (2014). Forecasting Euro and Turkish Lira Exchange Rates with Artificial Neural Networks (ANN). *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 307-316.

[8] Kamruzzaman, J., & Sarker, R. A. (2004). *ANN-Based Forecasting of Foreign Currency Exchange Rates.* Canberra: Neural Information Processing.

[9] Papiaonnou, M. G. (2006). *Exchange Rate Risk Measurement and Management: Issues and Approaches for Firms* . International Monetary Fund.

[10] Folks, W. R., & Stansell, S. R. (1975). The Use of Discriminant Analysis in Forecasting Exchange Rate Movements. *Journal of International Business Studies*, 33-50.

[11] Chong, C. W., Ahmad, M. I., & Abdullah, M. Y. (1999). Performance of GARCH models in forecasting stock market volatility. *Journal of Forecasting*, 333-343.

[12] Epaphra, M. (2016). Modeling Exchange Rate Volatility: Application of the GARCH and EGARCH Models. *Journal of Mathematical Finance*, 121-143.

[13] Alam, M. Z., & Rahman, M. A. (2012). Modelling Volatility of the BDT/USD Exchange Rate with GARCH Model . *International Journal of Economics and Finance*, 193-204.

