MODELING THE EUR/USD RETURN VOLATILITY ON THE DAYS OF SIMULTANEOUS RELEASES OF ECONOMIC INDICATORS: UNEMPLOYMENT RATE AND NON-FARM PAYROLL.

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Abstract

Among the currencies traded in the foreign exchange (Forex) market, Euro against the US Dollar (EUR/USD) remains as one of the dominant currency pairs. This study examines the disparities in the behavior of EUR/USD return volatility during 2011with the simultaneous release of two economic indicators of the US namely, unemployment rate (UR) and non-farm payroll (NFP) and the applicability of GARCH family models in modeling the return volatility. Literature on this kind of studies reveals that UR and NFP are highly influential on exchange rate movements. AR(2) and GARCH(1,2) models can be used to forecast the conditional mean and conditional variance of returns respectively. Conditional variance model can further be improved by including time around the release of indicators as a variance regressor.

Keywords: Foreign exchange, Economic indicators, Volatility, GARCH
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1. INTRODUCTION

Among the currencies traded in the foreign exchange (hereinafter referred as Forex) market, Euro against the US Dollar (EUR/USD) remains as one of the dominant currency pairs [1]. Involvement in the Forex transactions is needed for a country to facilitate international trade and financial transactions. In order to be beneficial from Forex trading, currencies should be bought and sold at optimal prices. Volatility of exchange rate return is one important fact considered by market participants since, high risk is associated with highly volatile market. Exchange rates tend to move according to the economic status of a country. Hence, the market participants should always be kept informed on the changes in the economic environment of a country when involving in trading activities.

Impact of economic indicators on exchange rates has widely been studied in the literature [2] [3] [4] [5]. Those studies revealed that the US economic indicators such as unemployment rate (UR: "percentage of the total work force that is unemployed and actively seeking employment during the previous month"[1]), non-farm payroll (NFP: "the change in the number of employed people during the previous month, excluding the farming industry"[1]), trade balance, etc. are more influential for exchange rates such as Euro, Deutsche Mark, British Pound against the US Dollar. Among the most influential indicators UR and NFP indicators release simultaneously. When two indicators release simultaneously, the impact of one indicator may be hidden by the other indicator. Therefore, studying the simultaneous impact of such indicators is worthwhile.

Main objective of this study is to examine the disparities in the behavior of EUR/USD rate and the return volatility with the simultaneous release of two economic indicators of the US namely, UR and NFP and to model the return volatility of the days on which these two indicators are released.

[1] www.forexfactory.com/calendar.php

Wide variety of techniques such as iterative weighted least square procedures, time series regression, generalized autoregressive conditional heteroskedasticity (GARCH) have been employed in past studies [2] [3] [5] to model the exchange rate return volatility. To the best of our knowledge, this will be the first study aims at modeling the volatility of EUR/USD return in the days on which UR and NFP indicator are released, by considering the time around the indicator release as an additional explanatory variable. Such a model can be used to forecast the return volatility around the release time of these indicators. Hence, the traders will be benefited by making less risky decisions depending on the level of volatility at release time of indicators.

2. METHODOLOGY

Average of the bid and ask prices of the EUR/USD pair at five minute frequency for the period starting from 1st of January 2011 to 31st of December 2011 were considered for this study. Exchange rate at each five minute was obtained by calculating the average of bid and ask price at each five minute interval. Exchange rate percentage return Y_t was calculated as follows;

$$Y_t = \left(\frac{P_t - P_{t-1}}{P_{t-1}}\right) * 100$$

Here, P_t represents the exchange rate at time t. Both UR and NFP indicators are released on the first Friday in each month. Intraday behavior of EUR/USD rate at five minute intervals were examined during each released date using time plots. Financial returns are known to be non normal [6]. Hence, Brown-Forsythe test [7] was employed for testing the null hypothesis of equality of variances of EUR/USD returns during different hours before and after the release time.

Conditional mean or returns was modeled using autoregressive (AR) model whereas the conditional variance was modeled using two types of autoregressive conditional heteroskedasticity (ARCH) models namely, generalized ARCH (GARCH) [8], Integrated GARCH (IGARCH) [9] and threshold GARCH (TARCH) [10] [11]. Model parameters are estimated using the method of maximum likelihood and by assuming either student's t or normal distribution for model errors. The basic model was augmented by introducing hours around the news release times as dummies in the conditional variance equation. These time dummies are defined as follows;

$$\mathrm{X}_1 = \begin{cases} 1; \text{if t is within an hour after the release of indicators} \\ 0; \text{otherwise} \end{cases}$$
$$\mathrm{X}_2 = \begin{cases} 1; \text{if t is within an hour before the release of indicators} \\ 0; \text{otherwise} \end{cases}$$
$$\mathrm{X}_3 = \begin{cases} 1; \text{if t is after the first hour of the release of indicators} \\ 0; \text{otherwise} \end{cases}$$

Best model was selected according to the Schwarz criterion and the adequacy of the model was tested by ARCH LM test [12] with the null hypothesis that there is no ARCH effect in residuals. AR(p) conditional mean is represented by equation (2.1).

$$Y_t = c + \sum_{i=1}^{p} \theta_i Y_{t-p} + \varepsilon_t \qquad (2.1)$$

Conditional variance of GARCH (q,p), IGARCH (q,p) and TARCH (q,p) with aforementioned variance regressors is represented by equations (2.2), (2.3) and (2.4) respectively:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{k=1}^{3} \gamma_k X_k \qquad (2.2)$$

Where, ω = constant

σ_{t-j} = variance at time t-j

ϵ_{t-i} = residual of the mean equation at time t-i

$$\sigma_t^2 = \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{k=1}^{3} \gamma_k X_k \quad (2.3)$$

Such that

$$\sum_{j=1}^{q} \beta_j + \sum_{i=1}^{p} \alpha_i = 1$$

Where, σ_{t-j} = variance at time t-j

ϵ_{t-i} = residual of the mean equation at time t-i

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{k=1}^{3} \gamma_k X_k + \sum_{l=1}^{r} \delta_l \epsilon_{t-l}^2 I_{t-l}^- \quad (2.4)$$

Where, ω = constant

σ_{t-j} = variance at time t-j

ϵ_{t-i} = residual of the mean equation at time t-i

$$I_t^- = \begin{cases} 1; if\ \epsilon_t < 0 \\ 0; otherwise \end{cases}$$

3. RESULTS AND DISCUSSION

Null hypothesis of equality of variance during different hours around the release time of indicators was rejected by the Brown-Forsythe test with p value < 0.05. This implies that there is a significant difference among the volatility of EUR/USD return around the release time of indicators. Moreover, Figure 1 depicts EUR/USD return volatility during the first hour after the release of the indicators is approximately twice as much as that during the preceding hour. After the first hour of the release of indicators the level of volatility becomes same as that as the preceding hour. Moreover, a sudden drop in volatility is observed in the five hours after the release.

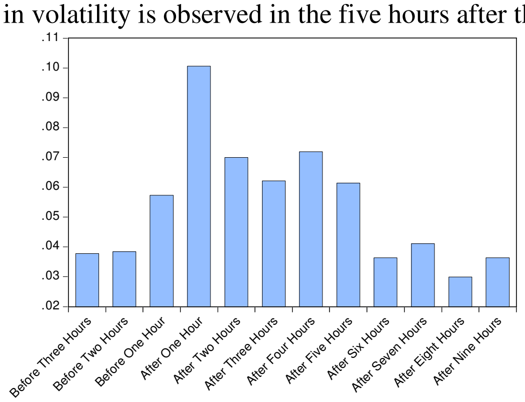

Figure 1: Standard deviation of EUR/USD return within different hours around the release time

Even though no IGARCH model found significant to model the return volatility, both GARCH and TARCH models are found as appropriate models to model the return volatility. Table 1 illustrates the estimation results. Conditional mean of the EUR/USD returns is well represented by AR(2) model. Whereas the conditional variance is modeled using both GARCH(1,2) and TARCH(1,2) models. Q Q plot suggests that the residuals of GARCH(1,2) well fits with the student's t distribution. However, the normality of errors of TARCH(1,2) is rejected by the Anderson Darling test with p-value < 0.05. This fact concludes that the TARCH(1,2) is not adequate to model the return volatility. A decrement in Schwarz criterion and an increment in log likelihood in the Model 3 compared to Model 1 is observed. This fact provide the evidence that the GARCH(1,2) can further be improved by introducing the time period around the release time of indicators as dummy variables in the conditional variance equation. Moreover, Model 3 which has the lowest Schwarz criterion and the highest log likelihood is found as the best model out of the models under study to represent the volatility of EUR/USD returns.

Table 1: Model estimation results

Model Parameters	Model 1	Model 2	Model 3	Model 4
	Parameter estimates of conditional mean model			
θ_1	-0.0858*	-0.0423*	-0.0847*	-0.0427*
θ_2	-0.0538*	-0.0532*	-0.0550*	-0.0512*
	Parameter estimates of conditional variance model – GARCH/ TARCH			
ω	0.0000*	0.0000*	0.0000*	0.0000*
β_1	0.8843*	0.8693*	0.8962*	0.8946*
α_1	0.2132*	0.2272*	0.1707*	0.1555*
α_2	-0.0883*	-0.1127*	-0.0777*	-0.0797*
	Estimates of threshold parameter in conditional variance model			
δ_1		0.0355*		0.0277*
	Estimates of additional dummy parameters in conditional variance model			
γ_1			0.0005*	0.0002
γ_2			0.0003*	0.0005*
γ_3			0.0000	0.0000
Error distribution	Student's t	Normal***	Student's t	Normal***
Schewarz criterian	-3.684767	-3.57943	-3.69214	-3.621295
Log likelihood	5595.731	5436.568	5618.892	5511.846
ARCH LM test p value	0.0704**	0.1116**	0.1835**	0.1481**

* represent the rejection of the null hypothesis that the parameter is not significant.

** represent the acceptance of the null hypothesis that there is no ARCH effect in residuals.

*** represent the rejection of the null hypothesis of normality of model errors.

4. CONCLUSIONS

US economic indicators namely, NFP and UR are influential for the EUR/USD return volatility. During the study period significant change in the volatility of EUR/USD return can be observed at the time around the release of these two economic indicators. The volatility during the first hour immediately after the release of the indicators is approximately twice as much as that during the preceding hour. GARCH (1,2) model with AR (2) conditional mean outperform the other models under study. This model can be augmented by including the preceding and succeeding hours of the release of the indicators as dummy variables in the conditional variance model. Finally, this model can be proposed as an appropriate model to predict EUR/USD return volatility in the days on which UR and NFP indicators are released.

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