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Assessing implied correlations for FX options

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Abstract

Implied Correlations, derived from option prices, have been shown to be useful in forecasting realized correlation of foreign exchange currency triplets. Analyzing this further, we notice that in a linear model evidence is found for most of the currency triplets, but the results are undermined by the strong autocorrelation and heteroscedasticity. Transformed to a model where only the differences of the correlations are analyzed, only one statistical significant factor was found. Reasons for this could be the application of a simple backdating rule or that the change in the correlation forecast is only the change of the forecast for two days which are different in today's forecast compared to the previous day's forecast. This contradicts previous research where statistical evidence was found with the simple linear model. Further research was done, on whether the correlation forecast can explain the Libor interest rate differential between the two exclusive exchange rates in the currency triplet. Again, evidence is found for a simple linear relationship, but autocorrelation and heteroscedasticity undermined the results. In a model where only the changes are analyzed, no statistically significant factor was found.

Executive Summary

This Bachelor thesis analyzes different correlation forecast methods and assesses them statistically. In the first chapter we look at the results other researchers have found in this area and what they have examined. In the second chapter the formula is derived with which a correlation forecast is possible based on volatility forecasts. This allows us to create a correlation forecast from forecasted volatilities with an enclosed formula. In the third chapter we have a close look at the data used for the thesis. In short, historical volatilities, the implied volatilities and GARCH(1,1) modeled volatilities from Bloomberg are used. The author uses additionally his own GARCH(1,1) model to create an additional correlation forecast. In the fourth chapter the models and statistical tests are explained. The initial model explains the realized correlation with the forecast correlation as a simple linear relationship where the realized correlation is described with a constant and a factor times the respective forecast. This regression analysis shows that there is a strong linear relationship for all forecast methods. The implied correlation shows the highest statistical significance for most currency pairs and forecast horizons. But the statistical tests performed on this linear model revealed strong autocorrelation and heteroscedasticity. These two unfavorable statistical properties lead to an inefficient regression, therefore the regression results should be treated carefully. The second model analyzes whether the change in the correlation forecast describes the change of the realized correlation. This model is recognized to solve the autocorrelation issue and was developed by D. Cochrane and G.H. Orcutt in 1949.[1] In fact it does improve the autocorrelation and heteroscedasticity, but only one statistically relevant factor which describes the difference in the realized correlation with the difference in the predicted correlation could be found. A statistically significant beta of -0.1116 for the implied correlation forecast for USDCAD/EURCAD for the one week forecast horizon on the 10% significance level is observed. Reasons for the generally very low statistical significance could be the application of a simple backdating rule or that the change in the correlation forecast is only the change of the forecast for two days which are different in today's forecast compared to the previous day's forecast.

In the second part, the interest rate differentials and the correlation forecasts are analyzed. The idea behind this model is that the uncovered interest rate parity suggests that in an environment of high correlation, the interest rate differential should be small. Again a linear

[1] Cochrane, D. / Orcutt, G.H.: Application of least squares regression to relationships containing autocorrelated error terms, 1949, P. 32-61.

model is set up where the Libor interest rate difference between the two separate currencies are described with a constant and one or several factors times the correlation forecast. A strong relationship is found between the implied correlation and the difference between the two exclusive interest rates in a currency triplet. This relationship holds well for the implied correlations but not for the GARCH based correlations. Also the realized correlation performs not as well as the implied correlation, this leads us to the assumption that interest rates and interest rate differentials are priced in and are reflected in the currency options market. Since the historical correlation is not able to describe the difference in the historic Libor interest rate for the given period, we can assume vice versa that Libor interest rate differentials contain little information to forecast future correlation. But this is not researched further. Strong heteroscedasticity and autocorrelation is observed again. This undermines the statistical findings.

In a second step the difference of the correlation forecasts and the respective difference in the interest rate differentials are analyzed. This model is able to solve some of the autocorrelation and heteroscedasticity issues, but no statistical significant parameters are found. Interesting is that autocorrelation is much worse compared to the other Cochrane-Orcutt modified regressions.

The results show that it is tremendously difficult to assess the statistical properties of the used datasets. Whenever evidence can be found for a simple linear relationship, strong heteroscedasticity and autocorrelation persist. Therefore the computed results are inefficient because a linear regression is not efficient in such an environment.

If we transform the model to a Cochrane Orcutt model, the heteroscedasticity and autocorrelation problems are improved, but not always solved. There is no combination of a statistically significant factor and no heteroscedasticity and no autocorrelation.

To summarize the results on the correlation forecasts, a simple linear relationship between the forecast and realized correlation exists and is statistically significant for most of the currency pairs, but these results are inefficient as autocorrelation and heteroscedasticity are present. A model where the changes, the mathematical difference between the forecast of two periods, is described with the changes in the forecast shows no statistically significant values in combination with no heteroscedasticity and no autocorrelation. Therefore we cannot determine with our unsophisticated statistical tools whether the three forecast methods contain

statistically significant information. This contradicts the research by Walter and Lopez[2] and the analysis of Mazzotta[3]. Their findings are presented in the Literature Review section.

For the analysis of the Libor interest rate differentials, the picture looks similar to the correlation analysis. In absolute terms a linear relationship can be found, but the existence of strong autocorrelation and heteroscedasticity undermine the results from the OLS regression. The model where we only look at the differences provides no statically relevant result in combination of no heteroscedasticity and no autocorrelation. Again we can doubt that there is a statically significant relationship between the correlation forecast and the Libor interest rate differentials.

[2] Walter, C. / Lopez, M.: Is Implied Correlation Worth Calculating? Evidence from Foreign Exchange Options and Historic Data, 1997, P. 15-20.
[3] Mazzotta, S.: Performance, Bias, and Efficiency of Foreign Exchange Correlation Forecasts, 2008, P. 12.