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Forecasting conditional correlations in stock, bond and foreign exchange markets

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Abstract

The paper forecasts conditional correlations between three classes of international financial assets, namely stock, bond and foreign exchange. Two countries are considered, namely Australia and New Zealand. Forecasting will be conducted using three multivariate GARCH models, namely the CCC model [T. Bollerslev, Modelling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model, Rev. Econ. Stat. 72 (1990) 498–505], VARMA-GARCH model [S. Ling, M. McAleer, Asymptotic theory for a vector ARMA-GARCH model, Econometric Theory 19 (2003) 280–310], and VARMA-AGARCH model [M. McAleer, S. Hoti, F. Chan, Structure and asymptotic theory for multivariate asymmetric volatility, Econometric Rev., in press]. A rolling window technique is used to forecast 1-day ahead conditional correlations. To evaluate the impact of model specification on conditional correlations forecasts, this paper calculates and compares the correlations between conditional correlations forecasts resulted from the three models. The paper finds the evidence of volatility spillovers and asymmetric effect of negative and positive shock on the conditional variance in most pairs of series. However, it suggests that incorporating volatility spillovers and asymmetric do not contribute to better conditional correlations forecasts.

JEL classification: G11; G15

Keywords: Conditional correlation; Forecasting; Rolling window; Stock; Bond; Foreign exchange

1. Introduction

Three key elements in portfolio construction are estimates of returns, risks and correlations of assets in the portfolio. Researchers have, for so long, focused mainly on estimating returns and risk, and have assumed that correlations are constant and have therefore paid less attention on them. However, recent studies uncover that the correlations vary over time (see de Santis and Gerard [8] and Longin and Solnik [21] for stock, Hunter and Simon [15] and Solnik et al. [31] for bonds). Therefore, modelling and forecasting future correlations between those financial assets become a need.

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A growing topic in finance literature is the investigation of the relationship between correlation and volatility. King and Wadhwani [18] and Bertero and Mayer [1] find that international correlations tend to increase during periods of market crises. Ramchand and Susmel [29] document that the correlations between stock markets are higher in a high variance state as compared to a low variance regime. Longin and Solnik [20] and Karolyi and Stulz [17] find that correlations across major stock markets are higher when market are more volatile. On the other hand, the development in GARCH family model uncovers the importance of volatility spillovers and asymmetric effect of negative and positive conditional shock on the conditional variance in explaining the volatility in financial assets (see Fleming et al. [12] and Hakim and McAleer [14], among others). These motivate the paper to investigate whether multivariate GARCH models which capture volatility spillovers and asymmetric effect provide better conditional correlations forecasts.

Three multivariate GARCH models will be estimated for the purposes, namely the VARMA-AGARCH of McAleer et al. [26], the VARMA-GARCH model of Ling and McAleer [19], and the CCC model of Bollerslev [3]. A rolling window is used to forecast 1-day ahead conditional correlations. Both VARMA-AGARCH and VARMA-GARCH models incorporate volatility spillovers, with VARMA-AGARCH also considers asymmetric effects of negative and positive shock on the conditional variance. The CCC model is estimated as benchmark for comparison, as the model does not consider both volatility spillovers and asymmetric effects. Three classes of assets are included in the models, namely stock, bond and foreign exchange, considering the importance of those assets in portfolio construction (see Chen et al. [6] and Odier and Solnik [27], among others). Two countries are considered, namely Australia and New Zealand. Both countries have strong economy relationship; hence volatility spillovers are expected to occur across both markets. In addition, both countries are of the same time zone. This avoids the problem of non-synchronous data.

To evaluate the impact of model specification on the forecast of conditional correlations, the paper calculates and compares the correlations between the forecast of conditional correlations resulted from the three models. In the presence of volatility spillovers, we would expect low correlations between the forecasts of CCC and that of the other models. In the presence of asymmetric effect, we would expect low correlations between VARMA-AGARCH and that of the other two models.

2. Literature review

Forecasting correlations between financial assets have been undertaken by several papers using various models. Various tests have been used to evaluate the forecasts accuracy such as statistic, VaR forecast, and the correlations between the conditional correlations forecasts tests.

Statistic test for evaluating the forecast have been used by Campa and Chang [5] and Vargas [33]. Campa and Chang [5] use implied, historical, RiskMetrics's Moving Average, and bivariate GARCH based correlation to forecast the correlations between exchange rates. The forecasts are evaluated by computing Root Mean Squared Error for the alternative forecasts, regress the realized correlation individually against each of the alternative forecasts, and 'encompassing regressions' in which two or more alternative forecasts are included as regressors. They suggest that implied correlation forecast is superior to the others. Vargas [33] proposes the asymmetric version of Block DCC, and compares the correlation forecast with that of the DCC model of Engle [10]. Using RMSE and Average MSE criteria, he finds that the Asymmetric DCC model outperforms the DCC model in providing correlation forecast.

VaR forecast test for evaluating correlations forecast has been applied by Skintzi and Sisinis [30] in the portfolios consist of stock, bond and currencies. They find that GARCH models can better account for the correlation's dynamic structure in the stock and bond portfolios, while simpler specifications such as the historical mean model or simple moving average models are better suited for the currency portfolio.

Correlation between forecast of conditional correlation for evaluating correlations forecast have been used by Wainscott [34] and McAleer and da Veiga [25]. Wainscott [34] uses historical rolling correlations to forecast future correlations between stock and bond. To test the accuracy of the forecasts, he calculates the correlation between the conditional correlation forecasts and the following period non-overlapping correlation. He suggests that historical correlation is an unsatisfactory predictor of future correlation. McAleer and da Veiga [25] estimate the CCC, VARMA-GARCH, and a new proposed model, the Portfolio Spillover (PS)-GARCH to conduct correlations forecast. A rolling window approach is used to forecast 1-day ahead conditional correlations. To compare the forecast accuracy, they calculate the correlation between conditional correlation forecasts. They find that all three models yield very similar results.