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Predicting Returns Volatilities and Correlations of Stock Indices Using Multivariate Conditional Autoregressive Range and Return Models

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Abstract : This paper extends the conditional autoregressive range (CARR) model to multivariate CARR (MCARR) model and further to the two-stage MCARR-return model to model and forecast volatilities, correlations and returns of multiple financial assets. The first stage model fits the scaled realised Parkinson volatility measures using individual series and their pairwise sums of indices to the MCARR model to obtain in-sample estimates and forecasts of volatilities for these individual and pairwise sum series. Then covariances are calculated to construct the fitted variance-covariance matrix of returns which are imputed into the stage-two return model to capture the heteroskedasticity of assets' returns. We investigate different choices of mean functions to describe the volatility dynamics. Empirical applications are based on the Standard and Poor 500, Dow Jones Industrial Average and Dow Jones United States Financial Service Indices. Results show that the stage-one MCARR models using asymmetric mean functions give better in-sample model fits than those based on symmetric mean functions. They also provide better out-of-sample volatility forecasts than those using CARR models based on two robust loss functions with the scaled realised open-to-close volatility measure as the proxy for the unobserved true volatility. We also find that the stage-two return models with constant means and multivariate Student-t errors give better in-sample fits than the Baba, Engle, Kraft, and Kroner type of generalized autoregressive conditional heteroskedasticity (BEKK-GARCH) models. The estimates and forecasts of value-at-risk (VaR) and conditional VaR based on the best MCARR-return models for each asset are provided and tested using Kupiec test to confirm the accuracy of the VaR forecasts.

Keywords : range-based volatility, correlation, multivariate CARR-return model, value-at-risk, conditional value-at-risk
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