Volatility and Quantile Forecasts of Financial Returns Using Realized Stochastic Volatility Models with Generalized Hyperbolic Distribution

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Abstract

The realized stochastic volatility model of Takahashi, Omori and Watanabe (2009), which incorporates the asymmetric stochastic volatility model with realized volatility, is extended with more general form of bias correction in realized volatility and wider class distribution, the generalized hyperbolic skew Student's t-distribution, for financial returns. The extensions make it possible to adjust the bias due to the market microstructure noise and non-trading hours, which is possibly depending on the level of the realized volatility, and to consider heavy tail and skewness in financial returns. With the Bayesian estimation scheme via Markov chain Monte Carlo method, the model enables to estimate the parameters in the return distribution and in the model jointly. It also makes it possible to forecast volatility and return quantiles by sampling from their posterior distributions jointly. With the asymmetric stochastic volatility model as a benchmark, the model is applied to quantile forecasts of financial returns such as value-at-risk and expected shortfall as well as volatility forecasts. The volatility and quantile forecasts are evaluated by several back testing procedures. Empirical results with Spyder, the S&P 500 exchange-traded fund, show that incorporating realized volatility improves both volatility and quantile forecasts, that heavy tail and skewness of daily returns are important for quantile forecasts but to a lesser extent for volatility forecasts, and that the additional bias correction does not substantially improve the model fit nor volatility and quantile forecasts.

Keywords: Backtesting; Bias correction; Expected shortfall; Generalized hyperbolic skew Student's t-distribution; Markov chain Monte Carlo; Realized volatility; Stochastic volatility; Value-at-risk.

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