Cholesky Realized Stochastic Volatility Model with Leverage Effects: Flexible modeling for the high dimensional covariance matrix

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Abstract

Multivariate stochastic volatility models play important roles in financial applications, including asset allocation and risk management. However, the estimation of multivariate stochastic volatility models has several difficulties. The first difficulty is the curse of dimension. For p dimensional time sereis, we have to estimate $p(p+1)/2$ volatility and correlation. The second difficulty is the positive definiteness of estimated covariance. For the multivariate stochastic volatility models, we usually convert the covariance matrix into a more tractable form, but this converted structure doesn't necessarily guarantee the positive definiteness of estimated covariance matrix. Cholesky decomposition based multivariate stochastic volatility model can solve these two big problems for high dimensional covariance estimation. In this framework, we incorporate the some of stylized facts of financial markets such as the leverage effects and the correlation between volatilities and propose a flexible modeling.

On the other hand, it is well known that the realized measures (realized volatility or realized covariance) have more information of the volatility (covariance matrix) than standard daily return based estimators and models. We incorporate the realized covariance as the information for true covariance matrix. We take Bayesian estimation procedures and propose a simple efficient sampling scheme (Single Move Sampler). We also conduct the model comparison and show the superior predictive performances of our model and the estimation procedure.

Keywords: Cholesky decomposition; leverage effect; volatility forecast; Markov Chain Monte Carlo; Single Move Sampler; Realized Covariance; Realized stochastic volatility model; State space model.

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