論文の内容の要旨

論文題目

Efficient Bayesian Estimation of Multivariate Stochastic Volatility Models with Leverages Effects

（レバレッジ効果のある多変量確率的ボラティリティ変動モデルの効率的なベイズ推定）

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This thesis includes the three researches about the modeling of multivariate financial time series including stock returns. The time-varying properties of the volatility are studied, especially the leverage effect, namely the correlation between the today's return and tomorrow's volatility for each series. The relations between the other series are also specified. Three multivariate stochastic volatility models with leverage effects are proposed and studied. The first part presents the multivariate stochastic volatility models with cross leverage effects (MSV model). This model incorporates the volatility dynamics, the constant correlation between the returns, the correlations between the volatilities, the leverage effect, and the cross asset leverage effect. An extension to the model with heavy-tailed return distribution is also considered. The computationally efficient Bayesian estimation via Markov chain Monte Carlo (MCMC) called the multi-move sampler is applied to the models. In the algorithm, the blocked many latent variables are sampled at a time via a state space representation of the conditional posterior of them. The computational efficiency is shown using a simulation data set by a comparison with other simple algorithm. An empirical analysis using returns of the Standard ¥& Poor's 500 sector indices are presented. The cross leverage effects are estimated to be negative for all series and the effects are asymmetric. The model comparison using deviance information criterion (DIC) is conducted between the model with the normal error distribution and the model with the heavy-tailed error distribution.
The auxiliary particle filter is applied for the calculation of the DICs. In the second part, the matrix exponential stochastic volatility model with leverage effects (MESV model) are proposed and studied. The model accounts the dynamics of the

covariance of the returns, the dependences of the elements of them, and (cross) leverage effects. The matrix exponential transformations are utilized to keep the covariance matrices positive definite. As in the first part, a multi-move sampler is proposed for the MESV model. The proposal probability density for the conditional posterior distribution is derived analytically. The algorithm is illustrated using a simulation data set. An empirical analysis is presented via Tokyo Stock Price Index (TOPIX), Japan Government Bond Price Index, and foreign exchange rate of Japanese yen to U.S. dollar. The time-varying correlations are estimated. The model comparison with the MSV model using the DIC is conducted. The auxiliary particle filter for MESV model is also proposed for the calculation of the DIC. In the third part, the dynamic factor multivariate stochastic volatility model with cross leverage effects (DFSV model) is considered. The model accounts the dynamic covariance matrix and leverage effects using the dynamic factors and errors. Both of them follow the univariate stochastic volatility models with leverage effects respectively. The DFSV model includes the error terms following the heavy-tailed distribution.

An efficient Bayesian estimation via the multi-move sampler is considered for the model. An empirical application to the predictive portfolio optimization problem is presented. The portfolio is made of thirty three sectors of TOPIX by industry. The Rao-Blackwellized auxiliary particle filter is proposed for the prediction.