論文の内容の要旨

論文題目

The SIML Estimation of Volatility and Covariance for Irregular, Non-synchronized and Noisy High Frequency Data

(非等間隔・非同期・ノイズ付き高頻度データに対するSIMLによる分散・共分散推定)

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Estimating the volatility and covariance of asset prices has been a key issue in finance, since it is very important for option pricing, asset allocation, risk management, and so on. By now it is possible to use a large number of high-frequency data in financial markets including Tokyo and Osaka, and considerable interest has been paid on the estimation problem by using high-frequency data in financial econometrics.

One of the conventional methods to estimate the volatility and covariance is the *realized volatility*, introduced by Andersen, Bollerslev, Diebold and Labys (2001). The realized volatility is defined by simply summing up the intraday squared returns. They have argued that under some appropri-

ate assumptions the realized volatility converges to the *integrated volatility*, which is a natural measure of volatility.

However, it has been well known that the realized volatility works poorly when there exist micro-market noise, of which we cannot ignore the affects in actual markets.

Following several earlier works to deal with the problem, Kunitomo and Sato (2008a, b) have proposed a new estimation method called the Separating Information Maximum Likelihood (SIML) for estimating the integrated volatility and covariance under the presence of micro-market noise.

The SIML method has been originally defined on equidistant observations, but in actual markets the transactions occur randomly. In addition, when we wish to estimate the integrated covariance by the SIML estimation, we need synchronized data of two or more series of assets, but actual transactions are usually non-synchronously observed. In this respect Hayashi and Yoshida (2005, 2008) have proposed the covariance estimator by using non-synchronous data without micro-market noise.

The main purpose of this thesis is to investigate the SIML estimation of the volatility, covariance and other related quantities such as hedging ratio, by using irregular and non-synchronous high-frequency data.

In this thesis we find the usefulness of the SIML estimation in three ways as follows.

First, we find that the SIML estimator is asymptotically robust in the sense that it is consistent and has the asymptotic normality under general conditions when the high frequency data are randomly sampled.

Second, we shows that the SIML estimator has reasonable robust properties in finite samples even when the micro-market structure has the nonlinear adjustments by conducting a number of Monte Carlo simulations.

Finally, we apply the SIML estimation to the transaction prices of individual stocks traded at the Osaka Securities Exchange (OSE), and estimate the integrated volatilities, covariances and correlations. We also estimate the hedging ratio of the individual stocks by the Nikkei-225 Futures. Comparing to some alternative estimators, we conclude that the SIML method is quite useful in practice.