Hierarchical Bayes Modeling of Autocorrelation and Intraday Seasonality in Financial Durations*

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Abstract

Intraday financial transactions are irregularly spaced, and their durations exhibit positive autocorrelation (a long duration will tend to be followed by another long one) and intraday seasonality (durations tend to be shorter immediately after the opening or near the closing, but they tend to be longer in the middle of the trading hours). In the literature, the former is formulated as a time-dependent duration model such as the stochastic conditional duration (SCD) model while the latter is dealt with by filtering out any cyclical fluctuations in time series of durations with a spline smoothing method before the duration model is estimated. Moreover, most of the previous studies pooled filtered duration data on different trading days and estimated a single duration model with them. In this paper we propose a hierarchical Bayes approach to model both autocorrelation and intraday seasonality in durations simultaneously. In our new approach, the autocorrelation structure of durations is captured by the SCD model while the intraday seasonality is approximated with B-spline smoothing, and the parameters in both models are allowed to differ on each trading day. In B-spline smoothing, we incorporate the smoothness prior (the penalty on variations in the seasonality on the same trading day) as well as the similarity prior (the penalty on differences in the seasonality between consecutive trading days) in order to prevent overfitting. The resultant model is regarded as a non-linear non-Gaussian state space model of unbalanced panel data, for which a Bayesian approach is suitable. We developed an efficient Markov chain sampling scheme for the posterior analysis of the proposed model and applied it to high-frequency commodity futures transaction data in the Tokyo Commodity Exchange.

KEYWORDS: High-Frequency Transaction Data, Stochastic Conditional Duration, Intraday Seasonality, Commodity Futures Market, Hierarchical Bayes Model.

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