

# **The UHF-GARCH Model in Analysis of Intraday Volatility and Durations – Bayesian Approach and Example from the Polish Stock Market**

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## **Abstract**

There has been a considerable amount of empirical research in financial market microstructure recently. New perspectives for the empirical studies and analysis of financial market microstructure processes and effects have been made possible by the availability of financial data recorded on transaction level. A key property of transaction data is the irregular spacing in time. The time intervals between events of the transaction process called durations can bring important content about the intensity of the information flow to the market. Hence, duration analyses may furnish information on the microstructure of the financial market, affording a more accurate insight into various market interdependencies. In recent years, very popular in modelling the durations between the selected events of the transaction process and modelling of financial market microstructure effects have become autoregressive conditional duration models (the ACD models) introduced by Engle and Russell [1998].

In empirical research of financial market microstructure and in testing some predictions from the market microstructure literature, the behavior of some marks given the durations can be important and useful. Among all characteristics associated with tick-by-tick data, the trading time and the price are the most important. The first joint model for prices and durations has been introduced by Engle [2000] as the so-called UHF-GARCH model. It turned out that durations have an important effect on the volatility of the returns, see also for example Grammig and Wellner [2002], Ghysels and Jasiak [1998]. The joint model of return and duration allows to provide a clear picture of the dynamics of the volatility and can help discriminate market microstructure hypotheses.

The main aim of the paper is to present Bayesian inference for certain UHF-GARCH models based on trade-to-trade data. Intraday dynamics of the volatility of the returns will be modelled by a EGARCH-type model adopted to irregularly time-spaced data conditional on durations and the past. In the analysis of durations the Box-Cox ACD model with the

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generalized Gamma distribution for innovation term will be considered. To our knowledge, the UHF-GARCH model with such a combination of EGARCH model and Box-Cox ACD model is the first one in the literature. Bayesian inference will be presented and practically used to estimation of UHF-GARCH models describing intraday dynamics of volatility and durations. The MCMC methods including Metropolis-Hastings algorithm are suitably adopted to obtain posterior densities of interest as well as marginal data densities.

Moreover, many empirical studies in the foreign literature use transaction data from NYSE. Thus one of the main goal of this study is also examination of data from the Polish Stock Market. It could help to compare Polish market with other markets and trading systems. This analysis provides also more information on relationship between volatility and current durations and thus on the microstructure of the Polish financial market. Therefore, the empirical part of work will include modelling of intraday volatility and durations of selected equities from the Polish Stock Market.

**JEL Classifications:** C50, C58, C11, C22, G10

**Keywords:** market microstructure, the ACD model, the UHF-GARCH model, intraday volatility, durations, Bayesian inference