Duration Analysis of Eurex Tick Data

Short Proposal for SFB 649 Guest Researcher Program

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1 Motivation and Aims

Recent literature on financial econometrics has shown a growing interest in the empirical market microstructure research, due to the increased availability of ultra-high frequency transaction data. These time stamped tick data are mainly characterized by inequidistant time intervals between two consecutive observations. Since the time variable is now considered as stochastic, and not "fixed" as in the ordinary ("equally spaced") time series analysis, the study of tick data always requires alternative appropriate econometric models to account for the irregular spacing in time.

It is well-known that the state of the order book as well as the speed of the order arrival have a significant influence on the decision when to submit orders and, thus, affect the subsequent order placement strategy of future traders. Because durations between transactions reflect the intensity of trading and different degrees of the asset's liquidity, they become important indicators explaining the flow of information and the time-varying liquidity risk in financial markets. Hence, this project investigates the (asymmetric) trading behavior of market participants and the market efficiency of the Deutsche Börse option series and futures contracts by analyzing the frequency of data arrivals. For modeling the duration processes of the EUREX tick data, two different methodologies will be applied: While the class of common ACD models is characterized by strict parameterizations and autoregressive specifications, the semiparametric copula approach offers more flexibility in modeling the dynamic duration process by separating the marginal distributions of waiting times from their temporal dependence structure.

2 Requirements

- Data: Eurex Tick database.
- Software (if available): Gauss + CML Procedure.

3 Planned Time Frame

- 12. – 23.June 2006 (2 weeks), **anticipated schedule:**

3.1 Data acquisition and description (30%).

3.2 Fitting the Eurex tick data with ACD models (40%).

Based on the influential work by Engle and Russell (1997, 1998), who modeled financial point processes with the *Autoregressive Conditional Duration* (*ACD*) model, many studies have concentrated on the further development of this framework in order to describe limit order book activities more accurately. This part of the project applies various ACD models for describing the changing cluster structure of different duration processes in a limit order book.

Generally, the finance literature only pays attention to the price dimension of assets, losing sight of the volume variable. It is often overlooked that the investigation of transaction volume is also important, because it is one of the key factors responsible for market liquidity. Hence, the study will especially focus on the volume variable of the EUREX tick data.

For this purpose, the concept of volume duration will be suggested, which is defined as the time elapsed until a certain quantity of shares is absorbed by the market. Short volume durations imply that a certain quantity of stocks can be traded very quickly, whereas long ones signalize a (temporarily) illiquid market. The analysis of volume durations is important especially for liquidity traders, who are, first and foremost, interested in fast trading rather than risky speculative attacks or aggressive order submissions. For the analysis of the time varying market depth, the estimation results will reveal the market's absorption limit for high volumes of shares, expanding the liquidity risk when trading these quantities.

3.3 Fitting the Eurex tick data with Copula models (40%).

A plethora of ACD models have been introduced in the recent literature, more often than not extended to the multivariate case analyzing additional variables stored in the order book such as price or volume. Although the modifications comprise a broad spectrum of versatile improvements, they often have strict autoregressive structures and require strong parameterizations. Due to the recursive procedure in the estimation, computational burdens are almost inevitable.

In contrast, a new framework based on copulas, which are popular tools in risk analysis, will be applied for modeling the duration process. The dynamic semiparametric approach is closely related to the study of Chen and Fan (2004). As time series generally can be seen as a drawing from a multivariate distribution, one may split this distribution into two components: (a) the unconditional marginal distributions and (b) the dependence structure given by the copula. In this part of the project, different models will be estimated, in which the copulas are parameterized and control the temporal dependence of the time series, but the unconditional distributions are left unspecified, permitting all kinds of possible margins. With this feature at hand, the approach allows more general non-linear relationships for the whole "waiting time series".

3.4 SFB 649 discussion papers

The research paper(s) of this project will be written after the visit.