Realized Volatility:
Modeling Volatility under Microstructure Noise and Direct Forecasting of Realized Volatility

Bachelor Thesis

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Executive Summary

The central subject of this bachelor thesis is *the realized volatility (RV) measure*, a recently defined new approach for estimating ex-post integrated volatility. The realized volatility measure is computed from the sum of frequently squared intraday returns. According to this definition of the RV measure, it declares itself as an efficient non-parametric estimator for the latent notional variance in a frictionless market. In contrast to former popular parametric approaches such as ARCH, GARCH and stochastic volatility models, the realized volatility approach reveals less complexity for empirical evaluation, yet it shows superiority of estimation to the former approaches. In addition, direct modeling and forecasting based on realized volatility successfully reproduces stylized facts of volatility such as fat tail distribution, stationarity of volatility or long memory persistence. Hence, extensive research has been devoted to the field of realized volatility. Unfortunately the traditional realized volatility estimator displays inefficiency when realistic microstructure contaminations are present. As a consequence subsequent research adopted this inefficiency due to noise in their development to model robust realized volatility for the estimation of ex-post integrated volatility. Nevertheless, direct forecasting of traditional realized volatility still seems to be feasible when sparse sampling frequencies are used for the generation of the RV measure.

In this bachelor thesis we therefore investigate the realized volatility measure, by specifically highlighting the modeling under microstructure noise and the direct forecasting of the basic realized volatility. In a first step we introduce the typology of the term variability and also former approaches for estimation and forecasting of volatility that are parametric frameworks. After giving the definition of realized volatility we discuss the traditional realized volatility and the theoretical description of the RV measure as an efficient estimator of the ex-post integrated variance.In a next step, we introduce the traditional realized volatility under the presence of realistic market microstructure contaminations. In regard of modeling volatility under noise, we examine an example of a bias correction with the Two-Scales Estimator of Zhang et al. (2005) for robust modeling of realized volatility. In terms of forecasting volatility we determine the direct forecasting approach of traditional realized volatility by showing the example of the Heterogeneous Autoregressive realized volatility model (HAR-RV) proposed by Corsi (2004). We also conduct a short empirical evaluation of the HAR-RV with tick-time data, consisting of Bank of America trade quotes spanning from January 2001 until December 2003. We investigate three sampling frequencies and provisorily find that 5 min and 15 min sampling frequencies show significant

predictive power for the determination of the one-day-ahead realized volatility, whereas the 60 min return horizon demonstrates a decline in capturing the one-day-ahead realized volatility and the residual is also minimal lower than the residual of the more frequent sampling frequencies.

This bachelor thesis has allowed an insight in one of today's extensively discussed topics in terms of modeling and forecasting volatility. The learning curve was similar to a strong negatively skewed distribution, because the subject showed complexity in respect of the theoretical foundation. Though as we acquired the knowledge steadily, the subject also got more and more interesting and in the end could be consolidated with an empirical implementation.