

## Executive Summary

Financial models and theories play a crucial role in various fields of finance. Thereby, the risk or volatility of an asset is of great importance. The variance of returns is mostly considered when assessing the volatility of an asset or portfolio. Since portfolio returns correlate with each other, the covariance matrix is an important determinant for the portfolio variance. In order to construct efficient portfolios, the matrix needs to be estimated. This thesis focuses on the estimation of the covariance matrix using intraday data. The analysis is based on US stock and bond data. Therefore, S&P 500 futures as well as US 10Y Treasury bond futures are considered. The examined data frequencies range from 15-minute returns to daily returns. By using different estimation approaches it is tested whether intraday data allows for a more accurate estimation of the covariance matrix compared to daily data. As for the different approaches, a basic rolling window estimator as well as AR, ARMA and GARCH models are used.

The results are compelling and show that estimations based on 15-minute returns deliver the best results. Intraday data is especially beneficial when estimating the covariance between different assets. All estimation approaches delivered very similar results. While the results from the AR and ARMA models are nearly identical, the basic rolling window estimator was able to deliver marginally better results despite representing the simplest approach. Estimation results are consistent throughout the analyzed years from 2010 to 2020 and across all market regimes that occurred during that period.

Based on the different covariance matrix estimations, this thesis also examines whether the estimations using intraday data allow for more efficient portfolios. For that purpose, mean-variance optimal two-assets are created and tested for improved portfolio allocation. The two respective assets are stock and bond futures. The focus was set on minimum-variance and maximum Sharpe ratio portfolios.

Results for minimum-variance portfolios show that portfolios based on 15-minute estimations have the highest variance or standard deviation across all other frequencies. However, the higher volatility was compensated by higher returns. The lowest variance across the estimations using on the rolling window estimator, AR, and ARMA models derived from estimations based on 30-minute returns. Again, portfolio variances based on estimations using the rolling window estimator, AR, and ARMA models are nearly identical. Although portfolios based on daily estimations of the GARCH model were able

to achieve better results, benefits of using intraday data still emerged for the other three approaches.

The analysis of maximum Sharpe ratio portfolios found a clear advantage of intraday data for estimations based on the rolling window estimator, AR, and ARMA models. Portfolios based on 15-minute estimations achieved the highest Sharpe ratios across all imposed frequencies. The results are conclusive throughout the majority of the ten-year period. However, intraday data was found to be especially beneficial during times of low to normal volatility while portfolios based on daily estimations slightly outperformed during times of high volatility as for example experienced in 2020. Despite the great results of intraday data, portfolios based on the GARCH model using daily returns were again able to beat the results in terms of higher Sharpe ratios. Nevertheless, portfolios based on intraday data achieved considerably higher returns, be it in combination with higher volatility.

In essence, intraday data enables more accurate estimations of the covariance matrix based on rolling window estimators and statistical models. Further, these estimations allow for more efficient mean-variance portfolios. However, the results are still beaten by daily data when using the GARCH model.