Executive Summary

The amount of literature concerning appropriate modelling of financial asset returns is tremendous. It is well-known that asset prices do not follow a simple normal distribution but are much more complex and exhibit certain empirical properties that apply to most asset classes. One phenomenon is the regular occurence of large, unexpected movements in prices, known as jumps. Since the pioneering work of Merton (1976), who popularized the use of jump diffusion models to capture these extreme price changes, various modifications have been presented in the empirical literature. While most of the jump diffusion models assume jumps to be independent and identically distributed (i.i.d.), some researchers have introduced models where the arrival of jumps depends on certain state variables and events such as past returns, implied volatility or macroeconomic announcements. Another aspect that has been shown to be related to jumps in financial asset prices is market liquidity (e.g. Jiang, Lo, and Verdelhan (2011) or Boudt and Petitjean (2013)). Despite the wide consensus about the importance of liquidity risk and its impact on asset prices, to the best of our knowledge, this is the first attempt to include market liquidity risk into a jump diffusion model.

The aim of this thesis is on one side to combine market and liquidity risk in a jump diffusion model and show how the model parameters can be estimated, and on the other side to find out if it is appropriate to consider mid prices when modelling the returns of various corporate bonds by a jump diffusion process.

After providing some theoretical background knowledge on liquidity risk, two jump diffusion models are presented, in which market risk is modelled by a standard geometric Brownian motion process and liquidity risk is captured in the jump dynamics. In the first model, the jump probability directly depends on the bid-ask spread, which is a widely used measure of market liquidity. In the second model, the probability of jumps as well as the jump direction is governed by the changes in the bid-ask spreads. Thus, when the bid-ask spread widens, the probability of negative jumps increases and the other way around. The parameters of the models can be estimated by the indirect in-

ference method. Indirect inference is a simulation-based estimation technique, usually applied when the likelihood function of the model is intractable or too difficult to evaluate.

In a further section, the returns of various corporate bonds of all constituents of the Dow Jones 30 index, as of the end of September 2011, are analyzed. The newly available high-frequency corporate bond price data provides an optimal setting to investigate the distribution of returns and their tail properties in detail. Various empirical characteristics of bid and ask returns are studied separately and compared to each other. This is done for different sampling frequencies: from a 300 second up to a 10 second time interval.

First, the results indicate that neither bid nor ask returns follow a simple normal distribution. Second, the two-way price anaylsis reveals considerable differences in bids and asks. Bid returns are on average more volatile than asks and behave more extreme in the tails. Moreover, bids are on average negatively skewed, while asks exhibit a positive average skewness. The leptokurtic feature, so-called *fat tails*, is observed in bid as well as in ask return distributions. The fact that asks exhibit on average a higher kurtosis might stem from some extreme positive price movements. These findings suggest that bid and ask returns also differ in their jump behavior.

When liquidity in asset markets is low, it is difficult to sell assets at fair market prices and therefore, from a risk management perspective, bid prices might be more important. Ignoring the fact that there exist significant differences in bid and ask returns, and hence also mid returns, may seriously underestimate the risk to which an asset or portfolio is exposed at the time it is liquidated. As a consequence, it seems appropriate to apply the new liquidity-related jump diffusion models to the corporate bond bid returns instead of considering an average value.