Executive Summary

Variance swaps are popular OTC-traded derivatives that allow to take on direct exposure to the volatility of an underlying. It is in the nature of such swaps to be traded with a zero upfront premium, while at maturity, the holder receives realized variance on the underlying and pays the swap rate (implied variance). The fair-value swap rate equals the risk-neutral expectation of the swap's payoff, i.e. the realized variance. In practice, realized variance is determined by monitoring at discrete times. Swaps on higher moments of an underlying's return distribution ought to be defined in an analogous fashion. This has however proven not to be straightforward, the problem beeing rooted in the definition of the realized component. For skewness swaps in which skewness is defined in the common way as the standardized third moment analogously to the variance, the fair-value swap rate proves to vary with the monitoring frequency of the realized component.

Neuberger (2012) tackles the above problem by setting up the Aggregation Property (AP) which holds for all swaps for which the swap rate is independent of the monitoring frequency. The author finds a measure related to the third moment of a distribution for which the AP holds. Alexander and Rauch (2016) take up Neuberger's ideas and introduce the set of discretisation-invariant (DI) swaps, defining swaps on a variety of payoffs for which the swap rate is independent of the monitoring frequency, the single assumption being that the underlying asset process is a martingale. Among those are payoffs related to higher moments of return distributions, enabling the definition of higher moments swaps.

Although conventional swaps are traded with a zero premium, the parties in a swap end up with non-zero payoffs equal to the difference between the realized and implied component, which constitutes the swap risk premium. Risk aversion of investors is a common explanation for risk premia in financial markets. Brinkmann and Korn (2014) provide a result to assess the degree of risk aversion in higher moment swaps: Implied moments under the risk-neutral measure (swap rates) can be converted to such under the physical measure with the use uf a utility function representing investors' preferences, thus allowing conclusions on the risk aversion necessary to explain the difference between implied and realized swap components.

This thesis explores features of higher moment DI swaps in several empirical applications, including swaps on the S&P 500 as an index and such on sixty single securities which are major

components of the S&P 500. The empirical analysis provides an overview of the swap term structure and tests the predictive power of implied moments and risk premia for future returns, performing regression for the index and portfolio sort for single stocks. The pattern of swap components around FOMC meetings is further investigated, while short-term components and risk premia are explored with the use of weekly options. The final part of the analysis deals with extracting market-implied risk aversion from higher moment DI swaps for investors with CRRA utility.

The term structure of higher moment DI swaps on the S&P 500 shows that variance and fourth (third) moment risk premia are principally negative (positive) except for times of market crises. Skewness and kurtosis risk premia are less volatile, but their direction and magnitude significantly depends on the swap maturity. The variance risk premium on single stocks is more volatile and not generally negative. Implied skewness has steadily decreased for the index as well as single securities over the past fifteen years. The S&P 500 further exhibits lower skewness and higher kurtosis than most of the single stocks.

Regressing S&P 500 excess log returns on standardized implied moments reveals a significant negative (positive) relation for implied skewness (kurtosis) for horizons of three months up to one year. Estimated risk premia, in which the realized component is approximated by its value in the previous period, show no predictive power for returns. The portfolio analysis for single stocks shows that portfolios in which the stocks exhibit higher (lower) skewness (kurtosis) perform significantly better, however only after the financial crisis 2008-2009. Financial research has produced mixed evidence on the predictive power of higher implied moments and risk premia. The results in this thesis confirm that the outcome is heavily dependent on the chosen sample period and study design. Furthermore, they suggest that isolating comoments in portfolios could add value in examining the relation with returns. Conveniently, the DI swap framework would potentially allow to define such in a model-free way.

Swaps with a one-week maturity built with weekly options show structurally different features than such with longer maturities, observing that one-week skewness and kurtosis risk premia are significantly higher in absolute terms. With the appearance of a larger number of maturities of weekly options in 2016, a richer data sample will be at disposal in the near future to shed further light on short-term moment swaps. The analysis of moment components prior to and

after FOMC meetings reveals that implied moments do not react in a characteristic way to prospective changes in monetary policy. Risk premia do show a slight pattern characterizied by even vs. odd weeks around FOMC meetings, which however rather reflects an effect already observed in the literature for excess returns that is not inherent to moment swaps specifically.

The conversion of risk-neutral to physical implied moments, assuming a representative investor with CRRA utility, shows that the degree of relative risk aversion which can explain part of the risk premium varies over time: It tends to be higher in times of bullish and lower in times of bearish markets, being generally higher for variance and kurtosis than for skewness. Furthermore, the coefficient of risk aversion is similar to those found in other financial applications, implying that the theoretical framework is consistent when applied to DI swaps. As risk aversion of CRRA type cannot explain the entire risk premium, future research could focus on exploring whether more flexible forms of utility functions can explain risk premia and analyze the corresponding degrees of risk aversion.