Short summary

Master Thesis "Optimal Equity Factor Investing"

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The pervasive low yield environment in major markets severely challenges investors who strive for positive and stable investment performance. For this purpose, the bedrock of investment management was to diversify managed funds across asset classes, a concept which is often referred to as the only "free lunch", see Ilmanen and Kizer (2012) among others. However, the concept of diversification mostly failed during the financial crisis in 2007-08. Except for high-quality sovereign debt, virtually all asset classes went down and were characterized by high volatility. In turn, many investors following the traditional asset allocation approach were not as diversified as they had thought. Hence, investors started looking for new sources to generate sufficient investment returns at a reasonable risk.

In a related vein, the recent academic literature synthesizes that all asset classes are subject to some common underlying factor exposures or risk premia. For instance, Ang, Götzmann, and Schäfer (2009) argue that a high proportion of active fund returns can be explained by exposure to various risk premia. To foster intuition, Podkaminer (2013) provides a chemistry analogue: "If asset classes are molecules, then factors are atoms". In this picture, factors are the smallest units determining the performance characteristics of a given asset. Based on the observation that factors are hardly correlated, Ilmanen and Kizer (2012) argue that the concept of diversification is not dead but that investors simply failed to diversify across these factors historically.

This thesis thoroughly investigates the idea of directly investing into factors instead of traditional asset classes. In Chapter 2, we provide a theoretical foundation for factor investing based on asset pricing theory that allows to link factor premia to the stochastic discount factor. In addition, we review the recent advancements in the literature on factor investing. Having established a sound theoretical rationale for factor investing, Chapter 3 introduces the equity factor set used in the subsequent empirical analysis. Specifically, we concentrate on equities and build on a consensual set of 12 equity factors that are associated with firm characteristics and have proved meaningful in explaining the cross-section of stock returns. First, we describe how the underlying long-short factor portfolios are constructed. Then, we define each equity factor and present rationales for their existence as well as descriptive statistics. Finally, we analyze the relation between equity factors in terms of the corresponding correlation structure.

The major challenge is to combine these factors into a coherent portfolio that is capable of optimally harvesting the associated factor premia. In Chapter 4, we construct diversified portfolios using risk-based allocation techniques such as equal-weighting, minimum-variance, or risk parity. Equity factor investing would have provided investors with attractive risk-adjusted returns over the last 60 years for most of the analyzed U.S. factors. Even though there has been a decline in the equity factor performance and significance over the post-publication period, we document that diversified factor portfolios would still have performed well with highly significant *t*-statistics in that period. The risk parity portfolio emerges as a benchmark portfolio which will serve as a reference point for more active equity factor investing strategies. These active strategies are commonly referred to as factor timing. Note that we will distinguish between factor *timing* that seeks to exploit time-series information and factor *tilting* that seeks to exploit cross-sectional information.

In Chapter 5, we particularly pursue factor *timing* by forecasting equity factor returns based on a variety of fundamental variables and technical indicators commonly used for predicting the equity risk premium. The ensuing equity factor forecasts are then implicitly exploited in the parametric portfolio policy framework of Brandt and Santa-Clara (2006). Chapter 6 dives into a complementary way of equity factor investing: We pursue factor *tilting* by couching four cross-sectional factor characteristics into the parametric portfolio policy of Brandt, Santa-Clara, and Valkanov (2009). We find that the factor timing and tilting approaches represent complementary information to maximize an investor's utility. In terms of risk-adjusted performance and maximum drawdown, the factor tilting strategy is more compelling and robust than the factor timing strategy. Still, the factor timing strategy improves upon the risk parity benchmark because the parametric portfolio policy is able to exploit the sparse information in a meaningful way.

Synthesizing both approaches, Chapter 7 investigates *optimal* equity factor investing by blending both strategies into one integrated parametric portfolio policy: One obtains a well-diversified portfolio which is superior in terms of information ratio for all periods. Although not exhibiting the highest risk-adjusted performance, the blended strategy is still to be preferred to the stand-alone tilting approach as it allows the investor to include all of the available and complementary information sets.

Still, actively timing and tilting equity factors should not be pursued too actively. Instead, this thesis makes a strong case for anchoring active equity factor strategies in a diversified and robust benchmark allocation. A viable candidate is the risk parity allocation which strikes a balance between risk minimization and concentration of factor weights. The parametric portfolio policies have proven as natural candidates to cater the desire for diversification and active management of

factors: Whenever the predictive content of time-series or cross-sectional information is deemed to be significant, the strategy actively deviates from the risk parity allocation. Conversely, whenever the predictive content is weak, the strategy naturally resorts to the risk parity allocation. As a result, the ensuing overall strategy captures at least the associated factor premia in a diversified fashion.

Finally, in Chapter 8 we test the robustness of our performance results with respect to changes in the risk aversion of an investor as well as for long-only implementations and discuss the role of transaction costs. Our findings are robust when restricting short-sales of equity factors and unlikely to be invalidated by the introduction of transaction costs.