Summary of the Research Project Proposal

"The impact of model instability on long-term investors"

By

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The strategic asset allocation decision for a long-term investor is the choice how to invest in broad asset classes such as stocks or bonds to meet one's long-term goal. The allocations will vary over time due to changes in investment opportunities, the investment horizon, and long-term macro-economic risk factors like inflation and interest rates. It is a major determinant of the risk-return profile of a long-term investor.

The common practice in the strategic asset allocation literature is to estimate a model for predicting asset returns on a data-set of 50 years or more and to assume that model coefficients remain constant over this period. However, a priori there is no reason to believe that they indeed are. Aspects such as institutional changes, wars or changes in the stock market behavior of participants due to changing risk aversion or financial sophistication levels could lead to changes in the relation between asset returns and predictor variables or to changes in the properties of the error term. Unfortunately, relatively little is known about the impact of this model instability on the portfolios of long-term investors.

In this project we analyze the impact of model instability on the composition and performance of portfolios of long-term investors. As a first contribution, we develop a methodology to take such time-variation into account by estimating a time-varying VAR(1) model in which parameters are allowed to change in every period. We develop a methodology that is able to handle time-varying intercepts, time-varying slope coefficients, time-varying error volatility, time-varying error correlation, the leverage effect and fat tails. We assess the importance of these model components for long-term investors.

We specifically focus on the persistence of changes in the different parameters of the time-varying model. While small changes in coefficients might not have a large impact on short-term investors, they can have a large impact on long-term investors if they are long-lasting and persistent. In that case, the mistakes one makes in using a constant model add up over the investment horizon and can become very large. If on the contrary the changes in coefficients are not persistent but of transitory nature, they are unlikely to be important for long-term investors. In that case the coefficients only deviate from the constant model for a fraction of the investment horizon.

An alternative specification is the regime-switching model that Guidolin and Timmermann (2007) and Pettenuzzo and Timmermann (2010) implement. We do not pursue this alternative here because of three reasons. Firstly, a priori it seems more plausible that the behavior of stock market participants changes smoothly over time due to changes in risk aversion or financial sophistication instead of abruptly, which suggests that a regime-switching model is not appropriate. Secondly, one of our objectives is to assess which kind of model instability is the most important for long-term investors. A regime-switching model does not allow us to assess the individual components, since all components change jointly. Finally, a regime-switching model pools the persistence parameter of all components. In other words, changes in say the slope of stock returns are equally persistent as changes in the volatility of a predictor variable, while there is a priori no reason to impose such a restriction.

As a second contribution, we develop numerical techniques to be able to calculate optimal dynamic portfolios. This allows us to calculate the optimal investment strategy of a long-term investor facing model instability. The methodology is an extension of Brandt, Goyal, Santa-Clara and Stroud (2005) and Koijen, Nijman and Werker (2010). We extend their methodology by allowing for (i) latent variables and (ii) a large number of state variables. The latter extension is important, because of the large number of parameters in the time-varying VAR model and is based on taking the principal components of the large set of state variables.

As a final contribution, we assess the impact of neglecting time variation in both an in-sample and out-of-sample context. As a first step, we evaluate the portfolio performance in-sample by evaluating the utility loss of (wrongly) using a time-constant model when the time-varying model is known to be true. This is done by simulating from the time-varying model. In a second step, we evaluate the portfolio performance out-of-sample.

Our research is very relevant for long-term investors such as pension funds, because (i) we develop tools for quantitative finance professionals to incorporate time-variation in models and (ii) assess the impact of neglecting such time-variation on calculated investment portfolios. We assess the latter in a realistic out-of-sample analysis to be able to obtain relevant results for actual long-term investors.