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Optimal asset allocation for strategic investors

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ABSTRACT

This paper studies optimal asset allocation for investors over multiple investment horizons. Rather than first model the various features of the conditional return distribution and subsequently characterize the portfolio choice, we focus directly on the dependence of the portfolio weights on the predictor variables through a linear parametric portfolio policy rule. This characterization allows us to apply GMM estimation and testing methods to sample analogues of the multiperiod Euler equations that characterize our optimal portfolio choice. Our model accommodates an arbitrarily large number of assets in the portfolio and state variables in the information set. The empirical results for a portfolio of stocks, bonds and cash provide ample support to the linear specification of the portfolio weights and reveal significant differences between myopic (one-period) and strategic (long-term) optimal portfolio allocations.

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1. Introduction

Optimal portfolio decisions depend on the details of the economic and financial environment: the financial assets that are available, their expected returns and risks, and the preferences and circumstances of investors. These details become particularly relevant for long-term investors. Such investors must concern themselves not only with expected returns and risks today, but with the way in which expected returns and risks may change over time. It is widely understood at least since the work of [Merton \(1969, 1971, 1973\)](#) and [Samuelson \(1969\)](#) that the solution to a multiperiod portfolio choice problem can be very different from the solution to a static portfolio choice problem. In particular, if investment opportunities vary over time, then long-term investors care about shocks to investment opportunities as well as shocks to wealth itself. This can give rise to intertemporal hedging demands for financial assets and lead to strategic asset allocation as

a result of the farsighted response of investors to time-varying investment opportunities.

Unfortunately, intertemporal asset allocation models are hard to solve in closed form unless strong assumptions on the investor's objective function or the statistical distribution of asset returns are imposed. A notable exception is when investors exhibit log utility with constant relative risk aversion equal to one. This case is relatively uninteresting because it implies that Merton's model reduces to the static model. Another exception within the class of utility functions describing constant relative risk aversion and represented by the family of power utility functions is when asset returns are log-normally distributed. In this case, maximizing expected utility is equal to the mean-variance analysis proposed by [Markowitz \(1952\)](#) in his seminal study. In this model, the investor trades off mean against variance in the portfolio return. The relevant mean return is the arithmetic mean return and the investor trades the log of this mean linearly against the variance of the log return. The coefficient of relative risk aversion acts as a penalty term adding to the variance of the return.

More generally, the lack of closed-form solutions for optimal portfolios with constant relative risk aversion has

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limited the applicability of the Merton model and has not displaced the Markowitz model. This situation has begun to change as a result of several developments in numerical methods and continuous time finance models. More specifically, some authors such as Barberis (2000) and Brennan, Schwartz, and Lagnado (1997, 1999), among a few others, provide discrete-state numerical algorithms to approximate the solution of the portfolio problem over infinite horizons. Closed-form solutions to the Merton model are derived in a continuous time model with a constant risk-free interest rate and a single risky asset if long-lived investors have power utility defined over terminal wealth (Kim & Omberg, 1996), or if investors have power utility defined over consumption (Watcher, 2002), or if the investor has Epstein and Zin (1989, 1991) utility with intertemporal elasticity of substitution equal to one (Campbell & Viceira, 1999; Schroder & Skiadas, 1999). Approximate analytical solutions to the Merton model have been developed in Campbell, Chan, and Viceira (2003) and Campbell and Viceira (1999, 2001, 2002) for models exhibiting an intertemporal elasticity of substitution not too far from one. An alternative to solving the investor's optimal portfolio choice problem has been proposed by Ait-Sahalia and Brandt (2001), Brandt (1999) and Brandt and Clara (2006). Ait-Sahalia and Brandt (2001), for example, show how to select and combine variables to best predict the optimal portfolio weights, both in single-period and multiperiod contexts. Brandt and Clara (2006) solve the dynamic portfolio selection problem by expanding the asset space to include mechanically managed portfolios and compute the optimal static portfolio within this extended asset space. The intuition of this strategy is that a static choice of managed portfolios is equivalent to a dynamic strategy.

The current paper builds on the seminal articles initiated by Ait-Sahalia and Brandt (2001) and Brandt (1999). More specifically, we contribute to the literature on financial forecasting by proposing an optimal portfolio allocation for investors with constant relative risk aversion (CRRA) utility functions defined over multiple, potentially infinite, investment horizons. Rather than first model the various features of the conditional return distribution and subsequently characterize the portfolio choice, we focus directly on the dependence of the portfolio weights on the predictor variables over a multiperiod investment horizon. We do this by solving sample analogues of a set of multiperiod Euler equations that characterize our portfolio choice. This method is made operational through a linear parametric portfolio policy rule that models the dynamics of the portfolio weights, see Ait-Sahalia and Brandt (2001), over the investor's multiperiod horizon. In contrast to most of the related literature, our model accommodates an arbitrarily large number of assets in the portfolio and state variables in the information set. The main advantage of our linear portfolio policy rule is that the first order conditions of the maximization problem yield a simple system of equations that is overidentified and provides a very intuitive empirical representation. Furthermore, in our framework we avoid the implementation of time-consuming stochastic dynamic programming methods.

The sample analogues of the multiperiod Euler conditions obtained from the investor's maximization problem

allow us to apply the generalized method of moments (GMM) of Hansen and Singleton (1982) for estimation and also for testing the linear parametric portfolio policy specification. We do this by developing two different but related tests. First, we adapt the specification J-test obtained from the overidentified system of Euler equations to assess whether the linear parametric portfolio policy is statistically correctly specified for long investment horizons. Second, we adapt the incremental testing approach developed by Sargan (1958, 1959) to assess the marginal statistical relevance of the state variables in the linear portfolio policy specification. We complete the econometric section by proposing a further test that gauges the effect of the number of investment horizons on the optimal allocation of assets to the portfolio. This is done by developing a Hausman type test that compares different specifications of the investor's maximization problem in terms of the investment horizon. More specifically, we contemplate a short-term and a long-term investment horizon and assess statistically the informational content of the interval spanning between the short and long-term horizons.

Our empirical application compares the optimal asset allocation of a myopic investor only concerned with maximizing one-period-ahead wealth with the allocation of a strategic investor with a long multiperiod investment horizon. The empirical application closely follows similar studies such as Brandt (1999) and Brennan et al. (1997). The investor is assumed to invest in a portfolio given by three assets: a one-month Treasury bill as risk-free security, a long-term bond, and an equity portfolio. The variables that predict expected returns on these assets are the detrended short-term interest rate, the U.S. credit spread, the S&P 500 trend and the one-month average of excess stock and bond returns. Our econometric specification shows that the strategic allocation to the S&P 500 and GOQO Bond index differs in two main aspects with respect to the myopic asset allocation. First, the absolute value of the optimal portfolio weights in the strategic case is usually larger than in the myopic case. Second, the strategic allocation to the S&P 500 index is found to be positively and significantly related to the trend variable and negatively related to the detrended short-term interest rate. In contrast, the strategic allocation to bonds is found to be negatively and significantly related to the detrended short-term interest rate with such relationship increasing with the degree of risk aversion. The analysis of the optimal stocks and bonds' hedging demands varies significantly with the state variables and highlights the importance of the dynamics of the state variables in determining the differences between the myopic and strategic optimal portfolio allocations. We also compare the performance of these two portfolios by analyzing their annualized certainty equivalent return and simulating the wealth of each investment strategy over time. The results show the outperformance of the strategic portfolio over the myopic portfolio. These differences in portfolio performance can be attributed to the presence of larger exposures to each asset for the long-term investment strategy that result in higher profits.

We also perform several robustness exercises. First, we assess the robustness of our choice of state variables to the inclusion of other variables in the investor's information

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