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A dynamic model of active portfolio management with benchmark orientation ☆

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Abstract

This paper studies optimal dynamic portfolios for investors concerned with the performance of their portfolios relative to a benchmark. Assuming that asset returns follow a multi-linear factor model similar to the structure of Ross (1976) [Ross, S., 1976. The arbitrage theory of the capital asset pricing model. Journal of Economic Theory, 13, 342–360] and that portfolio managers adopt a mean tracking error analysis similar to that of Roll (1992) [Roll, R., 1992. A mean/variance analysis of tracking error. Journal of Portfolio Management, 18, 13–22], we develop a dynamic model of active portfolio management maximizing risk adjusted excess return over a selected benchmark. Unlike the case of constant proportional portfolios for standard utility maximization, our optimal portfolio policy is state dependent, being a function of time to investment horizon, the return on the benchmark portfolio, and the return on the investment portfolio. We define a dynamic performance measure which relates portfolio's return to its risk sensitivity. Abnormal returns at each point in time are quantified as the difference between the realized and the model-fitted returns. Risk sensitivity is estimated through a dynamic matching that minimizes the total fitted error of portfolio returns. For illustration, we analyze eight representative mutual funds in the U.S. market and show how this model can be used in practice.

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1. Introduction

Professional fund managers are frequently judged by their *ex post* excess returns relative to a prescribed benchmark. Most money managers adopt an optimal strategy that maximizes an expected excess return adjusted by the tracking error relative to the benchmark; see, Roll (1992). This is a sensible investment approach because fund sponsors wisely expect their investment portfolios to maintain a performance level that is close to a desired benchmark.

We analyze an optimal dynamic portfolio and asset allocation policy for investors who are concerned about the performances of their portfolios relative to that of a given benchmark. Maximizing the expected utility of the excess return over a chosen benchmark is sometimes referred to as active portfolio management, while passive portfolio management just establishes a portfolio that possibly tracks the chosen benchmark; see, Roll (1992) and Sharpe (1964). There are many professional and institutional investors who follow this benchmark-oriented procedure. For example, many equity mutual funds take the S&P 500 Index as a benchmark and try to beat it. Some bond funds try to exceed the performance of Lehman Brothers Bond Index. For an analysis of active portfolio management in a static setting, see Grinold and Kahn (2000).

In the standard utility maximization with *constant relative risk aversion* (CRRA), the optimal policies are all constant proportion portfolio allocation strategies. The portfolio is continuously rebalanced so as to always keep a constant proportion of the total fund value in the various asset classes, regardless of the level of the fund. Although such policies have a variety of optimality properties for the ordinary portfolio problem and are used in asset allocation practice (see, Perold and Sharpe (1988) and Black and Perold (1992)), some investors are reluctant to use constant proportion strategies in the belief that their expectations suggest that varying weights would be more profitable. By maximizing the probability that the investment fund achieves a certain performance goal before falling below a predetermined shortfall relative to the benchmark, Browne (2000) relates the optimal portfolio policy to a state variable, *the ratio of the level of investment portfolio to the benchmark portfolio*, which leads to an analytical solution in a complete market setting.

Managers of actively managed mutual funds are interested in shifting the investment policy with changes of returns on both their investment portfolios and the benchmark portfolio from time to time. Academic researchers define this market activity as market timing; see, Becker et al. (1999), Coggin et al. (1993), Ferson and Warther (1996), and Treynor and Mazuy (1966). This paper addresses this issue for a general incomplete market where the investor is allowed to invest in a large number of stocks which may include all the individual components of equity indices. In a static setting, all efficient portfolios can be obtained from the market portfolio by using leverage, assuming normally distributed returns or quadratic utilities. However, as shown here, this is generally not true in a dynamic setting except for the very special case that the market portfolio is equivalent to a leveraged growth optimum portfolio.