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Modern portfolio management with conditioning information☆

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ABSTRACT

This paper studies models in which active portfolio managers utilize conditioning information unavailable to their clients to optimize performance relative to a benchmark. We derive explicit solutions for the optimal strategies with multiple risky assets, with or without a risk-free asset, and consider various constraints on portfolio risks or weights. The optimal strategies feature a mean–variance efficient component (to minimize portfolio variance), and a hedging demand for the benchmark portfolio (to maximize correlation with the benchmark). A currency portfolio example shows that the optimal strategies improve the measured performance by 53% out of sample, compared with portfolios ignoring conditioning information.

1. Introduction

A common problem in modern portfolio management is to earn a higher expected return than a pre-specified unmanaged benchmark portfolio return, while minimizing the variance of the difference of the two returns, the "tracking error variance." Active managers, who are compensated for performance relative to a given benchmark, typically face this kind of problem. While this problem is obviously interesting in practice, it is also important for academic scholars since its distinct portfolio policies and equilibrium implications add new insights to the conventional mean–variance setting.

This paper intends to answer the following questions: What is the informed benchmark investors' optimal strategy, given that the performance evaluators are uninformed? How is the optimal strategy related to mean–variance investing and the tendency to track the benchmark? Empirically, what is the economic value of the optimal strategy?

This paper makes the following contributions. We develop explicit solutions for the optimal active portfolios, with an array of possible constraints, under the assumption that active managers have information about security returns (the "conditioning information," which this paper interprets to mean any predetermined information active managers can access) that is not available to their

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clients. We focus in particular, on problems in which the manager uses the information to optimize mean–variance performance measures that the clients without the conditioning information can observe. The generic form of the optimal portfolios can be characterized by two components: a mean–variance efficient portfolio, and a "hedging demand" for the benchmark portfolio. The mean–variance component intends to minimize unconditional portfolio variance, while the hedging demand component maximizes unconditional correlation with the benchmark. Such a representation generalizes Hansen and Richard (1987), and specializes Fama (1996) and Ferson et al. (2006). A simulation shows that, abstracting from misspecification and estimation errors, our solutions potentially improve the measured performance by a factor of four when compared to portfolios ignoring conditioning information. When implemented realistically on currency or equity data, the optimal portfolios actually produce robust superior performance.

The problem of tracking error investing is formally posed in Roll (1992). He argues that it takes a long time to reliably measure the value-added from a fund manager, and a benchmark reduces the estimation error in portfolio performance. Starks (1987), Admati and Pfleiderer (1997), and Ou-Yang (2003) study compensation contracts involving benchmarks and address the agency problems between the fund managers and their clients that arise because the two parties potentially have conflicts of interests. Jorion (2003) argues that active managers may not be willing to disclose their information to the clients, and ex post performance based on realized returns is very noisy. Such issues motivate the use of constraints on portfolio risk profiles. Roll (1992), Jorion (2003), Stutzer (2003), and Alexander and Baptista (2008) consider different constraints and provide analytical solutions.[1] Brennan (1993), Cuoco and Kaniel (2011), Gómez and Zapatero (2003), Stutzer (2003), and Cornell and Roll (2005) derive market equilibrium implications of tracking error variance minimization.

The above studies raise interesting issues related to tracking error variance minimization but ignore the presence of conditioning information. Conditioning information plays a central role in modern portfolio management since a substantial portion of clients delegate their investment decisions to professional money managers in the belief that managers are better informed; see Avramov and Chordia (2006), and Bansal et al. (2004). This is the first study to explore the optimal portfolios of tracking error investors and their equilibrium implications when conditioning information is explicit.[2]

There are alternative ways to exploit conditioning information. An active manager may pursue "conditional tracking efficiency" or CTE, where he uses the conditioning information to optimize *conditional* measures. Even if conditioning information is not explicitly stated, we can interpret the means and variances in previous studies like Roll (1992), Jorion (2003), and Stutzer (2003) as conditional moments to produce CTE solutions. This is what these authors probably have in mind. However, this paper illustrates that when there is conditioning information, an active manager may pursue "unconditional tracking efficiency" or UTE, where he uses conditioning information to form portfolios that optimize *unconditional* performance measures.[3] We argue this is a natural formulation. We call problems which ignore conditioning information altogether "no-information tracking efficiency" or NITE.

The central contribution of this paper is to develop the UTE problem. The information structure of UTE is common in practice. The portfolio manager conducting an optimization uses more information than is available to his clients. If the clients do not have conditioning information, they can only form unconditional performance measures. It is sensible that the active manager uses conditioning information to form portfolios that maximize his performance from the clients' perspective. Our focus on unconditional measures is consistent with Dybvig and Ross (1985), Hansen and Richard (1987), Ferson and Siegel (2001), Ferson et al. (2006), Zhou (2008), and Abhyankar et al. (2012).

The rest of this paper is organized as follows. Section 2 provides solutions to UTE versions of the modern portfolio management problem. It also discusses the properties of the solutions, connecting them to the familiar concepts of mean–variance efficiency and hedging demands. Section 3 provides illustrative examples. Section 4 presents an international financial market application. Section 5 concludes the paper. The Appendix provides all explicit solutions as well as the proof of their generic form. A separate Internet Appendix provides extensions and further empirical evidence.

2. The modern portfolio management problem

Consider an active manager who faces N risky assets and a risk-free asset. Suppose R is an N-dimensional vector of raw asset returns, and R_b is the raw return of the benchmark. The risk-free rate R_f can be *conditionally* risk-free, i.e. varying from period to period, and observed at the beginning of each period. Suppose $r \equiv (R - R_f\mathbf{1})$ is an N-vector of risky asset returns in excess of the risk-free rate, where $\mathbf{1}$ is an N-dimensional vector of ones. Let $r_b \equiv R_b - R_f$ denote the benchmark return in excess of risk-free rate. The benchmark excess return has unconditional mean μ_b and unconditional variance σ_b^2, and the unconditional moments are the ones we estimate using the usual sample means and variances.

At the beginning of the period, the active manager uses conditioning information Z, unavailable to his clients, to choose an unrestricted weights vector $x(Z)$ of the N risky assets, investing the rest of the funds in the risk-free asset or borrowing at the rate R_f. The observed returns on the manager's portfolio will be $R_p = x(Z)^\top r + R_f \equiv r_p + R_f$, where r_p is the excess return of the active portfolio.

[1] Following Roll (1992), Jorion (2003), and Stutzer (2003), among others, we formulate the tracking-error investing problem in a mean–variance framework. Such a formulation leads to the analytically tractable solutions in this paper. However, the usual criticisms on the mean–variance class models apply to this paper: the quadratic, symmetric nature of the utility function is not theoretically desirable. Furthermore, estimation errors and misspecification may lead to poor out-of-sample empirical performance. We examine the empirical issues in Section 4 of the paper.

[2] Zhou (2008) recently introduces conditioning information to the active portfolio management context in a different problem. He revisits the fundamental law of active portfolio management by Grinold (1989) and Grinold and Kahn (1999), and considers how an informed active manger can maximize *unconditional* value-added, approximated by unconditional risk-adjusted portfolio return.

[3] An Internet Appendix provides simple analytical illustration of the amount of unconditional inefficiency a CTE strategy produces.