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# Momentum in strategic asset allocation

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ABSTRACT

This paper explores a continuous-time intertemporal consumption and portfolio choice problem for an infinite horizon investor with recursive utility defined over consumption. The investor who tries to exploit momentum is assumed to have access to a risk-free asset and a risky asset whose return exhibits short run momentum. We derive an exact explicit solution and an approximate analytical solution to the dynamic asset allocation problem. We find that the optimal portfolio demand for stocks contains two components: the "momentum-adjusted" myopic demand and the intertemporal hedging demand. When the model is calibrated to Chinese stock market data, it implies that intertemporal hedging demand motives greatly decrease the portfolio demand for stocks by investors whose risk aversion coefficients exceed one when the latest levels of stock returns are non-negative or moderate negative. In addition, hedging motives increase the optimal portfolio when they are sufficiently negative. Also, we find that risk aversion is the main preference parameter in determining portfolio choice rather than the elasticity of intertemporal substitution.

## 1. Introduction

The optimal consumption and portfolio selection for long-term investors has been studied extensively in modern finance. Academic research in this field has so far offered much guidance to investment advisors who provide portfolio advice to long-term investors. Thus this research is of great importance from both theoretical and practical purposes. The pioneering work in continuous time finance can be traced to Merton (1969) which provides a basic paradigm and useful quantitative methods to investigate multiperiod optimal portfolio choice problem. However, this model ignores several critically significant factors. Most importantly, it assumes that stock returns are unpredictable and the dynamics of the price process is modeled by the classical geometric Brownian motions. We know that this key assumption that stock prices follow random walk (constant investment opportunity set) is not consistent with the actual behavior of financial asset price data.

Nowadays, the idea that asset returns are actually predictable has been widely accepted among financial economists. Predictability has become a growing part of mainstream finance. There is strong empirical evidence in recent empirical work that stock market returns are predictable and tend to continue over short horizons (momentum). For example, Jegadeesh and Titman (1993) demonstrate that there exists momentum for individual U.S. stocks, predicting returns over horizons of 3–12 months using returns over the past 3–12 months. Fama and French (1998) find similar evidence for stocks in other countries. More recently, there is related evidence that security returns exhibit time series momentum. Moskowitz et al.(2012) document that time series momentum based on the past 12 month excess returns persists for between one and 12 months. Given that predictability is the empirical features in the financial asset price data, thus it would be of practical relevance and importance for financial economists to consider how a rational long-term investor is engaged in the strategic asset allocation when there is predictability in asset returns.

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In response to these empirical findings, predictability has been considered in the optimal consumption and portfolio choice literature mainly in the form of nonconstant investment opportunity set, usually modeled by time-varying expected returns. There is an abundant literature exploring portfolio choice in the presence of drift-based predictability. The seminal work of Merton (1971) is the first to show that the solution to dynamic asset allocation is totally different from the solution to a single-period portfolio choice problem. Specifically, long-term investors care about the current risk-return trade-off as well as future investment opportunities. They may wish to hedge against time variation in future risk-return trade-offs through intertemporal hedging demand which deviates from the myopic mean-variance efficient portfolio.

Since then, there has been growing interest in applications of Merton's idea into strategic asset allocation for long-lived investors. Some early works include Kim and Omberg (1996), Brennan et al.(1997), Campbell and Viceira (1999) and some references therein. Brennan et al. (1997) have created this term "strategic asset allocation" to describe the portfolio problem when there is time-variation in expected returns. Some recent works include Campbell et al.(2001), Campbell and Viceira (2002), Wachter (2002) and others. They analyze the consequences of time-variation in expected returns for financial decisions. In addition, Chacko and Viceira (2005) document the effect of time-varying return volatilities. Along this active line of research, the above-mentioned literature has concentrated on the study of mean reversion in the risk premium. However, these studies ignore that stock returns tend to continue over short horizons. Indeed, with a few exceptions, for example, Balvers and Mitchell (1997), Rodriguez and Sbuelz (2006), Koijen et al.(2009) and Li (2013), it seems that one important issue, namely momentum, that may be overlooked by the existing literature on strategic asset allocation.

Momentum is a strong stylized empirical feature of stock returns. Note that the definition of momentum in Campbell (2004) refers to the inclination of stock prices to continue moving in the same direction for several months after an initial shock. Momentum over short horizons indicates that the recent performance of stock price has predictive ability for future returns. It induces positive autocorrelation of holding-period returns. Return continuation of certain holding-period does affect dynamic portfolio choice by originating strategic asset allocation. The ensuring autocorrelation has motivated widely known active portfolio management strategies, for example, "buy winners/sell losers" to benefit from momentum. It leads the investor to modify his/her portfolio strategy. Thus return continuation (momentum) induces hedging demand and impacts market-time opportunities. For these reasons, it is natural and imperative for us to study optimal dynamic portfolio choice and theoretical implications of such positive return autocorrelation.

In this paper, we explore systematically optimal dynamic portfolio choice with momentum in asset returns in a continuous-time setting. In particular, we examine the implications of momentum in stock returns on intertemporal optimal portfolio choice and consumption. In order to do this, we consider the optimal consumption and portfolio choice problem of an infinitely long-lived investor with Duffie and Epstein (1992a, 1992b) recursive utility over an infinite stream of consumption. As in Rodriguez and Sbuelz (2006), we assume that there are two assets available for investors in financial markets, a risk-free asset paying instantaneous return rate $r$ and a risky asset (e.g. stock index, or mutual fund) with constant return volatility and positive autocorrelation in expected return.

Under these assumptions, we derive exact explicit expressions for the optimal consumption and portfolio choice when investors have unit elasticity of intertemporal substitution of consumption and approximate solution for elasticities of intertemporal substitution different from one. The optimal portfolios are obtained in closed-form, enabling a neat interpretation and intuition. This helps us to study the theoretical and quantitative implications of momentum on the speculative and hedging demands for the stock. In our closed-form analysis, we isolate and discuss two clear effects of momentum on strategic asset allocation: the myopic active portfolio and Merton intertemporal hedging demand. The myopic active portfolio nest well known momentum strategies buy winners/sell losers, where the momentum state variable neatly appears. Regarding the hedging demand, it includes two components: the conditional and unconditional hedging demand. Furthermore, the sign of the conditional hedging demand depends on whether the latest levels of stock returns have been above the long-run expected returns or not. Moreover, the sign of the total hedging demand depends on the initial value of momentum state variable.

The model is closely related with the literature on time-varying expected return, for example, Kim and Omberg (1996) and Wachter (2002). They assume that the risk premium of a risky asset follows a mean-reverting process. As discussed in Rodriguez and Sbuelz (2006), the model studied in this paper can recast their models with a number of significant restrictions which are advantageous to capture short run momentum in asset returns and give a clear explanation of the impacts of momentum on the corresponding optimal policies.

To the best of our knowledge, this paper is most related to Rodriguez and Sbuelz (2006) and Li (2013) since the two papers also discuss the dynamic portfolio choice problems with short run momentum in asset returns. However, the distinction between them and our paper are also evident. Rodriguez and Sbuelz (2006) propose a theoretical model in which stock returns exhibit momentum. They first study dynamic asset allocation problem for an investor with power utility defined over terminal wealth. Next, they only directly give a optimal portfolio strategy for power utility over consumption, but lack of the solution to consumption and necessary analysis for the implications of the optimal strategy. Li (2013) considers the optimal porfolio problem of an investor who worries about model uncertainty when facing short run momentum. The investor is assumed to have power utility defined over wealth at a terminal date. As we all know, the time-separable expected utility equipped with a constant relative risk aversion (CRRA) imposes a potentially restrictive relation between the preference parameters. In order to separate the effects of risk aversion from the effects of the investor's willingness to substitute consumption intertemporally, our paper, by contrast, assumes Duffie and Epstein (1992a, 1992b) parameterization of recursive utility in continuous time defined over an infinite stream of consumption rather than wealth. Besides, assuming utility over consumption enables us to capture the consumption and savings decision at the same time. Furthermore, we solve the problem analytically. Also, different from Rodriguez and Sbuelz (2006), we use the parameter estimates