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International portfolio selection with exchange rate risk: A behavioural portfolio theory perspective

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ABSTRACT

This paper analyzes international portfolio selection with exchange rate risk based on behavioural portfolio theory (BPT). We characterize the conditions under which the BPT problem with a single foreign market has an optimal solution, and show that the optimal portfolio contains the traditional mean–variance efficient portfolio without consideration of exchange rate risk, and an uncorrelated component constructed to hedge against exchange rate risk. We illustrate that the optimal portfolio must be mean–variance efficient with exchange rate risk, while the same is not true from the perspective of local investors unless certain conditions are satisfied. We further establish that international portfolio selection in the BPT with multiple foreign markets consists of two sequential decisions. Investors first select the optimal BPT portfolio in each market, overlooking covariances among markets, and then allocate funds across markets according to a specific rule to achieve mean–variance efficiency or to minimize the loss in efficiency.

1. Introduction

According to the behavioural portfolio theory (BPT) proposed by Shefrin and Statman (2000), investors segregate total wealth into multiple mental accounts with different risk attitudes and goals. Next, the investors select the sub-portfolio in each account by attempting to achieve the account's specific investment goal, overlooking covariances among mental accounts. As a consequence, the optimal BPT portfolio is simply the combination of these sub-portfolios rather than Markowitz's (1952) optimal portfolio of all assets. In addition, in the BPT model, risk is measured by the probability (the failing probability) that the portfolio return is less than a pre-specified threshold level. While BPT investors do not follow two-fund separation, their optimal portfolios are consistent with Friedman and Savage's (1948) puzzle. Following Shefrin and Statman (2000) and Das et al. (2010) propose a new mental accounting (MA) framework, where the sub-portfolio within any given account is chosen by maximizing the account's expected return, subject to a constraint that reflects the account's motive. This constraint specifies the sub-portfolio's threshold return and the maximum probability of failing to reach that threshold in the account. Das et al. (2010) show that these sub-portfolios are actually mean–variance efficient, as is the aggregate portfolio composed of these efficient sub-portfolios.

Consider a domestic portfolio investor who wishes to diversify over foreign markets. It is important to note that the investor faces various foreign markets that have many structural and institutional distinctions, including market regulations, trading mechanisms, and trading hours. Individual foreign markets may also exhibit distinct risk-return characteristics and information processing capabilities due to their different economic and political systems as well as their particular developmental stages. Moreover, political and economic risks are distinct across foreign markets. As a result, the investor's risk attitudes may vary across markets. Therefore, instead of identifying a common goal to achieve in multiple distinct foreign markets, the investor specifies a particular investment objective in one market based on his/her risk attitude in that market, and then makes the investment decision to achieve the specific goal in the market as if there are no other portfolio risk exposures. Correspondingly, the investor views the whole portfolio as a combination of the selected portfolios in each market, rather than a combination of individual assets from all markets. This notion of international portfolio selection is supported by the empirical evidence provided by Jorion (1994), and is in line with the layered pyramid structure of portfolios described in Tversky and Kahneman (1986). It also makes practical sense, noting that investors are often recommended by professional fund managers to construct portfolios as pyramids of asset groups

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(Fisher and Statman, 1997). Thus, the investor essentially behaves in accordance with the BPT in our problem, placing assets from one market in one particular mental account with a specific goal to achieve in that account. Evidently, international portfolio selection resembles the BPT problem in the sense that portfolio optimization is divided into sub-portfolio optimizations. Two separate decisions are involved in this particular problem: portfolio selection in each individual foreign market and fund allocation across various foreign markets.

However, international portfolio investments involve not only portfolio risk but also exchange rate risk. Portfolio risk arises from movements in prices of individual assets measured in local currencies, while exchange rate risk is due to the portfolio's domestic currency return variations as a result of exchange rate fluctuations. The presence of distinct exchange rate risk in each individual market provides a further economic rationale for investors to put assets from different markets into distinct mental accounts and to follow the two-decision separation process in international portfolio selection. Given that exchange rate returns and portfolio's local currency returns are correlated (Kaplanis and Schaefer, 1991) and that domestic currency returns are the major concern, it is believed that exchange rate risk greatly impacts the portfolio selection decision in a foreign market. Thus, the selected optimal portfolio in the foreign market can deviate notably from the efficient portfolio without consideration of exchange rate risk (Jiang et al., 2010). If an investor follows the BPT strategy in foreign portfolio selection, then we must ask how exchange rate risk impacts the investor's decision, and why the optimal BPT portfolio is constructed the way it is. The BPT analysis of Das et al. (2010) considers portfolio risk only. Using the framework of Das et al. (2010) and Baptista (2012) deals with the portfolio selection problem with multiple mental accounts in the presence of background risk in each account. It is noteworthy that exchange rate risk can be considered background risk in international portfolio selection (Finkelshtain et al., 1999; Franke et al., 2006).

Motivated by Baptista (2012) and Das et al. (2010), this paper intends to provide a theoretical analysis of international portfolio selection from the perspective of BPT with consideration of exchange rate risk. Given the above-mentioned arguments, the BPT approach is of practical interest and relevance in analyzing international portfolio selection. Further, the BPT approach allows investors' risk attitudes and investment goals to vary by market. For instance, international investors may choose one market to primarily reduce risk and another market to achieve a relatively high expected return. As a result, the BPT approach allows investors to construct a sub-portfolio that meets the investment goal for any given foreign market. Additionally, in contrast with the standard deviation of returns, the failing probability in BPT is a risk measure that is closely related to the value at risk (VaR), and provides a direct application in risk management.

Our paper extends previous work in three respects. First, in contrast with Baptista (2012) and Das et al. (2010), our model includes not only risky assets but also a risk-free asset. Fund allocation between risky and risk-free assets reflects investors' precautionary motives in the present of background risk (Malevergne and Rey, 2010; Menegatti, 2009; Tzeng and Wang, 2002). Thus, our model enables us to investigate both investors' risky asset selection and their precautionary saving behaviour with exchange rate risk. Second, in our analysis the investment set differs from one market to another, whereas the investment set is the same in all mental accounts in Baptista (2012) and Das et al. (2010). Due to this difference, the general conclusions regarding aggregate portfolios in the typical BPT with multiple accounts are not true in our setting. For example, aggregate portfolios in Das et al. (2010) still lie on the mean–variance efficient frontier, while aggregate portfolios in our BPT setting with multiple foreign markets are not mean–variance efficient unless a particular condition is satisfied. Our finding is in line with those in recent work on portfolio selection with mental accounts. Alexander and Baptista (2011) develop a mental account setting with delegation where the optimal portfolios within each account and the aggregate portfolio lie generally away from the mean–variance frontier. This is because (1) investors are assumed to delegate the task of allocating wealth among assets to managers in the model, and (2) managers select portfolios that generally lie away from the mean–variance frontier. Das and Statman (forthcoming) find that optimal portfolios within accounts can noticeably deviate from the portfolios on the mean–variance frontier if asset returns have non-normal distributions. Our paper differs from both studies in that we consider background risk in each account. Baptista (2012) documents that there exist mental account settings where the aggregate portfolio is mean–variance inefficient due to aggregate background risk in mental accounts. However, the mean–variance inefficiency of the aggregate portfolio in our paper is primarily due to the fact that the investment set varies across the markets and due to the lack of integration among the investment decisions in these markets. Third, while the allocation of wealth among accounts is exogenous in Baptista (2012) and Das et al. (2010), it is endogenous in our setting, and represents an important subsequent decision in international portfolio selection.

More specifically, in this paper we explore how BPT investors choose the optimal portfolio in individual foreign markets and how exchange rate risk affects the existence of such portfolios. Our focus is not only on the impact of exchange rate risk on portfolio selection in foreign markets, but also on investors' hedging behaviour. To gain insights, we examine the properties and composition of the optimal BPT portfolio, which also has practical implications for managing exchange rate risk. Investors' precautionary saving behaviour is further analyzed by theoretical and numerical investigations of the proportion of total funds in the risk-free asset. Similar to Alexander and Baptista (2011) and Baptista (2012), we derive the condition under which the aggregate portfolio lies on the efficient frontier in our setting. Moreover, we examine the BPT investors' optimal decision on fund allocation across various markets in the case where this condition is not satisfied, and investigate the efficiency loss of the aggregate portfolio.

In the background risk literature, many portfolio selection models are proposed in an effort to provide theoretical insights into impacts of background risk on the composition of efficient portfolios or on investors' degree of risk aversion under either the utility function framework (Gollier and Pratt, 1996; Kimball, 1993; Pratt and Zeckhauser, 1987; Tsetlin and Winkler, 2005) or the mean–variance framework (Baptista, 2008; Eichner and Wagener, 2009; Jiang et al., 2010). By incorporating background risk into the framework, these models can better explain and predict investors' practical portfolio selection decisions than can traditional portfolio theory (e.g., Markowitz, 1952; Merton, 1969, 1971; Samuelson, 1969). Our work further enriches the body of literature on background risk by examining how exchange rate risk as a specific type of background risk influences international portfolio selection from a BPT perspective, which is of particular interest as argued. In addition, previous research on international portfolio selection and asset allocation is conduced primarily from the perspective of international diversification benefits, such as risk reductions and improvements in Sharpe ratios (De Roon et al., 2001; Driessen and Laeven, 2007; Eun and Resnick, 1988). Our paper complements this stream of research by analyzing the properties of the optimal international portfolio with an emphasis on investors' exchange rate risk hedging and precautionary saving behaviours.

Our contribution is as follows. We derive the conditions under which the solution to the BPT problem with exchange rate risk exists, and show that the optimal BPT portfolio contains the