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Properties of foreign exchange risk premiums ☆

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ABSTRACT

We study the properties of foreign exchange risk premiums that can explain the forward bias puzzle, defined as the tendency of high-interest rate currencies to appreciate rather than depreciate. These risk premiums arise endogenously from the no-arbitrage condition relating the term structure of interest rates and exchange rates. Estimating affine (multi-currency) term structure models reveals a noticeable tradeoff between matching depreciation rates and accuracy in pricing bonds. Risk premiums implied by our global affine model generate unbiased predictions for currency excess returns and are closely related to global risk aversion, the business cycle, and traditional exchange rate fundamentals.

1. Introduction

Uncovered interest rate parity (UIP) postulates that the expected exchange rate change must equal the interest rate differential or (because covered interest parity holds) the forward premium. UIP also forms the economic foundation for the forward unbiasedness hypothesis (FUH), stating that the forward exchange rate should be an unbiased predictor of the future spot rate. The empirical observation that there is a negative association between forward premiums and subsequent exchange rate returns, first noted in Hansen and Hodrick (1980), Bilson (1981), and Fama (1984), implies a rejection of UIP and the FUH. This stylized fact is often termed the 'forward bias puzzle.' A large literature has argued that risk premiums must be at the heart of this observation.

In this paper, we re-examine the relation between the term structure of interest rates and exchange rates by expressing the link between forward and spot exchange rates from the principle of no-arbitrage without assuming

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risk-neutrality. This setting implies that the forward exchange rate is the sum of the expected spot rate plus a time-varying risk premium which compensates both for currency risk and interest rate risk. We start from noting that forward rates are generally biased predictors of future spot exchange rates, and expected spot rate changes comprise a time-varying risk premium in addition to the forward premium. We refer to these general, model-free relations that extend the conventional FUH and UIP—in that they are free of risk preferences and consistent with no-arbitrage—as the 'risk-adjusted FUH' (RA-FUH) and as 'risk-adjusted UIP' (RA-UIP).

To work with the RA-UIP condition empirically, we put structure on the international financial market with a model for interest rate risk and currency risk. We use an affine multi-economy term structure model that relates countries' pricing kernels such that arbitrage-free pricing is ensured. We employ latent factors to model the uncertainty underlying the international economy for two reasons. First, this approach gives us maximum flexibility with respect to the statistical framework even with a relatively small number of factors. Second, we do not have to rely on exogenous observable variables driving the economy which are available only at low frequencies.[1] The design of our multi-economy model follows the pioneering work of Backus, Foresi, and Telmer (2001) but is more general in that it accounts for interest rate risk arising from fluctuations in the bond market over multiple periods. It also accommodates the findings of Brennan and Xia (2006) and extends their work in that we do not approximate the risk premium but derive the exact functional form of the term structure of foreign exchange risk premiums in closed form. This allows us to jointly match the term structures of interest rates and the term structure of foreign exchange risk premiums in the estimation procedure. Using daily data for six major US dollar exchange rates over the last 20 years, we generate model-implied exchange rate expectations and risk premiums for horizons ranging from 1 day to 4 years.

The global affine model used in this paper is designed to identify the stochastic discount factor that prices both currencies and bonds in all countries examined. However, an empirical tradeoff emerges. Specifically, we estimate two different models: a global model which estimates all foreign term structures of yields and foreign exchange risk premiums conditional on the US pricing kernel, using bond and currency market information; and a set of single-country term structure models that separately estimate countries' pricing kernels from which we then compute implied foreign exchange risk premiums. Depreciation rates implied by the global model closely match observed ones, but at the expense of low accuracy in fitting bond yields. Conversely, single-country term structure models price bonds with high accuracy, but imply depreciation rates very different from actual rates. Since both modeling strategies reveal empirical deficiencies, the choice of the model depends on the objective of the application. To study the properties of foreign exchange risk premiums, we choose the global model.

The empirical results reveal that the RA-UIP model is capable of identifying time-varying risk premiums that closely match observed exchange rate behavior. In particular, they fulfill the two conditions established by Fama (1984) such that the omission of the risk premium in conventional UIP tests results in a forward bias. We then show that the model generates unbiased predictions for exchange rate excess returns. This implies that accounting for risk premiums can be sufficient to resolve the forward bias puzzle without additionally requiring departures from rational expectations. We also perform a variety of predictive ability tests which, on the one hand, complement evidence that excess returns are predictable, and, on the other hand, further confirm that the RA-UIP model fits the exchange rate data substantially better than UIP and also better than a random walk. Finally, we decompose the risk premium, and show that although there is a compensation for interest rate risk, deviations from UIP and hence excess returns can almost entirely be explained by the premium for currency risk.

We also provide empirical evidence that risk premiums are closely linked to economic variables that proxy for global risk, the US business cycle, and traditional exchange rate fundamentals. The results suggest that expected excess returns reflect flight-to-quality and flight-to-liquidity considerations. Expected excess returns also depend on macroeconomic variables (e.g., output growth, money supply growth, consumption growth) in a way that risk premiums in dollar exchange rates are countercyclical to the US economy. Overall, a large part of expected excess returns can be explained by fundamentals deemed relevant in traditional exchange rate models.

1.1. Related literature in more detail

Earlier papers that study the link between interest rates and exchange rates with term structure factor models include Nielsen and Saá-Requejo (1993), Saá-Requejo (1994), Bakshi and Chen (1997), and Bansal (1997). A pioneering paper is Backus, Foresi, and Telmer (2001), who adapt modern (affine) term structure theory to a multi-economy setting. They establish important theoretical relations that must hold in the absence of arbitrage between the pricing kernels and the exchange rate driving the international economy. In their discrete-time one-period setting, they can replicate the puzzle under the following two alternative specifications: either there is a common-idiosyncratic factor structure and interest rates take on negative values with positive probabilities, or global factors and state variables have asymmetric effects on state prices in different countries. Motivated by the latter, related empirical studies, e.g., Dewachter and Maes (2001), Ahn (2004), Inci and Lu (2004), Mosburger and Schneider (2005), and Anderson, Hammond, and Ramezani (2010), elaborate on the effects

[1] Such economic variables are typically available at quarterly or at best at monthly frequency. In our context this is not feasible, as we are also interested in short horizons such as 1 day or 1 week, and our model estimation is hence based on daily data. However, as discussed below, we relate the model-implied risk premiums to observable economic variables later in the paper to refine our understanding of the drivers of the latent factors.