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Variance risk premiums and the forward premium puzzle[☆]

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ABSTRACT

We provide new empirical evidence that world currency and U.S. stock variance risk premiums have nonredundant and significant predictive power for the appreciation rates of 22 with respect to the U.S. dollar, especially at the four-month and one-month horizons, respectively. The heterogeneous exposures of currencies to the currency variance risk premium are systematically rising along the line of inflation risk. We rationalize these findings in a consumption-based asset pricing model, with local consumption uncertainty and global inflation uncertainty characterized, respectively, by the stock and currency variance risk premiums.

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1. Introduction

This paper provides new empirical evidence that the time variation in expected currency returns is strongly related to the world currency variance risk premium (XVP) and to the stock variance risk premium (VP). The world XVP is measured as an average of the variance risk premiums of 17 available currencies with respect to the U.S. dollar. Each currency-pair's variance risk premium is measured as the option-implied variance minus the realized variance of currency returns. The VP is measured alternatively as the U.S. stock variance risk premium or as a global average of major countries' stock variance risk premiums. We find that an increase in XVP predicts a depreciation of foreign currencies with respect to the U.S. dollar, while an increase in VP predicts an appreciation of these currencies. Thus, XVP and VP seem to have different informational contents for future exchange rate returns.

We set our empirical exercise against the background of pervasive violations in the uncovered interest parity (UIP). For a large panel of 22 available currency rates against the U.S. dollar from 2000 to 2011, interest rate differentials are insignificant predictors for exchange rate returns, often with wrong negative signs and low R^2s of less than 1% for one- to four-month horizons. However, including the world

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XVP increases the R^2 by 2.2% at the one-month horizon, 8% at the four-month horizon, and 1.5% at the 12-month horizon. The slope coefficients associated with the world XVP are uniformly negative and significant—a higher world XVP indicates greater global uncertainty, hence higher U.S. dollar safety value for currency investors. Including the U.S. VP increases the R^2 by 5.3% at the one-month horizon and almost zero at the 12-month horizon. The slope coefficients are, in this case, uniformly positive and significant for one- to six-month horizons—a higher VP indicates greater U.S. uncertainty, hence higher return premium compensation for currency investors.

To better understand the underlying economic mechanism behind the predictive power of variance risk premiums, we perform several in-depth diagnostics. First we run the empirical tests for each of the 22 currencies individually, and the findings for the predictive power of variance risk premiums remain intact except for the Japanese yen, a traditional funding currency, and for a few outliers, like the Hong Kong dollar and the Philippines peso, which have pegged or managed floating exchange regimes. Then, we sort currencies into portfolios and find that currencies of countries with higher average inflation tend to have more negative loading coefficients on XVP and higher forex return prediction R^2s. The heterogeneous forex return predictability by XVP and the exposure of XVP predictability to inflation risk shed light on how to provide a structural interpretation of our new empirical findings.

The joint predictability of XVP and VP for exchange rate returns remains robust if we consider a pre-global financial crisis sample. For XVP, the results also remain the same if the realized variance is replaced by the expected variance from an AR(1) model (Drechsler and Yaron, 2011), if the Black-Scholes implied variance is replaced by a model-free implied variance (Britten-Jones and Neuberger, 2000), or if the realized variance is calculated from high-frequency intraday forex returns (Andersen et al., 2001). For the VP, it makes no material difference if we use the U.S. VP or an equally weighted or value-weighted average of major countries' VPs. The predictability patterns of variance risk premiums for forex returns also hold after controlling for the countercyclical risk premium component of forex returns (Lustig et al., 2014).

To rationalize our empirical findings, we introduce a two-country consumption-based asset pricing model. Our model follows Bollerslev et al. (2009) to model the real economy and introduces a process for inflation, in line with Bansal and Shaliastovich (2013) and Zhou (2011), for the model to have realistic implications for nominal appreciation rates. In our model, both countries' real consumption growth processes are orthogonal to each other, while their inflation processes are exposed to global inflation. Moreover, global inflation level and volatility shocks are correlated. The orthogonality of the real-economy components of our model and the heterogeneous exposures to common inflation (level and volatility) risk yields the key implications that support our forex return predictability evidence. On the one hand, the XVP implied by the model reveals information about the global inflation uncertainty that cannot otherwise be obtained from domestic VPs. Thus, the XVP contains useful information to explain the time variation of appreciation rates that is additional to the VP. On the other hand, the predictive power of the XVP for the appreciation rate between two currencies depends crucially on the heterogeneity in the exposure of each country's inflation process to the global inflation risk.

We calibrate the parameters in the model to match the observed real growth and inflation dynamics for the United States and the United Kingdom and the dollar-pound XVP. For the benchmark calibration scenario, our model is able to qualitatively replicate the patterns for the predictive power of the currency and stock variance premiums for the exchange rate return. We also find that predictability patterns are highly sensitive to the degree of heterogeneity in the exposure to global inflation across countries. In particular, the predictability pattern of XVP for appreciation rates becomes more negative—an increase in XVP is followed by a depreciation of the foreign currency with respect to the U.S. dollar—as the United States is assumed to be less exposed to global inflation than the foreign economy, which explains the empirical evidence for the inflation-sorted currency portfolios.

1.1. Literature

Recent literature focuses on the role of the volatility risk premium in explaining the time variation in currency returns. Della Corte et al. (2011) provide empirical evidence that the volatility term premium is positive, time-varying, and predictable. In a related paper, Menkhoff et al. (2012) document the finding that global forex volatility risk is priced in currency markets (see also Bakshi and Panayotov, 2013). Chernov et al. (2015) find evidence that jump risk in currency variance may be priced in forex markets but is unrelated to interest rates or macroeconomic news. Using different methodologies, Farhi et al. (2015), Jurek (2014) and Brunnermeier et al. (2009) relate the high observed prices of currency options to the desire of agents to hedge rare and severe changes in exchange rate movements.[1] Finally, Mueller et al. (2015) find that the forex correlation risk premium is also priced in currency markets. To the best of our knowledge, our paper is the first one to show that both currency and stock variance premiums provide useful information to explain exchange rate returns at short horizons.

Our work is also intimately related to the early evidence that exchange rate volatility is time varying (Engle, 1982; Baillie and Bollerslev, 1989; Engel and Hamilton, 1990; Engle et al., 1990; Gagnon, 1993). However, we focus on the unique information content from the forex derivatives market not only to pin down the dynamics of forex volatility but also to show that this volatility risk is actually priced in forex markets. Graveline (2006) shows that the information from exchange rate options is valuable for the estimation of the exchange rate volatility that is much harder to identify using only time-series data for exchange rates. Bakshi et al. (2008) show that jumps are crucial to capture the currency return dynamics and to

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[1] The rare disaster model in Farhi and Gabaix (2016) aims to rationalize this empirical finding. Burnside et al. (2011) provide a related interpretation based on the peso problem.

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