Explaining exchange rate anomalies in a model with Taylor-rule fundamentals and consistent expectations ☆

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ABSTRACT

We introduce boundedly-rational expectations into a standard asset-pricing model of the exchange rate, where cross-country interest rate differentials are governed by Taylor-type rules. Agents augment a lagged-information random walk forecast with a term that captures news about Taylor-rule fundamentals. The coefficient on fundamental news is pinned down using the moments of observable data such that the resulting forecast errors are close to white noise. The model generates volatility and persistence that is remarkably similar to that observed in monthly exchange rate data for Canada, Japan, and the U.K. Regressions performed on model-generated data can deliver the well-documented forward premium anomaly.

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1. Introduction

This paper develops a simple framework that can reproduce numerous quantitative features of real-world exchange rates. The key aspect of our approach is the way in which agents' expectations are modeled. Starting from a standard asset-pricing model of the exchange rate, we postulate that agents augment a lagged-information random walk forecast with news about fundamentals. Fundamentals in our model are determined by cross-country interest rate differentials which, in turn, are described by Taylor-type rules, along the lines of Engel and West (2005, 2006). We solve for a "consistent expectations equilibrium," in which the coefficient on fundamental news in the agent's subjective forecast rule is pinned down using the observed covariance between exchange rate changes and fundamental news. This learnable equilibrium delivers the result that the forecast errors observed by an agent are close to white noise, making it difficult to detect any misspecification of the subjective forecast rule.[1]

We demonstrate that our consistent expectations model can generate volatility and persistence that is remarkably similar to that observed in monthly bilateral exchange rate data (relative to the U.S.) for Canada, Japan, and the U.K. over the period 1974 to 2012. We show that regressions performed on model-generated data can deliver the so-called "forward-premium anomaly," whereby a high interest rate currency tends to appreciate, thus violating the uncovered interest parity (UIP) condition. Moreover, the estimated slope coefficient in the model UIP regressions can vary over a wide range when estimated using a rolling sample period. This result is consistent with the wide range of coefficient estimates observed across countries and time periods in the data.[2]

In our model, agents' perceived law of motion (PLM) for the exchange rate is a driftless random walk that is modified to include an additional term involving fundamental news, i.e., the innovation to the AR(1) driving process that is implied by the Taylor-rule based interest rate differential. The standard asset-pricing model implies that the contemporaneous realization of the exchange rate at time t depends in part on agents' subjective forecast of the exchange rate at time $t + 1$. Following the methodology of the adaptive learning literature, we postulate that when constructing their subjective forecast, agents employ the lagged realization of the exchange rate at time $t - 1$. Use of the lagged realization ensures that the forecast is "operational." Since the contemporaneous realization depends on the forecast, it is not clear how agents could make use of this realization when constructing their forecast in real-time. Our setup captures an idea originally put forth in an informal way by Froot and Thaler (1990), who suggested that the empirical failure of the UIP condition might be linked to the fact that investors "may need some time to think about trades before executing them, or that they simply cannot respond quickly to recent information."

We assume that enough time has gone by for agents to have discovered the parameters governing the law of motion for the fundamental driving variable, thus allowing them to infer the fundamental innovation, i.e., news. Given the time series of past data, agents can estimate the coefficient on fundamental news in their PLM by running a simple regression. The agents' forecast rule can be viewed as boundedly-rational because the resulting actual law of motion (ALM) for the exchange rate exhibits a near-unit root with innovations that depend on Taylor-rule fundamentals.[3]

We show that regardless of the starting value for the coefficient on fundamental news in the subjective forecast rule, a standard real-time learning algorithm will converge to the vicinity of the fixed point which defines the unique consistent expectations (CE) equilibrium. Use of the lagged exchange rate in the subjective forecast rule is the crucial element needed to generate the forward-premium anomaly. In equilibrium, the CE model delivers substantial "excess volatility" of the exchange rate relative to the rational expectations (RE) version of the model. Indeed, the CE model's prediction for the volatility of exchange rate changes is very close to that observed in the data.

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[1] The equilibrium concept that we employ was originally put forth by Hommes and Sorger (1998). A closely-related concept is the "restricted perceptions equilibrium" described by Evans and Honkapohja (2001, Chapter 13). For other applications of consistent expectations to asset pricing or inflation, see Branch and McGough (2005), Evans and Ramey (2006), Hommes and Zhu (2014), Lansing (2009, 2010), and Sögner and Mitlöhner (2002).

[2] For evidence of variability in estimated UIP slope coefficients, see Baillie and Chang (2011), Baillie and Cho (2014), Bansal (1997), Ding and Ma (2013), and Flood and Rose (2002).

[3] Lansing (2010) employs a similar random walk plus fundamentals subjective forecast rule in a standard Lucas-type asset pricing model to account for numerous quantitative features of long-run U.S. stock market data.