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Model uncertainty and the Forward Premium Puzzle

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A B S T R A C T

This paper studies the Forward Premium Puzzle in a setting where investors doubt the specification of their models, and thus engage in *robust* portfolio strategies (Hansen and Sargent, 2008). It shows that an empirically plausible concern for model misspecification can explain the Forward Premium Puzzle. In particular, the paper shows that Hansen and Jagannathan (1991) volatility bounds can be attained with both reasonable degrees of risk aversion and reasonable detection error probabilities. Hence, observed excess returns in the foreign exchange market appear to be primarily driven by a *model uncertainty premium*.

1. Introduction

It is commonly found in empirical international finance that high interest rate currencies tend to appreciate on average, while Uncovered Interest Parity (UIP) predicts they should depreciate. That is, under the joint hypotheses of Rational Expectations and risk neutrality, the regression of realized exchange rate changes on interest rate differentials should give a coefficient of one. Most studies find that not only is this coefficient statistically different from one, but it is often negative.[1] One common explanation attributes this failure to time varying risk premia. However, empirical tests using standard utility models require implausibly high degrees of risk aversion to account for observed excess returns in foreign exchanges markets.[2]

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[1] Prominent examples include Hansen and Hodrick (1980), Fama (1984), Engel (1996) and Bansal and Dahlquist (2000).

[2] See *inter alia* Engel (1996) and Mark (2001) for a review of conventional risk premium explanations.

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This paper revisits the puzzle in a setting where investors are both risk and ambiguity averse. Following Hansen and Sargent (2008), I use the notion of a preference for *robustness*[3] to distinguish between risk and ambiguity. More specifically, I consider an ambiguity averse investor who decides how much to consume and how much to invest in domestic and foreign bonds. The overall portfolio is therefore risky due to exchange rate risk, and the investor is assumed to be uncertain about the low frequency covariance between consumption growth and the exchange rate.

In my model, fears of misspecification pertain to the equilibrium consumption growth process. In response, the agent constructs a set of unstructured alternative consumption growth models surrounding a benchmark approximating model. Each model in this set is difficult to distinguish statistically from the benchmark model. I use model detection theory (Anderson et al. (2003)) to calibrate the robustness parameter, and show that there is strong empirical evidence supporting the ambiguity aversion interpretation. In fact, the paper shows that a *model uncertainty premium* is more important than a risk premium in explaining the forward premium puzzle.

Behavioural foundations for robustness go back to Knight (1921), who tried to distinguish between risk and uncertainty. For Knight, *uncertainty* refers to situations where a decision-maker does not know the probability distribution of an event, while *risk* corresponds to the case where this probability distribution is known or can be constructed from past data. Although most economists found Knight's arguments intuitively plausible, Savage (1954) showed that this distinction is irrelevant when individuals can formulate subjective probabilities. However, Ellsberg's (1961) urn experiments suggest that, empirically, individuals seem to have a preference for knowing the probability distribution rather than having to form it subjectively. One of the most attractive approaches that takes account of the Ellsberg paradox is the multiple priors (or maxmin) approach developed by Gilboa and Schmeidler (1989). They show that in the presence of Knightian uncertainty, agents cannot form a unique probability distribution over states of the world. As a result, they proposed an approach where agents formulate multiple priors, and then base decisions on the worst probability measure. This approach has been extended to dynamic recursive environments by Hansen and Sargent (2008). It is inspired by robust control theory, widely used in engineering, and gives rise to so called *multiplier preferences*.[4]

This paper is not the first to use ambiguity as a potential solution to the forward premium puzzle. Li and Tornell (2008) use an overlapping generations framework with an ambiguity averse investor and an exogenous interest rate differential. They assume interest rate differentials are governed by temporary and persistent components that are unobserved by investors. Rational investors thus engage in robust filtering, and systematically distort their forecasts. A negative UIP coefficient is then the result of forecast distortion in response to interest rate differential shocks. Recently, Ilut (2012) used a similar assumption and showed that ambiguity averse investors systematically underestimate the hidden state of interest rate differentials, underreacting to good news and overacting to bad news.

There are several features that distinguish this paper from Li and Tornell (2008) and Ilut (2012). First, both these papers use a partial equilibrium model where interest rate differentials are exogenously specified. Their solutions depend sensitively on the specification of the interest differential. For instance, Ilut (2012, p53) shows that, with less persistence, his model cannot account for the puzzle, while a robust decision against the higher variance of temporary component generates a negative UIP slope. My test strategy relies on testing the volatility implications of the Euler equations of a general equilibrium model. This strategy is due to Hansen and Jagannathan (1991), and I examine the restrictions imposed by their volatility bound using multiplier preferences. In particular, my paper addresses the following question: can model uncertainty be an alternative to the implausibly high degrees of risk aversion found with standard preference specifications?[5] Second, these two papers do not focus on volatility, and it is likely that the combination of underaction to good news and overaction to bad news exacerbates the excess volatility puzzle (Djeutem and Kasa (2013)). Third, my choice of the stochastic discount factor environment is justified by the need to generate a time varying risk premium. As pointed out by Cochrane (2001, p. 451), and emphasized by Alvarez et al. (2009), variation in

[3] I use interchangeably the expressions model uncertainty, robustness, knightian uncertainty and ambiguity aversion.
[4] Axiomatic characterization of these preferences are provided by Strzalecki (2011) and Maccheroni et al. (2006).
[5] This paper is methodologically closely related to Tallarini (2000), Barillas et al. (2009) and Bidder and Smith (2011).