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The forward premium in a model with heterogeneous prior beliefs

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Abstract

This paper explores a model of bond prices where agents have diverse prior beliefs about domestic and foreign inflation. In the long run, the foreign exchange forward premium reflects expected differences in inflation, but in the short run, it depends upon the diversity of prior beliefs. If some people have diffuse priors about a country's inflation process, then its currency commands a forward premium that is eventually dissipated. Using data on the dollar–mark premium from the 1980s, it shows that this kind of diversity really matters. Thus models with a single representative agent give an inadequate description of the data.

JEL classification: F3; D83; G12

Keywords: International finance; Learning, information, and knowledge; Asset pricing

1. Introduction

This paper takes the idea of heterogeneity in financial markets seriously. It develops a theory of the foreign exchange forward premium based upon the notion that people in the world economy have diverse prior beliefs about inflation. For most plausible specifications of prior beliefs, agents eventually have completely accurate knowledge about each country's inflation

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processes. Indeed, in the long run, yields reflect the common inflation forecasts, and the forward premium predicts expected depreciation of the spot rate accurately. Thus the asymptotic behavior of the world economy can be modeled using the artifice of a single "representative agent" having "rational expectations" about all the "fundamentals" in the world economy.

But in the short run a fascinating theory of asset prices emerges. This theory has two important elements. First, the learning matters. Interest differentials depend upon the stochastic inflation history in the world economy, and the model provides a simple explanation for the "forward discount anomaly."[1] Second, the heterogeneity of beliefs matters. In this paper, I will show that it is not enough to ask traders what their inflation forecasts are; it is actually necessary to ask them *how sure they are* of their own forecasts. Because different classes of agents can hold more or less precise forecasts, bond yields typically have an option value inherent in them, even if everyone agrees on expected inflation. An asset is worth the sum of its expected real stream of income *and* the option value of reselling it at a later date. This option value can never be negative, and it is typically positive. Thus yields are lower than they would be if the world economy consisted of a single representative agent.

Whether this effect is stronger for domestic or foreign assets is at the heart of the theory. One implication is that diverse precision of beliefs about a country's inflation process will raise the price of its bonds and thus lower their yields. Hence there will be a forward premium for that currency. An important insight is that all the moments characterizing agents' beliefs matter. Thus it is not appropriate to consider only each person's point forecasts of expected inflation; it matters how precise these forecasts are.

How does a theory of asset prices emerge in a model where people have diverse prior beliefs? In particular, one question arises immediately: Why is this model not plagued by Milgrom and Stokey's (1982) No Trade Theorem? The answer lies in the subtle distinction between an environment in which agents have common priors but diverse ex post signals and one in which everyone has different priors but observes the same signals.

Consider, for example, the 500th digit in the decimal representation of e. A speaker walks into the seminar room and offers a contract that pays \$1 if that digit is 5. I may believe that it is likely to be an even number, and you may have more diffuse beliefs. We could easily announce our priors (thus establishing common knowledge), and we would both agree that you would pay more for the contract than I would.[2] Then the speaker opens a laptop and begins to read off numbers from the Taylor series expansion: 1.0, 2.0, 2.5, 2.67, and so on. After each new number, the speaker allows us to trade. It is quite possible that you and I would be willing to do so, with perhaps especially active trading once we get near the n-th term, where $n! \approx 10^{501}$. Thus the existence of a market (with limited short selling) where agents have heterogeneous priors is completely consistent with equilibrium.

Now think of a similar situation, but the speaker announces that he is willing to sell for \$1 a contract that pays \$1000 if the 500th digit in the decimal expansion of e is *not* 5. He then takes out his laptop and boots up. No matter what your priors were, you would be unwilling to buy that asset precisely because the speaker has shown he has received a superior signal about its

[1] See Engel (1996) for a good discussion.

[2] Of course, I might want to short that contract to the greatest extent possible, but we would both agree that some limit on my position is warranted because I have limited wealth. Likewise, you might like to go arbitrarily long, but your position too will be finite in practice. It will become apparent below that a limited short-selling assumption is necessary for equilibrium to exist in this kind of market.