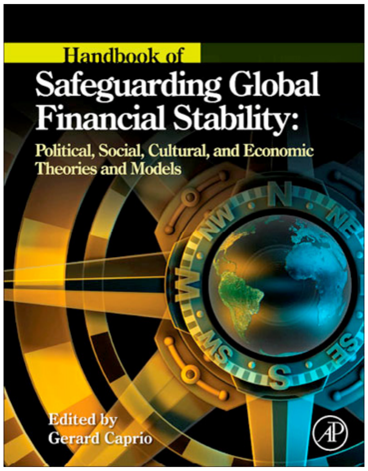

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CHAPTER

23

Explaining Deviations from Uncovered Interest Rate Parity

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OUTLINE

INTRODUCTION

A key relationship in international finance is uncovered interest rate parity (UIP). An approximated version of this relationship is

$$E_t s_{t+1} - s_t = i_t - i_t^* \tag{23.1}$$

where s_t is the log nominal exchange rate (domestic per foreign currency), i_i and i_t^* are domestic and foreign one-period nominal interest rates, and E_t is market expectation based on information at time t. This relationship, described in numerous textbooks, means that an expected depreciation should be compensated by an interest rate differential. It also implies that there should be no expected excess return from arbitraging across currencies. Define the linearized excess return from a foreign currency investment as $x_{t+1} \equiv s_{t+1} - s_t + i_t^* - i_t$. UIP means that $E_t x_{t+1} = 0$. However, the empirical evidence shows that expected excess returns are nonzero. Moreover, excess returns can be systematically predicted by interest rate differentials. This can be seen from the famous Fama (1984) regression that implies that x_{t+1} is predictable by the interest differential $i_t - i_t^*$. More precisely, consider the regression:

$$x_{t+1} = \alpha + \beta(i_t - i_t^*) + \varepsilon_{t+1} \tag{23.2}$$

The coefficient β is typically significant, which indicates predictability of excess returns. Moreover, β is systematically negative and is often below -1. This means, for example, that if the foreign interest rate, i_t^*, increases, the foreign currency appreciates so that the excess return in foreign currency increases more than the interest rate.

Furthermore, the interest differential (or the forward discount) can predict excess return at future dates. Consider a regression of a future 3-month excess return q_{t+k}, from $t+k-1$ to $t+k$, on the current interest rate differential $i_t - i_t^*$. Bacchetta and van Wincoop (2010) show that there is significant predictability with a negative sign for five to ten quarters. Over longer horizons, however, the slope coefficient becomes insignificant or even positive. This is consistent with the findings that UIP holds better at longer horizons. The persistence in the predictability of excess returns is related to the phenomenon of the so-called delayed overshooting.

The presence of expected excess returns naturally makes the foreign exchange market more interesting for investors, as the recent waves of carry trade illustrate. The basic question, however, is why we observe these predictable excess returns. Deviations from UIP, traditionally called the *forward premium puzzle*, have received extensive attention in the literature. While there is no consensus on a single explanation, the recent literature has made useful progress. The objective of this chapter

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is to review some of the most recent theoretical papers providing explanations for the puzzle. Previous literature reviews include Froot and Thaler (1990) and Engel (1996). Theoretical explanations of the forward premium puzzle can be grouped into three main categories: (i) risk premium, (ii) limited market participation, and (iii) deviations from rational expectations.[1]

RISK PREMIUM WITH REPRESENTATIVE INVESTORS

In the presence of risk aversion, we have $E_t x_{t+1} = \eta_t$, where η_t is a risk premium. For example, the risk premium for a small open economy would typically be positively related to the covariance between the excess return and the stochastic discount factor, M_t, that is, with $\text{cov}(x_t, M_t)$. This means that investors demand a premium because of the covariance between the expected excess return and the discount factor. It is useful to write the excess return as

$$x_{t+1} = \eta_t + \underbrace{x_{t+1} - E_t x_{t+1}}_{\text{prediction error}} \qquad (23.3)$$

Theories relying on the risk premium consider models with rational expectations where the risk premium η_t is negatively related to the interest differential and where there is no systematic prediction error. This means that, in a small open economy, $\text{cov}(x_t, M_t)$ should decrease with the interest rate differential.

The earlier literature had clearly rejected the explanations based on risk premium (e.g., see Engel, 1996) as they could not match the empirical evidence. In recent years, however, several papers had more success in matching the data. For example, Verdelhan (2010) proposes a two-country consumption-based model with habit formation that generates a negative relationship between the excess return and the interest differential. In his framework, a low domestic consumption implies higher risk aversion and therefore a higher risk premium. Lower consumption also leads to a lower domestic real interest rate. Therefore, a lower real interest rate differential coincides with a higher expected excess return.

Another way to introduce time-varying risk premia is to assume disaster risk. Farhi and Gabaix (2008) consider a multicountry model where a disaster takes the form of a drop in world consumption in tradeables and in countries' productivities. However, productivities are affected differently across countries so that some countries face larger disasters. In this context, countries with higher disaster risk face both a higher risk premium, and thus a higher expected excess return, and a lower interest rate. This explains the forward premium puzzle. Other papers that introduce disaster risk to explain the forward premium puzzle are Guo (2007) and Gourio et al. (2010).

While these recent papers generate a negative relationship between excess returns and interest rate differentials, they face some serious challenges with other features of the data. For example, it is well known that exchange rates are much more volatile than macroeconomic fundamentals (e.g., aggregate consumption). See Burnside et al. (2011a) for a more detailed discussion.

LIMITED PARTICIPATION

As models with representative individuals and rational expectations have difficulties matching certain aspects of the data, some recent papers have considered limited participation in the FX market, in the sense that only a subset of potential investors is active in a given period. Alvarez et al. (2009) consider a model with market segmentation, where an endogenous fraction of households is active in asset markets. The source of uncertainty comes from monetary shocks that generate a risk premium and expected excess returns. In this context, an increase in domestic money growth may lead to a negative correlation between excess returns and the interest differential. If money growth is moderately persistent, an increase in domestic money growth leads more households to be active in assets markets since higher inflation increases the cost of not participating. This reduces the risk premium. At the same time, it increases the domestic nominal interest rate due to an expected inflation effect. Hence, the expected excess return and the interest rate differential are negatively related. While the endogeneity of the fraction of active investors is likely to be an important feature to explain the FX market, the robustness of the specific mechanism proposed by Alvarez et al. remains to be determined.

Another form of limited participation is due to the fact that investors only change infrequently their international portfolio positions. Froot and Thaler (1990) have informally argued that models where some agents are slow in responding to new information lead to predictability in the right direction. The argument is simple. An increase in the interest rate of a particular currency will lead to an increase in demand for that currency and therefore an appreciation of the currency. But when investors make infrequent portfolio decisions, they will gradually buy the currency as time goes on. This can

[1] Some explanations of the forward premium puzzle do not fit in these categories. For example, one strand of the literature argues that there are econometric problems with the Fama regression. It is not the purpose of this chapter to give an exhaustive review of the literature and most of the relevant references can be found in the papers mentioned in this chapter.

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cause a continued appreciation of the currency, implying that a higher interest rate raises the expected excess return of the currency.[2]

In reality, only a small fraction of foreign currency holdings is actively managed. Outside a small industry that actively manages foreign exchange positions of investors, there is little active currency management over horizons relevant to medium-term excess return predictability. For example, banks conduct extensive intraday trade but hold virtually no overnight positions. Mutual funds do not actively exploit excess returns on foreign investment since they only trade within a certain asset class and cannot freely reallocate between domestic and foreign assets. Finally, most large financial institutions do not even devote their own proprietary capital to currency strategies based on the forward discount bias. Therefore, most of the international portfolios held over the medium run belong to institutions (or rich individuals) that are not active in the foreign exchange market.

Bacchetta and van Wincoop (2010) (henceforth BW) formalize this idea and examine the impact of infrequent portfolio decisions in a simple two-country general equilibrium model that is calibrated to data. Agents have the choice between actively managing their foreign exchange positions, at a cost, and making infrequent portfolio decisions. The cost of active currency management is measured by the actual fees charged by the active currency management industry. BW find that all or most investors do not find it in their interest to actively manage their foreign exchange positions as the resulting welfare gain does not outweigh the cost. Infrequent portfolio decisions mean that investors will look at excess returns over several periods. If we assume that investors change their portfolio every T periods, the relevant excess return is the cumulative excess return from t to $t+T$: $x_{t,t+T}=x_{t+1}+\cdots+x_{t+T}$. This implies the following approximated constant relative risk aversion optimal portfolio rule:

$$b_t^I = b^I + \frac{E_t x_{t,t+T}}{\gamma \sigma_I^2} \tag{23.4}$$

where b^I is a constant and σ_I^2 is a measure of the portfolio variance.

It is interesting to notice that there is also a well-defined risk premium for investors making infrequent portfolio decisions. For those investors, a T-period Euler equation applies:

$$E_t (c_{t+T})^{-\gamma} x_{t,t+T} = 0 \tag{23.5}$$

where c_{t+T} is consumption at $t+T$. The risk premium for infrequent investors applies over T periods and is equal to the rate of risk aversion times the covariance of the excess return over T periods and consumption in T periods.

In their model, BW find that infrequent portfolio decisions lead to a delayed impact of interest rate shocks on exchange rates. This can explain the phenomenon of delayed overshooting, whereby the exchange rate continues to appreciate over time after a rise in the interest rate. This delayed overshooting leads to excess return predictability in the direction seen in the data. Even future excess returns continue to be predictable by the current forward discount, with the magnitude of the predictability declining as time goes on. While the model with infrequent decision making can explain the forward premium puzzle, it also matches other aspects of the data, in particular, various univariate properties of exchange rates and interest rates (volatility and persistence).

BW show that excess return predictability resulting from infrequent portfolio decisions is even stronger when agents condition exchange rate expectations on a limited set of variables. In reality, the most common active currency management strategy is carry trade, which is mostly based on current interest rate differentials. When exchange rate expectations are based on either current interest rate differentials alone or random walk expectations, excess return predictability is larger than in the case where expectations are conditioned on the entire information set. Bacchetta and van Wincoop (2007) show that if investors have random walk expectations but trade frequently, high interest rate currencies depreciate much more than what UIP would predict. However, when agents make infrequent FX portfolio decisions, random walk expectations can explain the forward premium puzzle.

DEVIATIONS FROM RATIONAL EXPECTATIONS

The other strand of the literature focuses on prediction errors in Eq. (23.3). On average, investors make mistakes in predicting excess returns. Moreover, these errors must be negatively related to the interest rate differential so that the coefficient β in Eq. (23.2) is negative. This is consistent with empirical evidence. Expectational errors derived from survey data are clearly negatively correlated with the interest differential (e.g., see Bacchetta et al., 2009).

[2] Notice that models with imperfect information and learning can also produce this type of response. However, rational learning models usually converge to the full information case. Moreover, learning models do not necessarily generate excess return predictability with the right sign.

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A simple formal model was presented by Gourinchas and Tornell (2004). They assume that investors think that shocks to the interest rate differential are more temporary than they actually are. To understand how this affects the dynamics of exchange rate expectations, it is useful to remember that an increase in $i_t - i_t^*$ implies an initial domestic currency appreciation, followed by a gradual depreciation. The gradual depreciation is required to compensate for the interest differential, as Eq. (23.1) indicates. The smaller the future interest rate differential, the smaller the gradual depreciation and thus, the smaller the required initial appreciation. Therefore, when investors think incorrectly that the interest differential will decline more quickly than it actually does, the initial appreciation is smaller than it should be. But when investors realize that the interest differential declines more slowly than they expected, they revise their expectations and the domestic currency appreciates. Hence, in this learning period, we are in a situation of gradual appreciation, accompanied by a higher interest differential, which means a negative excess return. This clearly implies a negative relationship between the excess return and the interest differential. When this learning period is over, the currency starts to depreciate. This dynamic gradual appreciation followed by depreciation leads to the delayed overshooting described earlier.

Deviations from standard rational expectations in Gourinchas and Tornell are modeled in an ad hoc way. Recent research has modeled more carefully the behavior of investors. For example, Ilut (2010) introduces ambiguity aversion in a context where investors have imperfect knowledge of the underlying model. The author considers an example where investors do not know the true variance of temporary shocks to the interest rate differential. Ambiguity aversion leads investors to give more weight to the possibility of high volatility of temporary shocks. This leads to an effect which is similar to an overestimation of the variance of temporary shocks. Therefore, the mechanism in Ilut leads to results similar to the Gourinchas and Tornell model and can also explain the forward premium puzzle.

Burnside et al. (2011b) consider overconfident investors in the sense that they overestimate the precision (or underestimate the variance) of their private signals. In their model, signals are about future monetary policy. A signal about a future domestic inflation is taken 'too seriously' on average so that the interest differential increases excessively and the currency depreciates excessively, both due to an increase in expected inflation. This implies that in subsequent periods, when investors realize that inflation is not so high, the currency has to appreciate while the interest differential has to decline. Again, this implies a negative relationship between excess return and the interest differential.

CONCLUSION

It is relatively easy to design models that generate deviations from UIP as observed in the Fama regression. What is more challenging is to find mechanisms that are robust to various types of shocks and that can match the various aspects of the data, such as high exchange rate volatility. It is unlikely that a simple explanation can be sufficient to solve the puzzle and a combination of factors is therefore needed. For example, Bacchetta and van Wincoop (2010) show that infrequent decision making is likely to be a key ingredient. But to this feature they need to assume limited arbitrage, due to risk aversion, by active traders. Moreover, their results get closer to the data when some limited information processing is assumed.

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