Asymmetry in forward exchange rate bias:
A puzzling result

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Abstract

In this paper we document that the hypothesis that the forward exchange rate discount is an unbiased predictor of future currency depreciation holds in periods when the forward US dollar is quoted at a premium against the Japanese yen and the Deutschmark, but fails when it is quoted at a discount for the post-Bretton Woods floating exchange rate era. Moreover, the observed asymmetry is statistically significant. This puzzling result remains to be explained.

Keywords: Unbiasedness hypothesis; Forward market efficiency

JEL classification: F31

1. Introduction

The forward foreign exchange market has been subject to extensive studies on the issue of speculative efficiency. In a market with risk-neutral investors who have rational expectations, forward discounts should serve as unbiased predictors of future currency depreciation.\(^1\) That is to say, if the forward exchange rate exceeds the current spot rate by 1%, the future spot rate is expected to depreciate by 1%. Surprisingly, overwhelming empirical evidence seems to suggest the opposite. In typical studies, the ex post future exchange rate changes are regressed on current forward discounts. The estimated regression slope coefficient is found to be reliably less than one and is often not significantly different from minus one, which implies that forward discounts predict future spot rate changes in the wrong direction, if they have any predicting power at all. This is a puzzling and disturbing result for a market as active and liquid as the foreign exchange market.

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\(^1\) The risk-neutrality assumption is not necessary if the exchange rate risk is diversifiable.
Two main explanations, time-varying risk premium and expectations error, have been offered in the literature to explain the negative slope coefficient. Fama (1984) demonstrates that if one maintains the rational expectations hypothesis, then the standard regression results can only be reconciled by a time-varying risk premium that must be both negatively correlated with, and more volatile than, the expected currency depreciation. However, subsequent empirical studies on the time-varying risk premia have led Froot and Thaler (1990) to conclude that “risk premia which are derived from economists’ asset pricing models show no sign of being systematically related to the predictable excess returns derived from econometricians’ regression”. Using survey data on the expectations of foreign exchange traders, Froot and Frankel (1989) find that biased predictions are mainly caused by expectation errors. Although survey data allow one to gain some insights about the expectations of a group of traders, the approach can always be questioned on the grounds of whether they can represent the true unobservable market expectations. It would be puzzling indeed if the foreign exchange market makes expectation errors across all major currencies over the post-Bretton Woods period, given the fact that hundreds of billions of US dollars of foreign exchanges are traded per day.

In this paper we ask a simple and yet important question: Is the rejection of the unbiasedness hypothesis dependent on whether the US dollar is quoted at a premium or at a discount in the forward market? To this end, we re-examine the hypothesis by using the Japanese yen and the Deutschmark over the post-Bretton Woods period. We classify the observations into two categories: one with positive forward discounts and the other with negative forward discounts, and conduct the simple forward market efficiency test for each category of observations in an exogenous switching regression framework. Surprisingly, we find that the significantly negative slope coefficient in the standard forward discount regression reported in the literature is mainly associated with those periods when forward discounts are positive. In sharp contrast, the null hypothesis that the regression coefficient is equal to one cannot be rejected in those periods when forward discounts are negative. Our findings indicate that the unbiasedness hypothesis holds when the US dollar is expected to appreciate, but fails when the dollar is expected to depreciate. These apparent opposite results for positive forward discount periods and negative ones is puzzling. Our findings suggest that the different behaviours of spot rates in positive and negative forward discount periods must be considered in future theoretical modelling and empirical investigation of exchange rates.

The remainder of the paper is organized as follows. Section 2 describes the data and outlines the simple efficiency test. Section 3 reports the results. Section 4 concludes the paper.

2. The data and the simple efficiency test

In this study, we use two most important foreign currencies: the Deutschmark (DM) and the Japanese yen (JY). Germany and Japan are the two most powerful economies after the

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2 The existing literature is quite extensive. Recent attempts to understand the negative slope coefficient also include Evans and Lewis’ (1992) ‘peso problem’ explanation, McCallum’s (1994) policy reaction argument, Mark et al. (1993) parametric structural time-series model and Wu and Zhang’s (1994) non-parametric approach.
United States. In addition, the DM is the anchor currency of the Exchange Rate Mechanism of the European Monetary System. Monthly observations of spot and one-month forward US dollar prices of the DM and the JY are obtained from the Harris Bank's Weekly Review. The sample begins in March 1973 when the Bretton Woods system broke down and ends in May 1993 with a total of 243 consecutive observations.

The standard test of forward market unbiasedness hypothesis is based on regressing the change in the future spot rate on the current forward discount as follows:

\[ s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \epsilon_{t+1} , \tag{1} \]

where \( s_t \) is the US dollar price of a unit of foreign currency and \( f_t \) is the US dollar one-period forward price of one unit of foreign currency at time \( t \), all in natural logarithms. The term \((f_t - s_t)\) is the forward discount.\(^3\) The unbiasedness hypothesis maintains that \( \beta \) should be equal to one.\(^4\) The following two hypotheses are tested:

Hypothesis I \( H_0: \beta = 1 \), against the alternative, \( H_a: \beta \neq 1 \).

Hypothesis II \( H_0: \beta \geq 0 \), against the alternative, \( H_a: \beta < 0 \).

Many studies find that the estimate of \( \beta \) is reliably less than one and often significantly below zero.

In this study, we re-examine the unbiasedness hypothesis for two samples that are constructed according to the signs of the forward discount, \((f_t - s_t)\). The very same regression technique that is often used in the literature is employed to analyze the two samples. Specifically, we employ the following exogenous switching regression model:

\[ s_{t+1} - s_t = \alpha^+ i(f_t - s_t \geq 0) + \alpha^- i(f_t - s_t < 0) + \beta^+ (f_t - s_t) i(f_t - s_t \geq 0) + \beta^- (f_t - s_t) i(f_t - s_t < 0) + \epsilon_{t+1} , \tag{2} \]

where

\[ i(\cdot) = 1, \quad \text{if the argument is true}, \]
\[ i(\cdot) = 0, \quad \text{otherwise}. \]

Now Hypotheses I and II are tested for both positive and negative forward discount periods. Furthermore, we test if the slope coefficients are the same for the two periods. This is:

Hypothesis III \( H_0: \beta^+ = \beta^- \), against the alternative, \( H_a: \beta^+ \neq \beta^- \).

\(^3\) Some researchers call it the forward premium.

\(^4\) Hodrick (1987, p. 28) has explained why the intercept term \( \alpha \) can be allowed to be different from zero in an efficient forward market. We focus our attention on the slope coefficient, \( \beta \):
Table 1
Regression results: Full sample

<table>
<thead>
<tr>
<th>Currency</th>
<th>( \alpha )</th>
<th>( \beta )</th>
<th>( t )-ratio</th>
<th>( t )-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>( H_0: \beta = 1 )</td>
<td>( H_0: \beta \geq 0 )</td>
</tr>
<tr>
<td>DM</td>
<td>0.004</td>
<td>-0.836</td>
<td>-2.442*</td>
<td>-1.112</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.752)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JY</td>
<td>0.004</td>
<td>-0.143</td>
<td>-2.957**</td>
<td>-0.371</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.387)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1) Numbers in parentheses are standard errors. (2) * and ** denote test statistics significant at the 5% and 1% levels respectively.

3. The results

For ease of comparison, we run the standard OLS regression of Eq. (1) with our own data and the test results are reported in Table 1. Consistent with previous findings in the literature, the regression slope estimates are negative for both currencies. The null hypothesis of \( \beta = 1 \) can be rejected at the 1% level for the JY and at the 5% level for the DM.

The regression results for the exogenous switching regression model of Eq. (2) are reported in Table 2. There is an obvious dichotomy for positive forward discount periods versus negative ones. For positive forward discount periods, the estimates of \( \beta^+ \) are -3.493 and -3.046 for the DM and the JY respectively. The unbiasedness hypothesis can be rejected at the 1% level. In addition, the null hypothesis of \( \beta \geq 0 \) can be rejected at the 1% level in favour of the alternative hypothesis of \( \beta < 0 \). However, for negative forward discount periods, the estimates of slope coefficients are 0.702 for the DM and 0.750 for the JY. The unbiasedness hypothesis (\( \beta^- = 1 \)) cannot be rejected. Furthermore, it is found that \( \beta^+ \) and \( \beta^- \) are significantly different from each other at the 10% for the DM and at the 1% for the JY.

The exogenous switching regression estimates indicate that when the forward US dollar is quoted at a discount of 1%, the dollar turns out to appreciate by more than 3% on average in the subsequent spot market. However, the unbiasedness hypothesis approximately holds when the forward US dollar is quoted at a premium.

Table 2
Regression results

<table>
<thead>
<tr>
<th>Currency</th>
<th>( \alpha^+ )</th>
<th>( \alpha^- )</th>
<th>( \beta^+ )</th>
<th>( \beta^- )</th>
<th>( t )-ratio</th>
<th>( t )-ratio</th>
<th>( t )-ratio</th>
<th>( t )-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>( H_0: \beta^+ = 1 )</td>
<td>( H_0: \beta^+ \geq 0 )</td>
<td>( H_0: \beta^- = 1 )</td>
<td>( H_0: \beta^- \geq 0 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>0.013</td>
<td>0.003</td>
<td>-3.493</td>
<td>0.702</td>
<td>-3.347**</td>
<td>-2.602**</td>
<td>-0.139</td>
<td>0.328</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.007)</td>
<td>(1.342)</td>
<td>(2.143)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JY</td>
<td>0.014</td>
<td>0.007</td>
<td>-3.046</td>
<td>0.750</td>
<td>-4.400**</td>
<td>-3.312**</td>
<td>-0.482</td>
<td>1.446</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.920)</td>
<td>(0.518)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1) Numbers in parentheses are standard errors. (2) * and ** denote test statistics significant at the 10% and 1% levels respectively.
4. Concluding remarks

In this paper, we report that the unbiasedness hypothesis holds in periods when the forward US dollar is quoted at a premium but fails when it is quoted at a discount. The observed asymmetry is statistically significant. This puzzling result remains to be explained.

Acknowledgements

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