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Is there asymmetry in forward exchange rate bias? Multi-country evidence

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Is There Asymmetry in Forward Exchange Rate Bias? Multi-Country Evidence

Working Paper

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Is there asymmetry in forward exchange rate bias?
Multi-country evidence

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Abstract

This study illustrates that the empirical rejection of the forward rate unbiasedness hypothesis is not sensitive to whether the forward U.S. dollar is quoted at a premium or a discount. It is argued that the reported finding of so-called asymmetry in forward exchange rate bias in earlier work is simply due to the inclusion of a sample period during which a forward rate anomaly exists.

Keywords: Asymmetry in forward exchange rate bias; Forward rate anomaly

JEL Classification: F31; G15

1. Introduction

The forward rate unbiasedness hypothesis (FRUH), which states that the forward premium is an unbiased predictor of the future change in the spot exchange rate, has been extensively studied in the empirical literature of international finance. While the FRUH suggests a proportionally positive relationship between the forward premium and the future change in the spot rate, empirical studies have often indicated a negative relation between the two. This finding has been referred to as the forward premium anomaly in the literature.[1] In an influential article by Wu and Zhang (1996), it is claimed that forward exchange rate bias is asymmetrical in the sense 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 (p. 411)." No explanation is offered for such a puzzling result, however.

In contrast to the findings of Wu and Zhang (1996), a recent study by Zhou (2002) shows that the unbiasedness hypothesis does not hold in any period between 1980 and 1998, and the forward premium anomaly exists only for one period, namely, the 1980-87 period, where both the forward premia and the changes in the spot rates of the majority of countries contain a significant time trend component but with opposite signs. She argues that such a phenomenon could be explained by the peso problem in small samples associated with the uncertainty about the time of policy changes.

Building upon the earlier work of Zhou (2002), this paper demonstrates that the rejection of unbiasedness hypothesis does not depend on whether the forward U.S. dollar is quoted at a premium or a discount and the test results of Wu and Zhang (1996) do not necessarily suggest asymmetry in forward exchange rate bias. Moreover, it is shown that empirical evidence reported in Wu and Zhang (1996) based on the U.S. dollar exchange rates of the German mark and Japanese yen may not hold for many other exchange rates, indicating that their results provide little empirical evidence for asymmetry in forward rate bias.

The rest of the paper is organized as follows. Section 2 addresses some methodological issues of this study. The construction of data and the sample period are briefly described in Section 3, and the test results are reported and analyzed in the same section. The last section concludes the paper.

2. Methodological issues

We first explain why the test results of Wu and Zhang (1996) do not actually suggest that the unbiasedness hypothesis holds in periods when the forward U.S. dollar is quoted at a premium. To begin with, the standard test of FRUH is usually represented by the following regression:

$$s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \varepsilon_{t+1} \tag{1}$$

with the null hypotheses of $\alpha = 0$, $\beta = 1$, and $E_t(\varepsilon_{t+1}) = 0$, where s_t is defined as the natural logarithm of the spot exchange rate of the U.S. dollar at time t, f_t denotes the natural logarithm of the one-period forward exchange value of the dollar contracted at time t for delivery at time t+1, and $E_t(.)$ denotes conditional expectation on the basis of information available at time t. Wu and Zhang (1996) reject the FRUH for the periods when the forward U.S. dollar is quoted at a discount by rejecting both null hypotheses of $\beta = 1$ and $\beta \geq 0$ for these periods. However, their evidence of failure to reject both null of $\beta = 1$ and $\beta \geq 0$ for the periods when the forward U.S. dollar is quoted at a premium does not provide empirical support for the FRUH during such premium periods. Instead, it simply implies that the forward premium cannot be considered as an unbiased predictor of the future change in the spot exchange rate because there is no statistically significant relationship found between the two when the forward U.S. dollar is quoted at a premium.

Following Wu and Zhang (1996), our empirical results are based on the following regression:

$$s_{t+1} - s_t = \alpha^- d[(f_t\text{-}s_t)<0] + \alpha^+ d[(f_t\text{-}s_t)\geq 0] + \beta^-(f_t\text{-}s_t)d[(f_t\text{-}s_t)<0] + \beta^+(f_t\text{-}s_t)d[(f_t\text{-}s_t)\geq 0] + \varepsilon_{t+1} \tag{2}$$

where

$d[.] = 1$, if what is in bracket is true, and $d[.] = 0$, otherwise.[2]

Wu and Zhang (1996) define asymmetry in forward rate bias as the case where the unbiasedness hypothesis holds in periods when $f_t - s_t \geq 0$ but fails when $f_t - s_t \leq 0$. We refer to this case as Asymmetry I hereafter. Strictly speaking, the rejection of the null hypotheses of $b^- \geq 0$, $b^- = 1$, and $b^+ \geq 0$, and the failure to reject the null of $b^+ = 1$ would be considered as the evidence in favor of Asymmetry I. Yet, the test results of Wu and Zhang (1996), which indicate rejection of the null hypotheses of $b^- \geq 0$ and $b^- = 1$ but failure to reject both $b^+ \geq 0$ and $b^+ = 1$, do not suggest such asymmetry.

A different version of asymmetry in forward exchange rate bias, which we call as Asymmetry II, can be defined by that, although the FRUH does not hold in any periods, the relation between $s_{t+1} - s_t$ and $f_t - s_t$ is significantly negative when the forward U.S. dollar is quoted at a premium but there is no significant relationship between the two when the dollar is quoted at a forward discount. This asymmetry, which would be supported by the rejection of $b^- = 1$ and $b^- \geq 0$ and the failure to reject $b^+ = 1$ and $b^+ \geq 0$, is consistent with the results of Wu and Zhang (1996). Even so, we show that the evidence for Asymmetry II reported in Wu and Zhang (1996) with respect to the U.S. dollar exchange rates of German mark and Japanese yen cannot be extended to many other exchange rates. We also argue that the rejection of the null hypotheses of $b^- = 1$ and $b^- \geq 0$ is mainly driven by the 1980-87 period results.

3. Data and test results

Monthly series of the spot and forward exchange values of the U.S. dollar in terms of the currencies of eleven industrial countries are constructed from daily data for the period from September 1977 to June 1998. The eleven currencies are Belgian Franc (BF), British Pound Sterling (BP), Canadian dollar (CD), French Franc (FF), Dutch Guilder (DG), German Mark (GM), Italian Lira (IL), Japanese Yen (JY), Norwegian Kroner (NK), Swedish Krona (SK), and Swiss Franc (SF). The data are the average of London bid/offer spot exchange rates and one-month forward rates specified in terms of units of foreign currency per U.S. dollar.[3]

The results of the full sample period are reported in Table 1.[4] The reported test statistics indicate that Asymmetry I holds only for two exchange rates, BF/$ and FF/$, while Asymmetry II is supported by four exchange rates, DG/$, GM/$, JY/$, and SF/$.[5] For the rest of the five exchange rates, either there is no significant relation between $s_{t+1} - s_t$ and $f_t - s_t$ for the whole (or nearly whole) sample period regardless of whether $f_t - s_t$ is positive or negative, or, opposite to Asymmetry II, the null hypotheses of $b^+ = 1$ and $b^+ \geq 0$ are rejected but the hypotheses of $b^- = 1$ and $b^- \geq 0$ are not. These results support the notion that there is little empirical evidence for Asymmetry I as defined in Wu and Zhang (1996).

It is possible that the evidence for Asymmetry I or II may simply reflect the existence of an inverse relation between $s_{t+1} - s_t$ and $f_t - s_t$ for some exchange rates for the 1980-87 period.[6] To check on this claim, Equation (2) is re-examined for those six exchange rates that have yielded evidence of Asymmetry I or Asymmetry II, for the 1980-87 period as well as for the period from 1977 to 1998 but excluding 1980-87. The test results, displayed in Table 2, reveal that once the 1980-87 period is excluded from the sample, the evidence for Asymmetry I or II disappears for all the exchange rates, except in one case as the results for BF/$ favor Asymmetry I and those for JY/$ lend support to Asymmetry II.

For the 1980-87 period, a^+ and b^+ are not estimated for the DG/$, GM/$, JY/$, and SF/$ rates because, within this period, only few observations (ranging from 0 to 5) out of a total of 96 are corresponding to $f_t - s_t \geq 0$ for these four exchange rates. The reported test statistics provide no supporting evidence for Asymmetry I. Although the results based on the four exchange rates of DG/$, GM/$, JY/$, and SF/$ during this period may be considered as evidence supporting Asymmetry II, these results may also indicate that a forward rate anomaly existed during the same period. Indeed, Zhou (2002) finds that the forward premium anomaly existed in the 1980-87 period and it mainly stemmed from the trend movements of the forward premia and the changes in the spot rates in opposite directions. This phenomenon may reflect the peso problem that refers to biased expectations of the future exchange rates in small samples when there is uncertainty about when a future policy change will be implemented. Once a time trend is included in the regression of s_{t+1} - s_t on f_t - s_t, Zhou (2002) reports that the slope coefficient b is no longer significantly negative for any one of the four exchange rates.

4. Conclusions

Empirical evidence based on the eleven exchange rates lend little support to asymmetry in forward exchange rate bias, as it is defined in Wu and Zhang (1996). It is shown that the empirical rejection of the forward rate unbiasedness hypothesis is not sensitive to whether the forward U.S. dollar is quoted at a premium or a discount. We argue that the finding of Wu and Zhang (1996), that the relation between s_{t+1} - s_t and f_t - s_t is significantly negative for the forward discount periods but is not statistically significant for the forward premium periods, is essentially driven by the inclusion of the data for the 1980-87 period during which there existed a forward premium anomaly.

Footnotes

1. Engel (1996) presents the most recent survey on testing the forward rate unbiasedness hypothesis.

2. Note that f_t - s_t is defined as the forward premium on the U.S. dollar in this study, yet it is the forward discount on the U.S. dollar in Wu and Zhang (1996). Therefore, a^-, b^-, a^+ and b^+ here are equivalent to a^+, b^+, a^-, and b^-, respectively, in Wu and Zhang (1996).

3. The sample period is limited to 1977-1998 due to the availability of daily data for all eleven exchange rates. We are grateful to Andreas Fischer and Michael Dueker for providing the original daily data.

4. In testing the unbiasedness hypothesis, it is required to properly match the forward rates with the future spot rates. Wu and Zhang (1996) do not explain whether and how their data of f_t and s_{t+1} are properly matched. This study uses a two-day before end-of-month approach of constructing the data set. The approach minimizes possible biases from the end-of-period overlapping and clumping problems. Interested readers are referred to Breuer and Wohar (1996) and Zhou (2002) for a further explanation of this procedure.

5. For the IL/$ rate, a^- and b^- are not estimated because within the whole sample period only five out of 249 observations are corresponding to f_t - s_t < 0.

6. Zhou (2002) provides details why the 1980-87 period is different from others.

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Table 1
Regression results (Sample period: 77:9 - 98:6)

Exchange rate	a^-	a^+	b^-	b^+	t-statistic H$_0$: $b^- = 1$	$b^- \geq 0$	$b^+ = 1$	$b^+ \geq 0$
BF/$	-0.007	-0.010	-8.404	2.883	-3.104*	-2.774*	1.509	2.310*
	(0.005)	(0.004)	(3.030)	(1.248)				
BP/$	0.004	-0.001	-5.259	-0.660	-1.955	-1.642	-1.220	-0.485
	(0.004)	(0.007)	(3.202)	(1.361)				
CD/$	0.003	0.004	0.049	-1.912	-0.486	0.025	-3.830*	-2.195*
	(0.002)	(0.002)	(1.957)	(0.831)				
FF/$	-0.002	-0.007	-5.391	1.828	-2.366*	-1.996*	0.990	2.186*
	(0.006)	(0.003)	(2.701)	(0.836)				
DG/$	-0.014	-0.006	-5.635	2.019	-4.320*	-3.668*	0.397	0.786
	(0.004)	(0.008)	(1.536)	(2.568)				
GM/$	-0.009	-0.005	-2.733	1.616	-2.494*	-1.826*	0.218	0.571
	(0.005)	(0.009)	(1.497)	(2.830)				
IL/$	N.A.	0.002	N.A.	0.233	N.A.	N.A.	-1.130	0.343
		(0.004)		(0.679)				
JY/$	-0.018	-0.010	-4.514	4.128	-4.995*	-4.099*	0.514	0.679
	(0.005)	(0.008)	(1.114)	(6.082)				
NK/$	-0.001	-0.003	-2.810	0.808	-1.902	-1.403	0.304	1.278
	(0.005)	(0.003)	(2.003)	(0.632)				
SK/$	0.011	-0.004	3.152	1.282	0.537	0.787	0.345	1.569
	(0.006)	(0.004)	(4.005)	(0.817)				
SF/$	-0.014	0.002	-2.944	-1.800	-3.341*	-2.494*	-0.614	-0.394
	(0.006)	(0.010)	(1.180)	(4.563)				

Notes: Numbers in parentheses are the standard errors of the estimates. * denotes significance at the 5% level. N.A. = Not applicable.

Table 2
Regression results (Sub-samples)

Exchange rate	a^-	a^+	b^-	b^+	t-statistic H$_0$: $b^- = 1$	$b^- \geq 0$	$b^+ = 1$	$b^+ \geq 0$
			Sample: 77:9 - 98:6 excluding 80:1 - 87:12					
BF/$	-0.017	-0.016	-13.546	4.151	-2.725*	-2.538*	1.518	2.000*
	(0.008)	(0.007)	(5.338)	(2.076)				
FF/$	-0.007	-0.006	-7.209	1.133	-1.758	-1.544	0.087	0.744
	(0.007)	(0.005)	(4.669)	(1.522)				
DG/$	-0.012	-0.006	-5.784	1.986	-1.919	-1.636	0.385	0.776
	(0.007)	(0.008)	(3.535)	(2.557)				
GM/$	-0.004	-0.005	-0.628	1.565	-0.759	-0.293	0.197	0.546
	(0.006)	(0.010)	(2.145)	(2.864)				
JY/$	-0.018	-0.009	-5.534	4.993	-3.820*	-3.236*	0.366	0.458
	(0.007)	(0.010)	(1.711)	(10.895)				
SF/$	-0.006	0.002	-0.994	-1.800	-1.190	-0.593	-0.604	-0.389
	(0.008)	(0.010)	(1.676)	(4.631)				
			Sample: 80:1 - 87:12					
BF/$	0.005	-0.007	-6.220	2.310	-1.830	-1.577	0.618	1.090
	(0.009)	(0.006)	(3.945)	(2.102)				
FF/$	0.026	-0.007	0.214	2.044	-0.174	0.047	0.963	1.886*
	(0.017)	(0.005)	(4.515)	(1.084)				
DG/$	-0.016	N.A.	-5.649	N.A.	-3.747*	-3.184*	N.A.	N.A.
	(0.006)		(1.774)					
GM/$	-0.015	N.A.	-4.559	N.A.	-2.528*	-2.073*	N.A.	N.A.
	(0.008)		(2.199)					
JY/$	-0.016	N.A.	-2.925	N.A.	-3.014*	-2.246*	N.A.	N.A.
	(0.005)		(1.302)					
SF/$	-0.025	N.A.	-5.113	N.A.	-3.680*	-3.078*	N.A.	N.A.
	(0.008)		(1.661)					

See notes to Table 1.

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