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Forward Discount Puzzle and Official Interventions: An Empirical Note

Yuichi FUKUTA and Makoto SAITO *

Abstract

In this paper, we explore how official interventions affect the relationship between current forward rates and future spot rates of the yen/dollar for the period between 1991 and 2004. According to our empirical investigation, Japanese interventions induced not opposite movements between the two (recognized as the forward discount puzzle), but an overreaction of future spot rates to current forward discounts, in particular, during the first half of the 1990s. Our finding demonstrates that official interventions were not responsible for the forward discount puzzle that was present for the full sample period, and suggests other factors responsible for the puzzle.

JEL classification: E44, F31.

Keywords: forward discount puzzle, foreign exchange intervention

1 Introduction

Monetary authorities sometimes intervene in foreign exchange markets for policy reasons.¹ In particular, on more than 300 business days since April 1991, the Japanese authority has purchased U.S. dollars to prevent the Japanese yen from appreciating against the U.S. dollar. If these official interventions have any effect on future changes in spot rates, they may disturb the relationship between current forward rates and future spot rates.

In this paper, we examine whether official interventions affect the hypothesis that forward discounts (forward rates minus spot rates) serve as unbiased predictors for subsequent changes in spot rates. In other words, we explore the extent to which official interventions can resolve the forward discount puzzle, or the frequently observed opposite movements between current forward discounts and future spot rates.

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¹ A large literature deals with possible effects of interventions. Sarno and Taylor (2001) survey recent empirical studies of official interventions.

Most empirical papers on foreign exchange interventions, including Ito (2003) and Baillie and Osterberg (1997a, 1997b and 2000), explore immediate market impacts or subsequent effects of official interventions on exchange rates, rather than the relationship between current forward discounts and future changes in spot rates. However, there are not many papers that investigate the effect of official interventions on forward rates. Among exceptions, Osterberg (1997) examines the relationship between forward discounts and future changes in spot rates. For the period from 1985 to 1991, he finds that when the U.S. and German governments actively intervened in Deutschmark/U.S. dollar markets, forward discounts of Deutschmarks/U.S. dollars were more biased predictors of future spot rates. However, he does not explicitly document the extent to which official interventions affect the bias in forward discounts.

In this paper, we explicitly investigate how official interventions affect the relationship between current forward discounts and future changes in spot rates. The mere presence of effects of official interventions on immediate and subsequent spot rates may not completely determine the relationship between current forward discounts and future changes in spot rates. As Fama (1984) demonstrates, a possible correlation between forward discounts and intervention-induced effects on spot rates is a key to the relationship, and therefore to a resolution of the forward discount puzzle.

Using the time-series data on yen/U.S. dollar exchange rates between 1991 and 2004, we find that Japanese interventions did not induce opposite movements between current forward discounts and future spot rates; rather, it caused an overreaction of future spot rates to forward discounts during the first half of the 1990s and in a more recent period. That is, while the full sample period did exhibit the forward discount puzzle, our empirical finding demonstrates that the frequent and large-scale interventions of the Japanese authority were not responsible for this puzzle, and it suggests that other effects were sufficiently strong to dominate the observed overreaction.

This paper is organized as follows. In Section 2, we present the statistical specification and estimation results. In Section 3, we discuss implications of the empirical findings.

2 Specification and estimation

2.1 Data

Our chosen sample period covers April 1, 1991 to December 28, 2004. A major reason for this choice of sample period is that the Ministry of Finance made time-series data on foreign exchange interventions public from April 1991. The daily data on Japanese interventions are available from the web site of Ministry of Finance,² while data on U.S. interventions are available from the web site or from *the Quarterly Review of the Federal Reserve Bank of New York*.

For this sample period, the Ministry of Finance reports 343 days on which there was an intervention; 311 days involving dollar purchases and 32 days involving dollar sales. Japanese dollar purchases and sales interventions amounted to 63,401.7 billion yen and 4,879.4 billion yen, respec-

² In this dataset, the dates and times of Japanese interventions are based on New York time.

tively. The Federal Reserve Bank of New York reports 22 intervention days; 18 days with dollar purchases and 4 days with dollar sales. U.S. dollar purchases and sales interventions amounted to 7,345.8 million dollars and 1,033.0 million dollars, respectively. These data demonstrate that Japanese interventions were much more frequent and aggressive than were U.S. interventions. Note that the U.S. authority has not intervened in foreign exchange markets since July 1998.

In the context of Japanese interventions, Ito and Yabu (2007) report that the average amount of intervention per day was 47 billion yen from April 1991 to June 1995, while it was more than 500 billion yen for the period from June 1995 to December 2002. They also point out that the number of days on which the Japanese authority intervened was 165 days for the period from April 1991 to June 1995, while it was 49 days between June 1995 and December 2002. That is, in the former period, Japanese interventions were frequent but on a small scale, but were infrequent and on a large scale in the latter period.

For the period following that considered by Ito and Yabu (2007), Japanese interventions were extremely aggressive. The Japanese authority intervened on 129 days between January 2003 and December 2004, and the average amount per day was around 270 billion yen. In addition, the average number of consecutive days of interventions was 4.3, which is much longer than the averages for the earlier periods (2.6 days from January 1991 to June 1995, and 1.3 days from June 1995 to December 2002). Given these differences in the patterns of Japanese interventions, we split the full sample at June 20, 1995 and at December 31, 2002 to form subperiods.

The yen/dollar spot rate is measured at 17:00 New York time.³ Thus, the spot rate at this point in time is determined after both Japanese and U.S. interventions have taken place on that day. For the yen/dollar forward rate, we use as one-week forward discounts, differences in one-week offshore rates between yen and dollar in Japanese offshore markets. These offshore rates are measured in terms of averages of bid and offer rates.⁴

2.2 The effect of interventions on forecast errors for forward discounts

Following the existing literature cited in the introduction, we first examine the effect of Japanese and U.S. interventions on the ex post forecast errors of forward discounts. As already mentioned, we use as one-week forward discounts, $i_t - i_t^*$, where i_t (i_t^*) denotes offshore yen interest rates (offshore dollar interest rates) per week at time t . One-week-ahead (five-business-day-ahead) forecast errors of forward discounts are defined as $s_{t+5} - s_t - (i_t - i_t^*)$. INT_{t+5}^{JP} and INT_{t+5}^{US} are the sums of Japanese *net dollar sales* and U.S. *net dollar sales* between time $t + 1$ and $t + 5$ from the time

³ We could not obtain information on which markets authorities intervened in. The available intervention data are used for empirical analysis based on the assumption that when foreign exchange markets are closed on a holiday in New York, authorities can intervene in other foreign exchange markets, such as in Tokyo or London.

⁴ Spot exchange rates are measured at 17:00 New York time, while the average rates are quoted between 9:00 and 17:00 Japan time in Tokyo offshore money markets. Thus, the spot exchange rate and the forward discount based on offshore rates are not measured at the same time. To take this timing issue into account, we also use offshore market rates quoted on the next day (at time $t + 1$), and find that the estimation result does not differ from that based on the forward discount quoted at time t .

t perspective, respectively.⁵ Note that Japanese interventions at time t and U.S. interventions at time t are reflected in spot rates at time t (s_t), which are measured at 17:00 New York time. Thus, any immediate impact of *current* interventions on spot rates is not reflected in our estimation. We consider immediate impacts and subsequent effects of *future* interventions on spot rates.

Our base model adopts the following standard GARCH-M specification:

$$\begin{aligned} s_{t+5} - s_t - (i_t - i_t^*) &= \alpha_1 + \alpha_2 INT_{t+5}^{JP} + \alpha_3 INT_{t+5}^{US} + \mu h_t \\ &\quad + u_t + \kappa_1 u_{t-1} + \kappa_2 u_{t-2} + \kappa_3 u_{t-3} + \kappa_4 u_{t-4}, \\ u_t &= v_t \sqrt{h_t} \text{ with } v_t \sim N(0, 1), \\ h_t &= v_1 + \eta u_{t-1}^2 + \lambda h_{t-1}. \end{aligned}$$

In this specification, we assume a moving average structure of order four for the error term in order to control for the effect of overlapping periods.⁶ As mentioned later, the premium associated with the underlying volatility (μ) can be positive or negative in the case of exchange rates.

The coefficients on the sums of Japanese and U.S. net dollar sales (α_2 and α_3) measure not only the immediate impacts of *future* interventions, but also their subsequent effects. For example, when official interventions affect spot rates immediately but also have reversal or feedback effects on subsequent spot rates that nullify the initial immediate market impacts, the sign of α_2 (α_3) depends on the relative size of the initial market impacts and subsequent reversal effects.⁷ More concretely, if market impacts remain larger than reversal effects within one week, α_2 (α_3) is negative. If reversal effects completely cancel out market impacts within a week, α_2 (α_3) is zero. If reversal effects dominate market impacts, then α_2 (α_3) is positive; that is, dollar-sales (purchase) interventions may lead to dollar appreciation (depreciation).⁸

We refer to the case in which there is a negative α_2 (α_3) as the *intended* effect of interventions because, in that case, dollar sales (purchases) successfully prevent dollar appreciation (depreciation). Similarly, when α_2 (α_3) is positive, there are *unintended* effects of interventions.

As mentioned in the previous subsection, Japanese intervention policy changed significantly in the mid-1990s and the early 2000s. Thus, we estimate the above specification for not only the full sample period between 1991 and 2004, but also for the three subsample periods (those from April

⁵ Arguably, we should use components of future interventions that are unpredictable at time t . This is because predictable components are supposed to be reflected in current spot rates. However, using an econometric model to forecast official interventions, predictable components are extremely small relative to actual interventions. Therefore, our estimation results do not depend on whether we distinguish between unpredictable and predictable components.

⁶ We estimated other specifications, including GARCH models and GARCH models incorporating conditional volatility (h_t) dependent on interventions. We also estimated models specifying interventions as dollar-purchase and dollar-sale dummies rather than as amounts. However, the empirical results from these specifications did not differ substantially from those obtained from the standard GARCH-M specification.

⁷ Kearns and Rigobon (2005) find that Japanese interventions had weak reversal effects on subsequent spot rates.

⁸ Large-scale interventions may invite opposite transactions from speculators and thereby cause the subsequent reversal effect to dominate the immediate market impact.

1991 to June 1995, from June 1995 to December 2002, and from January 2003 to December 2004). We correct the standard errors using the method proposed by Newey and West (1987).

Table1: Estimation results from forward premium equations with GARCH-M specification

	Apr. 1, 1991 to Dec. 28, 2004	Apr. 1, 1991 to Jun. 20, 1995	Jun. 21, 1995 to Dec. 31, 2002	Jan. 1, 2003 to Dec. 28, 2004
Constant term (α_1)	7.89 x E(-4) (5.41 x E(-4))	-1.76 x E(-4) (8.55 x E(-4))	3.34 x E(-3)*** (7.67 x E(-4))	-1.86 x E(-3) (1.20 x E(-3))
Japanese intervention over coming five business days (α_2)	-5.64 x E(-7)*** (3.44 x E(-8))	2.72 x E(-6)*** (5.53 x E(-7))	-9.62 x E(-7)*** (5.94 x E(-8))	-3.17 x E(-7)*** (6.30 x E(-9))
U.S. intervention over coming five business days (α_3)	-1.06 x E(-5)*** (2.33 x E(-6))	-5.51 x E(-6)* (3.16 x E(-6))	-5.92 x E(-5)*** (5.68 x E(-6))	
GARCH characterization: Constant term (ν_1)	2.98 x E(-6)*** (1.54 x E(-7))	3.79 x E(-6)*** (3.03 x E(-7))	2.89 x E(-6)*** (2.00 x E(-7))	1.86 x E(-5)*** (1.33 x E(-6))
Lagged squared residual coefficient (η)	0.0820*** (2.10 x E(-3))	0.1075*** (4.87 x E(-3))	0.0755*** (2.56 x E(-3))	0.1529*** (0.0301)
Lagged conditional variance coefficient (λ)	0.8834*** (1.93 x E(-3))	0.8471*** (4.05 x E(-3))	0.8927*** (2.46 x E(-3))	0.5033*** (0.0253)
GARCH-M parameter (μ)	-15.5002** (6.3199)	-26.5418*** (9.9901)	-16.3369* (8.4965)	-9.1494 (18.1229)
The number of usable observations	3175	976	1736	455

(1) The following GARCH-M model is estimated:

$$s_{t+5} - s_t - (i_t - i_t^*) = \alpha_1 + \alpha_2 INT_{t+5}^{JP} + \alpha_3 INT_{t+5}^{US} + \mu h_t + u_t + \sum_{j=1}^4 \kappa_j u_{t-j},$$

where $u_t = v_t \sqrt{h_t}$, $h_t = v_1 + \eta u_{t-1}^2 + \lambda h_{t-1}$, and v_t follows the N(0,1) distribution.

(2) $E(-n)$ denotes 10^{-n} .

(3) Robust standard errors are reported in parentheses.

(4) *, **, and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

(5) Although a moving average structure of order four is applied to the error structure to control for the effect of overlapping periods, the above table does not report the estimated coefficients associated with these moving average components.

Table 1 reports the estimation results from the standard GARCH-M specification. For the full sample, Japanese interventions generated the intended effect on subsequent changes in spot rates. However, the estimation results depend on the choice of subsample period. Japanese interventions yielded unintended effects in the first subsample. That is, dollar-sales (purchase) interventions

resulted in subsequent dollar appreciation (depreciation). For the period between June 1995 and December 2004, Japanese interventions had the intended effect on subsequent changes in spot rates. In other words, Japanese dollar-purchase interventions caused subsequent depreciations of the yen. These results are consistent with existing empirical studies such as those obtained by Ito (2003) and Hillebrand and Schnabl (2003).

U.S. interventions had significant intended effects on subsequent spot rates throughout the sample period. That is, dollar-sales (purchase) interventions resulted in subsequent dollar depreciations (appreciations). This evidence for the intended effect of U.S. interventions is similar to the previous studies including those of Baillie and Osterberg (2000) and Ito (2003).⁹

An increase in conditional volatility led to appreciation pressures on the yen in the first and second subsamples. As Engel (1996) shows, the direction of the effect of the conditional variance on risk premiums depends on the variance of nominal consumption in both dollar and yen terms.¹⁰

2.3 Implications for the forward discount puzzle

The mere presence of effects of official interventions on immediate and subsequent spot rates may not completely determine the relationship between current forward discounts and future changes in spot rates. As Fama (1984) discusses, the extent to which future intervention-induced effects are correlated with current forward discounts is a key to the relationship between the two, and therefore to the resolution of the forward premium puzzle. We evaluate the above estimation result based on the argument of Fama (1984).

Suppose that subsequent changes in logarithmic spot rates are forecasted by current forward discounts ($i_t - i_t^*$) as follows:

$$s_{t+5} - s_t = \text{constant term} + \gamma(i_t - i_t^*) + u_{t+5},$$

where u_{t+5} is the error term. If forward discounts serve as unbiased predictors for future changes in spot rates, the estimator $\widehat{\gamma} = \frac{\text{cov}(s_{t+5} - s_t, i_t - i_t^*)}{\text{var}(i_t - i_t^*)}$ converges to unity with a constant term of zero.

If the intervention-induced component (X_{t+5} , which is a hidden component in the above forecasting equation) is correlated with the current forward discount, then it follows that:

$$\widehat{\gamma} = 1 + \frac{\text{cov}(X_{t+5}, i_t - i_t^*)}{\text{var}(i_t - i_t^*)}.$$

When the hidden component is related to official interventions, there are four possible cases in

⁹ As Ito (2003) points out, an explanatory variable for U.S. interventions may capture the impact of joint interventions by Japanese and U.S. authorities.

¹⁰ Similarly, Fukuta and Saito (2002) show that the signs of the coefficients on risk premiums depend on the covariance between consumption growth and inflation, the intertemporal marginal rate of substitution, and the variances of inflation in Japan and the U.S.

which current forward discounts fail to serve as unbiased predictors of future changes in spot rates. Suppose that interventions have unintended effects, or that $\hat{\alpha}_2$ or $\hat{\alpha}_3$ is positive. If future net dollar sales are positively correlated with current forward discounts, then $\hat{\gamma} > 1$. That is, future spot rates overreact to current forward rates. Conversely, if future net dollar sales are negatively correlated with current forward discounts, then $\hat{\gamma} < 1$. In other words, interventions induce the opposite movements between current forward discounts and future spot rates, which is regarded as the forward discount puzzle.

When interventions generate intended effects and there is a negative $\hat{\alpha}_2$ or $\hat{\alpha}_3$, a positive correlation between net dollar sales and current forward discounts results in $\hat{\gamma} < 1$, which corresponds to the forward discount puzzle. Conversely, a negative correlation between net dollar sales and current forward discounts yields $\hat{\gamma} > 1$; that is, there is an overreaction to forward discounts. In summary, a negative correlation between net dollar sales and forward discounts under a positive $\hat{\alpha}_2$ ($\hat{\alpha}_3$), or a positive correlation under a negative $\hat{\alpha}_2$ ($\hat{\alpha}_3$) resolves the forward discount puzzle.

Table 2-1: Correlation coefficients between forward discounts and interventions

	Apr. 1, 1991 to Dec. 28, 2004	Apr. 1, 1991 to Jun. 20, 1995	Jun. 21, 1995 to Dec. 31, 2002	Jan. 1, 2003 to Dec. 28, 2004
Correlation coefficients between forward discounts and the one-week sums of Japanese and U.S. interventions	-0.0720** (0.0282)	0.3103*** (0.0830)	-0.0524 (0.0422)	-0.2915*** (0.0651)
Correlation coefficients between forward discounts and the one-week sum of Japanese interventions	-0.0719** (0.0282)	0.3055*** (0.0832)	-0.0526 (0.0423)	-0.2915*** (0.0651)
Correlation coefficient between forward discounts and the one-week sum of U.S. interventions	-0.0110 (0.0216)	0.2140*** (0.0759)	0.0013 (0.0143)	n. a.

(1) Robust standard errors are reported in parentheses.

(2) *, **, and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

As reported in Table 2-2, the estimated $\hat{\gamma}$ is -2.133 with a standard error 0.954 for the full sample period; that is, the forward discount puzzle is apparent for the entire sample period. For the full sample, Table 1 shows that both Japanese and U.S. interventions have intended effects with a negative $\hat{\alpha}_2$ and $\hat{\alpha}_3$. However, Table 2-1 shows that future Japanese and U.S. interventions are negatively correlated with current forward discounts. Thus, these two results indicate that official interventions did not induce opposite movements between current forward discounts and future spot rates, but they did induce an overreaction of future spot rates to current forward discounts.

Table 2-2: Prediction biases of regression coefficients of forward discounts on changes in spot rates with and without adjusting intervention-induced movements

	Apr. 1, 1991 to Dec. 28, 2004	Apr. 1, 1991 to Jun. 20, 1995	Jun. 21, 1995 to Dec. 31, 2002	Jan. 1, 2003 to Dec. 28, 2004
Estimated γ without adjustment	-2.1328** (0.9543)	3.0133 (2.4367)	-1.8081 (2.3638)	12.8623 (17.2654)
Estimated γ with adjustment based on the terms associated with Japanese and U.S. interventions	-2.4482** (0.9639)	1.4033 (2.2481)	-2.3321 (2.4576)	2.9130 (17.3076)
Estimated γ with adjustment based on the terms associated with Japanese interventions	-2.4255** (0.9632)	0.9410 (2.1920)	-2.3484 (2.4625)	2.9130 (17.3076)
Estimate γ with adjustment based on the terms associated with U.S. interventions	-2.1555** (0.9544)	3.4756 (2.5092)	-1.7918 (2.3574)	n. a.

(1) The nonadjusted coefficient, γ , is estimated from the following regression:

$$s_{t+5} - s_t = \text{constant} + \gamma(i_t - i_t^*) + \varepsilon_{t+5},$$

where ε_{t+5} denotes the error term. The coefficient, γ , with adjustment based on the terms associated with Japanese and U.S. interventions is estimated from the following equations:

$$s_{t+5} - s_t - \hat{\alpha}_2 INT_{t+5}^{JP} - \hat{\alpha}_3 INT_{t+5}^{US} = \text{constant} + \gamma(i_t - i_t^*) + \varepsilon_{t+5},$$

where $\hat{\alpha}_2$ and $\hat{\alpha}_3$ are the estimated coefficients reported in Table 1. The coefficient, γ , with adjustment based on the terms associated with Japanese and U.S. interventions separately is estimated by replacing the left-hand

side of the above equation with $s_{t+5} - s_t - \hat{\alpha}_2 INT_{t+5}^{JP}$ and $s_{t+5} - s_t - \hat{\alpha}_3 INT_{t+5}^{US}$, respectively.

(2) Robust standard errors are reported in parentheses.

(3) *, **, and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

As shown in Table 2-2, regressing the change in spot rates adjusted by intervention-induced components, $(s_{t+5} - s_t) - \hat{\alpha}_2 INT_{t+5}^{JP} - \hat{\alpha}_3 INT_{t+5}^{US}$, on the current forward discount, yields an significant estimate $\hat{\gamma}$ of -2.448 . This is more negative than the estimate of -2.133 based on no adjustment. For the full sample, the consideration of intervention-induced movements would not help to resolve the forward discount puzzle.

Because there are different patterns in the impacts of official interventions on spot rates in the three subsample periods, we investigate how official interventions affect the relationship between forward discounts and future spot rates in each subsample period. As Table 2-1 shows, current forward discounts are positively correlated with future Japanese interventions for the subsample period from April 1991 to June 1995, and negatively correlated for the subsample period between January 2003 and December 2004, at the 1 percent significance level. Thus, Japanese interventions are likely to affect the relationship between forward discounts and future spot rates for these subsample periods.

As reported in Table 2-2, for the subsample period from April 1991 to June 1995, the estimated

$\widehat{\gamma}$ of 3.013 is well in excess of unity, and has a standard error of 2.437; that is, while the estimated coefficient is not significant, spot rates tended to overreact to forward discounts. As empirically examined in the previous section, Japanese interventions had unintended immediate and subsequent effects on spot rates in the corresponding subsample period. Given the above argument, a positive correlation between net dollar sales by the Japanese authority and forward discounts would generate such an overreaction. As shown in Table 2-1, Japanese interventions are positively correlated with current forward discounts, $i_t - i_t^*$, at the 1 percent significance level. To examine the effect of Japanese interventions, we regress the adjusted change in spot rates, $(s_{t+5} - s_t) - \hat{\alpha}_2 INT_{t+5}^{JP}$, on the current forward discount. We find that the estimated $\widehat{\gamma}$ has fallen from 3.013 to closer to unity (0.941). That is, current forward discounts could serve as unbiased predictors for future spot rates after adjustments of intervention-induced components.

U.S. interventions, on the other hand, had its intended impacts on spot rates, and are positively correlated with current forward discounts at the 1 percent significance level (see Table 2-1). This implies that the consideration of U.S. interventions by adopting $(s_{t+5} - s_t) - \hat{\alpha}_3 INT_{t+5}^{US}$ as a dependent variable would cause the estimated $\widehat{\gamma}$ to further exceed unity, thereby magnifying the overreaction of spot rates to forward discounts.

As reported in Table 2-2, we find an overreaction of spot rates to forward discounts in the third subsample period from January 2003 to December 2004; the estimated $\widehat{\gamma}$ of 12.862 is far in excess of unity and has a standard error 17.265. Again, although the estimated coefficient is not significant, spot rates tended to overreact to forward discounts. In that subsample period, a significantly negative correlation between net dollar sales and current forward discounts (reported in Table 2-1) together with Japanese interventions having its intended effect would help to explain this observed overreaction. The consideration of the component induced by Japanese interventions causes the estimated $\widehat{\gamma}$ to change from 12.862 to 2.913.

In the second subsample period between June 1995 and December 2002 (see Table 2-2), the estimated $\widehat{\gamma}$ of -1.808 is negative, with a standard error 2.364. That is, there is some weak evidence that the forward discount puzzle arose in that period. However, as reported in Table 2-1, for this subsample period, both Japanese and U.S. interventions are only weakly correlated with forward discounts. Hence, the consideration of intervention-induced movements would not help to resolve the forward discount puzzle.

3 Discussion

In this paper, we explored how official interventions affect the relationship between current forward discounts and future changes in spot rates of the yen/dollar for the period between 1991 and 2004. According to our empirical investigation, Japanese interventions did not induce opposite movements between current forward discounts and future spot rates, as has been frequently documented in the literature on the forward discount puzzle; rather, this caused an overreaction of spot

rates to forward discounts. In particular, the unintended effect of Japanese interventions, together with a positive correlation between net dollar sales and forward discounts, caused spot rates to overreact in the first half of the 1990s. For that subsample period, current forward discounts could serve as unbiased predictors for future spot rates after adjustments of intervention-induced components. The intended effect of Japanese interventions, with a negative correlation, also generated such overreactions in the early 2000s.

We have two remarks on these empirical findings concerning Japanese interventions. First, interventions by the Japanese authority tended to yield more responsive movements in the spot rate than dictated by intertemporal efficiency (interest parity relationship). Second, because there is evidence of the forward discount puzzle for the whole sample period, other effects were sufficiently strong to dominate the intervention-induced overreaction.

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