〈Note〉

Has the Tokyo Foreign Exchange Market Been Efficient?

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Abstract

This paper examines the efficiency of the Tokyo Foreign Exchange Market from two perspectives. One is to investigate whether or not interest rate parity has been achieved. The other is to investigate the effect of interventions in the market and focuses on whether or not a stable forecast has been made. By examining recent data, we can conclude that this market has been efficient.

1. Introduction

Many papers about the foreign exchange market have been presented. Above all, market efficiency has been paid much attention and many analyses have been performed. This paper focuses on (1) whether or not interest rate parity condition has been achieved and (2) the effects of interventions in the market.

For interest rate parity, many researchers have tackled this problem of forward premium puzzle along with the condition of interest rate parity. Their results have not been inclusive; however, most studies have concluded that interest rate parity holds. Recently, the reason that the condition does not hold has been examined.

Louis et al. (1999) indicated that the forward markets tested have become efficient in the sense that interest rate parity holds well. Cook (2009) found little or even a negative relationship between expected excess returns on

exchange rate adjusted U.S. money market rates. Batten and Szilagyi (2010) suggested that evidence of declining deviations from equilibrium over the sample period is consistent with a more efficient trading environment. Fong et al. (2010) showed that positive CIP (covered interest parity) arbitrage deviations include compensation for liquidity and credit risk.

Almost all of these authors have shown that forward premium is inversely related to future exchange rate changes or the excess return, as shown by Fama (1984). Recently, Lyons (2001) showed a reason for the occurrence of the forward premium puzzle.[1] Lyons noted that the forward bias in foreign markets does not attract speculative funds until the trading strategy is expected to bring an excess return that exceeds that of other trading strategies. This indicates a band of inaction in which the forward bias will continue until the bias is large enough to attract speculative funds. Sarno et al. (2006) supported this idea by employing nonlinear models that incorporated the band of inaction. Building on this idea, this paper re-examines the relationship between excess returns and the forward premium to allow for deviations from covered interest arbitrage.

Moreover, in academic fields, exchange rate expectations are assumed to be adaptive or rational. However, in the real world, exchange rate forecasters are heterogeneous.[2] Much attention has been paid to this heterogeneity. This paper focuses on this point. Heterogeneity in exchange rates seems to be a major source of volatility (Dominguez and Frankel, 1993). Allen and Taylor (1990) and Ito (1990) shed light on the question of how exchange is determined. Smith and Pitts (2006) indicated that empirical results suggest strong conditional heteroskedasticity, as well as contemporaneous correlation, in the mean-corrected volume measure. Kim and Sheen (2006) and Chari (2007) suggested that there are in central bank threshold effects an asymmetric volatility. Bertoli et al. (2010) employed the Exchange Market Pressure (EMP) index developed by Eichengreen et al. (1994) and suggested that the index is sensitive to some assumptions behind the

information available, especially when markets are involved. Also, Bertoli et al. showed that the relationship between exchange misalignment and forecast heterogeneity is important for the so-called coordination channel of intervention. Recent papers about central bank intervention seem to shed light on heterogeneity for the policy tool.[3] This paper focuses on the determinants of forecast heterogeneity in the Japanese yen-US dollar exchange market. This article takes into account of some control variables and allows dispersion of exchange rate forecasts and forecast dispersion of macroeconomic variables.

This paper is structured as follows: Section 2 provides the models. Section 3 explains the data. Section 4 reveals the empirical method and performs empirical analyses. Finally, section 5 makes a brief conclusion.

2. Empirical analyses

2.1 A Model for Forward Bias

Interest arbitrage transactions have been performed all over the world. The trading volume is far from the GDP in each country. Financial institutions have tackled this transaction every day. To check whether or not this condition has been right, this method is traditionally employed:

A standard regression is estimated as follows:

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

where s_{t+n} is the logarithm of exchange rate at time t+n, f_t is the logarithm of the forward rate for the horizon n, α, and β are positive constants, and ε_{t+n} is an error term that can follow up to an n-1 moving average error term under the null of efficiency.

When agents are risk-neutral, have rational expectations, and covered and uncovered interest parity hold, α and β are not significantly different from zero.

Following Paya et al. (2010), equation (1) is revised as follows:

$$s_{t+n} - f_t = \gamma + \delta(f_t - s_t)e^{-\zeta(ipt)^2} + \varepsilon_{t+n} \qquad (2)$$

where γ, δ and ζ are constants.[4] Limits to arbitrage imply that within a certain band, the forward bias does not attract capital and, as a consequence, the spot and forward rate may not move together.

The assumption of equation (2) is that when deviations from the condition of covered interest rate parity (ip) are large, the forward premium will become a more accurate forecast of future changes in the expected spot rate. Consequently, as deviations from ip become large and the coefficients of the forward premium become smaller, the bias of the forward premium as a predictor of future changes in spot exchange rates becomes smaller. The smooth adjustment captures the idea of heterogeneous traders with different trading limits.

2.2 A Model for Intervention Efficiency

This paper's other purpose is to focus on intervention in the foreign exchange market and to examine the efficiency of the foreign exchange market in Japan. This article examines dispersion of exchange rates in the case of intervention.

The equation is written as follows:

$$\text{Dispersion}_t = \alpha_1 + \alpha_2|MOF_{t-1}| + \alpha_3|s_t - s_{t-1}| + \alpha_4|s_t - s_{average}| + \alpha_5|f_t - E_t s_{t+1}| + \text{Volatility} + \varepsilon_t \qquad (3)$$

MOF means the volume of intervention by the Ministry of Finance. E means expectation. Deviations from covered interest parity on an annual basis, ip, are calculated as follows:

$$ip_t = i_t - i^*_t + fp_t \qquad (4)$$

i and i* mean Japanese interest rate and the U.S. interest rate respectively. fp means forward premium.

3. Empirical Analyses and the Data Set

For regression (3), dispersion is measured as the standard deviation of all individual exchange rate forecasts at each point in time. There are five explanation variables:

(1) Absolute volume of the Japanese Ministry of Finance intervention,
(2) One week of exchange rate difference,
(3) Deviation of the exchange rate from an exchange rate target,
(4) Deviation of forward exchange rate from one period ahead of spot exchange rate, and
(5) Volatility of exchange rate.

For the target, a half year average is employed.

The real data are from Nikkei Needs (Japanese Nippon Keizai Shinbun, Inc.) and the Japanese Ministry of Finance in Japan. Interest rates and forward exchange rates are all for three months. Prediction data are from AR (1) and are monthly. The sample period is from September 1991 to August 2010. The AR (1) period is five years.

4. Empirical results

4.1 Forward Bias

Table 1 reports the standard regression results.

Table 1. Standard regression

Constant	0.00198 (0.0018)
$f_t - s_t$	−3.880 (1.56)
Adj. R^2	0.335

Note. Figures in parentheses are the Newey-West standard errors.

The forward premium has a negative point coefficient of −3.880 and is significantly different from zero.

Table 2 reports the estimated nonlinear models. The coefficient for the deviation from covered interest rate parity is negative and significantly different from zero.

Table 2. Nonlinear regression

Constant	0.0205
$f_t - s_t$	−4.353 (1.76)
ip_t	1.365 (0.69)
Adj. R^2	0.376

Note. Figures in parentheses are the Newey-West standard errors.

Recent empirical study has demonstrated that nonlinear models can provide some explanation for the forward premium puzzle. This paper confirmed this notion.

4.2 Case of Intervention

The results are shown in Table 3.

Table 3. Dispersion of exchange rates

Constant	2.12*** (7.67)
$\lvert MOF_{t-1} \rvert$	−0.023*** (−5.39)
$\lvert s_t - s_{t-1} \rvert$	1.99 (0.52)
$\lvert s_t - s_{average} \rvert$	6.08** (2.17)
$\lvert f_t - E_t s_{t+1} \rvert$	9.27** (1.97)
Volatility	108.55** (2.37)
log.kikel.	−188.36

***, **, and * are significant at 1%, 5%, and 10% levels. Parentheses are t-statistics.

It is interesting to note that the coefficients of departures from the

expected signs are positive and significant. It can be expected that forecaster heterogeneity increases as misalignments grow. On the other hand, the coefficients of the intervention measure are significantly negative. This indicates a lowering of uncertainty exchange rate fluctuations in the presence of intervention in the foreign exchange markets.[5,6]

5. Conclusions

This paper examined recent data and found that the degree of bias varies significantly. When deviation is large, the degree of bias is smaller than that implied by the standard regression.

This paper also analyzed the impact of central bank intervention on Japanese foreign exchange markets and found misalignments as well as recent returns of exchange rate as these variables have proven to be important for heterogeneity among forecasters on foreign exchange markets. This study also found that Japanese Ministry of Finance interventions have a dampening effect on the dispersion.

In the past year or so, intervention in the foreign exchange market has received much attention as exchange rate volatility and movement have been large. Direction is important. Fatum and Pedersen (2009) indicated that only when the direction of intervention is consistent with the monetary policy stance does intervention exert a significant influence on exchange rate returns. For example, Beine et al. (2009) suggested that appropriate speeches that clarify the current intervention policy can have marginally positive effects, both in terms of exchange rate level and exchange rate volatility. Suwardi (2008) indicated that interventions by the Bank of Japan and the Federal Reserve are more effective in changing the direction of the exchange rate movements and reducing its volatility level in a regime when the exchange rates are severely misaligned. Wan and Kao (2010) found that magnitudes of interventions are affected by the price impacts of contrarians

and their activities on market stabilization. Kaiyvitis and Skotida (2010) indicated that a delayed overshooting pattern in cross exchange rates is accompanied by asymmetric interventions by central banks in the foreign exchange markets under consideration triggered by a U.S. monetary policy shock. Breedon and Vitale (2010) suggested that the strong contemporaneous correlation between order flow and exchange rates is largely due to portfolio-balance effects. As in these examples, many important factors should be taken into account. Iinterventions are more successful if they obey certain conditions, such as being coordinated among central banks and going with the market and fundamentals (Kurihara, 2007). Moreover, this paper's sample encompasses a remarkable variation in intervention frequencies. Further research is needed. Cooperation is important. In the past, Japanese authorities appeared to intervene mainly in response to deviations of the exchange rate from some implicit target levels and to a rise in market uncertainty. U.S. monetary authorities intervened only in cooperation with the Japanese authorities.

Notes

1. Paya et al. (2010) estimated the forward premium puzzle in the interwar period.
2. Elliot et al. (2008) examined heterogeneity in output. Mankiw et al. (2003) examined expectation heterogeneity in inflation. Kurihara (2007) found support for the chartist and fundamental approach investigating the determinants of forecast dispersion.
3. See Fratzscher (2008) and Beine et al. (2009). Ferré and Manzano (2009) suggested that the degree of superior information held by the central bank will influence the decision to intervene secretly or publicly.
4. If $\zeta = 0$, equation (1) holds.
5. Fatum and Hutchison (2010) indicated that only sporadic and relatively infrequent intervention is effective.
6. The results are similar to those of Reiz et al. (2010) but differ from those Beine et al. (2007). This suggests that neither expected nor unexpected interventions had an impact on forecast heterogeneity between 1992 and 1994.

Acknowledgements

Financial support from the Japanese KAKEN is appreciated.

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