DISCUSSION PAPER
October 2009

No.35

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[Abstract]

This paper analyzes the effectiveness of Bank of Japan interventions between November 1995 and December 2004. We follow the methodology proposed by Fatum and Hutchison (2006) to determine the success of intervention by measuring prior and posterior exchange rate movements. Conditional on the successful intervention activities, we examine the impact of interventions on exchange rate expectations of market participants using the Foreign Exchange Consensus Forecasts poll in a panel data framework, rather than only focusing on sample average and variance of forecasts. Compared to the existing literature, which argues that interventions have, if at all, only very short-term effects on the exchange rate, we also find medium-term effects of interventions on exchange rate expectations.

Keywords: Bank of Japan; Central bank intervention; Forecasts; Exchange rate expectations; Successful intervention.

JEL Classification Codes: F31, G15

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We are especially grateful to Rasmus Fatum for his constructive comments on an earlier version of this paper. We also thank Yu-Ming Hsiao and other participants at WEAI conference in Kyoto for helpful comments and suggestions.

1. Introduction

As the financial turmoil originating in the U.S. credit market transformed into an economic crisis and spread its influence to the rest of the world, the value of the Japanese yen against the U.S. dollar rose to its highest level since the collapse of the Bretton Woods system. Already severely affected by a downturn of the world economy in the first half of 2008, world-leading Japanese manufacturers such as Toyota and Panasonic incurred undervalued foreign sales, caused by a sharp appreciation of the Japanese yen, which resulted in huge losses in the 2008-2009 fiscal year.

In the beginning of 2009, the Bank of Japan (BOJ) quietly oversaw the development of the foreign exchange market. The BOJ had not conducted an official intervention in the foreign exchange market since March 2004, after the unprecedented, large and frequent interventions in 2003. However, a G7 meeting of Treasury ministries and central bank governors in February 2009 indicates that central banks will respond in a coordinated fashion to further substantial exchange rate changes. Coupled with on-going fiscal stimulus packages by almost all governments in the world, coordinated official intervention in the foreign exchange market may effectively influence the market.

How long does the effect of interventions last? From a microstructural perspective, in the time span of a few tick orders, the value of the yen should decline as sell orders of the Japanese currency by the BOJ eliminate standing orders of yen purchases in the foreign exchange market (Evans and Lyons, 2002). The lingering effect of altering the psychology of market participants may last throughout the entire day or maybe even a few days. To have a significant long-term effect on the exchange rate, the central bank needs to alter the expectations of market participants. Therefore, a direct way to measure the long-term effect of intervention is to look at the changes in exchange rate forecasts by market participants.

This paper investigates this possible long-term effectiveness of intervention on market participants. In particular, we estimate the effect of BOJ interventions on the expected exchange rate published in the Foreign Exchange Consensus Forecast (FECF) survey. The most closely related study is Beine et al. (2007), which examines the impact of BOJ interventions on forecast heterogeneity among survey respondents. We extend Beine et al. (2007) in three important respects. First, our sample covers the period between November 1995 and December 2004, which includes the most frequent intervention year of 2003. Beine et al. (2007) ends in 2001[1]. The investigation of 2003 alone deserves attention because it reflects a period of large-scale interventions. Second, we implement a monthly intervention variable classified according to two characteristics. The first characteristic is the length of the "*evaluation period*"—that is, the number of days from the last intervention to the time of the survey. In particular, a longer evaluation period should give market participants time to assess more correctly the effectiveness of intervention on the current exchange rate. The second characteristic is the success of intervention, defined by comparing the pre-event movement and the post-event movement of the actual exchange rate, as suggested in Fatum and Hutchison (2006). Third, rather than focusing on a few sample moments, and median and standard deviation, we use disaggregated data of exchange rate forecasts in a panel data framework to exploit to the full extent of heterogeneity among survey respondents.

Our main finding is that expectations for the three-month ahead exchange rate are significantly affected by successful interventions by the BOJ. This result is contrary

[1] We chose this sample period because there has not been a single intervention by the BOJ between 2005 and now (September 2009). For robustness checks, we also obtain estimates for the extended period up to August 2007. The summary of results for robustness is given in section 4-4.

to the existing literature, which finds only short-term effects of interventions on the exchange rate (Frenkel et al. 2006, Sarno and Taylor, 2001). In addition, we find the impact is largest when the most dramatic change in the current market is observed by market participants.

This paper contributes to the literature by emphasizing the evaluation period after intervention. Market participants need to observe the reactions of the current market to correctly assess whether current interventions are successful, in order to reflect on their evaluation of exchange rate forecasts. The empirical examination in this paper support the following hypotheses. First, to affect forecasts of market participants, interventions must be observed well ahead of time to be correct. Second, interventions must be successful in the current market to influence the formation of forecasts for the market in the future.

The paper proceeds as follows. Section 2 discusses alternative approaches to estimate the effectiveness of interventions. We highlight the importance of using forecast data to correctly measure the medium-term to long-term effectiveness of interventions. Section 3 introduces the model and data set. By utilizing daily information in the monthly intervention variable, section 4 estimates the impact of interventions on the formation of expectations of market participants. We find evidence that interventions have a longer-term effect on the market, more than just short-term adjustments over a few days. Section 5 discusses the robustness of estimation results and concludes.

2. Effectiveness of Intervention on Exchange Rate Expectations

Traditionally, sterilized intervention is expected to affect exchange rates through either the portfolio balance channel or the signaling channel (Taylor, 1995). While the portfolio balance channel is based on the assumption that domestic and foreign assets are imperfect substitutes, an assumption that has been rejected repeatedly for the major currencies (Lewis, 1999; Dominguez and Frankel, 1993), the signaling channel requires that the central bank use foreign exchange interventions to signal future monetary policy to private market agents (Mussa, 1981). Hence, a prerequisite of intervention effectiveness via the signaling channel is that interventions are publicly announced or that the market expects the central bank to intervene. Therefore, it is not surprising that evidence on the effectiveness of intervention through both channels is mixed (Dominguez and Frankel, 1993; Kaminski and Lewis, 1996; Fatum and Hutchison, 1999).

In a break from this traditional reasoning, analyses based on microstructural models suggest that exchange rate movements may be largely determined by foreign exchange market order flows submitted by heterogeneous market agents, so that interventions become a means of disseminating information to the market (Evans and Lyons, 2002; Lyons, 1997). This type of microstructural channel of intervention effectiveness has received infrequent and mixed empirical support (Peiers, 1997; Dominguez, 2003; Neely, 2005).

In this paper, we assess the effectiveness of intervention on exchange rate expectations of market participants, using disaggregated data. Different approaches remain to measure exchange rate expectations. If expectations are regarded as rational, expectations can be proxied by ex-post realizations. Analyzing the period between 1992 and 2003, Morel and Teiletche (2005) find ambiguous results of the impact of BOJ interventions on the Japanese yen – USD exchange rate volatility. Interestingly, in the case of a purchase (sale) of JPY against USD, volatility increases (decreases). Gnabo und Teiletche (2009) find that transparent policies (i.e., public and oral interventions) appear to have the strongest effect on exchange rate volatility. A major shortcoming of these studies is that they use *realized*, i.e., ex-post, exchange rate movements to measure market expectations. However, the rational expectation hypothesis has been rejected so frequently (Frankel and Froot, 1987; Frankel and Rose 1995) that irrational expectations have been established as a stylized fact. Hence, ex-ante variables need to be taken into account to measure expectations.

Expectations can be approximated through option prices. Kim and Sheen (2006) and Watanabe and Harada (2006) found that interventions by the BOJ amplified market volatility in GARCH estimation frameworks. Adopting an event study approach, Fatum and Hutchison (2006) find evidence that sterilized BOJ intervention systematically affect the exchange rate in the short-run, i.e., less than one month. Fatum and Scholnick (2006) investigate the impact of market expectations on exchange rates, even though they focus on periods in which no monetary policy changes occurred and no central bank interventions took place. Using Federal funds futures contracts, they found that exchange rates respond within the same day to changes in market expectations. Frenkel et al. (2005) use the implied volatility to analyze the effects of BOJ interventions on the exchange rate volatility during the period between 1993 and 2000. They found that especially secretly conducted interventions correlate with an increase in exchange rate volatility. Dominguez (1998) provides an explanation for this result, arguing that ambiguous information or signals are more likely to increase volatility.

In general, the effect of interventions on exchange rate volatility depends on whether it is measured as the realized volatility (Beine et al., 2004), by conditional volatility (Baillie and Osterberg, 1997a, 1997b; Dominguez, 1998; Beine, 2004), or by implied expected volatility as recovered from option prices (Galati et al., 2007; Iwatsubo et al., 2007; Bonser-Neal and Tanner, 1996; Galati and Melick, 1999; Frenkel et al., 2005).

3. Model and Data

We define exchange rate, s_t (s_{t+k}) to be the yen value of one unit of U.S. dollar at time *t (t+k)*. We assume that a market participant at time *t* forms her expectations for exchange rate at *t+k*, based on a conditional probability distribution $f(s_{t+k}|\Omega_t)$. The exchange rate premium, $E(s_{t+k}) - s_t$, is, thus, also conditional on the current information set, Ω_t. In particular, this information set can be partitioned into interventions in the previous period, I_{t-1}, and other information subset, $\Omega_t^{'}$. If there are no interventions in the previous period, the respective expected exchange rate premium can be represented as equation (1)

$$\begin{aligned} erp_0 &= E(s_{t+k}|\Omega_t) - s_t = E(s_{t+k}|I_{t-1} = 0, \Omega_t^{'}) - s_t \\ &= \int s_{t+k} f(s_{t+k}|I_{t-1} = 0, \Omega_t^{'}) ds_{t+k} - s_t \end{aligned} \qquad (1)$$

If the BOJ purchases U.S. dollars, and market participants observe the value of U.S. dollars ($\underline{s}$) at which the official intervention is conducted,[2] the exchange rate premium in equation (1) can be partitioned into two parts:

[2] Observation by market participants, here, is used in the broadest sense, including public announcement of intervention and rumors among market participants among other situations in which market participants are aware of official intervention one way or another. See also the discussion in section 2.

$$erp_1 = \int s_{t+k} f(s_{t+k} \left| I_{t-1} > 0, \Omega_t^{'} \right.) ds_{t+k} - s_t$$
$$= \int_{s_{t+k} \geq \underline{s}} s_{t+k} f(s_{t+k} \left| I_{t-1} > 0, \Omega_t^{'} \right.) ds_{t+k} + \int_{s_{t+k} < \underline{s}} s_{t+k} f(s_{t+k} \left| I_{t-1} > 0, \Omega_t^{'} \right.) ds_{t+k} - s_t \qquad (2)$$

In the case that the BOJ intervention is successfully conducted and market participants believe that the lowest value of U.S. dollar ($\underline{s}$) is credibly supported, the second term in the second line of equation (2) becomes very small or zero. It is straightforward to see that the exchange rate premium is larger with successful intervention in the previous period.

It is noteworthy that intervention must be observed in the *previous* period to have an effect on the expected exchange rate premium, because an agent needs an *evaluation period* to assess the effectiveness of intervention on the current exchange rate. An individual agent cannot judge with certainty whether an intervention is successful if it is still on-going at the time of the survey. Therefore, we excluded current or "on-going" intervention (I_t) at time *t*, from the information set while "completed" intervention (I_{t-1}) is included. See Figure 1.

Insert Figure 1 here

We follow the methodology by Reitz and Taylor (2008) and measure the information set ($\Omega_t^{'}$), which is uncorrelated with interventions as the interest rate spread ($i_t^{JPN} - i_t^{US}$). The interest rate spread should affect the expected exchange rate premium through the uncovered interest parity condition. The expected exchange rate premium should increase correspondingly with an increase in the interest rate spread between Japan and the U.S., if uncovered interest rate parity (UIP) holds. Additionally, we control for the past exchange rate movement to account for chartists in foreign exchange market that may respond to past exchange rate movements. An agent may expect the exchange rate to move in the reverse direction if she regards the current movement as temporary. Frenkel et al. (2009a,b) provide evidence for this kind of behavior using exchange rate expectations.[3] By linearly approximating equation (2) with the interest rate spread and past exchange rate movements in addition to interventions, we obtain equation (3):

$$E(s_{t+k}|\Omega_t) - s_t = \alpha + \beta I_{t-1} + \gamma(i_t^{JPN} - i_t^{US}) + \lambda \Delta s_t \qquad (3)$$

where I_{t-1} is the intervention in the previous period, $i_t^{JPN} - i_t^{US}$ is the interest rate spread between Japan and the U.S., and Δs_t is the past exchange rate movement.

For exchange rate expectations, we use the survey data from the FECF poll. The survey asks market participants for their forecasts of the Japanese yen/U.S. dollar exchange rate for one, three, and twelve month ahead horizons. The survey covers 32 institutions for between November 1995 and December 2004, i.e., 110 periods. The survey is, therefore, structured as in a panel framework and covers about 9,000 observations. The survey is conducted on the first Monday of each month, and the results are published before the 15th of that month. Survey participants work for investment banks, commercial banks, and private agencies.[4]

4. Intervention Impact on the Expectation Formation of Market Participants

In this section, we investigate the effect of BOJ intervention on the formation of exchange rate expectations in the yen/dollar market. The basic estimation equation for foreign exchange market forecasts in this paper, therefore, focuses on the

[3] The mean-reverting behavior of exchange rates is also confirmed in the overshooting model of Dornbusch (1976) and in the literature on excess volatility of foreign exchange rates.
[4] The complete list of the 32 institutions is attached in the appendix. The Appendix also shows the source of the data used in this paper.

characteristics of the BOJ intervention, while controlling for the market trend and other factors. Because the FECF survey is conducted on a monthly basis, we need to aggregate interventions, which are observed on a daily basis, into a monthly variable.

We constructed the monthly basis intervention in the following manner. First, an intervention is counted for the current month if the day of intervention is on or after the day of submitting a current survey and before the submission day of the next survey. Market participants are required by the FECF survey to submit their forecasts on the first day of the month. Constructed this way, interventions in the current month can only affect market expectations in the next month.

Second, because official interventions are not conducted during weekends, we count only weekdays as business days. National holidays on weekdays are counted as business days in this study because the BOJ in fact intervened in the foreign exchange market on Japanese national holidays.[5]

Third, we only focus on interventions in which the BOJ is involved in foreign exchange markets to sell Japanese yen. This approach is justified on the basis that the purchase of Japanese yen by the BOJ is observed only on a few occasions. In most cases, the intention of BOJ interventions is to keep the Japanese yen from further appreciation—that is, a "leaning against the wind" strategy.

4-1. Baseline model result

Following closely the methodology introduced by Dominguez and Frankel (1993) and our model in section 3, our baseline model tests whether exchange rate forecasts for the m-th month ahead, $f_{t,i}^{m}$, by *i*-th survey correspondent, adjusted for

[5] For example, the BOJ intervened on the National Day, the 11th of February in 2003.

current exchange rate, s_t, are affected by central bank interventions while controlling for past movements of exchange rate, Z_t, and interest rate spread at the end of previous period, IRS_{t-1}. In equation (4), we apply panel data analysis to exploit fully the heterogeneous nature of survey respondents.

$$f_{t,i}^{m} - s_t = \alpha_i + \beta INT_{t-1} + \gamma IRS_{t-1} + \lambda Z_t + \varepsilon_t \qquad (4)$$

The number of days on which interventions are conducted in the previous month is denoted as INT_{t-1}.[6] We also calculated the number of intervention days in the previous two months as $INT2_{t-1}$, and in the previous three months as $INT3_{t-1}$. Past exchange rate movements are defined as the difference between the current exchange rate and the past exchange rate—these movements are also included as control variables: $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$. Ito (2002) adopts past daily exchange rate changes as explanatory variables in his exchange rate equation. Corresponding terms of the interest rate spread between Japan and the U.S. are also included as a control variable.[7] All variables are in logarithmic form, except for the intervention variable and the interest rate spread. While the parameter β is expected to be positive,[8] the expected sign of γ is not immediately clear. According to the UIP, the interest differential should be an unbiased predictor of the percentage change in the exchange rate. Equivalently, given that covered interest rate parity is known to hold closely, at least among eurodeposit

[6] We decided not to use the total values of intervention simultaneously with the number of intervention days because correlation between these variables is very high.

[7] For one-month forecasts, discount rates are used to calculate one-month equivalent interest rates. Similarly, treasury bill rates and financing bill rates are used for three-month forecasts and government bond yields are used for 12-month interest rates. This data is drawn from International Financial Statistics, IMF. See the appendix for more details.

[8] We expect β to be positive because a sale of Japanese Yen against the U.S. dollar should yield an appreciation of the yen and thus, the yen/dollar exchange should decrease.

interest rates (Taylor, 1987, 1989), UIP implies that the forward exchange rate should be an unbiased predictor of the spot rate. If market participants believe in the UIP, therefore, one would expect γ to be positive. However, the failure of UIP (equivalently, the failure of forward rate unbiasedness) is so well documented as to have established itself as a stylized fact (Froot and Thaler, 1990; Taylor 1995). It seems that, if anything, there is a tendency among traders to bet against UIP using various "forward-rate bias" or "carry trade" strategies (Fabozzi, 2001; Rosenberg, 2003; Galati et al. 2007), which suggest a negative sign for γ.[9]

As a preliminary estimation, we estimated equation (4) as a panel model. In Table 1, within-estimation results of the baseline model are presented. Our main findings are as follows. Central bank interventions do not affect market participants in forming medium-term and long-term forecasts, f^3-s and f^{12}-s. The number of intervention days seems to influence short-term forecasts, f^1-s; however, the negative sign of estimated coefficients contradicts the expected sign. Hence, at a first glance, the evidence for the impact of interventions on exchange rate expectations are, at best, very weak.

By comparing the magnitude of estimated coefficients for alternative intervention variables, we can conclude market participants are more sensitive to immediate interventions, *Int(-1)*, than to distant interventions a few months ago, *Int2(-1)* or *Int3(-1)*. In the following subsections we, therefore, focus on interventions in the immediate previous month.

It is also noteworthy to mention the result for the control variables. The interest rate spread is not statistically significant or contradictory to the expected sign of the UIP

[9] The act of buying high-interest rate currencies is also referred to as a "carry trade" (Galati and Melvin 2004). Overall, therefore, the sign of this coefficient is ambiguous.

hypothesis. Hence, our results favor the carry trading strategies. On the other hand, past movements of the exchange rate consistently have negative impacts on all horizons of forecasts. The $\Delta_1 S$ coefficient for the one month forecast of about -.33 indicates that whenever the yen, for example, depreciates by 10 percent during the last month, forecasters expect the yen to appreciate by 3.3 percent. This behavior is found frequently in empirical studies on exchange rate expectations (Frenkel et al., 2009a.b). For short-term forecasts, however, past movements of exchange rates in six-month forecasts have positive impacts on forecasts, while past movements in one and three-month forecasts have negative impacts. Interestingly, the length of past movements and forecast horizons seems to coincide for medium- and long-term forecasts. The negative coefficients of past changes in exchange rates on forecast equations is indicative of market participants' takes on current movements as temporary or over-shooting, and market participants expect rates to return to the previous level in the future.

Insert Table 1 here

4-2. Ongoing versus completed interventions

In the previous subsection, we only find weak evidence for the effect of intervention on forecasts. This might be due to the process of aggregating daily intervention data into a monthly variable by only counting the numbers of actual interventions. This procedure assumes that at the beginning and at the end of the previous period the intervention has the same impact on exchange rate expectations. We relax this assumption and test whether the evaluation period, i.e., the length of interval between the last day of an intervention and the day on which the survey is collected, has an effect on exchange rate forecasts.

If the central bank initiates interventions just a day before market participants are asked for future forecasts, survey respondents may not be able to assess whether the intervention was effective to influence the current level of exchange rate. This is also true once the central bank reports its intervention with a certain time lag. If the central bank still needs consecutively to intervene in the market, market participants perceive that the central bank has not, yet, managed to shift the market to its target level. On the other hand, the end of a continued intervention series itself can be a signal of successful/effective interventions to market participants. To influence forecasts insignificantly as defined in equation (2), a series of interventions needs to be completed or ceased well before the survey date.

If completed interventions represent effective interventions, the measured impact of interventions on market forecasts should be greater. We investigate this hypothesis by utilizing the number of days elapsed from the last interventions, *Days,* in a multiplicative form with an intervention variable. We also use dummy variables, *1W* and *2W*, which take value of one if the last series of interventions stops more than 5 days and 10 days, respectively, before the survey date. In particular, we estimate the following equation (5) with *Days*, *1W*, and *2W* instead of d_{t-1}:

$$f_t^m - s_t = \alpha + \beta Int_{t-1} + \delta(d_{t-1} \times Int_{t-1}) + \gamma IRS_{t-1} + \lambda Z_t + \varepsilon_t \qquad (5)$$

The estimation results for equation (5) are presented in Table 2. Even when the *Days* variable as an interaction term with Int_{t-1} is introduced, Int_{t-1} independently remains statistically significant for short-term forecasts. Moreover, the impact of intervention on exchange rate forecasts increases if intervention is completed at least one week prior to the survey date.

For medium-term forecasts, the interaction term becomes positive with statistical significance in specification (iv) and (vi). The positive value indicates that a purchase of U.S. dollars by the BOJ becomes more effective in influencing medium-term forecasts if the intervention series is completed well ahead of the survey date. For example, a one-day intervention completed ten days prior to the survey date increases the expected exchange rate by 0.15% in specification (iv).[10] If an intervention is completed at least two weeks prior to survey day, a single-day intervention increases exchange rate expectations by 0.19%. Similar to table 1, the control variables, such as the interest rate spread and the past exchange rate change, remain significant.

In sum, our main finding is that completed interventions (the more distant in time from the survey date) are more effective than ongoing interventions (more recent in time) for short-term forecasts. This is consistent with the formation of an expectation in which information updates require longer observation of the event outcome. If the event is ongoing, market observers cannot assess with confidence whether intervention is successful. Hence, our results provide some evidence for learning in the foreign exchange market. Apparently, market participants have to learn whether the BOJ's intervention in the foreign exchange market is transitory or permanent. Completed (or discontinued) interventions, on the other hand, may signal to market participants that the objective of the central bank has been achieved—upholding the yen's devaluation vis-à-vis the U.S. dollar. In pursuing this hypothesis that only successful intervention can affect forecasts of market participants, we implement successful measures

[10] "Days of ongoing intervention" takes a value of one. The overall impact of intervention is the sum of β and δ *Days* multiplied by the number of intervention days in equation (5).

developed in Fatum and Hutchison (2006) in the next subsection.

Insert Table 2 here

4-3. Does the success of intervention matter?

We define "events" and successful interventions following the event study approach in Fatum and Hutchison (2006). First, we define the event window as including pre-event days, the event day, and post-event days. We decided to use the baseline model in Fatum and Hutchison (2006) of 2-day event windows and a tranquility period of 5 days.

Second, we adopt the definition of successful interventions from Fatum and Hutchison (2006). Following the "direction" criterion, an intervention is successful if sales of Japanese yen are associated with a depreciation of the yen in the post-event window. According to the "smoothing" criterion, an intervention is successful if sales of Japanese yen cause a change in the exchange rate in the associated post-event window to be greater than an exchange rate change in the pre-event window. In particular, this definition covers a wider set of interventions as successful, including ones that diminish the rate of an appreciation in the post-event window. The last definition is the "reversal," in which an intervention yields a depreciation of the Japanese yen in the post-event window after observing an appreciation in the pre-event window.

Instead of using the number of intervention days in the previous month as an intervention variable, we introduce as an alternative a binary variable denoted as D_{t-1}. We define four distinct dummy variables, according to the above definitions for successful interventions. *D_Int(-1)* takes value of one if an intervention is conducted and not continued to at least the day before the survey date, i.e., it takes the value of zero when the previous month has either ongoing interventions or no intervention. The next three dummy variables, *D_DIR(-1)*, *D_SMO(-1)*, and *D_REV(-1)*, are constructed according to the above definitions of successful interventions. In case there is more than one intervention event, the last intervention in the current month is used. These dummy variables are used alternatively. The estimation equation can be summarized as follows.

$$f_t^m - s_t = \alpha + \beta D_{t-1} + \gamma IRS_{t-1} + \lambda Z_t + \varepsilon_t \qquad (6)$$

Estimation results for equation (6) are presented in Table 3. Different from the intervention variable, *Int(-1)*, which counts the number of intervention days, in equation (5), *D_Int(-1)* takes binary values according to whether there is an intervention at all and the last intervention is *complete*. The first row in Table 3 shows that the intervention in the previous month, measured in this way, affects the market forecasts in the short- and medium-term. So a mere observation of central bank involvement in the foreign exchange market still influences the way market participants form their exchange rate expectations if an intervention is *complete*.

The second through fourth rows in Table 3 provide the estimated coefficients of successful interventions in the previous month. For the short-term and the long-term forecasts, successful interventions in the previous month have statistically insignificant effects on exchange rate forecasts, except for “smoothing” intervention in short-term.

For medium-term forecasts, however, successful intervention defined by any criteria is effective in influencing forecast, in such a way that the expected exchange rate increases. Given the magnitude of a three-plus percent increase in the expected exchange rate, the economic significance of successful intervention is substantial. Combined with the magnitude of one percent for *D_Int(-1)*, the effective result for the successful intervention variable suggests that the success of interventions is essential in affecting market participants' forecasts in the medium-term.

Insert Table 3 here

4-4 Robustness on parameter stability over sample periods

Our survey data on exchange rate forecasts covers a longer period than in previous subsections, even though intervention by the BOJ stopped after 2004. The estimation results for the extended sample period between November 1995 and August 2007 do not change qualitatively and are available upon request. A noticeable difference is that the coefficients of the interaction term between the intervention variable and the *2W* dummy variable for one-month and three-month forecasts and the coefficient of smoothing intervention dummy variable become insignificant. For the other variables, however, the qualitative result remains quite robust, especially with regards to the coefficients of the intervention variables. Moreover, the fitness of regressions decreases for all cases when the sample period is extended to August 2007. So our result based on the original sample period is more suitable for examining the effect of intervention activity on market forecasts.

More importantly, there seem to be different regimes for the attitude of the BOJ regarding foreign exchange market intervention during 2003-2004. Both the values and frequency of interventions during these years are unprecedented. So, the response of market participants may have changed between the pre-2003 period and these two years. To check the stability of model parameters, we re-run the regressions for the period from November 1995 only up to December 2002[11]. The estimated results are presented in Table 4-6. Regarding intervention variables, all variables remain significant and comparable in size. In addition, the intervention variable, *Int(-1)*, becomes statistically significant for all specifications for equation (6). Put differently, the inclusion of these exceptional two years in the sample weakens the effect of interventions on the forecasts of market participants. Intuitively, market participants are less sensitive to intervention activities in these two years because the BOJ intervention in the foreign exchange market became relatively ordinary.

For the other variables, we have two noteworthy results. First, the interest rate spread becomes statistically insignificant for all specifications. Second, the past exchange rate changes become statistically significant for the long-term forecasts.

Insert Tables 4, 5 and 6 here

5. Discussions and Conclusions

In reviewing the results of the different specifications we proposed in this paper, we discuss important two issues: How long does the effect of intervention last and to what degree is the success of intervention a decisive factor in affecting forecasts of market participants?

First, we discuss the intervention effect on exchange rate forecasts in terms of time horizon. Regarding the intervention effect on medium-term and long-term forecasts, our results are very clear. Market participants adjust their 3-month forecasts in the direction of yen depreciation when they observe completed and successful U.S. dollar purchase interventions by the BOJ, while 12-month forecasts are not influenced

[11] A Chow-test cannot reject the null hypothesis of equal coefficients for all variables including fixed dummies between two sub-sample periods.

by any intervention activities in the current market.

However, our result of intervention impacts in the short-term is not entirely clear. The negative effect of intervention on the short-term forecast is obtained for specifications (i) through (vi) in Tables 1 and 2 when the intervention variable includes “on-going” intervention. The interpretation of this result is not straightforward because interventions in this study are strictly restricted to U.S. dollar purchases and therefore market participants should receive signals that the BOJ supports depreciation of the Japanese yen (an increase in the dependent variable). However, the sign of the intervention effect becomes positive when the intervention dummy variable excluded “on-going” intervention in specification (vii) in Table 3. We feel tempted to interpret this sign switch as supporting evidence for our emphasis on the “evaluation period.” However, intervention dummy variables based on success is again negative for specifications (viii) to (x). Concerning the first question of how long the intervention effects can last, given this evidences, we confirm that BOJ intervention is most effective in influencing medium-term forecasts.

Next, we discuss the extent to which the success of intervention matters in influencing foreign exchange market forecasts. By focusing on the magnitude of the coefficients on interventions in three categories for the medium-term horizon, the impact is the largest (4.8% rise in exchange rate premium) for interventions that were capable of reversing the appreciation trend of the yen in the pre-intervention period. On the other hand, interventions that only slowed down the appreciation trend had the impact of increasing exchange rate premium 3.5% upward. Therefore, the result is very intuitive—intervention is the most effective in influencing market forecasts when it results in the most dramatic changes in the market.

A number of studies demonstrated that central bank interventions are effective in influencing the current market exchange rate. Some studies extended this idea by studying the effectiveness of interventions on the volatility of the market. This paper contributes to the literature by emphasizing the evaluation period of market participants in which they reflect on their formation of forecasts of the exchange rate, after taking time to correctly assess whether current interventions are successful. Based on the disaggregated FECF poll and BOJ interventions between 1995 and 2004, this paper provides strong evidence that only *successful* interventions affect forecasts of market participants. This effect is most apparent in the case of medium-term exchange rate expectations. This result is consistent with the existing literature, which finds an impact on the actual exchange rate only for the short run, if at all.

Data Appendix:

Monthly interest rate:
Discount Rate (End of Period) (Japan)*:* Rate at which the Bank of Japan discounts eligible commercial bills and loans secured by government bonds, specially designed securities, and eligible commercial bills. This rate is considered the key indicator of the Bank's discount policy.
Discount Rate (End of Period)(U.S.): Rate at which the Federal Reserve Bank of New York discounts eligible paper and makes advances to member banks. Establishment of the discount rate is at the discretion of each Federal Reserve bank but is subject to review and determination by the Board of Governors in Washington every fourteen days; these rates are publicly announced. Borrowing from a Federal Reserve bank is a privilege of being a member of the Federal Reserve system. Borrowing may take the form either of discounts of short-term commercial, industrial, and other financial paper or of advances against government securities and other eligible collateral; most transactions are in the form of advances. Federal Reserve advances to or discounts for member banks are usually of short maturity up to fifteen days. Federal Reserve banks do not discount eligible paper or make advances to member banks automatically. Ordinarily, the continuous use of Federal Reserve credit by a member bank over a considerable period of time is not regarded as appropriate. The volume of discounts is consequently very small. † Effective January 9, 2003 the rate charged for primary credit replaces that for adjustment credit. Primary credit, which is broadly similar to credit programs offered by many other central banks, is made available by the Federal Reserve Bank for short terms as a backup source of liquidity to depository institutions that are in sound financial condition.

Three- month interest rate:
Financing Bill Rate (Japan)*:* Average rate of yield on 13-week Financing Bills.
Treasury Bill Rate (U.S.)*:* Weighted average yield on multiple-price auctions of 13-week treasury bills. Monthly averages are computed on an issue-date basis. Beginning on October 28, 1998, data are stop yields from uniform-price auctions.

Annual interest rate:
Government Bond Yield (Japan)*:* Prior to December 1998, data refer to arithmetic average yield to maturity of all ordinary government bonds. Beginning in December 1998, data refer to arithmetic average yield on newly issued government bonds with 10-year maturity.
Government Bond Yield (U.S.): Yield on actively traded treasury issues adjusted to constant maturities. Yields on treasury securities at constant maturity are interpolated by the U.S. Treasury from the daily yield curve. This curve, which relates the yield on a security to its time to maturity, is based on the closing market bid yields on actively traded treasury securities in the over-the-counter market. These market yields are calculated from composites of quotations obtained by the Federal Reserve Bank of New York. *Medium-Term* rate refers to three-year constant maturities. *Long-Term* rate refers to ten-year constant maturities.

Consumer Price Index:
To construct the purchasing power parity, the not seasonally adjusted consumer prices indexes for Japan and the U.S. were taken from the International Monetary Fund's International Financial Statistics database. The Mnemonic codes are JPI64...F and USI64...F, respectively.

Interventions of the Bank of Japan:
The interventions of the Bank of Japan in the Japanese yen/us dollar market were taken from the website of the Ministry of Finance (http://www.mof.go.jp/english/e1c021.htm). The figures were in bn. Japanese yen.

Lists of Survey participants:

Institution	Institution	Institution	Institution
ABN Amro	Bank of America	Bank of Tokyo	Bankers Trust Company
Banque Nationale de Paris	Barclays Bank	Barclays Capital	Barclays de Zoete Wedd
BNP Paribas	Chase Manhattan	Citigroup	Commerzbank
Credit Suisse	Deutsche Bank	Dresdner Kleinwort Wasserstein	General Motors
Global Insight	HSBC	Imperial Chemical Inds	Industrial Bank of Japan
ING Barings	JP Morgan	Merrill Lynch	Morgan Stanley
NatWest Group	Nomura Research Institute	Oxford Econ Forecasting	Royal Bank of Canada
Societe Generale	Standard Chartered Bank	UBS Warburg	Westdeutsche LBank

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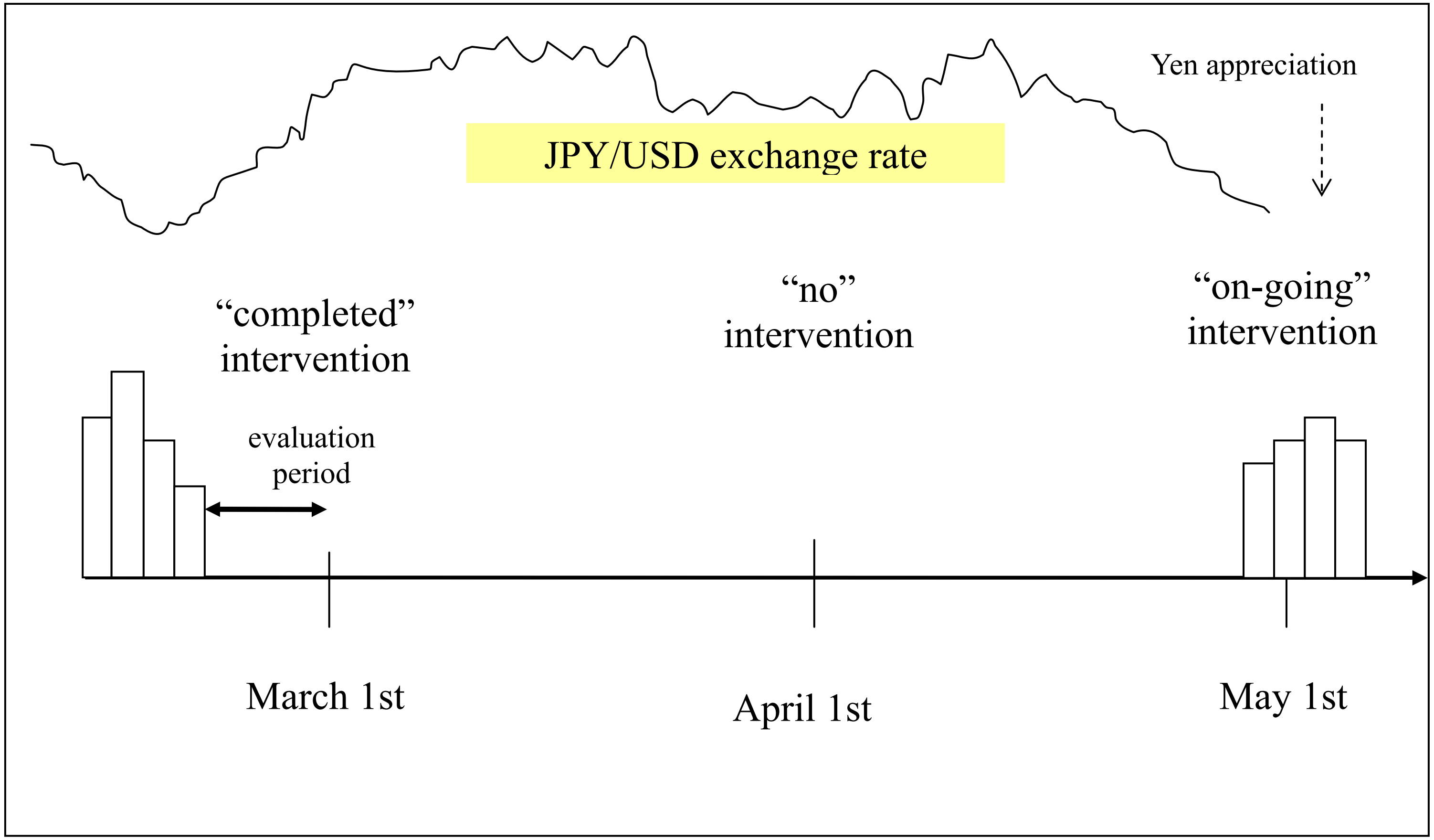
Figure 1. 'Completed' intervention versus and 'on-going' intervention



Note: The graph on the top part represents JPY/USD exchange rate movement. The bars on the bottom represent the amount of interventions. The survey is conducted on the first day of every month.

Table 1. Panel estimation of interventions on exchange rate forecasts, Nov1995 -Dec2004.

	F^1-S			F^3-S			F^{12}-S		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Int(-1)	-0.0011 ***			-0.0004			0.0020		
	(0.0002)			(0.0006)			(0.0032)		
Int2(-1)		-0.0007 ***			-0.0003			0.0020	
		(0.0001)			(0.0004)			(0.0018)	
Int3(-1)			-0.0006 ***			-0.0004			0.0018
			(0.0001)			(0.0003)			(0.0013)
IRS(-1)	-0.67	-0.34	0.18	-3.98 ***	-3.89 ***	-3.62 **	-1.25	-1.72	-2.03
	(1.91)	(1.90)	(1.95)	(1.37)	(1.42)	(1.45)	(1.32)	(1.30)	(1.29)
$\Delta_1 S$	-0.3371 ***	-0.3312 ***	-0.3305 ***	-0.2564 ***	-0.2540 ***	-0.2525 ***	-0.1867	-0.2031	-0.2041
	(0.0261)	(0.0259)	(0.0254)	(0.0680)	(0.0663)	(0.0665)	(0.2088)	(0.2089)	(0.2081)
$\Delta_3 S$	-0.0533 ***	-0.0558 ***	-0.0511 ***	-0.1064 **	-0.1069 **	-0.1028 **	-0.0990	-0.0928	-0.1025
	(0.0193)	(0.0192)	(0.0193)	(0.0501)	(0.0498)	(0.0502)	(0.1361)	(0.1388)	(0.1364)
$\Delta_6 S$	0.0352 ***	0.0352 ***	0.0306 **	-0.0056	-0.0066	-0.0120	-0.3540 ***	-0.3486 ***	-0.3416 ***
	(0.0131)	(0.0130)	(0.0130)	(0.0361)	(0.0364)	(0.0358)	(0.0969)	(0.1003)	(0.1010)
Adj R^2	0.062	0.063	0.065	0.055	0.055	0.056	0.103	0.103	0.104
NOB	2006	2006	2006	2105	2105	2105	2102	2102	2102

Note: Dependent variables are one-month forecast, three-month forecast, and twelve-month forecast, all subtracted by current exchange rate. *Int(-1)* , *Int2(-1)* and *Int3(-1)* are the number of intervention days, respectively, in previous one, two, and three months. $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$ are difference between current exchange rate and past exchange rate one, three, six months ago, respectively. *IRS* is interest rate spread between Japan and US. Coefficients are estimated by within estimation and the figures in the parenthesis are heteroskedasticity-robust standard errors. The statistical significance of one, five and ten percent are denoted by "***","**","*", respectively.

Table 2. Impact of completed versus ongoing interventions, Nov1995 -Dec2004.

	F^1-S			F^3-S			F^{12}-S		
	(iv)	(v)	(vi)	(iv)	(v)	(vi)	(iv)	(v)	(vi)
Int(-1)	-0.0010 ***	-0.0010 ***	-0.0010 ***	-0.0015***	-0.0006	-0.0007	0.0016	0.0020	0.0012
	(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0005)	(0.0005)	(0.0042)	(0.0034)	(0.0033)
*Days*Int(-1)*	0.0000			0.0003 *			0.0001		
	(0.0000)			(0.0002)			(0.0008)		
*1W*Int(-1)*		-0.0006 **			0.0013			-0.0004	
		(0.0003)			(0.0011)			(0.0070)	
*2W*Int(-1)*			-0.0006 *			0.0026 *			0.0067
			(0.0003)			(0.0015)			(0.0084)
IRS(-1)	-0.67	-0.66	-0.67	-4.02 ***	-4.00 ***	-4.01 ***	-1.28	-1.25	-1.37
	(1.91)	(1.91)	(1.91)	(1.38)	(1.37)	(1.38)	(1.31)	(1.31)	(1.31)
$\Delta_1 S$	-0.3375 ***	-0.3384 ***	-0.3391 ***	-0.2547***	-0.2540 ***	-0.2487 ***	-0.1862	-0.1875	-0.1666
	(0.0261)	(0.0261)	(0.0262)	(0.0687)	(0.0691)	(0.0707)	(0.2076)	(0.2050)	(0.2011)
$\Delta_3 S$	-0.0527 ***	-0.0534 ***	-0.0517 ***	-0.1101**	-0.1062 **	-0.1131 **	-0.1001	-0.0992	-0.1152
	(0.0192)	(0.0193)	(0.0193)	(0.0506)	(0.0501)	(0.0511)	(0.1359)	(0.1365)	(0.1352)
$\Delta_6 S$	0.0351 ***	0.0353 ***	0.0347 ***	-0.0052	-0.0058	-0.0036	-0.3545***	-0.3537 ***	-0.3516 ***
	(0.0132)	(0.0131)	(0.0132)	(0.0360)	(0.0361)	(0.0360)	(0.0966)	(0.0965)	(0.0974)
Adj R^2	0.061	0.061	0.061	0.056	0.055	0.055	0.102	0.102	0.103
NOB	2006	2006	2006	2105	2105	2105	2102	2102	2102

Note: Dependent variables are one-month forecast, three-month forecast, and twelve-month forecast, all subtracted by current exchange rate. $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$ are difference between current exchange rate and past exchange rate one, three, six months ago, respectively. *Days* indicates the number of days elapsed from the last intervention to current survey date. *1W* and *2W* are dummy variables which takes value one if elapsed days are more than 5 days and 10 days, respectively. Coefficients are estimated by within estimation and the figures in the parenthesis are heteroskedasticity-robust standard errors. The statistical significance of one, five and ten percent are denoted by "***","**","*", respectively

Table 3. Impact of successful intervention, Nov1995 -Dec2004.

	F^1-S				F^3-S				F^{12}-S			
	(vii)	(viii)	(ix)	(x)	(vii)	(viii)	(ix)	(x)	(vii)	(viii)	(ix)	(x)
D_Int(-1)	0.0107 ***				0.0102 **				-0.0038			
	(0.0022)				(0.0042)				(0.0324)			
D_DIR(-1)		-0.0027				0.0460 **				-0.0054		
		(0.0023)				(0.0231)				(0.0266)		
D_SMO(-1)			-0.0046 *				0.0355 *				-0.0327	
			(0.0024)				(0.0205)				(0.0245)	
D_REV(-1)				-0.0030				0.0480 **				0.0002
				(0.0024)				(0.0245)				(0.0281)
IRS(-1)	-1.14	-1.74	-1.77	-1.76	-3.97 ***	-4.18 ***	-4.20 ***	-4.05 ***	-0.90	-0.88	-0.95	-0.88
	(1.90)	(1.91)	(1.91)	(1.92)	(1.20)	(1.18)	(1.19)	(1.14)	(1.28)	(1.28)	(1.28)	(1.28)
$\Delta_1 S$	-0.3540 ***	-0.3325 ***	-0.3254 ***	-0.3325 ***	-0.2707 ***	-0.3702 ***	-0.3594 ***	-0.3627 ***	-0.1798	-0.1718	-0.0910	-0.1856
	(0.0268)	(0.0283)	(0.0289)	(0.0281)	(0.0698)	(0.0590)	(0.0606)	(0.0582)	(0.2115)	(0.2109)	(0.2136)	(0.2090)
$\Delta_3 S$	-0.0558 ***	-0.0606 ***	-0.0624 ***	-0.0609 ***	-0.1055 **	-0.0759	-0.0815 *	-0.0732	-0.0952	-0.0982	-0.1185	-0.0942
	(0.0193)	(0.0199)	(0.0200)	(0.0199)	(0.0491)	(0.0490)	(0.0488)	(0.0493)	(0.1362)	(0.1351)	(0.1352)	(0.1349)
$\Delta_6 S$	0.0427 ***	0.0490 ***	0.0459 ***	0.0491 ***	-0.0080	0.0284	0.0352	0.0267	-0.3684 ***	-0.3745 ***	-0.4070 ***	-0.3710 ***
	(0.0128)	(0.0129)	(0.0130)	(0.0129)	(0.0361)	(0.0356)	(0.0377)	(0.0354)	(0.0968)	(0.1076)	(0.1116)	(0.1074)
Adj R^2	0.060	0.058	0.058	0.058	0.056	0.063	0.061	0.063	0.102	0.102	0.103	0.102
NOB	2006	2006	2006	2006	2105	2105	2105	2105	2102	2102	2102	2102

Note: Dependent variables are one-month forecast, three-month forecast, and twelve-month forecast, all subtracted by current exchange rate. Dummy variable, *D_Int(-1)* , takes value of one if "completed" intervention is conducted in previous month. *D_DIR(-1)* , *D_SMO(-1)* and *D_REV(-1)* take value of one if "completed" intervention in previous month is defined as successful intervention respectively by "direction," "smoothing," and "reversing" criteria. $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$ are difference between current exchange rate and past exchange rate one, three, six months ago, respectively. Coefficients are estimated by within estimation and the figures in the parenthesis are heteroskedasticity-robust standard errors. The statistical significance of one, five and ten percent are denoted by "***","**","*", respectively.

Table 4. Panel estimation of interventions on exchange rate forecasts (Sub-sample), Nov1995-Dec2002.

	F^1-S			F^3-S			F^{12}-S		
Int(-1)	-0.0044 ***			0.0001			-0.0068		
	(0.0008)			(0.0034)			(0.0051)		
Int2(-1)		-0.0029 ***			0.0010			-0.0035	
		(0.0005)			(0.0028)			(0.0041)	
Int3(-1)			-0.0024 ***			0.0001			-0.0007
			(0.0004)			(0.0020)			(0.0036)
IRS(-1)	2.38	2.59	2.86	-2.74	-2.82	-2.75	-0.95	-0.94	-0.99
	(2.03)	(2.00)	(2.13)	(1.88)	(1.93)	(1.96)	(1.26)	(1.26)	(1.27)
$\Delta_1 S$	-0.3458 ***	-0.3425 ***	-0.3389 ***	-0.2318 ***	-0.2330 ***	-0.2321 ***	-0.2319	-0.2293	-0.2320
	(0.0295)	(0.0295)	(0.0291)	(0.0835)	(0.0822)	(0.0815)	(0.1583)	(0.1574)	(0.1582)
$\Delta_3 S$	-0.0687 ***	-0.0720 ***	-0.0725 ***	-0.1155 **	-0.1102 **	-0.1150 **	-0.2917 ***	-0.2911 ***	-0.2758 **
	(0.0218)	(0.0221)	(0.0210)	(0.0555)	(0.0529)	(0.0555)	(0.1136)	(0.1119)	(0.1124)
$\Delta_6 S$	0.0412 ***	0.0374 ***	0.0335 **	-0.0064	-0.0035	-0.0058	-0.2815 ***	-0.2845 ***	-0.2791 ***
	(0.0137)	(0.0137)	(0.0138)	(0.0388)	(0.0401)	(0.0383)	(0.0937)	(0.0953)	(0.0958)
Adj R^2	0.051	0.052	0.052	0.051	0.052	0.051	0.092	0.092	0.092
NOB	1506	1506	1506	1605	1605	1605	1602	1602	1602

Note: Dependent variables are one-month forecast, three-month forecast, and twelve-month forecast, all subtracted by current exchange rate. *Int(-1)*, *Int2(-1)* and *Int3(-1)* are the number of intervention days, respectively, in previous one, two, and three months. $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$ are difference between current exchange rate and past exchange rate one, three, six months ago, respectively. *IRS* is interest rate spread between Japan and US. Coefficients are estimated by within estimation and the figures in the parenthesis are heteroskedasticity-robust standard errors. The statistical significance of one, five and ten percent are denoted by "***","**","*", respectively.

Table 5. Impact of completed versus ongoing interventions (subsample), Nov1995-Dec2002.

	F^1-S			F^3-S			F^{12}-S		
Int(-1)	-0.0038 ***	-0.0039 ***	-0.0042 ***	-0.0135 ***	-0.0051 ***	-0.0048 ***	-0.0153 **	-0.0104 **	-0.0104 **
	(0.0008)	(0.0008)	(0.0007)	(0.0043)	(0.0016)	(0.0015)	(0.0061)	(0.0049)	(0.0043)
*Days*Int(-1)*	-0.0002			0.0038 **			0.0024		
	(0.0002)			(0.0018)			(0.0019)		
*1W*Int(-1)*		-0.0017			0.0181 *			0.0129	
		(0.0015)			(0.0100)			(0.0128)	
*2W*Int(-1)*			-0.0017			0.0522 *			0.0407
			(0.0029)			(0.0288)			(0.0328)
IRS(-1)	2.18	2.22	2.27	-0.79	-1.96	-1.19	-0.54	-0.81	-0.48
	(2.17)	(2.11)	(2.16)	(1.52)	(1.72)	(1.57)	(1.21)	(1.24)	(1.22)
$\Delta_1 S$	-0.3406 ***	-0.3426 ***	-0.3415 ***	-0.3430 ***	-0.2656 ***	-0.3644 ***	-0.3033 **	-0.2556 *	-0.3348 **
	(0.0310)	(0.0301)	(0.0317)	(0.0719)	(0.0784)	(0.0828)	(0.1476)	(0.1515)	(0.1510)
$\Delta_3 S$	-0.0705 ***	-0.0704 ***	-0.0700 ***	-0.0758	-0.0971 *	-0.0756	-0.2729 **	-0.2809 **	-0.2685 **
	(0.0223)	(0.0222)	(0.0224)	(0.0585)	(0.0573)	(0.0609)	(0.1113)	(0.1112)	(0.1101)
$\Delta_6 S$	0.0405 ***	0.0415 ***	0.0399 ***	0.0074	-0.0096	0.0328	-0.2637 ***	-0.2812 ***	-0.2400 **
	(0.0138)	(0.0138)	(0.0142)	(0.0384)	(0.0391)	(0.0420)	(0.0942)	(0.0939)	(0.0990)
Adj R^2	0.051	0.051	0.051	0.062	0.053	0.060	0.093	0.092	0.094
NOB	1506	1506	1506	1605	1605	1605	1602	1602	1602

Note: Dependent variables are one-month forecast, three-month forecast, and twelve-month forecast, all subtracted by current exchange rate. $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$ are difference between current exchange rate and past exchange rate one, three, six months ago, respectively. *Days* indicates the number of days elapsed from the last intervention to current survey date. *1W* and *2W* are dummy variables which takes value one if elapsed days are more than 5 days and 10 days, respectively. Coefficients are estimated by within estimation and the figures in the parenthesis are heteroskedasticity-robust standard errors. The statistical significance of one, five and ten percent are denoted by "***","**","*", respectively

Table 6. Impact of successful intervention (subsample), Nov1995-Dec2002.

	F^1-S				F^3-S				F^{12}-S			
D_Int(-1)	0.0187 ***				0.0283 ***				0.0344			
	(0.0038)				(0.0074)				(0.0312)			
D_DIR(-1)		-0.0062				0.0778 *				0.0433		
		(0.0038)				(0.0406)				(0.0389)		
D_SMO(-1)			-0.0099 **				0.0625 *				0.0224	
			(0.0041)				(0.0367)				(0.0361)	
D_REV(-1)				-0.0062				0.0778 *				0.0433
				(0.0038)				(0.0406)				(0.0389)
IRS(-1)	2.62	1.60	1.38	1.60	-2.32	-1.24	-1.36	-1.24	-0.97	-0.78	-0.78	-0.78
	(2.06)	(2.18)	(2.22)	(2.18)	(1.83)	(1.52)	(1.55)	(1.52)	(1.26)	(1.22)	(1.25)	(1.22)
$\Delta_1 S$	-0.3595 ***	-0.3350 ***	-0.3252 ***	-0.3350 ***	-0.2507 ***	-0.3901 ***	-0.3721 ***	-0.3901 ***	-0.2560 *	-0.3213 **	-0.2838 *	-0.3213 **
	(0.0297)	(0.0323)	(0.0329)	(0.0323)	(0.0839)	(0.0794)	(0.0808)	(0.0794)	(0.1551)	(0.1529)	(0.1555)	(0.1529)
$\Delta_3 S$	-0.0556 ***	-0.0592 ***	-0.0593 ***	-0.0592 ***	-0.1154 **	-0.0607	-0.0870	-0.0607	-0.2717 **	-0.2448 **	-0.2648 **	-0.2448 **
	(0.0211)	(0.0221)	(0.0218)	(0.0221)	(0.0552)	(0.0577)	(0.0554)	(0.0577)	(0.1118)	(0.1092)	(0.1098)	(0.1092)
$\Delta_6 S$	0.0376 ***	0.0417 ***	0.0355 **	0.0417 ***	-0.0181	0.0351	0.0522	0.0351	-0.2906 ***	-0.2487 ***	-0.2496 **	-0.2487 ***
	(0.0138)	(0.0142)	(0.0145)	(0.0142)	(0.0394)	(0.0418)	(0.0485)	(0.0418)	(0.0916)	(0.0950)	(0.1025)	(0.0950)
Adj R^2	0.050	0.047	0.048	0.047	0.053	0.064	0.060	0.064	0.092	0.093	0.092	0.093
NOB	1506	1506	1506	1506	1605	1605	1605	1605	1602	1602	1602	1602

Note: Dependent variables are one-month forecast, three-month forecast, and twelve-month forecast, all subtracted by current exchange rate. Dummy variable, *D_Int(-1)* , takes value of one if "completed" intervention is conducted in previous month. *D_DIR(-1)* , *D_SMO(-1)* and *D_REV(-1)* take value of one if "completed" intervention in previous month is defined as successful intervention respectively by "direction," "smoothing," and "reversing" criteria. $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$ are difference between current exchange rate and past exchange rate one, three, six months ago, respectively. Coefficients are estimated by within estimation and the figures in the parenthesis are heteroskedasticity-robust standard errors. The statistical significance of one, five and ten percent are denoted by "***","**","*", respectively.