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[Abstract]

This paper analyzes the effectiveness of Bank of Japan (BOJ) interventions between November 1995 and December 2004 on foreign exchange expectations. Unlike previous studies, we focus on exchange rate expectations of individual market participants in the yen/dollar market. To this end, we use disaggregated forecast survey data from Consensus Economics. We find that, in principle, BOJ interventions do not affect exchange rate expectations when we disregard 'evaluation' period effect and successful intervention effect. However, applying the methodology proposed by Fatum and Hutchison (2006) to identify successful interventions on current spot market, we provide evidence that only successful interventions affect exchange rate expectations. Compared to the existing literature, which argues that interventions have, if at all, only short-term effects on the exchange rate, we show that successful interventions affect the exchange rate forecasts for up-to three months.

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

JEL Classification Codes: F31, G15

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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.

The most difficult question to answer in this context is: 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. The investigation of the year 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, median or standard deviation, we use disaggregated data of exchange rate forecasts in a panel data framework to exploit to the full extent the 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 to the existing literature, which finds only short-term effects of interventions on the exchange rate (Ito, 2002, Sarno and Taylor 2001, Frenkel et al. 2006, Ito and Yabu 2007). In addition, we find the impact is the largest when the most dramatic change in the current market is observed by market participants. We emphasize that an evaluation period after intervention is crucial for market participants to correctly assess whether interventions are successful. Particularly, we find that interventions must be successful to influence the expectations forming process in the foreign exchange market.

The paper is structured 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 expectation formation process of market participants and provides some robustness tests. Section 5 concludes.

2. Effectiveness of Intervention on Exchange Rate Expectations

An asset market approach to exchange rate determination results in that current exchange rate is affected by a change in economic fundamentals or a change in expected exchange rate in the future (equation (14) in Taylor, 1995). For the case of the BOJ interventions, a possible effect on current exchange rate comes from a change in expected exchange rate because the BOJ, in principal, sterilizes all interventions.

More specifically, 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 is lead by some means to expect the central bank to intervene. The evidence on the effectiveness of intervention through both channels is still mixed (Dominguez and Frankel 1993, Kaminski and Lewis 1996, Fatum and Hutchison 1999).

In this study, we pursue to focus on the signaling channel effect on the expectation of market participants. It is essential for empirical studies to choose how we measure exchange rate expectations. There exist at least three different approaches to measure exchange rate expectations; ex-post realized exchange rate, intrapolated exchange rate (volatility) and forecast surveys (Takagi, 1991).

First, expectations can be proxied by ex-post realizations if expectations are regarded as rational. 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.

Second, expectations can be also approximated through option prices. Kim and Sheen (2006) and Watanabe and Harada (2006) found that BOJ interventions 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., 2007), by conditional volatility (Baillie and Osterberg 1997a, 1997b, Elliott and Ito 1999, 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).

Third, we can directly apply forecasts of market participants from market surveys (Beine et al., 2007) In this survey approach, we may benefit from studies based on microstructural models suggest that exchange rate movements may be largely determined by foreign exchange market order flows submitted by heterogeneous market agents(Evans and Lyons 2002, Lyons 1997). In this microstructural model setting, interventions may become a means of disseminating information to the market. 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 survey data to reflect on the microstructural model approach. In the next section, we propose a simple framework in which market participants respond differently whether intervention is successful or not.

3. Model and Data

We define the exchange rate, s_t (s_{t+k}) as 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 the 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, $\Omega_t^{'}$. If there are no interventions in the previous period, the respective expected exchange rate premium can be represented as equation (1)

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

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

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

In the case that the BOJ intervention is successful and market participants believe that the lowest value of the 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 the 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

[1] 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.

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 the 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. (2009, 2010) provide evidence for this kind of behavior using exchange rate expectations.[2] By linearly approximating equation (2) with the interest rate spread and past exchange rate movements in addition to interventions, we obtain equation (3):

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

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 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 the respective month. Survey participants work

[2] 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.

for investment banks, commercial banks, and private agencies.[3] The FECF poll has several advantages over other surveys, such as the Wall Street Journal Forecast poll or the survey collected by the Japan Center for International Finance. First, the respondents are major commercial and investment banks engaged to a large extent in foreign exchange trading. Since these banks are bound in their survey answers by their recommendations to clients, an analyst may find it hard to justify why he gave a recommendation different to the one in the survey. This is expected to increase the incentives of the survey participants to submit their best rather than their strategic forecast (Keane and Runkle, 1990). Second, the panelists are headquartered in different countries rather than working only in Japan. Thirdly, the FECF poll is published on a monthly basis and contains three different forecast horizons which enables us to investigate the link between interventions and the expectation forming process in more detail.

4. Intervention Impact on the Expectation Formation of Market Participants

In this section, we investigate the impact of BOJ intervention on the expectation formation process in the yen/dollar market while we control for the market trend and fundament exchange rate factors. Since the FECF survey is conducted on a monthly basis, we constructed interventioin variable to match the monthly frequency by aggregating daily interventions. In constructing monthly intervention variable, we carefully addressed the following three issues.

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

[3] 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.

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, e.g. on February 11th, 2003.

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, i.e. a "leaning against the wind" strategy. However, our results are also robust including all BOJ interventions.

4-1. Baseline model result

Following closely the methodology introduced by Dominguez and Frankel (1993) and outlines in section 3, the baseline model tests whether exchange rate forecasts for the month *m* ahead, $f_{t,i}^{m}$, by survey correspondent *i*, adjusted for current exchange rate, s_t, are affected by BOJ interventions while controlling for past exchange rate movements, Z_t, and the interest rate spread at the end of previous period, IRS_{t-1}.[4] In equation (4), we apply a panel data analysis to exploit fully the heterogeneity of survey respondents.

[4] 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.

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

The number of days on which interventions are conducted in the previous month is denoted as INT_{t-1}.[5] 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 $\Delta_6 S$[6]. All variables are in logarithmic form, except for the intervention variable and the interest rate spread. We expect the impact of BOJ interventions on yen/dollar expectations (β) to be positive because a sale of Japanese Yen against the U.S. dollar should yield a depreciation of the yen and thus, the yen/dollar exchange rate should increase. An advantage of analyzing the yen/dollar market in this context, however, arises only from the fact that the US monetary authorities have refrained from intervening in this market (Federal Reserve Bank, 2006). Therefore, we can conclude that, insofar as there is a significant link between interventions and the exchange rate, it arises from BOJ interventions. 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 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

[5] Since the total intervention volume and the number of intervention days are highly correlated we do not use both variables simultaneously in equation (4).
[6] $\Delta_1 S$, $\Delta_3 S$, and $\Delta_6 S$ are difference between the current exchange rate, s_t, and past exchange rate one, three, and six month ago, resepectively.

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.[7]

We first 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. BOJ 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 coefficient indicates that a sale of Japanese Yen yields an appreciation of the yen[8]. Hence, at a first glance, the evidence for the impact of interventions on exchange rate expectations is, 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 our subsequent analysis 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 hypothesis. Hence, our results are in favor of 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

[7] 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.

[8] This result is consistent with Kaminski and Lewis (1996) that interventions signal changes in monetary policy in the opposite direction. However, we revisit this reverse effect for short-term forecast in section 4-4 for a possible cause of downward bias.

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., 2009, 2010). 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

The reason why we find little effect, or in reverse sign for short-term forecast, of BOJ interventions on the yen/dollar expectations might be due to the simple aggregation process of daily intervention data into a monthly variable. This procedure assumes that the intervention has the same impact on exchange rate expectations regardless of whether intervention is conducted at the beginning or at the end of the previous period. As discussed in section 3, market participants may not be able ot correctly evaluate current outcome of interventions just recently conducted. Hence, 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 if the BOJ reports its intervention with a certain time lag. If the BOJ still needs consecutively to intervene in the market, market participants perceive that the BOJ 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. In order to influence forecasts systematically 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, we can measure the impact of interventions on market expectations. We investigate this hypothesis by utilizing the number of days elapsed from the last interventions, *Days,* multiplied 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* in place 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 BOJ interventions on exchange rate forecasts increases in absolute value 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 for Japanese yen depreciation 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% (depreciation of the Japanese yen) in specification (iv).[9] If an intervention is completed at least two weeks prior to survey day, a single-day intervention increases exchange rate expectations by 0.19% (depreciation of the Japanese yen) in specification (vi). 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) in terms of shifting med-term forecasts in expected direction. We also observe this 'completed' effect for short-term forecasts, but in wrong direction. We will revisit this seemingly puzzling reverse effect of short-term forecast in section 4-4. Apparently, exchange rate forecasters respond to BOJ completed interventions. If the intervention series is still ongoing, market participants cannot fully assess whether the interventions are successful. Put differently, exchange rate forecasters have to learn whether the BOJ intervention 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 a successful measure developed in Fatum and Hutchison (2006) in the next subsection.

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[9] For single-day intervention in the past month, the effect of 'ongoing intervention' is β while the overall effect of 'completed intervention' is the sum of β and δ times *Days* in equation (5). For example above, $-0.0015+0.0003\times(10)$ gives the overall effect of (single-day) intervention completed at ten days ago.

Insert Table 2 here

4-3. Does the success of intervention matter?

According to Fatum and Hutchison (2006), we define the pre- and post-event window of two days prior to the event day, and the tranquility period of five days. We also adopt the definition of successful interventions from Fatum and Hutchison (2006) by using three criteria. Following the "direction" criterion, an intervention is successful if a sale of Japanese yen is associated with a depreciation of the yen in the post-event window. According to the "smoothing" criterion, an intervention is successful if a sale of Japanese yen causes 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 criterion 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 measure 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 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.

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

Table 3 reports the estimation results for equation (6). Different from the intervention variable, *Int(-1)*, which counts the number of intervention days, in equation (5), *D_Int(-1)* takes a binary value 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 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 do not have an impact on exchange rate expectations, except for 'smoothing' intervention for one-month ahead forecast. For medium-term forecasts, however, the coefficients of about 0.04 indicate that if the BOJ intervention series of U.S. dollar purchase is successful, market participants expect the Japanese yen to depreciate by 4 percent in the subsequent three months.

Insert Table 3 here

4-4. Revisiting the effect of intervention on the short-term forecast

We find strong evidence for effectiveness of BOJ (dollar purchase) intervention to influence three-month forecasts for Japanese yen depreciation if intervention is completed and successful. For short-term forecast, however, our results indicate negative (Japanese yen appreciation) effect of intervention for specifications (i) through (vi) in Tables 1 and 2 when the intervention variable includes ‘un’-successful intervention. The interpretation of this negative coefficient 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). We provide possible causes of downward bias in the following three issues: inclusion of unsuccessful intervention, smoothing intervention, and possible non-linearity in forecast formation.

First, the estimate negative coefficients for short-term forecast are no longer statistically significant when applied to ‘completed’ or successful interventions. Interestingly, the sign of the intervention effect for short-term forecast becomes positive when the intervention dummy variable excluded “on-going” intervention in specification (vii) in Table 3. In addition, the coefficients of successful interventions for ‘direction’ and ‘reversal’ become no longer statistically significant. We interpret this sign switch as supporting evidence for our emphasis on the evaluation period and successful interventions.

Second, we still need to address the fact that estimated coefficient for ‘smoothing’ intervention is still negative and statistically significant at ten percent level. We should note that ‘smoothing’ intervention measure is the weakest form of successfulness. This measure allows current exchange rate of the Japanese yen to continue appreciating after the US dollar purchase interventions which might be regarded as ‘unsuccessful’ intervention by market participants. It is also noteworthy that non-parametric sign test does not reject the null hypothesis of pure randomness only for 'smoothing' intervention among successful intervention measures in Fatum and Hutchison (2006)[10]. Again, our argument against the negative effect of intervention for short-term forecast is due to possible inclusion of 'unsuccessful' interventions.

Third, we need to point out that dependent variable is the difference between forecast and current exchange rate. Therefore, it is still possible that market participants adjust their one-month forecast in the direction consistent with the intention of the BOJ even when the estimated coefficient of intervention is negative. The estimated coefficient becomes negative as long as an increase (Japanese yen depreciation) in forecast exchange rate is smaller than an increase in current exchange rate when intervention is conducted. It is noteworthy that this breakdown of dependent variable poses us another puzzle that depreciation rate of current exchange rate, one-month forecast and three-month forecast for BOJ US dollar purchase intervention is possibly non-linear in forecast length. The immediate impact (on current exchange rate) becomes smaller in one-month forecast and then become amplified in three-month forecast, overshooting the original impact. We leave further analysis of this non-linearity issue for future task.

4-5. Robustness on parameter stability over sample periods

Our survey data on exchange rate forecasts covers a longer period than in previous subsections, even though BOJ intervention 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

[10] Specifically, the sign test rejected the null for 'smoothing' for 2-day windows.

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. In sum, our result based on the full sample period is even 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 value and frequency of interventions during these years are unprecedented. Hence, 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 estimated the regressions for the period from November 1995 only up to December 2002.[11] The estimated results are presented in Tables 4, 5 and 6. Regarding the 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.

Insert Tables 4, 5 and 6 here

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

5. Conclusions

This paper addresses the questions of how long the effect of BOJ intervention lasts on yen/dollar exchange rate expectations and whether the success of intervention matters for the effectiveness. Contributions of this paper are threefolds; use of disaggregated survey data, introduction of 'evaluation' period, and evaluating the impact of successful intervention on exchange rate forecasts.

Though a number of studies report that central bank interventions are effective in influencing the current market exchange rate or exchange rate expectations, literature has yet not focused on disaggregated data, i.e. institution specific exchange rate forecasts. To answer these questions, we use the Consensus Economic Forecast Poll which reports disaggregated yen/dollar forecast for one-, three- and twelve-month forecast for the time period between November 1995 and December 2004.

We provide evidence that BOJ interventions in general do not affect three-month and twelve-month forecasts while market participants adjust their one-month forecasts in the inverse direction as suggested by the intervention *when we disregard 'evaluation' period effect and successful intervention effect.* Distinguishing ongoing vs. completed interventions, we provide evidence that three-month forecasts is influenced by intervention activities in the current market. This finding indicates that exchange rate forecaster need a certain period of time to evaluate whether BOJ interventions affectively influence the exchange rate. Hence, exchange rate expectations are only affected by completed intervention series. From an economic policy perspective our results, therefore, emphasize on the importance of an "evaluation period" which should be granted to the market before assessing the effectiveness of interventions. Our results can also be interpreted in the way that financial market participants have to learn whether the BOJ emphatically intervenes in the yen/dollar market.

With BOJ dollar purchase intervention, three-month forecasts of Japanese yen exchange rate is lead to depreciate and the effect on one-month forecast becomes negligible when we introduce strong criteria for successful interventions. In sum, we provide evidence that exchange rate forecasters perceive BOJ interventions to affect the yen/dollar exchange rate for a three-month time period while they do not expect the exchange rate to respond in a longer time horizon. In particular, we provide evidence that only *successful* interventions affect forecasts of market participants. This effect is most apparent in the case of medium-term exchange rate expectations.

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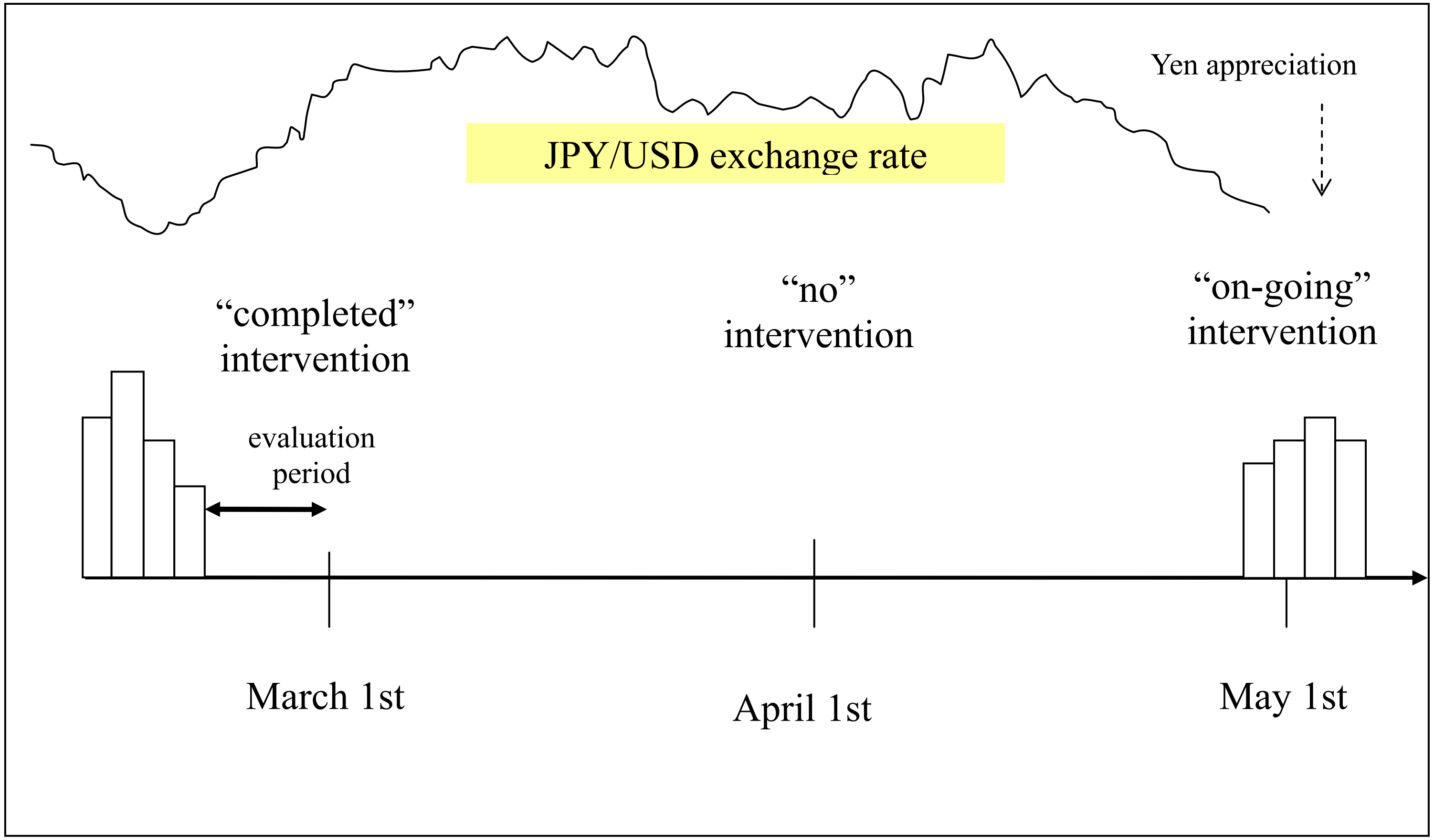
Figure 1. 'Completed' intervention versus and 'on-going' intervention



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.