

## **Cheap Talk and the BOJ:**

### **An Analysis of Japanese Officials' Intervention Remarks on the Yen/Dollar Rates**

Alan H. Chang and Yuanchen Chang<sup>\*</sup>

#### **Abstract**

This paper examines the impact of Japanese officials' comments on the yen/dollar exchange rate. We explore possible impact of central bank's manipulation of market expectations through statements around interventions. Our empirical results show that statements released by Japanese officials convey important information to market participant. We find ineffectiveness of official remarks confirming interventions by the Bank of Japan. Verbal intervention warning possible intervention has negative impact on the yen's level. By contrast, no-comment statements by Japanese officials amplified the effectiveness of the Bank of Japan intervention. Our results are consistent with the cheap talk mechanism of Crawford and Sobel (1982), which suggests that the Bank of Japan should make intervention announcements that are imprecise.

**Keywords:** Foreign Exchange, Central Bank Intervention, Bank of Japan, Cheap Talk

**JEL classification:** F31; F33, G14; G15

---

<sup>\*</sup> Alan H. Chang is from Department of Money and Banking of the National Chengchi University and Yuanchen Chang is from Department of Finance of the National Chengchi University.  
Tel.: + 8662 29393091-81102; fax: + 8662 29393394; e-mail: yccchang@nccu.edu.tw

## **Cheap Talk and the BOJ:**

### **An Analysis of Japanese Officials' Intervention Remarks on the Yen/Dollar Rates**

#### **1. Introduction**

Central bank intervention in the foreign exchange market contains important information to market participants, because it can have a significant impact on the currency values involved. In recent years, Japan is more prepared to intervene in the foreign exchange market relative to many other countries both in words and in deeds. The Japanese monetary authorities (the Ministry of Finance and the Bank of Japan) intervened in the yen/dollar markets aggressively and the size of the intervention is unprecedented during the period 2000- 2004<sup>1</sup>. In the mean time, the yen/dollar market was full of attempts of verbal intervention by Japanese officials. This paper explores possible impact of Japanese officials' manipulation of market expectations through statements around interventions.

Goodfriend (1986) and Stein (1989) show that there is an inherent time consistency problem in verbal intervention policies. The time inconsistency consists of the problem that policy-makers may be able to achieve more efficient outcomes by providing false information to the public. This may lead to a sub-optimal outcome that markets may pay too little attention to information from the authorities. As such, the trade-off a monetary authorities faces is how to maintain credibility while providing effective information to the markets. Stein (1989) shows that one solution to the time inconsistency is for the authority to give imprecise announcements on its information and

---

<sup>1</sup> Japan spent 14.83 trillion yen intervening in the currency market during the January to March quarter 2004, in a bid to

views. On the other hand, Vitale (2003) shows that an alternative solution to this problem is for the central bank to conduct actual foreign exchange interventions. He argues that this is an effective solution because an actual intervention is most transparent and because it is potentially costly, thereby ensuring credibility of the authority among market participants. However, most of the cheap talk type paper focused on theoretical modeling instead of empirical research.

With a recently released data set on intervention by the Bank of Japan, this paper provides an empirical study on the effects of the market's perception of the Bank of Japan's verbal intervention between January 2000 and December 2004. The relevance of the sample period stems from the fact that the Japanese yen was volatile against the US dollar during this period, which resulted in active intervention by the Bank of Japan. In addition, the Japanese monetary authority engaged in active verbal intervention during this period. Therefore, our paper provides important documentation of the relationship between intervention remarks by the Japanese officials and change of the yen/dollar rate.

Evidence about the effectiveness of interventions by the central banks in the literature is mixed (Ito, 2002, Frenkel, Pierdzioch and Stadtmann, 2005, Watanabe and Harada, 2005). Ito (2002) compares intervention by the Bank of Japan in recent years and concludes that stealth intervention is a worse tactic. He argues that intervention announcements should amplify the impact of intervention through signaling effects and shows that too frequent interventions may reduce the effectiveness of intervention. Watanabe and Harada (2005) examine the effects of the Bank of Japan's intervention on the volatility and the level of the yen/dollar rate. They find that intervention only reduce the short-run volatility components of the yen/dollar rate and does not have an impact on

the long-run volatility of the yen/dollar rate from late 1990 to 2003.

There is another area of research that focuses on the effectiveness of verbal intervention by government officials. Guthrie and Wright (2000) use announcement data from New Zealand and find that verbal intervention by government officials lead to large changes in interest rates across all maturities. They conclude that central bank statements can be used to implement monetary policies. Chiu (2003) examines various dimensions of the choice between transparency versus ambiguity in central banks' foreign exchange intervention. Though her assessment suggests that benefits seem to outweigh risk in enhancing the transparency of the objectives and the actual operations by the central banks, she concludes that there is strong justification for retaining a degree of constructive ambiguity in terms of intervention tactics.

An interesting question concerning different results in the literature on the effectiveness of intervention is whether actual and verbal interventions by the Bank of Japan in recent years lead to changes of the yen/dollar rates. We contend that, after examining the relationship between the effectiveness from different intervention operations, we are able to offer additional evidence on the implications for the conduct of intervention by the Bank of Japan.

Our results contribute in three ways. Firstly, previous studies of intervention by a central bank rely mainly on the effectiveness of actual interventions (Frenkel, Pierdzioch and Stadtmann, 2005, Watanabe and Harada, 2005). This paper goes beyond the earlier studies by assessing both the effects of actual and verbal intervention on the yen/dollar rate. Secondly, we compare the impact of verbal interventions by different Japanese officials. We find that the impact on the yen/dollar level is less for

intervention remarks that are precise but is more pronounced when these remarks are ambiguous. Thirdly, the evidence provided in this paper demonstrates that the effectiveness of Japan's intervention was affected by its policy to reveal information to the public. Our results are consistent with the cheap talk mechanism of Crawford and Sobel (1982), which suggests that the Bank of Japan should make intervention announcements that are imprecise.

The remainder of the paper is organized as follows. Section 2 describes actual and verbal intervention by Japanese officials. Section 3 presents the empirical results. A final section concludes.

## **2. Actual and verbal intervention by Japanese officials**

In this paper we investigate the impact of both actual and verbal intervention by the Bank of Japan between the beginning of January 2000 and the end of December 2004. The Japanese yen was volatile during this period, with the Bank of Japan conducting an unprecedented scale of intervention to manage the yen's upswing against major currencies<sup>2</sup>.

The yen/dollar rates and monthly intervention volumes during the sample period are given in Figure 1. A general pattern can be seen from Figure 1 that interventions are clustered in time. Noteworthy during this period were interventions by the Bank of Japan in the beginning of 2000 when the euro was weak and after the September 11 terrorist attacks in the United States. The size of intervention increased when the yen started to appreciate from May 2002 to June 2002. There was little intervention from July 2002 to the end of 2002. Interventions picked up from January 2003 and reached a

peak in October 2003. The patterns shown on Figure 1 indicate that the Bank of Japan intervened more often when the yen was appreciating in the sample period.

[Insert Figure 1 here]

Following Fatum and Hutchison (2002), we divide news reports into four categories. Category A contains speculations or rumors of intervention by the Bank of Japan and Category B contains verbal intervention by Japanese officials in support of a weak yen. Category C consists of reports of confirmation of Bank of Japan's intervention by Japanese officials and Category D contains no-comments intervention remarks. We use keywords to assign news reports into each category. We assume reports in Categories A and C, and Categories B and D to be mutually exclusive, but allow for overlaps between Categories A and B, and between Categories B and C. Sample reports for the four categories of news reports from the JiJi News Service are given in Appendix A<sup>3</sup>. It is seen from Table 1 that there are 232 days when the JiJi News reported speculations or rumors of intervention by the Bank of Japan from January 2000 to December 2004. The numbers of verbal intervention by Japanese officials in support of a weak yen is 317. The numbers of confirmation and no-comments remarks were 12 and 16, respectively.

We also decomposed the reports of B, C and D Categories by the name of the Japanese officials. We selected remarks from the Minister of Finance and Vice Finance Minister of International Affairs in Japan. The Minister of Finance is in charge of the exchange rate policy, while Vice Finance Minister of International Affairs is in charge of

---

<sup>2</sup> Japan spent 45,658 billion yen intervening in the currency market during the January 2000 to December 2004.

<sup>3</sup> The JiJi News, established in November 1945, is a Japanese news wire with a solid reputation for its

the actual intervention operations. During the sample period, Kiichi Miyazawa (1999-2001), Masajuro Shiokawa (2001-2003) and Sadakazu Tanigaki (2003-2004) were Minister of Finance in Japan. Haruhiko Kuroda (1999-2003), Zenbe Mizoguchi (Jan/2003-July/2004) and Hiroshi Watanabe (July/2004-Dec/2004) were Vice Finance Minister of International Affairs in Japan during the sample period. We find that all of the officials in our sample tried to use verbal intervention in support of a weak yen. Among them, Zenbe Mizoguchi and Haruhiko Kuroda use verbal interventions more often than the others. It is seen that most of the officials have both confirmation and no-comments reports in the sample. Masajuro Shiokawa confirmed more often, while Zenbe Mizoguchi prefer to use both confirmation and no-comments strategies.

[Insert Tables 1]

### **3. Results of the GARCH regression**

In this paper, we estimate the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model proposed by Bollerslev (1986) with the intervention dummy variables. In the analysis presented below, we examine the relationship between the changes of yen/dollar rate and intervention variables, which include actual intervention amounts, rumors of intervention, verbal intervention in support of a weak yen, confirmation of intervention operation and no-comment intervention remarks by the Japanese officials.

The data we use are the daily closing rate retrieved from Datastream for the yen/dollar exchange rate from January, 1, 2000 to December 30, 2004. The daily

returns for the yen/dollar rate, which are denoted by  $R_t$ , are the continuously compounded returns calculated as the difference in the logarithm of the closing rate of the two consecutive days. There are total 1,304 observations in our sample. Because the descriptive statistics of the yen/dollar rate show that the squared returns exhibit strong serial correlation; therefore, we employ the GARCH model to capture this feature in the following analysis.

We hypothesize that both actual and verbal interventions affect the changes of the yen/dollar rate. In the GARCH regressions we also take into account the impact of the confirmation and no-comment remarks by Japanese officials. There are five explanatory variables, in our analysis in Table 2, which include an actual intervention by the Bank of Japan on day  $t$ ,  $AMT_t$ , a suspected report of an intervention by the Bank of Japan on day  $t$ ,  $S_t$ , a verbal intervention in support of a weak yen by Japanese officials,  $V_t$ , a confirmation ( $C_t$ ) and no-comment ( $N_t$ ) remarks by Japanese officials.

The GARCH regression also considers the impact on the change of yen/dollar rate from individual Japanese officials. We examine the relationship between changes of yen/dollar rate and the actual and verbal interventions using the GARCH model as follows:

$$R_t = \alpha_0 + \alpha_1 AMT_t + \alpha_2 S_t + \alpha_3 V_t + \alpha_4 C_t + \alpha_5 N_t + \varepsilon_t, \quad \varepsilon_t \sim N(0, h_t)$$

$$h_t = \beta_0 + \beta_1 h_{t-1} + \beta_2 \varepsilon_{t-1}^2 \quad \dots \quad (1)$$

The estimation is based on the maximum likelihood method and  $R_t$  is the yen/dollar rate return.  $\alpha_0$  is the constant term and  $\alpha_1$  is the coefficient for

actual amounts of intervention by the Bank of Japan.  $\alpha_2$  is the coefficient of a suspected report of an intervention by the Bank of Japan on day  $t$ .  $\alpha_3$  is the coefficient a verbal intervention in support of a weak yen by Japanese officials,  $\alpha_4$  is the coefficient of a confirmation remark and  $\alpha_5$  is the coefficient of no-comment remarks by Japanese officials. The specification for the conditional variance is a GARCH (1,1) model and the distribution of the error term in equation 1 is assumed to follow a normal distribution.

Table 2 reports the results of estimating the GARCH models using the actual and verbal intervention by the Bank of Japan. It is seen that the coefficient of the actual intervention amounts,  $\alpha_1$ , has a negative and significant effect on the yen/dollar rate, which indicates that the Bank of Japan was adopting a lean-against-the-wind policy during the sample period. The parameters of the suspected report of an intervention by the Bank of Japan,  $\alpha_2$ , the coefficient a verbal intervention in support of a weak yen by Japanese officials,  $\alpha_3$  are also negative and significant at the five percent level. This indicates that verbal intervention did not help to alleviate the depreciation of the yen/dollar rate. The coefficient of a confirmation remark  $\alpha_4$  is negative and significant at the five percent level, which suggests the ineffectiveness of official remarks confirming interventions by the Bank of Japan. By contrast, the coefficient of no-comment remarks by Japanese officials,  $\alpha_5$ , has a positive but insignificant effect on the return of the yen/dollar rate. Unlike other verbal intervention announcements, it implies that these no-comment remarks did not increase the depreciation of the yen/dollar rate.

The second regression estimates the results based on equation (2) for individual Japanese officials.  $R_t$  is the yen/dollar rate return.  $\alpha_0$  is the constant term and  $\alpha_1$  is the coefficient for actual amounts of intervention by the Bank of Japan.  $\alpha_2$  is the coefficient of a suspected report of an intervention by the Bank of Japan on day  $t$ .  $\alpha_3$  to  $\alpha_{20}$  are the coefficients of verbal interventions, confirmation and no-comment remarks by Japanese officials, which include Kiichi Miyazawa, Masajuro Shiokawa, Sadakazu Tanigaki, Haruhiko Kuroda, Zenbe Mizoguchi and Hiroshi Watanabe.  $\beta_0, \beta_1$  and  $\beta_2$  are parameters of the conditional variance of the yen/dollar returns.

$$\begin{aligned}
R_t = & \alpha_0 + \alpha_1 AMT_t + \alpha_2 S_t + \alpha_3 Miya\_V_t + \alpha_4 Miya\_C_t + \alpha_5 Miya\_N_t \\
& + \alpha_6 Shio\_V_t + \alpha_7 Shio\_C_t + \alpha_8 Shio\_N_t + \alpha_9 Tani\_V_t + \alpha_{10} Tani\_C_t + \alpha_{11} Tani\_N_t \\
& + \alpha_{12} Kuro\_V_t + \alpha_{13} Kuro\_C_t + \alpha_{14} Kuro\_N_t + \alpha_{15} Mizo\_V_t + \alpha_{16} Mizo\_C_t + \alpha_{17} Mizo\_N_t \\
& + \alpha_{18} Wata\_V_t + \alpha_{19} Wata\_C_t + \alpha_{20} Wata\_N_t + \varepsilon_t \\
, \quad & \varepsilon_t \sim N(0, h_t), \quad h_t = \beta_0 + \beta_1 h_{t-1} + \beta_2 \varepsilon_{t-1}^2 \quad \dots\dots\dots (2)
\end{aligned}$$

Results for equation (2) are summarized in Table 3. The coefficients of the actual amounts and speculation of the intervention reports are negative and significant at the five percent level. These results are consistent with those in Table 2. The parameters of verbal interventions by most of the officials are negative and significant. The coefficients of the confirmation remarks by all officials, except Zenbe Mizoguchi, are negative, which suggest that confirming interventions by the Bank of Japan increase the depreciation of the yen/dollar rate. On the other hand, it is seen that parameters of the no-comment remarks are mostly positive, which indicate that imprecise remarks on the intervention operations help to alleviate the depreciation of the yen/dollar rate.

#### **4. Conclusions**

Previous empirical studies on the impact of central bank intervention focus mainly on the actual intervention effect. With the recent release of official Japanese intervention data, we now have the opportunity to gauge the effectiveness of both actual and verbal intervention by the Bank of Japan. This issue is important, because central banks rely on both instruments to intervene in the currency markets.

The novelty of this paper is that we assess the impact of individual official in Japan by categorizing intervention into verbal, confirmation and no-comment remarks. Our results indicate that statements released by Japanese officials convey important information to market participant. We find ineffectiveness of official remarks confirming interventions by the Bank of Japan. Verbal intervention warning possible intervention has negative impact on the yen's level. By contrast, no-comment statements by Japanese officials amplified the effectiveness of the Bank of Japan intervention. Our results are consistent with the cheap talk mechanism of Crawford and Sobel (1982), which suggests that the Bank of Japan should make intervention announcements that are imprecise.

## **Appendix A:**

### **Sample intervention reports by the JiJi News**

---

#### **Panel A: Rumors or speculation of intervention by the Bank of Japan**

##### **JiJi News:**

Tokyo, March 4, 2003, The dollar was stuck around 117.50 yen in Tokyo Tuesday, as rumored intervention by Japanese authorities discouraged active dollar-yen trading.

#### **Panel B: Verbal intervention by Japanese officials**

**JiJi News:** Tokyo; March 08, 2002, Japanese Minister of Finance Masajuro Shiokawa said some action may be taken if exchange rates are found to be manipulated, and Vice Minister of Finance for International Affairs Haruhiko Kuroda also reportedly suggested readiness to launch yen-selling intervention.

#### **Panel C: Confirmation remarks of Bank of Japan officials**

**JiJi News:** Tokyo; February 28, 2003; Tokyo, MOF source confirms secret forex intervention in late Feb.

#### **Panel D: No-comment remarks of Bank of Japan officials**

**JiJi News:** Tokyo; December 10, 2003; Tokyo, Minister of Finance Sadakazu Tanigaki Wednesday declined to comment on market speculation that Japan stepped in to weaken the yen.

---

News reports are retrieved from the ABI-BPO and Lexis-Nexis database.

## References:

- Baillie, R.T., Humpage, O.F., Osterberg, W.P., 2000. Intervention from an Information Perspective, *Journal of International Financial Markets, Institutions and Money*, 10 (3), 407-421.
- Chang, Y., Taylor, S.J., 1998. Intraday Effects of Foreign Exchange Intervention by the Bank of Japan. *Journal of International Money and Finance*, 17 (1), 191-210.
- Chiu, P., 2003, Transparency versus Constructive Ambiguity in Foreign Exchange Intervention, BIS working paper, 144.
- Covrig, V., Melvin, M., 2002. Asymmetric Information and Price Discovery in the FX Market: Does Tokyo Know More about the Yen?, *Journal of Empirical Finance*, 9 (3), 271-285.
- Crawford, V., Sobel J., 1982, Strategic Information Transmission, *Econometrica*, 50, 1431-51.
- Dominguez, K.M., Frankel, J. A., 1993. Does Foreign Exchange Intervention Work? Institute of International Economics, Washington DC.
- Fatum, R., Hutchison, M.M., 2002. "ECB Foreign Exchange Intervention and the EURP: Institutional Framework, News and Intervention" *Open Economies Review*, 13 (4), 413-425.
- Frenkel, M., Pierdzioch, C., Stadtmann, G., 2005. The Effects of Japanese Foreign Exchange Market Interventions on the yen/dollar exchange rate volatility, *International Review of Economics and Finance*, 14 , 27-39.
- Galati, G., Melick, W., 1999. Perceived Central Bank Intervention and Market Expectations: An Empirical Study of the Yen/Dollar Exchange Rate. BIS working paper No 77.
- Goodfriend M, 1986, Monetary Mystique: Secrecy and Central Banking, *Journal of Monetary Economics*, 1986, 1, 17, 63-92.
- Guthrie, G, Wright J., 2000, Market Implemented Monetary Policy with Open Mouth Operations, *Journal of Monetary Economics*, 489-516.
- Ito, T., 2002. Is Foreign Exchange Intervention Effective? The Japanese Experiences in the 1990s. NBER Working Paper No 8914.
- Ramaswamy, R., Samiei, H., 2000. The Yen-Dollar Rate: Have Interventions Mattered? IMF Working Paper 95.

- Sarno, T., Taylor, M., 2001. Official Intervention in the Foreign Exchange Market: Is It Effective and, If so, How Does it Work? *Journal of Economic Literature*, 39 (3), 839-868.
- Stein J., 1989, Cheap Talk and the Fed, *American Economic Review*, 33-42.
- Vitale P, 2003, Foreign Exchange Intervention: How to Signal Policy Objectives and Stabilize the Economy, *Journal of Monetary Economics*, 50, 841-870.
- Watanabe T. and Harada K, 2005, Effects of the Bank of Japan's Intervention on yen/dollar Exchange Rate Volatility, *Journal of Japanese and International Economies*, 1-13.

**Table 1. Number of Japanese officials' intervention remarks**

<b>A. Full sample</b>					
News Categories	A	B	C	D	Total
Number of intervention reports	232	317	12	16	577
<b>B. Individual Japanese officials</b>					
Kiichi Miyazawa	-	29	1	1	31
Masajuro Shiokawa	-	60	3	1	64
Sadakazu Tanigaki	-	44	0	2	46
Haruhiko Kuroda	-	78	2	4	84
Zenbe Mizoguchi	-	135	6	7	148
Hiroshi Watanabe	-	22	0	2	44

Notes: The sample period is from January 2000 to Dec 2004. Category A contains speculations or rumors of intervention by the Bank of Japan from the JiJi News. Category B represents statements by officials about Bank of Japan's interventions. Category C represents firm reports of interventions by the Bank of Japan. Category D represents no-comment remarks by Japanese officials. Kiichi Miyazawa (1999-2001), Masajuro Shiokawa (2001-2003) and Sadakazu Tanigaki (2003-2004) were Japanese Minister of Finance during the Sample period. Haruhiko Kuroda (1999-2003), Zenbe Mizoguchi (Jan/2003-July/2004) and Hiroshi Watanabe (July/2004-Dec/2004) were Vice Finance Minister of International Affairs in Japan during the sample period.

**Table 2. Results for the impact of actual and verbal intervention**

Variable	Coefficient	<i>t</i> values
Constant (*10)	0.005***	2.58
Amount of intervention (*100)	-0.002*	-1.83
Suspected report of intervention	-0.001***	-2.72
Verbal intervention in support of a weak yen (*10)	-0.008**	-2.18
Confirmation remarks	-0.004**	-2.28
No-comment remarks(*10)	0.003	0.25
$\gamma_0$ (*1,000)	0.002*	1.90
$\gamma_1$	0.031***	2.71
$\gamma_2$	0.920***	27.07
Log Likelihood	4,879.21	
Number of Observations	1,304	

Notes:  $R_t = \alpha_0 + \beta_i X_{i,t} + \varepsilon_t$ ,  $i = 1, \dots, 5$ ,  $\varepsilon_t \sim N(0, h_t)$ ,  $h_t = \gamma_0 + \gamma_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2$ . The estimation is based on the maximum likelihood method and  $R_t$  is the yen/dollar rate return.  $\alpha_0$  is the constant term and  $\beta_1$  is the coefficient for actual amounts of intervention by the Bank of Japan.  $\beta_2$  is the coefficient of a suspected report of an intervention by the Bank of Japan on day  $t$ .  $\beta_3$  is the coefficient a verbal intervention in support of a weak yen by Japanese officials,  $\beta_4$  is the coefficient of a confirmation remark and  $\beta_5$  is the coefficient of no-comment remarks by Japanese officials.  $\gamma_0, \gamma_1$  and  $\gamma_2$  are parameters of the conditional variance of the yen/dollar returns. \*, \*\*, and \*\*\* indicate that the coefficient is statistically significant at 10%, 5%, and 1% levels, respectively.

**Table 3. Results for the impact of individual verbal intervention**

Variable	Coefficient	<i>t</i> values
Constant (*10)	0.005***	2.74
Amount of intervention (*1000)	-0.003**	-2.09
Suspected report of intervention	-0.001***	-2.98
Miyazawa Verbal intervention	-0.001	-1.33
Miyazawa Confirmation remarks	-0.004	-0.61
Miyazawa No-comment remarks	0.005	0.72
Shiokawa Verbal intervention	-0.001*	-1.78
Shiokawa Confirmation remarks	-0.007**	-2.05
Shiokawa No-comment remarks	0.013**	2.41
Tanigaki Verbal intervention	0.007	0.79
Tanigaki Confirmation remarks	-0.002	0.00
Tanigaki No-comment remarks	0.003	0.72
Kuroda Verbal intervention	-0.001	-1.62
Kuroda Confirmation remarks	-0.010**	-2.03
Kuroda No-comment remarks	-0.004*	-1.84
Mizoguchi Verbal intervention (*100)	-0.009	-0.20
Mizoguchi Confirmation remarks (*100)	0.005	0.02
Mizoguchi No-comment remarks (*10)	0.002	0.10
Watanabe Verbal intervention (*100)	0.008	0.06
Watanabe Confirmation remarks (*10)	-0.007	0.00
Watanabe No-comment remarks	-0.002	-0.65
$\gamma_0$ (*1,000)	0.002**	1.97
$\gamma_1$	0.0299***	2.51
$\gamma_2$	0.9236***	28.89
Log Likelihood	4887.52	
Number of Observations	1,304	

Notes:

$$\begin{aligned}
R_t = & \alpha_0 + \beta_1 X_{1,t} + \beta_2 X_{2,t} + \beta_3 \text{Miya} - X_{3,t} + \beta_4 \text{Miya} - X_{4,t} + \beta_5 \text{Miya} - X_{5,t} \\
& + \beta_6 \text{Shio} - X_{3,t} + \beta_7 \text{Shio} - X_{4,t} + \beta_8 \text{Shio} - X_{5,t} + \beta_9 \text{Tani} - X_{3,t} + \beta_{10} \text{Tani} - X_{4,t} + \beta_{11} \text{Tani} - X_{5,t} \\
& + \beta_{12} \text{Kuro} - X_{3,t} + \beta_{13} \text{Kuro} - X_{4,t} + \beta_{14} \text{Kuro} - X_{5,t} + \beta_{15} \text{Mizo} - X_{3,t} + \beta_{16} \text{Mizo} - X_{4,t} + \beta_{17} \text{Mizo} - X_{5,t} \\
& + \beta_{18} \text{Wata} - X_{3,t} + \beta_{19} \text{Wata} - X_{4,t} + \beta_{20} \text{Wata} - X_{5,t} + \varepsilon_t
\end{aligned}$$

$$\varepsilon_t \sim N(0, h_t), \quad h_t = \gamma_0 + \gamma_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2$$

The estimation is based on the maximum likelihood method and  $R_t$  is the yen/dollar rate return.  $\alpha_0$  is the constant term and  $\beta_1$  is the coefficient for actual amounts of intervention by the Bank of Japan.  $\beta_2$  is the coefficient of a suspected report of an intervention by the Bank of Japan on day  $t$ .  $\beta_3$  to  $\beta_{20}$  are the coefficients of verbal interventions, confirmation and no-comment remarks by individual Japanese officials, which include Kiichi Miyazawa, Masajuro Shiokawa, Sadakazu Tanigaki, Haruhiko Kuroda, Zenbe Mizoguchi and Hiroshi Watanabe.  $\gamma_0, \gamma_1$  and  $\gamma_2$  are parameters of the conditional variance of the yen/dollar returns. \*, \*\*, and \*\*\* indicate that the coefficient is statistically significant at 10%, 5%, and 1% levels, respectively.

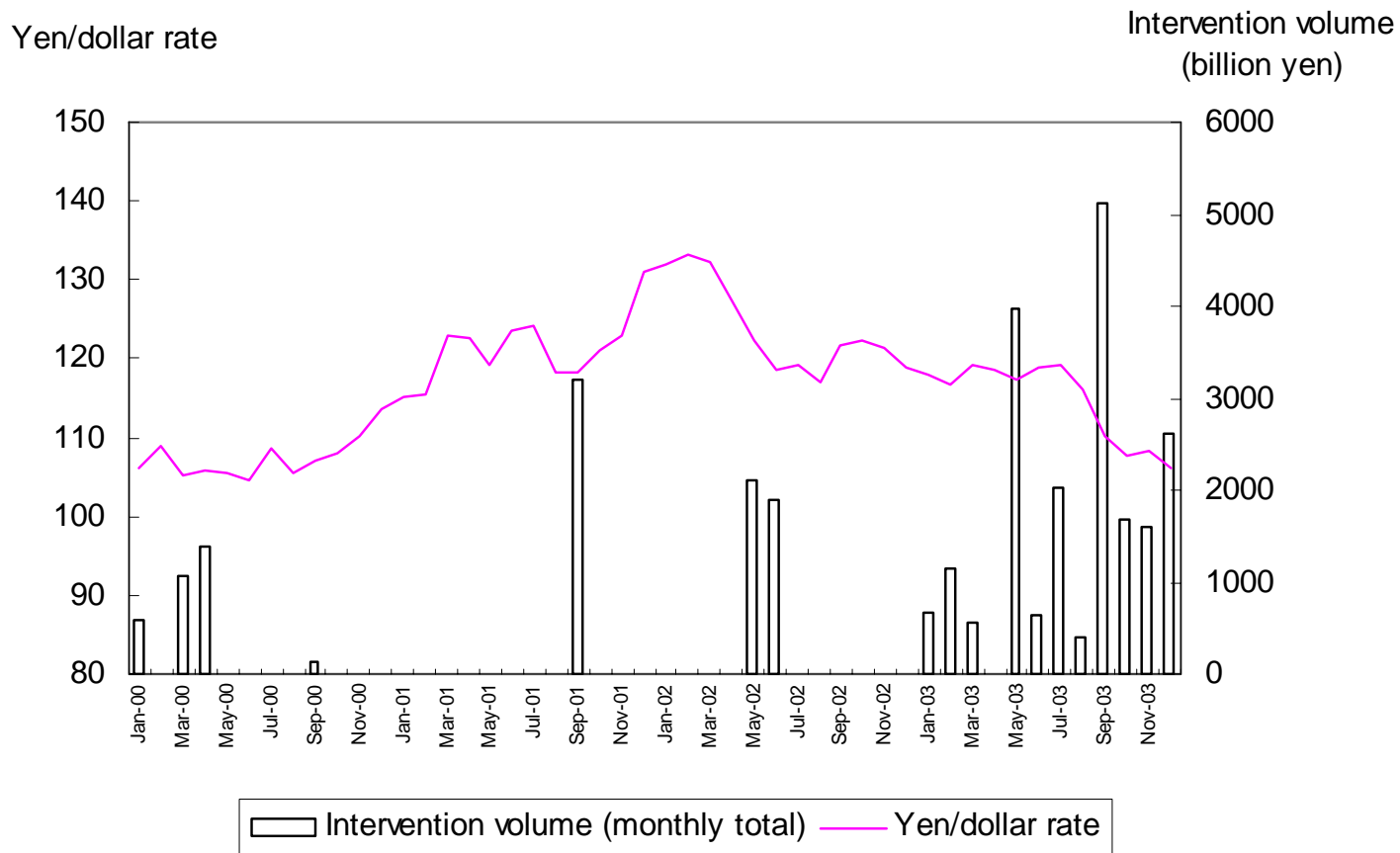


Figure 1. Japanese interventions and the yen/dollar rate over the period January 2000 to December 2003 (Note that the scale of monthly intervention volume is on the right-hand side of the figure)