Kiel Institute for World Economics
Duesternbrooker Weg 120
24105 Kiel (Germany)

Kiel Working Paper No. 1165

The Effects of Japanese Foreign Exchange Market Interventions on the Yen/U.S. Dollar Exchange Rate Volatility

by

Michael Frenkel, Christian Pierdzioch, and Georg Stadtmann

May 2003

The Effects of Japanese Foreign Exchange Market Interventions on the Yen/U.S. Dollar Exchange Rate Volatility

Abstract

Previous studies have mainly used reports in the financial press to analyze the link between the interventions of the Bank of Japan (BoJ) and exchange rate volatility. We use official intervention data for the period 1993-2000 that were released only recently by the BoJ and find that the interventions of the BoJ increased the volatility of the yen/U.S. dollar exchange rate. We find that that the interventions of the BoJ, in particular those interventions not reported in the financial press, were positively correlated with exchange rate volatility.

Keywords: Foreign exchange market interventions; Exchange rate volatility; Bank of Japan

JEL classification: F31, F33, E58, G15

Addresses:

Michael Frenkel
Department of Economics
WHU Koblenz
Burgplatz 2
56179 Vallendar
Germany
Phone: +49-261-280
Email: mfrenkel@whu.edu

Georg Stadtmann
Department of Economics
WHU Koblenz
Burgplatz 2
56179 Vallendar
Germany
Phone: +49-261-6509-273
Email: stadtman@whu.edu

Christian Pierdzioch
Kiel Institute for World Economics
Duesternbrooker Weg 120
24105 Kiel
Germany
Phone: +49-431-8814-269
Email: c.pierdzioch@ifw.uni-kiel.de

Acknowledgements:

Part of this paper was written during a research visit of C. Pierdzioch at the National Bureau of Economic Research (NBER), Cambridge MA. The hospitality of the NBER is gratefully acknowledged. We are greatly indebted to Thomas Trauth from Credit Suisse First Boston for providing the implied volatility data. We thank Ramana Ramaswamy and Hossien Samiei for providing us with their data on press reports of the foreign exchange market interventions of the Japanese monetary authorities. The usual disclaimer applies.

1. Introduction

Over the past two decades, the effects of central bank interventions in foreign exchange markets on exchange rate volatility have been the focus of a number of empirical studies (see, e.g., Dominguez 1998 and Aguilar/Nydahl 2000). Researchers have not only been interested in the magnitude of the effect of central bank interventions on exchange rate volatility but also in the sign of this effect. The importance of the sign of this effect stems from the fact that the exchange rate theories often applied in the intervention literature have clear-cut implications with respect to the sign of the effect of central bank interventions on exchange rate volatility. For example, a model frequently used in the literature to describe the intervention-volatility correlation is the asset-pricing model of exchange rate determination. As discussed by Dominguez (1998), this standard forward-looking rational expectations exchange rate model implies that, due to its stabilizing effects on agents' exchange rate expectations, a credible central bank intervention should either dampen exchange rate volatility or should not affect exchange rate volatility at all. If, in contrast, interventions are not credible or the monetary authorities send out ambiguous signals, central bank interventions should amplify exchange rate volatility.

We provides further evidence on the sign of the intervention-volatility correlation by using a new official data set on Bank of Japan (BoJ) interventions in the U.S. dollar/yen foreign exchange market.1 In the past, no official data were available to researchers because the BoJ did not release official data on its intervention behavior. Lacking official intervention data, previous studies mainly used intervention reports in the financial press to analyze the link between BoJ interventions and exchange rate volatility (see, e.g., Bonser-Neal/Tanner

[1] In Japan, the jurisdiction over deciding on whether or not to intervene in the foreign exchange market rests with the Japanese Ministry of Finance. The Bank of Japan conducts transactions as an agent of the Ministry of Finance. See Ito (2002) for a discussion of the institutional details.

1996, Dominguez 1998, Galati/Melick 1999).[2] However, as we argue in this paper, for the sample period we analyze, intervention reports in the financial press are likely to represent a relatively inaccurate proxy of the actual BoJ intervention policy. The analysis presented in this paper is not subject to this inaccuracy, since we use daily official intervention data recently released by the BoJ to test for the effects of the BoJ interventions on the volatility of the U.S. dollar /yen exchange rate. To measure exchange rate volatility, we use volatilities implicit in foreign currency options. Our key finding is that the BoJ interventions were positively correlated with the volatility of the U.S. dollar/yen exchange rate during our sample period 1993-2000. This effect tends to be particularly strong for those ("secret") BoJ interventions that were not reported in the financial press. We also find a positive link between interventions and exchange rate volatility for the U.S. dollar purchases of the BoJ. Our results also indicate that coordination of foreign exchange market interventions between the BoJ and the Federal Reserve (Fed) did not change the positive sign of the intervention-volatility correlation.

We organize the remainder of the paper as follows. In Section 2, we lay out the quantitative model we use in our empirical analysis and describe some stylized facts of the official BoJ intervention data. In Section 3, we present our empirical estimates and discuss our results. In Section 4, we conclude.

2. The Empirical Model and the Data

To analyze the link between BoJ interventions and exchange rate volatility, we use a research strategy similar to the one suggested by Bonser-Neal and Tanner (1996) and Dominguez (1998). Specifically, we estimate the following equation:

[2] An empirical study also using official BoJ data is Baillie and Osterberg (1997). They study the impact of cental bank interventions on the risk premium in the forward market during the period 1985-1990. Ito (2002) uses the data we analyze in this paper to study the effect of the interventions conducted by the BoJ in the 1990s on the level of the U.S. dollar/yen exchange rate.

$$\ln\left(\frac{ISD_t}{ISD_{t-1}}\right) = \beta_0 + \beta_1 ISD_{t-1} + \beta_2 INT_t + \beta_3 SELL_t + \beta_4 BUY_t + \beta_5 COR_t + \beta_6 INTDUM_t + \beta_7 DVONI_t + \varepsilon_t \quad (1)$$

where ISD_t denotes the implied volatility of yen/U.S. dollar foreign currency options on day t. We used implied volatilities of at-the-money forward over-the-counter yen/U.S. dollar foreign currency options collected at 11:30 a.m. New York time (London closing) as compiled by a large investment bank. The time-to-maturity of the options is one month.[3] The key advantage of using implied volatilities to estimate the intervention-volatility correlation is that implied volatilities embody market participants' expectations regarding the perceived exchange rate volatility over the remaining time to maturity of the options and are, therefore, forward-looking variables by nature. INT_t denotes the absolute amount of the BoJ intervention on day t. The series $SELL_t$ and BUY_t are dummy variables that equal unity if the BoJ sells or buys U.S. dollars, respectively. For days without any intervention, these dummies are set equal to zero. COR_t is a dummy variable that takes the value one whenever an intervention of the BoJ is accompanied by an intervention of the Fed in the U.S. dollar/yen market so that it can be assumed that the intervention activities were coordinated.[4] To study whether exchange rate volatility was affected by the mere presence of the BoJ in the foreign exchange market or by the magnitude of its interventions, we use the variable $INTDUM_t$. This is a dummy variable assuming the value one on intervention days and zero else. We also include the first difference of the squared percentage change of the NIKKEI 500 index ($DVONI_t$) to control for the impact of economic or political events on overall financial market volatility (see also Bonser-Neal/Tanner 1996). The term ε_t denotes a disturbance term.

[3] In the over-the-counter market for foreign currency options, option traders use implied volatilities for the Garman and Kohlhagen (1983) currency option pricing model to quote the price of an option. Because the volatility of the exchange rate is the only unobservable input variable in the Garman-Kohlhagen model, the dollar price of an option can easily be computed upon plugging the implied volatility quote into the Garman-Kohlhagen model. Also note that the strike price of the at-the-money forward options we use is equal to the forward rate, so that, given put-call parity, the price of a put is equal to the price of the corresponding call option. The option quotes we use in our empirical analysis are averages of the respective bid and ask quotes.

[4] The data on the Fed interventions are taken from the Federal Reserve Bank. A data set for Fed interventions during the period 1973 – 1996 can be downloaded from the Federal Reserve Bank of St. Louis. This data set was used by Neely (1998). More recent data were taken from the Federal Reserve Bank of New York (2002).

We use a recently released data set on the interventions of the BoJ in the yen/U.S. dollar foreign exchange market (BoJ 2002). Because this new data set has not been used in previous empirical studies, we plot in Figure 1 the data we use in our empirical analysis. In Panel A, we plot the yen/U.S. dollar exchange rate. In Panel B, we plot the yen/ U.S. dollar option-implied volatility data.[5] In Panel C, we plot the BoJ interventions data.

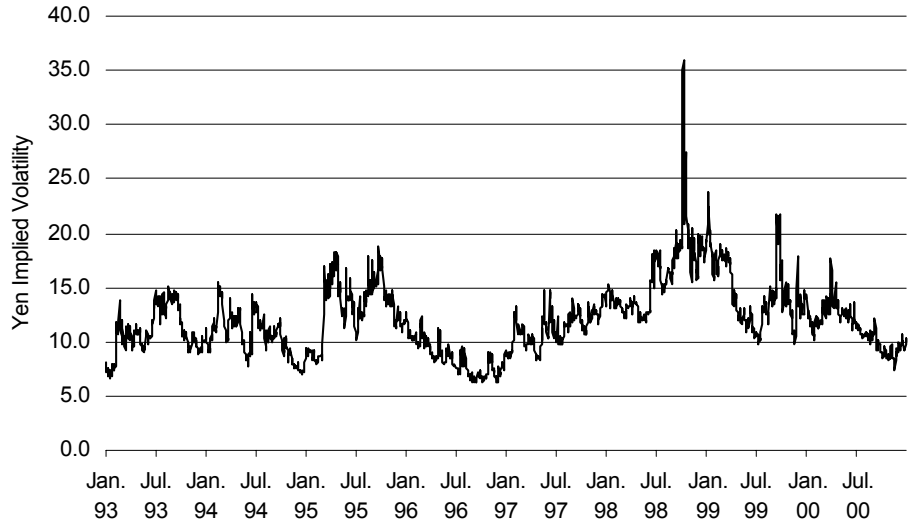
The data we analyze in this paper cover the period 1993–2000. As can be seen in Figure 1, this period includes several episodes of fairly significant foreign exchange market interventions. The main statistical characteristics of the foreign exchange market interventions of the BoJ during the sample period under investigation are shown in Table 1. The BoJ intervened on 171 days. On 165 days, it bought U.S. dollars and on only 6 days it sold U.S. dollars. The unconditional probability of a BoJ intervention was 8.3 percent. The mean absolute size of BoJ interventions, conditional on the fact that an intervention took place, was 147 billion yen. Table 1 further reveals that the BoJ carried out all its U.S. dollar purchases when the yen/U.S. dollar exchange rate was below 125 and it carried out all its sales of U.S. dollars when the yen/U.S. dollar exchange rate was above 125. This finding confirms the results reported by Ito (2002). It suggests that the exchange rate level of 125 yen/U.S. dollar may have been used by the Japanese monetary authorities as a kind of implicit target or anchor exchange rate level. We will use this observation in Section 3 below when we specify a reaction function to describe the factors that have influenced the foreign exchange market intervention activity of the BoJ.

[5] It is interesting to note that on October 7, 1998, the yen price of a dollar fell from about 134 to 120 in a single day. This strong change in the exchange rate was accompanied by a sudden outburst of expected exchange rate volatility: the annualized yen/U.S. dollar option-implied volatility rose to a historical high of roughly 40 percent. For economic reasons discussed in detail in Cai et al. (2001), we do not treat this outburst of implied volatility as an outlier in our empirical analysis. The reason we do not is that the sharp appreciation of the yen in October 1998 was caused by the trading behavior of investors who suddenly unwound the short positions in yen they had accumulated. Taking such short positions had been profitable because investors could borrow funds in Japanese currency at interest rates near zero and invest these funds in securities yielding higher interest rates. The massive unwinding of short positions in yen in October 1998 resulted in bandwagon effects because many investors had to cover their short positions. As a result, exchange rate volatility rose sharply.

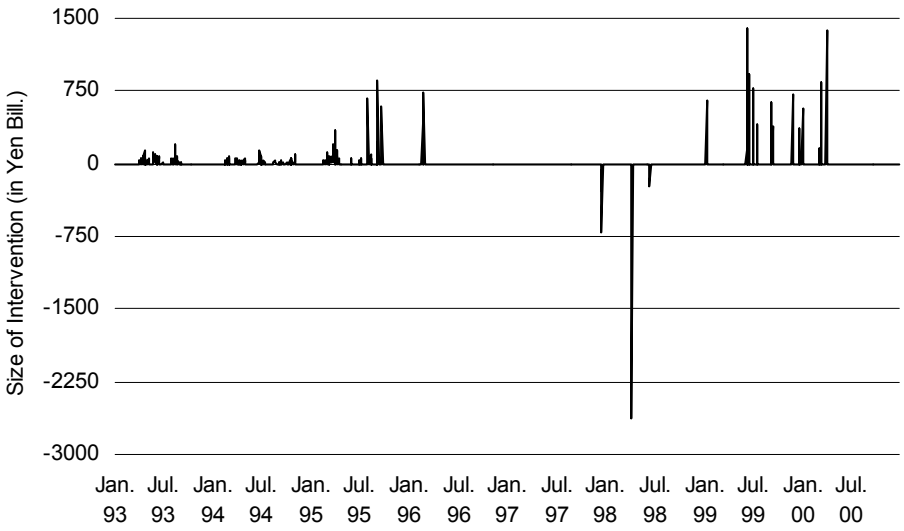
Figure 1 — Intervention and Exchange Rate Volatility Data Used in the Empirical Analysis

PANEL A: Exchange Rate

PANEL B: Implied Volatility



PANEL C: Interventions of the BoJ



The newly released official data on the foreign exchange market interventions of the BoJ allows the accuracy of intervention reports in the financial press used in previous empirical research identifying BoJ intervention days to be analyzed. To this end, we compare our data on actual BoJ interventions with a proxy variable recently used in an empirical study by Ramaswamy and Samiei (2000). Their data set, which the authors kindly provided, contains press reports of BoJ foreign exchange market interventions in the yen/U.S. dollar market stored in the electronic archives of the Financial Times and the Wall Street Journal.

Table 1 — Summary Statistics for BoJ Interventions in the Yen/U.S. dollar Foreign Exchange Market (March 1993 – December 2000)

Direction of Intervention	*Yen/U.S. dollar Exchange Rate…*		*Japanese Monetary Authorities*		
	…Above	*…At Or Below*	*Number of Intervention Days*	*Sum of Intervention Amounts**	*Amount*/ Number of Days*
Sell U.S. Dollar	145	150	0	0	–
	140	145	0	0	–
	135	140	1	231	231
	130	135	1	196	196
	125	130	4	3,679	920
Buy U.S. Dollar	120	125	3	3,117	1,039
	115	120	3	751	250
	110	115	16	1,268	79
	105	110	24	3,709	155
	100	105	54	7,141	132
	95	100	33	2,051	62
	90	95	8	1,192	149
	85	90	17	1,483	87
	80	85	7	368	53
		Subtotal Sell	6	4,106	684
		Subtotal Buy	165	21,079	123
		Total	171	25,185	147
Lowest Point of Selling U.S. Dollar			127.129	Dec. 17,1997	
Highest Point of Buying U.S. Dollar			122.489	Jun. 21,1999	
Probability of an Intervention			8.3 % (=171/2,070)		
Probability of Interventions Conditional Upon Interventions on the Previous Trading Day			57.3 % (=98/171)		
Probability of No-Interventions Conditional Upon No-Interventions on the Previous Trading Day			96.1 % (=1,825/1,899)		

Note: * In billions of yen.

Table 2 shows that, according to newspaper reports on BoJ interventions, the BoJ intervened on 50 days during the period 1995-1999, the sample period studied by Ramaswamy/Samiei (2000). Because the BoJ actually conducted foreign exchange market interventions on 66 days, this implies that the financial press underestimated the overall intervention activity of the BoJ by roughly 25 percent. When breaking down the overall intervention activity with respect to the direction of intervention, the degree of inaccuracy appears to be even larger. The financial press reported 39 interventions aimed at weakening the yen; whereas, in fact, 60 of such interventions were actually carried out. Table 2 also shows that the financial press overestimated the intervention activity aimed at strengthening the yen. While eleven interventions were reported, only six interventions actually took place. With respect to the interventions conducted by the BoJ jointly with the Fed (that is, coordinated interventions), Table 2 reveals that the number of press reports of coordinated interventions published in the financial press was quite accurate. Of the nine reported coordinated interventions, only two interventions (one sell and one buy intervention) were not classified correctly.

Table 2 — Accuracy of Press Reports of BoJ Interventions

	Newspaper Reports Say		Actual Intervention Data Says	
	Unilateral	Coordinated	Unilateral	Coordinated
Overall Interventions:	41	9	57	9
Number of Interventions to Weaken the Yen (= Buy Dollars):	32	7	52	8
Number of Interventions to Strengthen the Yen (= sell dollars):	9	2	5	1

Note: In this table, we compare the intervention proxy used by Ramaswamy/Samiei (2000) with the actual interventions of the BoJ. Bilateral refers to interventions of the BoJ coordinated with the Federal Reserve. The period under investigation is 1995–1999.

In Table 3, we show whether there was a link between the magnitude of interventions and the likelihood of a press report of interventions. We do this by classifying the actual and the reported interventions conducted by the BoJ according to their size. As evidenced by the results summarized in Table 3, there was no clear-cut correlation between the size of BoJ intervention in the yen/U.S. dollar market and press reports of intervention.

Table 3 – Size of BoJ Interventions and Press Reports of BoJ Interventions

Volume of Intervention (in millions of U.S. dollars)	Actual	Reported	Not Reported	Share of Correct Reports
10,000 – 25,000	2	1	1	50 %
7,500 – 10,000	3	2	1	67 %
5,000 – 7,500	7	5	2	71 %
2,500 – 5,000	6	2	4	33 %
1,000 – 2,500	14	6	8	43 %
500 – 1,000	19	9	10	47 %
0 – 500	15	5	10	33 %
Total	66	30	36	

Note: In this table, we compare the intervention proxy used by Ramaswamy and Samiei (2000) with the actual interventions of the BoJ. We measure the volume of BoJ interventions in terms of millions of U.S. dollar. The sample period we analyze is 1995–1999.

3. Results of the Empirical Study

Table 3 summarizes the results of our empirical analysis. To assess the robustness of our results, we estimate five alternative specifications of equation (1). In the first specification (1), we assess the link between BoJ interventions and the change in the yen/U.S. dollar option-implied exchange rate volatility by including the absolute intervention amount as a regressor and by setting $\beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$. In the second specification (2), we add the coordination dummy as an explanatory variable. In the third specification (3), we analyze whether the absolute amount of dollar purchases of the BoJ had different effects than dollar sales ($\beta_2 = \beta_5 = \beta_6 = 0$). In specification (4), we add the coordination dummy to the set of

regressors we use in specification (3). Finally, in specification (5), we add the, $INTDUM_t$, to our benchmark specification in order to study whether the mere the intervention dummy fact that the BoJ intervened in the market or the magnitude of its foreign exchange market interventions gave rise to the correlation between the BoJ interventions and exchange rate volatility. If only the magnitude of interventions matters, we should not be able to reject the null hypothesis that $\beta_6 = 0$.

Table 4 — Estimation Results on the Determinants of Exchange Rate Volatility

		Endogenous Variable: Yen/U.S. dollar Annualized Implied Volatility				
		(1)	(2)	(3)	(4)	(5)
β_0	*Intercept*	2.4121 (4.5300)***	2.4015 (4.5153)***	2.3446*** (4.4461)	2.3642*** (4.4442)	2.3609 (4.7693)***
β_1	*Lagged Volatility*	-0.2023 (-4.5700)***	-0.2023 (-4.5706)***	-0.2051*** (-4.1609)	-0.2072*** (-4.6224)	-0.2064 (-4.6294)***
β_2	*Intervention Volume*	0.0030 (2.0973)**	0.0029 (2.0724)**	–	–	0.0012 (0.8721)
β_3	U.S. dollar *Sales*	–	–	1.1652 (0.8645)	1.1786 (0.9688)	–
β_4	U.S. dollar *Purchases*	–	–	1.1663 (3.3992) ***	1.7079*** (3.3393)	–
β_5	*Coordinated Interventions*	–	1.3323 (1.0706)	–	0.1104 (0.0824)	–
β_6	*Intervention Dummy*	–	–	–	–	1.4845 (2.9954)***
β_7	*Nikkei Volatility*	0.0869 (3.2429)***	0.0859 (3.1822)***	0.0852*** (3.1507)	-0.0529** (-2.1481)	0.0847 (3.1373)**
	Adjusted R^2	0.0200	0.0201	0.0237	0.0205	0.0241

Note: *t*-statistics in parentheses. Robust standard errors are used to compute the *t*-statistics. ** = significant at the 5 percent level, *** = significant at the 1 percent level. Interventions are measured in billions of yen. All independent variables are in absolute values. All coefficients are multiplied by 100.

The results shown in Table 4 reveal that there was a statistically significant positive correlation between the interventions of the BoJ and the anticipated exchange rate volatility. This finding is confirmed when the interventions of the BoJ are broken down into U.S. dollar purchases and U.S. dollar sales. In the case of the U.S. dollar purchases of the BoJ, the coefficient is significantly different from zero and positive. In the case of the U.S. dollar sales

of the BoJ the coefficient is also positive, albeit not significantly different from zero. Furthermore, the results show that the coordination dummy is not significantly different from zero. Thus, though the sign of the coordination dummy is positive so that coordination of interventions led to an increase in exchange rate volatility, this result implies that coordinated interventions did not lead to a significant increase in exchange rate volatility. Finally, when we add the intervention dummy to our estimation equation, we find that mainly the presence of the BoJ in the foreign exchange market rather than the volume of its foreign exchange market interventions have significant explanatory power for changes in the exchange rate volatility.

The broad picture of our findings is consistent with the results reported in the literature that could not use official data disseminated by the BoJ. For example, Bonser-Neal and Tanner (1996) also find a positive link between volatility and presumed BoJ interventions when they use data covering the period 1987-1991. Similarly, Dominguez (1998) reports that, except during the post-Plaza period (1985-1987), estimated BoJ interventions and volatilities implicit in yen/U.S. dollar options were positively correlated. Galati and Melick (1999) find a positive link between volatility and interventions reported in the financial press for the period 1993-1996. Of course, the results reported in these studies cannot be directly compared with our results because of differences in, for instance, the sample period analyzed and the estimation methods used. Nevertheless, the fact that our results resemble the findings in the empirical studies mentioned above raises the question whether we would also find a positive correlation between volatility and BoJ interventions when we use the intervention reports of the financial press instead of the actual intervention data. In order to analyze this question, we use the data set on press reports of BoJ interventions compiled by Ramaswamy and Samiei (2000). As described in detail in Section 2, their data set on press reports of BoJ interventions covers the period 1995 – 1999.

In order to study the potential link between (expected) exchange rate volatility and the press reports of BoJ interventions, we proceed as follows (see Table 5). In a first step, we estimate again our benchmark model given in equation (1) for the sub period 1995 – 1999. The estimation results for this first specification are given in the second column of Table 4. As can be seen, the results we obtain for the entire sample period 1993 – 2000 also hold when we focus on the sub period 1995-1999.[6] This shows that our results are robust with respect to the specification of the sample period. In a second step, we split up the interventions of the BoJ into those interventions that were not reported in the financial press ("secret" interventions) and those interventions that were correctly reported in the financial press. The estimation results for this second specification are given in column (2) of Table 5. The estimation results reveal that the BoJ foreign exchange market interventions that were not reported in the financial press are positively correlated with exchange rate volatility. In a third step, we add a dummy variable to specification (2). This dummy variable assumes the value one whenever the financial reported a BoJ intervention but no BoJ intervention had taken place actually, and otherwise assumes the value zero. The estimation results for this third specification are given in column (3) of Table 5. Again, we can see that ~~only~~ those interventions that were not reported in the financial press were strongly positively correlated with exchange rate volatility. One reason for this interesting result could be that such "secret" interventions were less well understood by the market participants (and the financial press) and, thereby, tended to give rise to rumors about central bank intervention activity in the foreign exchange market. It could be that such rumors created uncertainty, so that, as a result, exchange rate volatility increased.[7]

[6] As emphasized by Ito (2002), it could be the case that the intervention strategy of the BoJ changed in 1995, when a new Director General of the Japanese International Finance Bureau was appointed who claimed to follow a different intervention philosophy based on less frequent but large interventions. Our sub sample analysis accounts for the implications of this potential change in the intervention policy of the BoJ for the interventions-exchange rate volatility correlation.

[7] Of course, we should not stretch this interpretation too far because we do not find a significant correlation between the magnitude of the interventions of the BoJ and the likelihood that reports of interventions were published in the financial press.

These results confirm the results documented by Dominguez (1998), according to which especially secret foreign exchange market interventions by central banks, i.e., interventions that are undertaken without notification of the public, tend to be positively correlated with exchange rate volatility. Our results further indicate that, given the inaccuracy of press reports of BoJ interventions we find for our sample period, it may be important to differentiate between correct and incorrect reports of BoJ intervention in the financial press when such press reports are used to analyze the impact of the BoJ interventions on exchange rate volatility. This again demonstrates the importance of having official intervention data at hand when analyzing the potential link between BoJ interventions and exchange rate volatility.

Table 5 — The Effects of Actual and Reported BoJ Interventions

	*Endogenous Variable: Yen/*U.S. dollar *Annualized Implied Volatility*		
	(1)	(2)	(3)
Intercept	2.3814 (3.6364)***	2.3822 (3.6389)***	2.3794 (3.6424)***
Lagged Volatility	-0.1878 (-3.6599)***	-0.1878 (-3.6577)***	-0.1895 (-3.6994)***
Actual Interventions	0.0036 (2.3822)**	–	–
Actual Interventions / Not Reported	–	0.0040 (2.5403)***	0.0041 (2.5396)***
Actual Interventions / Reported	–	0.0030 (0.9368)	0.0030 (0.9478)
No Actual Inter-vention / Intervention Report	–	–	1.6167 (1.3864)
Nikkei Volatility	0.1488 (3.0564)***	0.1489 (3.0576)***	0.1503 (3.0955) ***
Adjusted R^2	0.0250	0.0244	0.0248

Note: *t*-statistics in parentheses. Robust standard errors were used to compute the *t*-statistics. *** = significant at the one percent level. Interventions are measured in billions of yen. We use the absolute value of the interventions in the case of unreported actual interventions and reported actual interventions. When the press incorrectly reported a BoJ intervention, we use a dummy variable that assumes the value one in the case of a wrong report and zero else. We multiply all coefficients by 100.

We also test whether our result that BoJ interventions and exchange rate volatility are positively correlated may reflect that high exchange rate volatility triggered the BoJ interventions in the first place. To this end, we conduct a causality analysis using a probit

model. The dependent variable of this model is an intervention dummy and the vector of regressors includes a constant, a five-day moving average of the logarithm of implied volatility, and a five-day moving average of the absolute deviation of the yen/U.S. dollar exchange rate from 125 yen/U.S. dollar. We use 125 yen/U.S. dollar as a benchmark value for the yen/U.S. dollar exchange rate because Ito (2002) uses this exchange rate level as the implicit exchange rate target of the BoJ, given the fact that the BoJ did not sell any dollars below this level and it did not buy any dollars above this level. To account for the observation that the BoJ interventions tended to occur in clusters, we also include a lagged intervention variable in the set of regressors of our model. The estimation results are summarized in Table 6. The results show that exchange rate volatility did not exert a significant effect on the propensity of the BoJ to intervene.

Table 6 — Did Exchange Rate Volatility Cause BoJ Interventions?

Regressor	*Probit model*
Constant	-2.5144
	(-5.1087)***
Lagged Interventions	1.7932
	(16.4463)***
Movola	0.0912
	(0.4568)
Movav	0.0298
	(5.9337)***
Scale Parameter	--
	--
Log Likelihood	-408.7169
Restricted Log Likelihood	-408.8139
Likelihood Ratio Test	0.1939

Note: The significance of a regressor is analyzed by using the standard normally distributed ratio of the coefficient and its respective standard deviation (*z*-statistic). The *z*-statistic is given in parentheses below the coefficients. Robust standard errors were used to compute the *z*-statistics. *** = significant at the one percent level. *Movola* denotes the (lagged) five day moving average of the logarithm of the yen/U.S. dollar option-implied volatility. *Movav* denotes the (lagged) five day moving average of the absolute deviation of the yen/U.S. dollar exchange rate from 125 yen/U.S. dollar. The likelihood ratio test is computed upon taking the difference between the log-likelihood functions of the restricted (without *Movola*) and the unrestricted model. The likelihood ratio test is χ^2-distributed with degrees of freedom equal to the number of imposed restrictions. See Greene (2000) for further details.

This result is consistent with the finding of Galati and Melick (1999), who report that deviations in the yen/U.S. dollar exchange rate from an implicit target level –not exchange rate volatility– are the main argument in the BoJ reaction function they estimated for the 1993-1996 period. It is also consistent with the empirical results reported by Ito (2002), who uses the same data set of BoJ interventions as we do in order to estimate a reaction function model for the BoJ. Though it is, of course, reasonable to conjecture that the BoJ, like other major central banks, may have used foreign exchange market interventions from time to time to counter exchange rate volatility and to calm "disorderly markets", the results of our causality analysis as well as the results reported in the empirical studies mentioned above suggest that the potential simultaneity problem caused by such a reaction of the BoJ does not significantly distort our estimation results.[8]

4. Summary

We have used recently released daily official intervention to analyze whether the foreign exchange market interventions conducted by the Bank of Japan during the period 1993-2000 were correlated with the volatility of the yen/U.S. dollar spot exchange rate. Our findings suggest that, during the period under investigation, the BoJ interventions were, on average, positively linked to the yen/U.S. dollar exchange rate volatility. Moreover, our findings indicate that especially "secret" BoJ interventions, that is, interventions that were not reported in the financial press, tended to be associated with an increase in exchange rate volatility.

[8] Because we use daily data, we cannot rule out that there were high-frequency (intra day) feedback effects between exchange rate volatility and interventions. Also, though the results of our causality analysis are suggestive, one should note that the empirical approach we use in this paper is not structural in nature, so that one should be somewhat cautious when interpreting our results as providing evidence for a causal effect running from interventions to volatility. Note, however, that the fact that we include lagged implied volatility in our vector of regressors allows a potential simultaneity bias arising due to a reversed causality running from volatility to interventions to be taken into account. As pointed out by Bonser-Neal and Tanner (1996), if intervention is correlated with lagged volatility, the effect of intervention measured by equation (1) is conditional on the realization of volatility.

References

Aguilar, J. and S. Nydahl (2000), Central bank intervention and exchange rates: the case of Sweden. Journal of International Financial Markets, Institutions and Money 10: 303-322.

Almekinders, G.J. and S.C.W. Eijffinger (1994), Daily Bundesbank and Federal Reserve interventions: Empirical Economics 19: 111 – 130.

Baillie, R.T. W.P. and Osterberg (1997), Central bank intervention and risk in the forward market. Journal of International Economics 43: 483-497.

BoJ (Bank of Japan) (2002), Foreign exchange operations, [http://www.mof.go.jp/english/e1c021.htm].

Bonser-Neal, C. and G. Tanner (1996), Central bank intervention and the volatility of foreign exchange rates: evidence from the options market. Journal of International Money and Finance 15: 853-878.

Cai, J., Cheung, Y.-L., Lee, R.S.K., and M. Melvin (2001), "Once-in-a-Generation" yen volatility in 1998: Fundamentals, intervention, and order flow. Journal of International Money and Finance 20: 327-47.

Dominguez, K.M. (1998), Central bank intervention and exchange rate volatility. Journal of International Money and Finance 17: 161-190.

Federal Reserve Bank of New York (2002), Foreign Exchange Treasury and Federal Reserve – FX operations, [http://www.ny.frb.org/pihome/news/forex].

Galati, G. and W. Melick (1999), Perceived central bank intervention and market expectations: an empirical study of the yen/dollar exchange rate, 1993-96. Working Paper No. 77. Bank for International Settlements, Basel.

Garman, M. B. and S.W. Kohlhagen (1983), Foreign currency option values. Journal of International Money and Finance 2: 231-237.

Greene, W.H. (2000). Econometric Analysis, 4. Edition, Prentice Hall, New Jersey.

Neely, C. J. (1998). Technical analysis and the profitability of U.S. foreign exchange intervention. Federal Reserve Bank of St. Louis Review 80: 3-17 [http://www.stls.frb.org/publications/review/indexbak.html].