Why do central banks intervene secretly ?*

Michel BEINE†, Oscar BERNAL‡

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Abstract

This paper empirically investigates the main determinants of secret interventions in the foreign exchange (FX) market. Using the recent experience of the Bank of Japan, we estimate a model that explains the share of secret to reported interventions in the FX market. Two sets of determinants are clearly identified: the first is related to the probability of detection of the central bank orders by market participants; the second, to the central bank's internal decision to opt for secrecy. Our estimations support the arguments of current microstructure theories that rationalize the use of secret interventions.

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†University of Brussels (Belgium); mbeine@ulb.ac.be
‡University of Brussels (Belgium); obernal@ulb.ac.be

1 Introduction

Direct interventions in the foreign exchange (FX) market have been used as a policy instrument on a regular basis by the major central banks. The sterilization process has often made these interventions a tool that is independent of monetary policy. While the debate remains strong about the degree of efficiency of sterilized interventions (see Humpage [2003] among others), some major central banks such as the Bank of Japan (BoJ) have still relied extensively on such interventions over the recent period.

The motives for interventions as well as the nature of the actual interventions themselves have been closely scrutinized by academics and policy makers. Understanding why monetary authorities intervene is important for policy evaluation. Such an understanding is also valuable for capturing the exact nature of the endogeneity issue at stake when the relationship between interventions and exchange rates is investigated (Kearns and Rigobon 2004). Reaction functions have been estimated for the major central banks and suggest that monetary authorities react to reverse undesirable trends and to a lesser extent, to smooth exchange rate volatility (Almekinders and Eijffinger 1994; 1996). Central bank practices have also been studied in much detail (Dominguez and Frankel 1993; Neely 2001), showing that intervention policy is quite varied across both time and monetary authorities.

The literature contains many insights about the usual practice of central banks but has still not been able to rationalize the use of secret interventions (Sarno and Taylor 2001). Secret interventions are usually defined as foreign exchange operations that are not disclosed to market participants (at least not contemporaneously). Depending on the central bank's communication policy and the way the order is transmitted to the commercial banks, these operations can be hidden from foreign exchange traders and can be mistakenly viewed as purely private trades by the market. While the Federal Reserve (Fed) and the Bundesbank have progressively adopted more transparent policies, some central banks still rely on secret operations, as suggested by the recent operations of the BoJ (Beine and Lecourt 2004).

The signaling theory, which considers central bank interventions as a method of altering exchange rate expectations through the release of private information, obviously is unable to rationalize the use of secret operations. Theoretical arguments, based on alternative approaches such as noise trading (Hung 1997) or microstructure (Vitale 1999), have therefore been put forth to explain this practice. Purely informal arguments have also been proposed (Dominguez and Frankel 1993; Chiu 2003). While interesting, these explanations have not been assessed empirically in the literature to the best of our knowledge. This paper aims at correcting the situation.

To study the motives for using secret operations, we examine the intervention policy of the Bank of Japan over the recent period (1991-2004). For a decade, the BoJ has been the most active central bank by far in the foreign exchange markets. Over the full period under study, the BoJ was present in the market for more than 10 per cent of trading days. However, after 2002 up until April 2004, this increased to more than 40 per cent of trading days. The interventions of the BoJ vary greatly over time and thus form a useful basis for testing competing theories of the secrecy conundrum. While the Bank of Japan used public (reported) interventions most of the time during the pre-Sakakibara period (1991-1995) and the Sakakibara (1995-2002), nearly 80 per cent of their operations in the more recent period (2003-2004) remain undetected by market

participants on the day they were carried out.[1] This points to a major shift in the intervention policy.

This paper builds on the recent approach proposed by Beine and Lecourt (2004) to separate the official interventions of the BoJ into reported and secret operations. This was done using newswire reports that capture the extent to which market participants are aware, contemporaneously, of the central bank's presence in the market. We then carried out a logit analysis aimed at explaining the percentage of secret versus reported interventions. After controlling for the determinants of the intervention detection process by market participants, we assessed the empirical validity of the traditional explanations of secrecy developed in the theoretical literature. From our findings, we identified the major determinants that favor a central bank's operations being detected: the size of the operation; whether the operation is carried out in concert with other monetary authorities; the success of the operation; and the intensity of the past intervention policy. More importantly, the results lend strong empirical support to those explanations using the microstructure approach. In particular, we show that the BoJ tended to favor the use of secret operations when targeting an exchange rate value that was inconsistent with the fundamental equilibrium level.

The paper is organized as follows. Section 2 reviews the theoretical literature that rationalizes the use of secret interventions of the central banks. It also provides a short summary of the existing empirical analysis of the central bank practices, a summary that can be used as a useful starting point for our empirical analysis. Section 3 details the empirical strategy and discusses some methodological issues. Section 4 reports and comments on our findings while Section 5 concludes.

2 The literature

2.1 Theoretical background

As clearly identified by Sarno and Taylor (2001), the use of secret interventions by central banks remains puzzling. Indeed, along the signaling channel (Mussa 1981), central bank interventions should lead to successful results to the extent to which they alter the expectations of market participants. Theoretical arguments have therefore been developed, outside the signaling theory, to rationalize the choice of such operations.[2]

A traditional explanation of secret interventions is related to the unwillingness of the central bank to conduct an intervention that has been decided upon by some external authority, this authority often being the Ministry of Finance. For instance, the Japanese intervention policy is under the responsibility of the Ministry of Finance. Any intervention needs the Ministry's approval (internal departments of the Ministry manage the foreign reserves). The Bank of Japan implements its exchange rate policy through the intervention orders. In this context, the central bank will try to minimize the impact of any intervention decision that is considered inconsistent with its other objectives or with the general stance of its policy.

[1] E. Sakakibara, called "Mr. Yen", was the Director General of the International Finance Bureau in charge of the exchange rate policy.

[2] We do not develop the traditional arguments in terms of exchange rate regime (Chiu 2003) as the Japanese yen evolved into a flexible exchange regime over the full period of investigation. Secret operations are likely to occur in fixed exchange regimes with low credibility, either when there is a threat of speculative attacks (Enoch 1998) or when the rate is not far from the edge of the fluctuation band (see the European Monetary System experience in 1993).

The likelihood of a successful intervention is obviously one of the most direct determinants influencing the choice of this type of operation. As emphasized by Dominguez and Frankel (1993) and Chiu (2003), a low level of credibility or a previous failure to move the market in the desired direction may persuade the central bank to opt for secrecy. Using secret interventions would allow the central bank to avoid a further deterioration in its perceived ability to achieve the desired goal or to avoid significantly increased volatility of the exchange rate. Alternatively, in the case of a previous reported success and when the current context appears less favorable, the central bank might also want to intervene secretly to preserve its credibility. Credibility, as measured by previous performance, therefore exerts some ambiguous theoretical influence on whether secret operations are conducted.

Theoretical contributions based on the noise trading approach also provide some rationale for secret interventions. This is especially true when the central bank leans against the wind, that is, tries to reverse an undesirable evolution of the currency. In this case, a secret intervention can mitigate bandwagon effects by restoring a two-way risk (Dominguez and Frankel 1993). Central bank order flows and the resulting increase in volatility can cause the two-way market risk faced by market participants. The secrecy of these order flows might therefore lead market participants to consider exchange rate fluctuations as purely endogenous to the market (Hung 1997). In this context, leaning-against-the-wind behavior tends to favor secret operations.

Other arguments have also been advanced by the microstructure approach to exchange rates (Lyons 2001). These arguments rely on the main underlying assumptions, namely agents' heterogeneity and information asymmetry. The secrecy of order flows allows central bank trades to be undistinguishable from private trades. This is important for two main reasons. First, as developed by Vitale (1999), secrecy is desirable when the central bank targets some exchange rate level that is inconsistent with the fundamental equilibrium exchange rate. To a certain extent, while the concept of inconsistent policies is quite different, this fits with Stein's (1989) stressing the importance of the ambiguous nature of the information delivered by the central bank in such cases. Second, anonymous trades by the entral bank restore the case for a portfolio channel (as opposed to the signaling channel). As argued by Evans and Lyons (2001), in this context the efficiency of central bank interventions is enhanced when the information flow in the market is relatively important.

2.2 Empirical studies

Identifying the determinants of central bank interventions has given rise to an extensive empirical literature. Almekinders and Eijffinger (1996) estimate central bank reaction functions for the Fed and the Bundesbank. They find that central banks tend to adopt leaning-against-the-wind policies and respond to exchange rate volatility. They also emphasize the central banks' reluctance to intervene by estimating significant thresholds of intervention. These results are interesting for two reasons: to understand the motivations of central bank in intervening; and to tackle in an appropriate way the issue of reversed causality that is at stake in the empirical analysis of the efficiency of these operations.[3]

Subsequent studies of the major central banks have tended to confirm the importance of leaning-against-the-wind behavior. In contrast, there has been much less empirical support for

[3]For recent illustration, see Kearns and Rigobon [2004].

the goal of smoothing exchange rate volatility. Ito and Yabu (2004) confirm the leaning-against-the-wind type of behavior of the Japanese authorities and find support for a non-intervention band that reflects the costs of intervention. Baillie and Osterberg (1997) find that deviations of exchange rates from their target triggered interventions by the Fed and Bundesbank. However, they do not find robust evidence that the excess volatility prompted the banks to intervene. As a whole, this result seems robust to alternative measures of deviation and volatility as well as alternative econometric techniques. Using another estimate of the time-varying volatility, Beine et al. (2002) confirm this last finding for the G-3 central banks. Using expected moments drawn from implied distributions by currency option prices, Galati and Melick (1999) find quite similar results for the BoJ. Using a count data model that captures the dynamics of the intensity of Bank of Switzerland interventions, Frenkel et al. (2004) find support for leaning-against-the-wind behavior and a weak response to excessive fluctuations of the exchange rate. While the existing literature focuses extensively on the potential determinants of the FX interventions, to the best of our knowledge there has not been any attempt to analyze the choice of intervention mode. This paper aims at correcting this lack by analyzing the determinants of secret operations of the BoJ.

As for the impact of interventions, empirical studies have documented contrasting influences of secret interventions and of reported. Dominguez (1998) finds that while reported interventions can lead to lower volatility, secret operations generally tend to increase the uncertainty in the market. Beine et al. (2002) find that secret operations tend to be counterproductive in terms of exchange rate levels while reported ones have no systematic influence. While the results tend to be period- and country-specific, as a whole they suggest that the type of intervention chosen might affect the efficiency of these operations.

3 The empirical strategy

3.1 Measuring secret interventions

Our empirical investigation of the choice of secret operations uses the recent BoJ intervention policy. The Bank of Japan was chosen for two main reasons. First, the Bank of Japan in recent times has been by far the most active major central bank in the FX markets. Over the 1991-2004 period of interest here, the BoJ has intervened 343 times against the U.S. dollar (USD); this means the BoJ was in the market on more than 10 per cent of business days. In the recent period beginning in 2003, the BoJ was active more than 40 per cent of the time. This pattern is in sharp contrast to the recent experience of the two other major central banks, the Fed and the ECB. While the Fed and the Bundesbank were quite active before 1995, they have become increasingly reluctant to use this stabilization instrument. Since 1995, the Fed has intervened only twice in a concerted way while the ECB has conducted only four interventions to support the euro.

Second, the BoJ was chosen because of the proportion and the time variability of secret interventions. Based on their estimates of secret operations (see below), Beine and Lecourt (2004) find that the Fed became increasingly transparent over time. While most of their operations (90 per cent) against the DEM were secret during the Plaza period (September 1985-February 1987), this proportion fell dramatically afterward. The share of unreported Fed operations was only 23 per cent against the DEM after 1987 and 12.5 per cent against the yen after 1991. A similar trend was observed for the Bundesbank. These results are consistent with the trend of increasing

transparency in the FX intervention policies of these central banks. This is in sharp contrast to the BoJ policy. Beine and Lecourt (2004) document a major shift in the recent intervention policy of the BoJ in favor of secret operations. Since 2002, while intervening massively, more than 60 per cent of the daily operations of the BoJ have remained undetected by market participants on the day of the intervention. Updates of these estimates to April 2004 (at which time the BoJ stopped intervening) suggest that about 80 per cent of these operations remain unreported. The intervention policy of the BoJ suggests that secret operations remain an active instrument in the hand of central banks. Furthermore, this policy displays much variation over time, which suggests that market evolution might explain the central bank decisions about the types of operations.

We define a secret intervention as an intervention that has not been reported to market participants by the involved central bank or banks on the day it was carried out. We use the approach developed by Beine and Lecourt (2004) to capture the reported interventions in the FX market. The identification procedure is described extensively in Beine and Lecourt (2004). Basically, the approach relies on searching appropriate keywords in newswire reports that were sent on the days of official interventions.[4] These newswire reports are extracted using an online database (Factiva), which collects news of all types from all over the world.[5] The intervention is considered secret if there is no evidence of information provided to or by FX traders that the central bank was active in the market.[6] This search procedure provides numerous advantages over alternative approaches (such as the use of financial publications) that have been employed by several authors (Bonsner-Neal and Tanner 1996; Dominguez 1998).[7]

Table 1 gives the number of official intervention days (defined as interventions actually conducted by the central bank and confirmed in the data released on a quarterly basis by the central bank itself) plus the percentage of secret operations. The data are separated into three distinct periods that match definitions proposed by Ito (2003). The first period is called the pre-Sakalibara (1991-1995) during which the BoJ conducted frequent interventions. These operations involved relatively low amounts and were sometimes in concert with the Fed. The second period is the Sakakibara (1996-2002) with less frequent but massive currency sales or purchases. During that period, the Bank of Japan obviously adopted a policy of high transparency as reflected in the very low proportion of secret operations.[8] Finally, the recent period (2003-2004) displays a strong increase in both the number of interventions and the share of secret operations. Note that after 1995 the Bank of Japan conducted almost only unilateral operations.[9]

At first glance, it might be surprising that the Bank of Japan succeeded in conducting such a high proportion of secret interventions, often on several consecutive days. As documented by Dominguez and Frankel (1993), there are nevertheless several ways in which a central bank can hide its exchange rate operations. In this regard, the BoJ exhibited a high degree of creativity in its various intervention strategies, especially over the recent period. Exchange rate traders often

[4]We use the following keywords: "interventions", "Bank of Japan", "Federal Reserve", and "Ministry of Finance".

[5]A description of the database can be found at www.factiva.com.

[6]Section A of the Appendix provides examples of intervention reports and further details on the procedure.

[7]See Beine and Lecourt (2004) for a development of the advantages of this approach over the use of financial newspapers.

[8]It should also be noted that the BoJ decided to release the official central bank intervention data during that period.

[9]The last concerted operation with the Fed occurred on June 17, 1998. The Bank of Japan also joined the concerted operation to support the Euro on September 22, 2000.

Table 1: Features of BOJ intervention policy, YEN-USD, 04/01/1991-03/16/2004

Periods	Official	Concerted	Secret
Pre-Sakakibara (1991-1995)	174	21	17.2%
Sakakibara (1996-2002)	41	3	2.4%
Recent (2003-2004)	128	0	78.9%
Whole (1991-2004)	343	24	38.5%

Note: Official gives the number of interventions in the YEN/USD market as statistically reported by the Bank of Japan. Concerted gives the number of concerted official interventions. Secret reports the percentage of unreported interventions the day the operation was carried out.

mention these strategies without being able to provide strong evidence supporting their existence. As a result, the Bank of Japan succeeded in keeping the exchange rate operations undetected not only the day they were carried out but also on the succeeding days. This was partly due to the reluctance of the Bank of Japan to confirm the recent past operations. As a piece of evidence, we find very weak evidence that traders were aware of past secret operations during the week after their occurrence: out of the 132 secret operations observed over our sample period, only 6 were confirmed by the Bank of Japan during the 5 subsequent business days. A systematic analysis of the reports extracted from the Factiva online database allows listing some of the strategies used by the BoJ in order to keep the operations secret.[10] First, a systematic medium-run strategy used by the Bank of Japan is to decline any confirmation of recent past operations, whether they were detected or not.[11] Second, during the first and the third sub-period, the BoJ placed Forex orders with a very limited number of commercial banks, with an explicit requirement of confidentiality.[12] Third, over the recent period, the BoJ has intervened not only in their own local markets but also in the London, New York, and other Asian currency markets. This allows the BoJ to intervene over the full course of the day and to pick up the optimal moment for surprising the market.[13] A related strategy is to intervene during Japanese bank holidays.[14] Some other central banks such as the Fed and the ECB were also reported to intervene on behalf of the BoJ.[15] Finally, the BoJ was also reported to have placed conditional orders at different exchange rate levels. [16] This contrasted with the previous usual practice of aggressive buys and sells when the exchange rate level reached certain levels. This list of intervention strategies is, of course, far from being exhaustive. The range of the types of operations mentioned here just reflects the high degree of innovation in the way the Bank of Japan conducted its exchange operations.

[10]Some of the extracted reports can be obtained upon request by interested readers.

[11]A statement made by officials at the Forex Bureau of Japan's Ministry of Finance about this general strategy was issued on October 2, 2003.

[12]This strategy was mentioned by traders in June and August 1992. On August 12, 1992, the BoJ was even reported to have placed orders with a single commercial bank.

[13]This point was reported in some analysts' reports in January 2003.

[14]Some traders remembered his strategy on January 18, 2003.

[15]It is nevertheless unclear to what extent this strategy favors the secrecy of the operations. On one hand, the traders fail to identify the BoJ as one of the central bank taking part in the operations. On the other hand, the BoJ often tended to confirm the interventions when carried out by other central banks on its behalf.

[16]Some traders' reports in March 2003 noted this strategy.

3.2 The econometric model

We use the standard approach of binary response models in our analysis of the determinants of secret interventions. Defining $y_i = 1$ when intervention i of the BoJ remains secret and $y_i = 0$ when it has been reported [17], we use a logit specification of the following form:

$$Prob(y_i = 1) = \frac{exp(X\beta + Z\gamma)}{1 + [exp(X\beta + Z\gamma)]} \tag{1}$$

in which $X\beta = \beta_0 + \beta_1 x_1 + ... + \beta_K x_K$ and $Z\gamma = \gamma_1 z_1 + ... + \gamma_L z_L$.[18] $y_i = 1$ captures interventions that the central bank chose to conduct in a secret way *and* that were not detected by FX traders while $y_i = 0$ includes two types of interventions that turn out to be observationally equivalent, i.e., the ones the bank chose to report to market participants and those the bank wanted to remain secret but that were detected by market participants. We disentangle the determinants of y_i from two sets of explanatory variables. We include, as regressors, variables thought to increase the probability of detection (denoted as X in (1)) and variables believed to influence the central bank in its choice of intervention type (denoted as Z in (1)). While our primary interest lies in the γ coefficients to test theories of the endogenous choice for secrecy discussed in Section 2.1, failure to control for the X variables would obviously result in poor estimates of these γ. The model is estimated using the maximum likelihood estimators. To improve estimator efficiency, we used Huber-White (QML) robust standard errors.

Since logit and probit approaches are non-linear, one has to compute the marginal effects of the explanatory variables. These marginal effects are important in assessing the economic importance of these determinants. The marginal effect $mc(x_K)$ associated with a given continuous variable x_K is computed as:

$$mc(x_K) = \frac{exp(\overline{X}\widehat{\beta} + \overline{Z}\widehat{\gamma})}{(1 + [exp(\overline{X}\widehat{\beta} + \overline{Z}\widehat{\gamma})])^2} \times \widehat{\beta_K} \tag{2}$$

where $\overline{X}$ (resp. $\overline{Z}$) denotes the vector of explanatory variables X (resp. Z) computed at their sample means and $\widehat{\beta}$ (resp. $\widehat{\gamma}$) denotes the vector of estimates of β (resp. γ). The marginal effect $md(x_k)$ of a dummy variable x_K is computed as:

$$md(x_K) = g(\widehat{\beta_0} + ... + \widehat{\beta_K} 1 + \widehat{\gamma_1}\overline{z_1} + ... + \widehat{\gamma_L}\overline{z_L}) - g(\widehat{\beta_0} + ... + \widehat{\beta_K} 0 + \widehat{\gamma_1}\overline{z_1} + ... + \widehat{\gamma_L}\overline{z_L}) \tag{3}$$

where $g()$ denotes the logistic transformation.

3.3 The data

3.3.1 Determinants of detection

Beine and Lecourt's (2004) preliminary analysis provides some clues to finding variables that influence the probability of detecting the presence of the central bank in the market. These determinants pertain primarily to some of the features of the central bank interventions but also touch on market conditions.

[17] It should be clear that we include in the sample only observations associated to official intervention days. The inclusion of the non intervention days would imply the use of a multinomial probit of logit analysis. This cumbersome extension is left for future work.

[18] We get almost identical results using a probit approach. The results are not reported in this paper due to space constraints but are available upon request.

Beine and Lecourt (2004) document the relatively low proportion of unreported concerted interventions in both the DEM/USD and the YEN/USD markets. The joint presence of the two involved central banks increases the visibility of central bank trades and is therefore expected to increase the probability of detection. We thus build a dummy variable denoted *coord* that takes 1 if the intervention was concerted, 0 otherwise.

The size of the intervention is also expected to influence the extent to which traders might detect the presence of the central bank. Daily size reflects not only the size of the order flows given by the central bank but also the number of these orders.[19] Large daily amounts of intervention, such as the ones observed during the Sakakibara period, usually result in successive trades by the central bank over the full course of the trading day. Nevertheless, one should also account for developments in the size in the daily market turnover that show an upward trend over our investigation period. (See Bank for International Settlements [2004] on this point.) To account for this, a dummy variable (denoted by $size$) takes 1 if the daily size of the intervention is higher than the average amount of the year, 0 otherwise.

Previous reported interventions in the days before the intervention should also raise traders' attention to the presence of the central bank in the market. Empirical reaction functions (Almekinders and Eijffinger 1996) suggest that the probability of intervention is higher when the central bank has intervened during the days previous. This fits with the cluster behavior of central bank interventions that has been documented in numerous studies. Given that official data are released only with a 3-month lag, we build a variable (denoted $clusters$) that captures the number of successive reported interventions during the five days immediately preceding an intervention.

The success of the intervention can also influence the extent to which this intervention is detected. Dominguez (2004) provides a stunning example of such a success by looking at the effect of the Fed intervention on May 31, 1995. The first order of the Fed resulted in DEM/USD jumping more than 2 per cent, drawing the attention of traders and triggering newswire reports. Subsequent trades of the Fed on that day were also easily detected. A given intervention is considered successful if it moves the exchange rate in the desired direction. While restrictive, this definition is consistent with the main objective of the BoJ over our investigation period. We compare the sign of the exchange rate return between day $t-1$ and t and the sign of intervention occurring at date t.[20] The variable $success$ takes 1 if a purchase (respectively a sale) of dollars led to an appreciation (respectively a depreciation) of the dollar.

Finally, we also include the degree of misalignment (denoted mis) of the exchange rate, i.e., the size of the (absolute) deviation of the rate with respect to the equilibrium exchange rates. We use the equilibrium rates computed by Bénassy et al. (2004) that reflect the level of the exchange rate needed to reach a global equilibrium among these G-20 economies. The implied equilibrium level of the YEN/USD exchange rate is computed at an annual frequency.[21]

[19] Unfortunately, while the major central banks release information on both the days when they intervened as well as the amounts involved, they do not provide data on the number of trades within the intervention days, nor the exact timing of the operations. To the best of our knowledge, these data exist only for the (unilateral) interventions of the Bank of Switzerland and the Bank of Canada.

[20] The choice of the quotation time of the YEN/USD exchange rate (noon rates on the New York market) ensures that the intervention occurred before the record of the rate at time t, assuming that the BoJ intervened during Japanese business hours. This assumption is in line with the evidence provided by Dominguez (2004).

[21] The equilibrium exchange rates are available over the 1980-2001 period. For the subsequent period, we make the assumption that the equilibrium rate remains constant. To illustrate, the implied equilibrium rate of the YEN/USD was equal in 2003 to 98.50 yen per USD.

3.3.2 Determinants of choice for secrecy

We build variables to assess the theories rationalizing the use of secret intervention; these were discussed in Section 2.1.

Inconsistency of exchange rate policy

Our first variable aims at capturing the degree of inconsistency of an intervention. We build two measures of inconsistency, both based on the degree of misalignment with the exchange rate. As before, the misalignment is built using Bénassy et al.'s (2004) estimates of the equilibrium exchange rates. The first measure (*inconsist*) is in the form of a dummy variable that takes 1 when the BoJ intervenes in a direction opposite to the direction needed to reduce the degree of misalignment. This situation occurs when the BoJ bought yen when the yen was overvalued or sold yen when the yen was undervalued.[22] This first measure, however, does not account for the degree of misalignment and gives equal weight to both large and small deviations from the equilibrium rate. To overcome this limitation, we compute a second measure by multiplying this first measure by the absolute value of the misalignment. This leads to a new variable denoted by $inconsist \times mis$. Using this measure, inconsistency is expected to rise with the degree of misalignment.[23]

Under the assumption that the exchange rate target of the central bank is equal to the equilibrium exchange rate, both measures of inconsistency capture implicit conflicts between the central bank (i.e., the BoJ) and the external authority (i.e., the Ministry of Finance) as noted in the first theoretical explanation of secrecy. Over the recent period, the Japanese government reportedly favored an export-led growth policy through a weak yen.[24] Under the assumption of identical targets for both the central bank and external authority, the inconsistency variable might be used to assess the empirical validity of the Vitale (1999) arguments. Interventions reveal a discrepancy between the exchange rate target of the central bank and the fundamental value of the exchange rate (captured by the equilibrium rate). It is very difficult to assess the validity of the assumption of an identical exchange rate target between the BoJ and the Ministry of Finance.[25] Nevertheless, under both assumptions, both the explanation in terms of conflict between the authorities and the microstructure argument of Vitale (1999) clearly predict that our inconsistency measure should be associated with a higher probability of secret intervention.

Previous success of interventions

We measure the extent to which past interventions have been efficient. With this aim, we build three complementary measures of past intervention success. For the first, we compute whether

[22] Incidentally, our definition of a consistent intervention policy fully matches the intervention strategy recently proposed by Neely (2004). Neely (2004) argues that the adoption of such a policy rule should result in effective operations in the medium run.

[23] This second measure also implicitly accounts for the non-observability of the equilibrium rate. Given that several measures of the equilibrium might be used, small deviations lead to difficult evaluation of the under- or overvaluation of the currency. In contrast, large deviations should correspond to a broad consensus on whether the currency is under- or overvalued.

[24] Both measures also capture another type of inconsistency. Intervention policy might be seen at odds with the international monetary cooperation aimed at reducing economic imbalances. More precisely, the recent BoJ intervention policy that was aimed at supporting the dollar was inconsistent with the G-7 statements in September 2003 and February 2004 in favor of fully flexible exchange rates.

[25] The recent intervention policy nevertheless supports the view that purchases of dollars decided by the Ministry of Finance were fully endorsed by the BoJ. While the Ministry of Finance obviously targeted a weak yen to promote exports, the BoJ was said to use unsterilized operations as a way to expand the monetary base in a context of liquidity trap.

the last intervention (regardless of whether it was secret or reported) has been a success, using the same concept of success as previously used. This variable, denoted *previous success*, takes 1 if the last intervention succeeded in moving the exchange rate in the desired direction, 0 otherwise. Because traders might be unaware of secret interventions during the past few days, we compute a second measure that restricts the success assessment to reported interventions. More precisely, the variable denoted *previous reported success* takes 1 if the last reported intervention succeeded in moving the exchange rate in the desired direction, 0 otherwise. Our third and last measure captures previously known failures through a dummy variable (*last reported failure*) that takes 1 if the last known intervention was a failure, 0 if the last intervention was a success or was unknown to market participants. If one believes that past inefficiency of interventions should lead the central bank to opt for secrecy, one would expect the first two measures to be associated with negative coefficients in the logit specification (equation(1)) and the last to be positively associated with secrecy.

From a more general perspective, central bank practice suggests that past performance of interventions might influence a central bank's decisions about the intervention policy. Results of the survey conducted by Neely (2001) suggest that central bank trades depend on the response of exchange rate to previous interventions. The current analysis should also been seen as a formal way whether past performance does influence the type of the intervention conducted by central banks.

Declared policy targets

Another way to test for the microstructure arguments of Vitale (1999) is measuring the extent to which the central bank finds the level of the exchange rate at odds with fundamentals or any other target. Extracting the statements using Factiva reveals that central bank spokesmen or officials rarely mention explicit target levels. Nevertheless, a large number of statements might signal that the central bank has an explicit target in terms of exchange rate. To the extent that this target differs from the fundamental level of exchange rate, along the lines of Vitale (1999), this might lead the central bank to opt for secrecy. We measure the number of days on which verbal statements referring to the exchange rate level were made by BoJ officials over the five days preceding the intervention. This variable is denoted by *target level*. We found that about 57 per cent of interventions were preceded by at least one statement of this type. A positive relationship between this variable and the probability of secret intervention is also consistent with a noise trading strategy of the central bank. Indeed, statements that the exchange rate is disconnected from fundamentals might be addressed primarily to fundamentalists who favor a mean-reverting behavior of the exchange rate. The subsequent secret interventions might aim at creating a temporary trend in order to induce chartists to join the market.

While central bankers often make statements in terms of the exchange rate level, central bankers also denounce excess exchange rate volatility. We therefore create a similar type of variable capturing the number of days, over the five days preceding the intervention, that BoJ officials made verbal statements referring to the excess volatility level. This variable is indicated by *target volatility*. We found that over the full period, about 34 per cent of interventions were preceded by at least one statement of this type.[26]

[26]See section B of the Appendix for examples of news reports used to build *target level* and *target volatility* variables.

Leaning-against-the-wind

As another indirect way to test for a noise trading strategy, we also create a variable indicating whether the central bank adopted a leaning-against-the-wind behavior. To this end, we compare the sign of the last five previous daily exchange rate returns with the sign of the intervention. The variable *leaning* takes 1 when the intervention goes in the direction opposite to the previous trend, 0 otherwise. We find that more than 76 per cent of the interventions were of a leaning-against-the-wind type.

Along the noise trading channel, leaning-against-the-wind intervention strategies favor secret interventions so as to create seemingly market-endogenous fluctuations of the exchange rate. More generally, if associated with low credibility, leaning-against-the-wind behavior should induce the central banks to hide their presence in the market (Enoch 1998). Both arguments imply an expected positive relationship.

Exchange rate volatility

Finally, we also control for exchange rate volatility. Market volatility is known to be highly correlated with transaction volumes and the level of information flows. Microstructure approaches (Evans and Lyons 2001) argue that the efficiency of secret interventions should be greater with intense information flows. Volatility is estimated here using realized volatility, as suggested by Andersen et al. (2001). Since interventions are known to increase most of the time exchange rate volatility and in order to prevent any problem of simultaneity, we use one-day lagged volatility. This should be a rather good approximation, given the volatility clustering usually observed for exchange rates. Following Beine, Laurent, and Palm (2004), daily volatility at day t measured at hour h (denoted by $RV_{t,h}$) is calculated as the sum of the previous 24 hourly returns:

$$RV_{t,h} = \sum_{i=0}^{23} r_{t,h-i}^2. \tag{4}$$

We choose h corresponding to the opening of the Japanese market, i.e. 0.00 GMT+1. Table 2 summarizes the measures used to capture both the determinants of market detection and the motivation of the central bank to opt for secrecy.

4 Results

In order to make things clear, we conduct a systematic estimation strategy. Tables 3, 4 and 5 are organized along the following lines: specification (1) includes all the explanatory variables in the logit estimation; each table refers to the use of an alternative measure of previous performance of interventions, namely *previous success*, *previous reported success* and *previous reported failure*.

In specification (2), we omit two variables to account for two potential problems. First we exclude the variable related to the success of the intervention (*success*) as a determinant of the detection of the central bank trades. The aim is to account for some potential problems of endogeneity of this variable, to the extent that the type of intervention has a possible effect on its efficiency. While the empirical literature is rather inconclusive about such an effect (Dominguez 1998; Beine et al. 2002), we nevertheless look at the stability of the parameters related to the other determinants with and without this variable. Second, we also exclude the leaning-against-the-wind-behavior (*leaning*) as a test of robustness of our binomial logit approach. Indeed, our estimation strategy is carried out conditionally on the fact that the central bank decided to intervene. Ideally,

Table 2: Empirical measures of explanatory variables (X and Z) of secret interventions.

Variables	Definitions
Size	1 if intervention size higher than annual average level
Coord	1 if intervention is concerted
Clusters	Number of successive reported interventions over the last 5 preceding trading days
Success	1 if the intervention moves the exchange rate in the desired direction
Mis	Absolute level of misalignment in percentage
Previous success	1 if the last intervention was a success
Previous reported success	1 if the last reported intervention was a success
Previous reported failure	1 if the last intervention was a failure and was reported
Inconsist	1 if the intervention direction inconsistent with the reduction of the exchange rate misalignment
Target level	Number of verbal interventions signalling inconsistent level of exchange rate
Target volatility	Number of verbal interventions signalling excess volatility of exchange rate
Leaning	1 if the intervention tries to reverse recent exchange rate trend
$RV_{t-1,h}$	Realized exchange rate volatility of preceding day estimated at hour h

the estimation could be done in a nested logit specification (see McFadden 1984) where the first hierarchy of alternatives would concern the decision to intervene; a second hierarchy, on the choice between secret and public intervention; and a last cluster would concern the detection process of the secret interventions. Unfortunately, the observational equivalence between "detected secret interventions" (i.e., interventions the Bank wanted to remain secret but were detected by market participants) and public ones prevents the estimation of such model. As an alternative, one can estimate the determinants of the alternatives of this second cluster. The current analysis should be seen in this case as the first estimation step of a two-hierarchy nested logit model (one for the intervention decision, the second for the distinction between reported and secret ones) as proposed by Wooldridge (2002).[27] In this perspective, the *leaning* variable that should enter as a determinant within the first nest (Almekinders and Eijffinger 1996; Kearns and Rigobon 2004) should be excluded in this estimation. The fact that this variable is never significant is rather good news from this point of view.

Specification (3) is parsimonious as it excludes obviously insignificant variables such as the *mis*, *target level*, and *target volatility* variables. Specification (4) uses an alternative measure to the inconsistency variable to account for the effect of the size of the misalignment. It should also be mentioned that the inclusion of realized volatility ($RV_{t-1,h}$) points to a high level of insignificance of this variable. Furthermore, the unavailability of intra-daily exchange rates over the full period restricts the size of the sample used to estimate the probability of secret interventions. These results are therefore not reported here but are available on request.

Along with estimated coefficients, Tables 3, 4 and 5 report test statistics that can be used to assess the empirical relevance of our specification. We compute the traditional measures used for logit specifications, namely, McFadden R^2; percentage of correct prediction for the secret intervention and for both alternatives; and finally the Hosmer-Lemeshow test statistics for the null of a correct specification. In general, all estimated models provide a good fit with often more than 75 per cent of good prediction. They also pass rather well the Hosmer-Lemeshow misspecification test.

4.1 Detection of interventions

Our estimations succeed on the whole in capturing determinants of the detection of central bank interventions carried out by the BoJ. Market participants' identification of the central bank interventions tends to increase because of the relatively large amounts in the central bank orders. Thus, other things being equal, central banks will tend to favor small operations to keep their operations secret. Operations in concert with the Fed also result in higher detection by market participants. This fits with the previous evidence provided by Beine and Lecourt (2004) that coordinated operations are less successful in remaining undetected than unilateral ones. To a certain extent, this means that the decision to coordinate prevents the use of secret operations.

Successive previous reported interventions occurring over the recent period also result in better detection of central bank operations. This might occur in two ways. First, given the fact that central banks tend to intervene in a clustering way, identification of previous operations might raise traders' attention to order flows. This might result in a higher detection rate of central bank

[27] Note that such a nested logit approach would especially be called for if the primary interest lay in the response probability for each alternative. This, however, is beyond the scope of this paper.

Table 3: Determinants of secret interventions: BOJ, 1991-2004

Variables	(1)	(2)	(3)	(4)
Constant	-0.717	-1.234**	-1.055***	-0.490**
	[0.611]	[0.530]	[0.286]	[0.233]
Size	-0.642**	-0.712**	-0.710**	-0.643**
	[0.288]	[0.287]	[0.284]	[0.271]
Coord	-2.420**	-2.713**	-2.728**	-2.726**
	[0.971]	[1.060]	[1.072]	[1.106]
Clusters	-0.518**	-0.494**	-0.467**	-0.619***
	[0.227]	[0.206]	[0.194]	[0.193]
Success	-1.053***	-	-	-
	[0.307]			
Mis	0.298	0.186	-	-
	[2.320]	[2.285]		
Previous success	0.092	0.122	0.066	0.061
	[0.283]	[0.273]	[0.268]	[0.256]
Target level	0.0523	0.050	-	-
	[0.148]	[0.135]		
Inconsist	2.171***	1.984***	1.989***	-
	[0.362]	[0.326]	[0.296]	
Inconsist × Mis	-	-	-	9.176***
				[1.902]
Target volatility	0.229	0.194	-	-
	[0.164]	[0.162]		
Leaning	-0.309	-	-	-
	[0.333]			
Mc Fadden R^2	0.295	0.263	0.259	0.211
Correct cases (secret)	0.750	0.758	0.758	0.652
Correct cases (all)	0.798	0.754	0.749	0.766
Total gain	0.184	0.140	0.135	0.152
Hosmer-Lemeshow test	0.022	0.778	0.584	0.069
Number of observations	342	342	342	342

Note: The estimates are obtained from a logit model with dependent variable equal to 1 when the intervention is considered secret, 0 if not (i.e. reported). Previous success based on whether the last intervention was a success. Huber-White (QML) Standard Errors reported between brackets. ***, **, * denote significance level at 1, 5 and 10 % respectively. Correct cases provide the proportion of correct predictions, using a threshold value of 0.5. Total gain gives the improvement of the proportion of correct predictions compared to a constant probability model. The penultimate line provide p-values related to the Hosmer-Lemeshow test of goodness-of-fit, distributed as a χ^2 with $J-2$ degrees of freedom, J being the number of quantiles used in the test ($J = 10$).

Table 4: Determinants of secret interventions: BOJ, 1991-2004

Variables	(1)	(2)	(3)	(4)
Constant	-0.748	-1.248	-1.10***	-0.600**
	[0.653]	[0.542]	[0.298]	[0.252]
Size	-0.638**	-0.706**	-0.704**	-0.633**
	[0.289]	[0.287]	[0.285]	[0.272]
Coord	-2.400**	-2.698**	-2.713**	-2.708**
	[0.985]	[1.069]	[1.078]	[1.099]
Clusters	-0.508**	-0.484**	-0.460**	-0.603***
	[0.226]	[0.203]	[0.193]	[0.192]
Success	-1.058***	-	-	-
	[0.307]			
Mis	0.281	0.178	-	-
	[2.302]	[2.276]		
Previous reported success	0.117	0.143	0.143	0.243
	[0.307]	[0.285]	[0.285]	[0.263]
Target level	0.047	0.045	-	-
	[0.148]	[0.135]		
Inconsist	2.159***	1.964***	1.963***	-
	[0.364]	[0.330]	[0.303]	
Inconsist × Mis	-	-	-	8.907***
				[1.918]
Target volatility	0.221	0.184	-	-
	[0.162]	[0.161]		
Leaning	-0.287	-	-	-
	[0.350]			
Mc Fadden R^2	0.295	0.263	0.259	0.212
Correct cases (secret)	0.742	0.758	0.758	0.667
Correct cases (all)	0.795	0.754	0.752	0.772
Total gain	0.181	0.140	0.137	0.158
Hosmer-Lemeshow test	0.017	0.217	0.783	0.069
Number of observations	342	342	342	342

Note: The estimates are obtained from a logit model with dependent variable equal to 1 when the intervention is considered secret, 0 if not (i.e. reported). Previous success based on whether the last *perceived* intervention was a success. Huber-White (QML) Standard Errors reported between brackets. ***, **, * denote significance level at 1, 5 and 10 % respectively. Correct cases provide the proportion of correct predictions, using a threshold value of 0.5. Total gain gives the improvement of the proportion of correct predictions compared to a constant probability model. The penultimate line provide p-values related to the Hosmer-Lemeshow test of goodness-of-fit, distributed as a χ^2 with $J-2$ degrees of freedom, J being the number of quantiles used in the test ($J = 10$).

Table 5: Determinants of secret interventions: BOJ, 1991-2004

Variables	(1)	(2)	(3)	(4)
Constant	-0.325	-0.805	-0.733**	-0.159
	[0.577]	[0.511]	[0.285]	[0.230]
Size	-0.619**	-0.701**	-0.694**	-0.632**
	[0.291]	[0.289]	[0.289]	[0.278]
Coord	-2.374**	-2.639**	-2.659**	-2.636**
	[0.957]	[1.048]	[1.062]	[1.054]
Clusters	-0.387*	-0.371**	-0.354**	-0.479***
	[0.200]	[0.185]	[0.176]	[0.171]
Success	-1.117***	-	-	-
	[0.312]			
Mis	-0.049	-0.231	-	-
	[2.314]	[2.294]		
Previous reported failure	-1.078***	-0.997***	-0.999***	-1.099***
	[0.390]	[0.374]	[0.377]	[0.352]
Target level	0.046	0.052	-	-
	[0.149]	[0.134]		
Inconsist	1.972***	1.770***	1.794***	-
	[0.377]	[0.335]	[0.304]	
Inconsist × Mis	-	-	-	7.635***
				[1.970]
Target volatility	0.216	0.178	-	-
	[0.169]	[0.166]		
Leaning	-0.246	-	-	-
	[0.335]			
Mc Fadden R^2	0.313	0.279	0.276	0.233
Correct cases (secret)	0.720	0.735	0.773	0.682
Correct cases (all)	0.795	0.763	0.772	0.775
Total gain	0.181	0.149	0.158	0.161
Hosmer-Lemeshow test	0.260	0.231	0.204	0.113
Number of observations	342	342	342	342

Note: The estimates are obtained from a logit model with dependent variable equal to 1 when the intervention is considered secret, 0 if not (i.e. reported). Previous reported failure based on whether the last intervention was perceived *and* was a failure. Huber-White (QML) Standard Errors reported between brackets. ***, **, * denote significance level at 1, 5 and 10 % respectively. Correct cases provide the proportion of correct predictions, using a threshold value of 0.5. Total gain gives the improvement of the proportion of correct predictions compared to a constant probability model. The penultimate line provide p-values related to the Hosmer-Lemeshow test of goodness-of-fit, distributed as a χ^2 with $J-2$ degrees of freedom, J being the number of quantiles used in the test ($J = 10$).

trades, regardless whether they were initially intended to be secret or public. Second, central banks tend to keep the same intervention policy for a period of time. In other words, transparent policies that aim at informing market participants will tend to be applied to a number of successive operations.

Our estimations also suggest that successful operations will tend to be more easily detected by market participants. Nevertheless, given the potential problem of endogeneity with this variable, this result should be taken with caution. Importantly, while the variable is highly significant, its exclusion does not lead to any important parameter changes for the other variables, nor does it strongly reduce the goodness-of-fit performances of the model. Our results therefore tend to be robust to the inclusion of this variable. Finally, the misalignment variable was not found to affect the probability of undetected operations. This result tends to reject the idea that market participants will devote more attention to the presence of the central bank in the market at a time when there is a reason for the monetary authorities to use FX operations in order to reduce the degree of exchange rate misalignment.[28]

4.2 Endogenous choice for secrecy

The interpretation of Tables 3, 4 and 5 (taken together) shows there is no evidence whatsoever that poor performance of previous interventions induces the Bank of Japan to use secret interventions. This result holds regardless of the way we capture past performance. Results reported in Tables 3 and 4 do not support any significant relationship between the previous success variables and the proportion of secret operations. Furthermore, in Table 5, the *previous reported failure* variable suggests that when the Bank of Japan had been reported to have intervened without success, the bank tended to rely less on secret operations. Depending on specification in Table 5, the fact that the previous intervention was unsuccessful in moving the exchange rate in the desired direction and that this intervention was known by the market lowers the probability of using a subsequent intervention by about 19 per cent (using equation (3) to compute the marginal effect). While less robust, findings obtained in Tables 3 and 4 are not inconsistent with this result. While the explanation of such a result deserves further investigation, it clearly goes against the view that poorly performing central banks favor secret interventions (Chiu 2003).

The *leaning* variable is clearly insignificant in all tables, suggesting that a leaning-against-the-wind type of behavior did not induce the BoJ to use secret operations. Leaning-against-the-wind behavior is one particular circumstance in which the central bank may choose to follow a noise trading strategy. It is not, however, the only case that favors such strategies. An insignificant *leaning* variable therefore does not reject per se the adoption of a noise strategy. Nevertheless, we did not find any evidence that statements by the central bank that the exchange rate level was not consistent with the equilibrium rate (*target level variable*) tended to raise or decrease the probability of conducting subsequent secret operations. This tends to reject the idea that the

[28]This result might be due to the fact that traders internalized the fact that the Bank of Japan often intervened in the direction opposite to the reduction of the misalignment. The release of historical official intervention data after 2000 could have made it easier for traders to notice such a practice. We found that the share of inconsistent policies-i.e., interventions that went in a direction opposite to reducing the misalignment of the exchange rate-represents more than 51 per cent of the operations. This means that more than one of two interventions does not aim at reducing the misalignment of the YEN/USD exchange rate. Once more, this tends to fit with the central bank behavior proposed by Vitale (1999) in which the central bank targets not only the fundamental exchange rate but also some other (secret) target.

central bank intended to alter the behavior of both fundamental and noise traders.

The fact that the Bank stated that it had an exchange rate target (often without revealing the level) along with the use of secret interventions is quite supportive of the rationale proposed by Vitale (1999). The joint targeting of the fundamental exchange rate level and another value quite different from this level favors the use of secret intervention. The findings related to the effect of inconsistent intervention policies provide another striking degree of support for such a rationale. Both inconsistency measures indicate that when the BoJ acted in a direction opposite to the reduction of the misalignment of the yen, it favored the use of a secret operation. Depending on the specification, the marginal effect associated with this inconsistency is around 0.35. In other words, the Bank of Japan tended to use a secret operation 35 per cent more often when the intervention was aimed at increasing rather than reducing the degree of the misalignment. The impact of the interaction variable ($inconsist \times mis$) shows that this tendency increases with the size of the misalignment. On the whole, our findings strongly suggest that the effect formalized by Vitale (1999) is much more than a theoretical curiosity.

5 Conclusion

This paper provides the first attempt of an empirical evaluation of the reasons underlying the use of secret interventions by central banks in the foreign exchange market. The assessment examines the actions of the Bank of Japan over the recent period (1991-2004). Not only has the Bank of Japan been the sole major central bank using foreign exchange interventions as an instrument but the BoJ has also relied extensively on secret operations, especially in recent times.

Using newswire reports, we distinguish between reported and secret interventions. Our empirical analysis includes two sets of explanatory variables, one for the process of market participants' detecting the central bank, the other for the incentives for the central bank to opt for secrecy. The size of the amounts used in the interventions, coordination with another central bank as well as the presence of recent past operations are found to improve the detection of central bank operations.

Our findings provide strong support for the theoretical explanations of foreign exchange market operations that have recently been developed within the microstructure approach. Our findings show that the Bank of Japan tended to favor secret operations when it was targeting its own level and when acting in the opposite direction to reducing the exchange rate misalignment. In contrast, we did not find evidence in favor of a noise trading strategy of the BoJ in the sense that its actions would have targeted both fundamental and noise traders.

Appendix

A Identification method of secret and reported interventions

The Bank of Japan usually releases the data on its official interventions (i.e., days of intervention, currencies, and amounts involved) on a quarterly basis without specifying whether any given intervention was reported or secret. It is therefore necessary to separate out the official reported interventions from the secret interventions.

In the current paper, we achieve this by employing the same technique that was used in Beine and Lecourt (2004). Their dataset, available up to October 2003, was extended until March 2004 at which time the BoJ stopped its interventions. As secret interventions by definition cannot be observed, the method consists of searching for any news report that clearly states the bank was in the market for each day when there was an official intervention. An intervention is considered reported if the news was issued on the day of the intervention; otherwise, the intervention is considered as secret.

We searched for news reports using the online database Factiva that gives access to reports from numerous sources such as Reuters and Dow Jones, among others. Factiva has powerful search tools (e.g., keywords; choice of sources; choice of date ranges; ability to search titles, headlines, or full text of the news reports, etc.).[29] This facilitates the extraction of relevant information within a news report. More importantly, the Factiva database is available for the whole period analyzed in this paper. This makes it possible to use the same technique for the whole sample, thereby ensuring the consistency of the findings.

Using news reports to identify reported interventions presents some advantages compared with the usual method described in the literature-examining the financial press (Bonser-Neal and Tanner 1996; Dominguez 1998). As there is no guarantee that any information on interventions will be transmitted from the market to the press, using newspapers may cause an overestimation of the proportion of secret interventions. Using news reports allows a more accurate estimation of the proportion of secret interventions. [30]

A sample of four news reports, obtained using the technique described above, is in Table A1. As can be seen from this table, the news reports clearly indicate that the market was aware of the intervention the day the operation occurred. The interventions on these days should therefore be considered reported.

[29] For every official intervention day, we did a full-text search for the following keywords in the news reports: "interventions", "Federal Reserve", "Bank of Japan", and "Ministry of Finance". The sources were restricted to Reuters and Dow Jones.

[30] For further details, see Beine and Lecourt (2004).

Table A1: Sample of news reports indicating the occurrence of an intervention

Intervention date	Source	Relevant text of the news report
10 December 2003	Reuters News	We saw some dollar buying against the yen due to Bank of Japan intervention today
6 January 2004	Reuters News	The dollar [...] managed to hold above the previous day's three-year low on the yen as traders detected Bank of Japan intervention to lend it support
9 January 2004	Reuters News	The Bank of Japan was seen intervening heavily in the currency market on Friday
16 January 2004	Reuters News	The dollar slumped to a three-year low against the yen on Friday and traders said Japanese authorities intervened to try to contain the yen's export-crimping rise

Note: This sample of four news reports was extracted from the online database Factiva. The reports clearly indicate that the market was aware of the presence of the BoJ for every day of official intervention listed in the Table.

B Building the target level and target volatility variables

We searched for this information in the Factiva database [31] in a window of five days preceding any official intervention. Our findings indicate that precise and numerical targets were very scarce. However, monetary authorities did make many announcements that clearly indicated the exchange rate level was not satisfactory. We therefore built the *target level* variable to indicate the number of announcements stating the authorities are not comfortable with the exchange rate level.

Central banks may also target exchange rate volatility level. To capture that information, we built the *target volatility* variable the same way as the *target level* variable but using announcements on the market volatility. Tables A2 and A3 contain examples of announcements on the exchange rate level and volatility, respectively. It can be seen that the news reports clearly indicate that the exchange rate level or volatility are not satisfactory to the authorities.

[31] We carried out a full-text search of the news reports for the following keywords: "Bank of Japan," "Ministry of Finance", "Finance Minister", "yen", "dollar", "target", and "objective". Sources were not restricted as we wanted to be able to capture local newswires.

Table A2: Sample of news reports used to build the *target level* variable

Date	Source	Relevant text of the news report
11 December 1997	New York Times	Eisuke Sakakibara, Japan's Vice Finance Minister for International Affairs, said the excessive yen weakness was undesirable. Mr. Sakakibara added that Japan would take the appropriate steps in the currency markets
2 April 1998	Financial Times	Japan's finance minister, said: "The yen's fall is unfavourable. We will continue to monitor market developments and respond in a timely and appropriate manner"
2 September 2003	Dow Jones Int. News	There is no real reason for the yen to strengthen in foreign exchange markets at present, a top Japanese Ministry of Finance official said Tuesday, likely reflecting MOF concern over recent rise of the yen against the dollar.
9 December 2003	Dow Jones Int. News	The yen's latest surge against the dollar is out of step with economic fundamentals, Japanese Finance Minister Sadakazu Tanigaki said Tuesday, a clear signal to traders that Tokyo remains poised to curb the yen's rise through market intervention.

Note: This sample of four news reports were extracted from the online database Factiva. The reports indicate that the authorities are uncomfortable with the current exchange rate level. Although the news reports do not contain any explicit target, they let the traders know that the authorities have a target in mind and that the current exchange rate dynamic is inconsistent with that target.

Table A3: Sample of news reports used to build the *target volatility* variable

Date	Source	Relevant text of the news report
2 April 1993	Agence France-Presse	"It is not desirable for the yen to fluctuate wildly in a short period of time," Ozaki [Japanese Vice-Finance Minister] added. "Currently, the yen is swinging too much."
8 October 2003	Kyodo News	Finance Minister Sadakazu Tanigaki said Wednesday that swings in the dollar-yen exchange rate are too rapid and that Japan remains committed to its policy of intervening to stem volatility in the currency market.
14 November 2003	AFX Int.Focus	On Friday, Japanese finance minister Sadakazu Tanigakai was quoted [...] as saying that fluctuations in the forex market were too rapid and that Japan was ready to stem the volatility.
5 January 2004	Kyodo News	The Finance Ministry's top bureaucrat said Monday that Japanese monetary authorities [...] will continue acting against excessive volatility in the foreign exchange market. "We believe that recent movements have been rather rapid".

Note: The news reports in this table clearly indicate that the authorities are uncomfortable with the current exchange rate volatility.

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