The Impact of Central Bank Intervention on Exchange-Rate Forecast Heterogeneity[1]

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ABSTRACT

In this paper we investigate the impact of central bank intervention in the foreign exchange market on forecast heterogeneity. Market heterogeneity is based on a sample of forecasts made by a large number of commercial banks over two distinct periods, for the DEM (or EUR) and the JPY against the USD. We show that, in general, forecast heterogeneity increases as a result of interventions, regardless of whether the interventions are unexpected (DEM-EUR) or expected (JPY). Our results also emphasise the role of rumours, especially in the JPY-USD market. In sum, official interventions are shown to move market opinions, albeit differently across the two markets.

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1. INTRODUCTION

Exchange-rate misalignments and volatility are endemic features of floating exchange-rate regimes. They have consecutively justified official interventions in foreign exchange markets. In the macroeconomic literature, foreign exchange market intervention has various channels of influences, such as the portfolio balance and signalling channels (see Mussa, 1981 or Lewis, 1995). While the former covers the direct impact of official purchases and sales on the market price of a currency, the latter channel works indirectly through moving the expectations of market agents.

The impact of official interventions on exchange-rate misalignements and volatility has been widely studied. In general, the empirical literature concludes either that interventions are inefficient, or that they work in the wrong direction (see recent surveys by Frenkel et al. 2002 or Sarno and Taylor 2001). For instance, there is some slight evidence that net purchases of dollars by central banks were associated with subsequent dollar depreciation, which is often related to a unsuccesful "leaning-against-the-wind" policy from the central banks , i.e. central banks buying a specific currency when it is depreciating (see Baillie and Osterberg (1997b), for instance. In addition, central bank interventions are often found to raise exchange rate volatility. Such a conclusion can be drawn from the analysis of conditional short-term volatility estimated through GARCH models. Examples of this approach are Baillie and Osterberg (1997a and b), Dominguez (1998) and Beine, Bénassy and Lecourt (2002). However, some recent developments in the literature question these results. In particular, Beine, Laurent and Lecourt (2003) show that co-ordinated interventions of the Federal Reserve and the Bundesbank between 1985 and 1995 exerted a negative impact on exchange rate volatility in case exchange rate volatility was relatively high. In the same spirit, Mundaca (2001) shows that direct interventions carried out by the Bank of Norway were stabilising if they occurred while the exchange rate was moving around the central parity of the currency band rather than near the weakest edge of the band.

Rather than focusing on the ex post dynamics of the exchange rate, a complementary strand of the literature analyses the impact of central bank interventions on the expectation of the market. In this respect, expected volatility is usually measured using implied volatilities computed from currency options prices, as illustrated by Bonser-Neal and Tanner (1996),

Dominguez (1998), Galati and Melick (1999, 2002), Dauchy (2001). In general, these approaches also find a positive effect of central bank interventions on (expected) exchange rate volatility, although some stabilizing effect has been detected over some specific sub-periods (Beine, 2002). This result is reflected in traders opinions: according to Cheung and Chinn's (2001) survey, 61% of US traders believe that CBIs raise volatility.

Why do official interventions raise ex ante exchange-rate volatility? One interpretation could be that they are able to break a consensus on a "bad" equilibrium, but not to co-ordinate expectations on a new one: market expectations do react to interventions, but in a somewhat disorderly manner. Indeed, MacDonald and Marsh (1996) and Chionis and MacDonald (1997) find clear evidence of expectation heterogeneity driving both traded volumes and exchange-rate volatility. Interventions would raise volatility because it raises the heterogeneity of market expectations.

Such an interpretation would be broadly consistent with the microstructure literature suggesting that interventions may open up the dispersion of expectations. For example, the fact that some agents observe central bank behaviour before others will induce a progressive spreading of information through the trading process (Evans and Lyons 2000). Other theoretical work (see, inter alia, Popper and Montgomery (2001), Bhattacharya and Weller (1997), Vitale (1999)) is more ambiguous with respect to the direction of dispersion following on from intervention. For example, Popper and Montgomery (2001) show how central bank interventions can improve the efficiency of the aggregation of information (about future macroeconomic fundamentals, say) by serving an informational sharing role. According to Vitale (1999) or Evans and Lyons (2000), the dispersion of expectations should fall if the intervention is known, but rise if it is secret.

Using Bank of Canada intervention data D'Souza (2001) reports evidence that the effectiveness of central bank interventions is partly determined by market wide order flows which are generated subsequent to the intervention. Such flows are caused by dealers, who find that central bank interventions provide useful information about future fundamentals. It seems likely that this kind of intervention effect will increase the post intervention distribution of expectations. Indeed, Naranjo and Nimalendran (2000) have argued that dealers increase spreads at the time of interventions to protect them from greater informational asymmetry. This feature is confirmed by Dominguez (1999) who finds that some dealers receive early information on central bank intervention relative to other traders.

However, if this is the way intervention works it is likely to be limited to an intra-day horizon. It does not explain the persistent effect of interventions found on exchange-rate volatility, and does not match the inter-month horizon of central banks. The present paper tries to fill the gap between the macroeconomic and microstructure approaches to central bank interventions. More specifically, we show that official interventions have a positive impact on forecast heterogeneity, the latter being a persistent effect lasting more than the (intra-) daily horizon of the microstructure literature.

Our analysis involves the Deutschemark (or euro)-US dollar and Japanese yen –US dollar exchange rates. More specifically, we study whether official interventions from the Federal Reserve, the Bank of Japan, the Bundesbank and the European Central Bank (ECB) had an impact on forecast heterogeneity. As a measure of the latter, we use the cross-section coefficient of variation derived from Consensus Forecasts monthly survey data over the periods 1992-1994 and 1996-2001. We subsequently use wire reports to disentangle those interventions which had been anticipated from those which take the markets by surprise.

We find that official interventions have a positive impact on forecast heterogeneity, although in a different way across markets. For the Deutschemark and euro against the US dollar, it seems that only news of interventions have an impact, whereas for the yen against the US dollar, forecast heterogeneity is moved by false rumours and interventions which had been expected. One interpretation relates these different results to possible differences in efficiency between the two markets and in the ability of forecasters to find (and use) the correct information on interventions.

The outline of the remainder of this paper is as follows. Section 2 presents a discussion of our data set and in section 3 we present our empirical results. Section 4 contains some conclusions.

2. VARIABLE MEASURES AND DEFINITIONS

2.1 The dependent variable: A measure of heterogeneity

There are broadly two ways of measuring exchange-rate expectations. The first is to use option prices to derive the implicit distribution of expectations (see Breeden and Litzenberger, 1978). The advantage of this approach is that the recovered expectations are representative of what market dealers believe, rather than what they say they believe. A further supposed advantage of this approach is that, under some assumptions, the whole probability density function of the distribution can be recovered. However, expectations recovered with this method may include a risk premium since they are derived under the assumption of risk neutrality. Another drawback is the low availability of currency options data from which implied volatilities or the whole distribution may be extracted without bias (see Galati and Melick, 1999).

An alternative measure of expectations may be derived from surveys of forecasters. Clearly, there is no guarantee that market strategies are based on these expectations. However, the fact that some analysts are paid by banks to forecast exchange rates suggests that the corresponding forecasts must, at the very least, be useful at some stage in the foreign exchange process. The main advantage in using a survey-based measure of expectations is that it is not conditional on a specific model of the risk premium.

Hence, both methods have their pros and cons, and they should be viewed as complementary ways of revealing expectations. In this paper we use survey data collected from Consensus Forecasts (London) for the Japanese yen, the Deutschemark and the euro against the US dollar over two periods: January 1992 to December 1994, and January 1996 to March 2001. We rely on a monthly survey in which more than 100 analysts from banks and forecasting institutions are asked their one to 24-month forecasts. The survey is conducted on the first Monday of each month, and the results are published before the 15th of the corresponding month. Although the data source is the same for the two periods, it is not possible to connect the periods because a year of data is missing between periods. It should also be noted that the names of the banks are not available for the first period. However their country location is identified: over the two periods, the surveyed banks are located in North America, Japan as well as in various European countries.

One important feature of our study is that we assume that the euro's behaviour with respect to interventions is simply a continuation of the Deutschemark's behaviour. Although this assumption is perhaps questionable, it does raise the power of our tests (including those involving the yen) - which we perform with a SURE specification - and it is unlikely to affect the main tenor of our results since the Bundesbank and the Fed did not intervene on the DEM-USD market between 1996 and 1999, i.e. during the three first years of our second and last investigation period.

We concentrate on the 1, 3 and 12-month forecasts. The one-month forecasts are only available for the second period, while the 3 and 12-month horizons are available for both periods. The heterogeneity of expectations across forecasters is calculated as the cross-section coefficient of variation of each kind of expectation - currency/horizon - at each date. Using the coefficient of variation facilitates a comparison of heterogeneity across currencies and it also allows us to move from the DEM to the euro.

Unfortunately, there are many missing observations in the database. There is a possibility that heterogeneity moves over time or across currencies/horizons simply because the forecasters are not the same. We attempt to tackle this problem by calculating expectation heterogeneity on two different samples of forecasts: the whole sample at each date (a little more than 100 forecasters, depending on the currency/forecast/date); and a sub-sample of 25 (first period) or 24 (second period) "reliable" forecasters. Reliable forecasters are selected in the following way:

- For the first period (1992-1994), we select those respondents that did not fail more than 4 times over the 1990-1994 period (once a year on average) on each of the two markets (JPY/USD and DEM-EUR/USD) and on each horizon (3,12 months). Hence, the number of answers is generally very close to 25 for each date/currency/horizon.[2]

- For the second period, we select 24 respondents whose forecasts were reported for the three currencies and the three horizons (1, 3, 12 months). Over the 24 forecasters, between 2 and 13 did not answer at each date, depending on the currency/horizon.

[2] In a former version of this paper, the first investigation period ranged from 1990 to 1994. Nevertheless, precise Reuters reports which allow to capture rumours and to disentangle official interventions into expected ones and unexpected ones are only available since 1992. Threfore, for homogeneity purposes, we restricted the first period. More complete results are of course available upon request.

Heterogeneity is then calculated on the forecasts provided at each date. We have checked that there is no selection bias in the restricted samples by calculating the correlation between the number of missing values at each date and heterogeneity measured on the whole sample. The correlation is sometimes positive, sometimes negative, sometimes close to zero, depending on the currencies, periods and horizons, with no general rule which would signal some selection bias.

The evolution of the various measures of heterogeneity is illustrated in Figure 1. Unsurprisingly, heterogeneity is higher the longer the forecast horizon. It is also higher over the second period, especially for the JPY in 1998. Forecast heterogeneity tends to be higher for the JPY then for the DEM-EUR, especially over the 1996-2001 period, and for the 12-month horizon. Lastly, reducing the sample to a selection of "reliable" forecasters produces measures of heterogeneity that vary to a larger extent over time, especially at the 12-month horizon.

Cross-section coefficients of variation of individual forecasts range from 2% (DEM-EUR, three months) to 10% (YEN, 12 months in 1998). These orders of magnitude are similar to those of standard deviations of 3-month and 12-month exchange-rate changes over time. The latter range from 5% (DEM, 3 months over the same periods) to 10% (DEM-EUR and YEN, 12 months). Hence, cross-section heterogeneity is as important as time-series variance in the data and should be viewed as a complementary measure of uncertainty.

INSERT FIGURE 1

Alternative measures of the heterogeneity of expectations can be derived from the same data base. One candidate is the difference between the two extreme expectations at each date (the highest minus the lowest). However such a measure may capture potentially abnormal observations rather than significant expectation dispersion. This may have been exacerbated since there has been a marked concentration of market players in the foreign exchange market during the 1990s. Another measure of heterogeneity is based on inter-decile expectations. Here the robustness of the results has been tested by using the difference between the first and the last decile of the distribution as the alternative measure of expectation heterogeneity.

2.2 The explanatory variables: measures of central bank intervention

In this section we consider the construction of the explanatory variables set used in this paper. Two indicators are used to represent central bank intervention in the foreign exchange market. The first is data on official interventions provided by the central banks themselves,[3] while the second is the reported interventions by wire services. We use both sources of information sequentially. Our intervention variable is the number of intervention days during the month preceding each measure of forecast heterogeneity. Hence, we aggregate daily dummies (official or reported interventions) into monthly variables. Alternatively, we could have worked on cumulated amounts of interventions. But intervention amounts are not available for the ECB. In addition, previous work has shown that the signalling channel of interventions is more powerful than the portfolio channel (see Section 2). Of course, the amount of an intervention is part of the signal as it shows how much the monetary authorities are prepared to loose. However a given amount conveys a different information across time given the huge increase in the foreign exchanger turnover. Hence, results obtained with intervention amounts would be difficult to interpret. In contrast, cumulated dummies account for repeated interventions without having to tackle the problem of the growing size of interventions.[4]

The reported information variable is constructed the same way as the official intervention variable. It is based on Reuters headlines.[5] The availability of the latter constraints our data span to the February 1992 – March 2001 period. Figure 2 below shows that, although the bulk of official interventions have been reported by Reuter, in the case of the Bank of Japan a significant proportion has not; symmetrically, a significant proportion of reported interventions have not been confirmed officially.[6] However the monthly aggregation of the interventions makes the two variables much more similar: on a monthly basis, the correlation

[3] The Federal Reserve Board provides the daily amounts of its foreign currency trades on request. The Bundesbank also provides intervention data on the DEM up to the launching of the European Monetary Unification in 1999. Post 1999 the only indication that intervention has taken place in the Euro area is in the form of official statements made after each intervention. Interventions by the Bank of Japan have recently been made available on the web site of the Japanese Ministry of Finance (www.mof.go.jp).

[4] Due to high correlation between co-ordinated interventions and unilateral interventions on a monthly basis, it was not possible to isolate the impact of the former. However Galati and Melick (2002) find that concerted interventions do not have significantly different impact on expectations than do unilateral ones.

[5] See also Dauchy (2001) for details on the construction of this variable.

[6] The discrepancy between official and reported interventions on a daily basis is also evidenced by Frenkel et al. (2002).

between official interventions and reported ones ranges from 0.80 (JPY/USD, 1996-2001) to 0.96 (DEM-EUR/USD, 1992-1994).

INSERT FIGURE 2

Due to the unavailability of Consensus Forecasts individual expectations for 1995, we had to drop this year and finally work on two different sub-periods: February 1992-December 1994 and January 1996-March 2001. Table 1 below shows that over the whole period, there have been many more interventions on the JPY/USD market compared to the DEM-EUR/USD market: 173 interventions on JPY/USD compared to 21 on the DEM-EUR/USD market. This is a well-known feature of Japanese interventions, which are much more frequent than both their US and German/Euro area counterparts. Indeed, the Federal Reserve is responsible for less than 10% of all interventions on the JPY/USD market.

Interventions were much more frequent in the first period than in the second one. The drop was especially marked for the Bank of Japan, following a strategic change of the Japanese ministry of finance after June 1995 (see Ito, 2002). Finally, interventions by the ECB have been very rare, perhaps as a consequence of the rather complex decision process between the ECB and the Eurogroup.

INSERT TABLE 1

One advantage of our Reuters' database is that it contains other announcements, including rumours, made by market operators concerning central bank interventions. Following Dauchy (2001), we describe an intervention *rumour* as any news headline announcing the probability of a central bank intervening in the future, even if the intervention does not actually occur in the expected time period. Comparing rumours to official interventions allows us to disentangle *true* rumours from *false* ones. More precisely, false rumours are defined as rumours of interventions which are not followed by official interventions in the following four business days. As shown in Table 1, there have been more rumours in the 1996-2001 period than in the 1992-1994, contrasting with the fall in the number of official interventions.[7] Over both periods, however, most rumours were false in the sense that they were not followed by official interventions in the following four working days. This may have created some noise

[7] Interestingly, all central banks are concerned by false rumours.

around information on interventions, or at least some uncertainty about the timing of the interventions.[8]

The same daily database on reported interventions is used to construct a measure for *expected* interventions, defined as interventions that were preceded by rumours during the four days prior to the intervention.[9] *Unexpected* interventions are defined as the difference between the actual and expected interventions. If the foreign exchange market is efficient, the unexpected interventions should have a significant impact on heterogeneity while the expected interventions should not. Expected and unexpected intervention variables are only available from 1992 due to the time span of the Reuters' database. Table 1 shows that about half of official interventions had been expected, except for the DEM-EUR over 1996-2001 where all five interventions had been expected. Hence, although most rumours are false, the small number of true rumours stays significant compared to the number of official interventions.

On the whole, we conclude that Reuters reports of future interventions are very noisy, whereas the reports concerning past interventions are reliable at least on a monthly basis. We also conclude that the second period differs from the first one in that official interventions are less frequent whereas rumours are more frequent. This perhaps reflects a change in the strategy of the central banks, which have moved away from secrecy towards more continuous dialogue with the markets. Ito (2002) documents this phenomenon in the case of Japan. The fall in the Euro exchange rate over 1999-2001, and the multiplication of declarations by officials on this issue, also produced intense conjectures on a possible intervention by the ECB, although official interventions were actually scarce.

[8] Of course, some rumours that are classified as false rumours may actually have been realised more than four days later.

[9] Hence, expected interventions can be viewed as lagged true rumours. On the agregate monthly basis, the two variables are very close to each other.

3. ECONOMETRIC STRATEGY AND EMPIRICAL RESULTS

3.1 Econometric Strategy

Here we assume that the expectation made by an individual *i* at time *t* for the exchange rate in *t+h* (denoted $S^i_{t,h}$ thereafter) is drawn randomly at each time t from a normal distribution with mean $S_{t,h}$ and variance $\sigma^2_{t,h}$. Hence, we have:

$$\frac{S^i_{t,h}}{S_{t,h}} - 1 = \varepsilon^i_{t,h} \text{ with } E\left(\varepsilon^i_{t,h}\right) = 0 \text{ and } V\left(\varepsilon^i_{t,h}\right) = \sigma^2_{t,h}$$

We investigate whether the variance $\sigma^2_{t,h}$ is influenced by central bank interventions once the impact of monetary policy changes are accounted for.

Four model specifications are considered. In the first, we investigate the effects of the number of official interventions (OI) in the preceding month. We also include the effect of false rumours (FR), which, by construction, are orthogonal to official interventions at a daily frequency.

Consistent with previous research on the impact of foreign exchange intervention on the exchange rate (Galati and Melick 1999, Dominguez 1998), we introduce money market interest rates as control variables (where interest rate variations are assumed to summarise monetary policy news). According to Cheung and Chinn (2001), interest rates are continuously perceived by market agents as very relevant for the determination of exchange rates over time and this may well impact on the measure of heterogeneity. The maturities used are consistent with our expectations horizons. Since the direction of interest rate variations is not relevant for market heterogeneity, we used the absolute variation of the interest rate differential between the DEM/Euro and the USD or between the JPY and the USD (this variable is noted DS).[10]

This first model can thus be written as:

[10] The interest rate data was sourced from Datastream. Although the central banks under review have systematically sterilised their interventions, we cannot rule out some colinearity between interventions and the DS variable. However we have checked that this is not the case in our samples (the correlation between interventions and DS is always very close to zero).

$$H_t = \alpha + \beta_1 OI_t + \beta_2 FR_t + \beta_3 DS_t + u_t, \quad (1)$$

where H_t denotes forecaster heterogeneity on the relevant currency at time t, and u_t is an error term.

The second model is similar to the first except for the use of (the number of) reported interventions (denoted *RI*) instead of *OI*:

$$H_t = \alpha + \beta_1 RI_t + \beta_2 FR_t + \beta_3 DS_t + u_t. \quad (2)$$

In the third model, expected CBI (*EI*) are disentangled from unexpected ones (*UI*):

$$H_t = \alpha + \beta_{11} EI_t + \beta_{12} UI_t + \beta_2 FR_t + \beta_3 DS_t + u_t \quad (3)$$

Note that, by construction, *EI*, *UI* and *FR* are orthogonal to each other at a daily frequency: *EI* and *UI* only cover official interventions that did take place, whereas FR covers false rumours of interventions; and unexpected interventions are those official interventions that had not been expected by Reuters reports (hence, at a daily frequency, *UI=OI-EI*).

Our last model looks specifically at the impact of all rumours, either true or false ones. Since true and false rumours are highly correlated on a monthly basis, we pool them into a single *RU* variable[11]:

$$H_t = \alpha + \beta_1 RU_t + \beta_2 DS_t + u_t, \quad (4)$$

A priori we cannot rule out the existence of reverse causality from heterogeneity to intervention. However Galati and Melick (1999) and Frenkel et al. (2002) find no evidence to suggest that the purpose of central bank interventions is to reduce market uncertainty. Indeed, reaction functions of Japanese interventions estimated by Ito (2002) or Frenkel et al. (2002) point out that the monetary authorities lean against the wind, ie they try to reverse current deviations from some target exchange rate, not to reduce market uncertainty. In any case, since our measures for central bank interventions predate the heterogeneity measure, we believe that our results are robust to reverse causality.

[11] Another reason for summing up these rumours is that all forecasters are not necessarily able to know precisely whether these rumours are false or true. This is obviously the case for rumours reported during the three days before the forecast.

Each model is estimated with heterogeneity calculated on two alternative samples of forecasters: the first is based on all surveyed forecasters, while the second is based on a selection of "reliable" forecasters (see Section 2). Regression (3) is not carried out in the case of the DEM-EUR over the second period (1996-2001) due to the fact that all interventions have been expected during this period (see Table 1).

Following the discussion in Section 3, there is some evidence that the various central banks follow rather different intervention policies. For instance, interventions by the Federal Reserve, the Bundesbank and the ECB are somewhat scarce, whereas the Bank of Japan tends to intervene frequently with relatively small amounts (at least during the first period) so as to monitor expectations. Hence, there is no reason why forecast heterogeneity for the two markets under study (DEM-EUR/USD and JPY/USD) should react the same way to CBI.[12] Nevertheless, part of the forecast heterogeneity on both exchange rates comes from uncertainties concerning the USD, which affects both exchange rates. For this reason, we use a SURE-type estimator, which allows the residuals to be contemporaneously correlated across equations. The estimation method also incorporates a non-parametric correction for heteroscedasticity and serial correlation. [13]

3.2. Econometric results

The results for specifications (1) and (2), i.e. the model with the official measure of intervention are reported in Tables 2a and 2b and with the measure based on Reuter reports in Tables 3a and 3b.[14] These results indicate a positive relationship between *OI* and heterogeneity for both currencies over the two sub-periods at all horizons. However this relationship is generally not significant for the yen. Concerning the DEM-Euro/USD rate, the coefficient on *OI* is higher in the recent period, which may be a reflection of the uncertainty in the run-up to European monetary integration: as in the market microstructure model, the information imparted by official interventions may have opened up the distribution of expectations.

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[12] This contrasts with the necessary consistency of exchange rate determination models between DEM/USD and JPY/USD.

[13] We could alternatively have pooled the two currencies (JPY and DEM/EUR) into a single regression. However, preliminary tests suggested that, in all cases, individual effects were significant enough to reject the null hypothesis of a valid pooling against performing separate regressions, with respect either to the unconditional level of heterogeneity or to the reaction of heterogeneity to CBI. The results of these tests are available upon request.

[14] Some robustness checks have been carried out by re-estimating the various equations with an alternative measure of heterogeneity. Specifically, the cross-section coefficient of variation of the forecasts has been replaced by the difference between the first and the last decile of the forecast distribution. The results (available upon request) are virtually unchanged.

The size of the coefficient on official interventions indicates that each day of interventions during the previous month raises on average forecast heterogeneity by 0.4 (at a one month horizon) to 0.8 (at a twelve month horizon) over 1996-2001. Given that interventions are clustered over time, this means for instance that 5 interventions would double heterogeneity whose level is on average 2 and 4% over this period.

The results from disentangling expected interventions from unexpected ones (see Tables 4a and 4b) show that only the latter significantly increase forecast heterogeneity for the DEM-EUR/USD in the earlier period. This seems consistent with an efficient markets interpretation.[15] In contrast, for the JPY/USD, neither expected nor unexpected interventions have an impact on forecast heterogeneity in the first period, and only expected interventions seem to raise forecaster heterogeneity in the second period (in one instance the unexpected intervention term is significant but negative). This puzzling result would seem to indicate that the YEN/USD market was less efficient than the DEM-EUR/USD one, which can perhaps be related to the somewhat lower turnover on the latter market.[16]

The absolute variation of the interest-rate differential is almost never significant for the DEM-EUR/USD rate, whereas it is negative and often significant for the JPY/USD. This would seem to imply that forecasters have convergent views on the impact of monetary policy news for the latter exchange rate. This difference across currencies can be related to the mutual consistency of monetary and exchange rate policies in Japan over the 1990s (a policy attenuating the appreciation of the JPY, combined with a very loose monetary policy). In contrast, German monetary policy was driven largely by internal objectives which were more independent of the exchange rate.

False rumours, which form a conditioning variable in models (1) to (3), appear to significantly raise forecast heterogeneity for the JPY/USD over the period 1996-2001, but have little impact in other cases. On the whole, then, it seems that the strategy of the Bank of Japan of

[15] Unfortunatly, the absence of unexpected interventions on the DEM-EUR/USD market in the second period prevented us from estimating the same equation for the second period. However the results obtained with rumours seem to confirm the efficiency interpretation. See below.

[16] According to the BIS, the average daily turnover in April 2001 was USD bn 354 for the EUR/USD market, compared to USD bn 231 for the YEN/USD one. Previous surveys, carried out on the DEM instead of the euro, also evidenced differences in turnover, although generally smaller than in April 2001. See BIS, Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity 2001, Basel.

monitoring exchange-rate expectations through relatively frequent interventions has been somewhat successful over the 1996-2001 period as far as expected interventions had an impact on forecast heterogeneity. Nevertheless, the efficiency of such a strategy is reduced by the impact of false rumours over the same period (although the coefficient on false rumours is much lower than that the one relative to expected interventions). Conversely, Bundesbank interventions over 1992-1994 seem to have worked through surprises, whereas false rumours had no significant impact.

These findings are confirmed by the estimation of Eq. (4) which specifically measures the impact of all rumours (whether true or false, but mainly false, see Section 2) on heterogeneity. The results are reported in Tables 5a and 5b. When significant, the coefficient on rumours is positive. However rumours are not significant for the DEM over the second period. Additional regressions (not reported here) show that, in the case of the DEM, true rumours significantly raise heterogeneity at all horizons, whereas false rumours have no impact, for both the whole sample and the restricted one. It can be concluded that forecasters are better able to find the right information in the case of the DEM-EUR than in the case of the YEN.

In sum, our results would seem to reveal two different strategies regarding foreign exchange intervention in recent years. First, the Bank of Japan's strategy seems to be one which involves monitoring market expectations by providing insights on future interventions. This strategy produces some noise in terms of false rumours. However, this seems to have worked over the recent period in the sense that expected interventions had an impact on forecast heterogeneity and this is supported by a consistent monetary policy. Second, the Bundesbank seems to have tried to move market expectations much more through surprise announcements. Hence, expected interventions and false rumours did not carry any relevant information, whereas unexpected interventions and true rumours did raise forecast heterogeneity. On the whole, our results seem to indicate that the DEM-EUR/USD market has been more efficient than the JPY/USD one in the sense that forecasters were better able to find (and use) the correct information on interventions.

5. CONCLUSION

In this paper we have investigated the effect of central bank intervention on the heterogeneity of foreign exchange rate expectations using a newly constructed data set. The key question we sought to answer is the following: does central bank intervention have a significant effect on

heterogeneity at the macroeconomic time horizon? A growing amount of empirical evidence, based on market micro-structural principles, suggests that all of the effect of central bank interventions occurs within a single day. According to Dominguez (1999), for instance, the impact of an intervention on exchange-rate returns starts one hour before it is advertised and lasts a couple hours after that, the maximum impact coming 30 minutes after the intervention is made public. Although data limitations prevent us from drawing very general results, in terms of time and country samples, our empirical investigation shows that central bank interventions can have a significant impact on heterogeneity at a monthly horizon. Indeed, the heterogeneity of monthly expectations at the 1 month, 3 months and 12 months horizons is shown to significantly increase in the case of official (especially unexpected) interventions (DEM-EUR/USD) or of expected interventions and "false" rumours (JPY/USD). Hence, central bank intervention can be viewed as able to move market opinions, albeit in a way which is different for the two markets.

REFERENCES

BAILLIE, R.T., OSTERBERG, W.P. (1997a), "Why do Central banks Intervene ?", Journal of International Money and Finance, 16 (6), 909-919.

BAILLIE, R.T., OSTERBERG, W.P. (1997B), "Central Bank Intervention and Risk in the Forward Market", Journal of International Economics, 43, 483-49

BANK OF INTERNATIONAL SETTLEMENTS (2001), "Central Bank Survey of Foreign Exchange and Derivatives Market Activity in April 2001: Preliminary Global Data", press release, 9 October, available on www.bis.org.

Beine, M. (2003), "Volatility Expectations and Asymmetric Effects of Direct Central Bank Interventions in the FX Markets, Journal of the Japanese and International Economies, Forthcoming.

BEINE, M., BÉNASSY-QUÉRÉ, A., AND LECOURT, C. (2002), "The Impact of Central Bank Interventions: New Evidence from Figarch Estimations", Journal of International Money and Finance, 21, 115-144.

BEINE, M., LAURENT, S. AND LECOURT, C. (2003), "Official Interventions and Exchange rate Volatility: New Evidence form a Switching Regime Analysis", European Economic Review, forthcoming.

BÉNASSY-QUÉRÉ, A., LARRIBEAU, S. AND MACDONALD, R. (1999), " Models of Exchange Rate Expectations: How Much Heterogeneity?", forthcoming in Journal of International Financial Markets, Institutions and Money, available as CEPII working paper 99-03 on www.cepii.fr.

BHATTACHARYA, U. AND WELLER, P. (1997), "The advantage of Hiding One's Hand : Speculation and Central Bank Intervention on the Foreign Exchange Market", Journal of Monetary Economics, 39(2), 251-278.

BONSER-NEAL, K., TANNER, G. (1996), "Central Bank Intervention and the Volatilitiy of Foreign Exchange Rates: Evidence from the Options Market", Journal of International Money and Finance, 15 (6), 853-878.

BREEDEN, D., LITZENBERGER, R. (1978), "Price and State-Contingent Claims Implicit in Option Prices", Journal of Business 51, 621-651.

CATTE, P., GALLI, G., REBECCHINI, S. (1992), "Exchange Markets Can Be Managed!", Report on the G-7, International Economic Insights.

CHEUNG, Y.-W., AND CHINN, M.D. (2001), "Currency Traders and Exchange Rate Dynamics: a Survey of the US Market", Journal of International Money and Finance, 20, 439-471.

CHIONIS, D. AND MACDONALD, R. (1997), "Some Tests of Market Microstructure Hypotheses in the Foreign Exchange Market", Journal of Multinational Financial Management, 7 (3), 75-102.

DAUCHY, E. (2001), "The Effect of Official Speeches and Central Bank Intervention Rumours on Foreign Exchange Market Forecasts", Team Working Paper, University of Paris 1, Paris.

DOMINGUEZ, K.M. (1998), "Central Bank Intervention and Exchange Rate Volatility", Journal of International Money and Finance, 17, 161-190.

DOMINGUEZ, K.M. (1999), "The Market Microstructure of Central Bank Intervention", NBER Working Paper no. 7337.

D'SOUZA, C. (2001), "The market microstructure of FX intervention in Canada", Bank of Canada, Mimeo.

ELLIOTT, G. AND ITO, T. (1999), "Heterogeneous Expectations and Tests of Efficiency in the yen/dollar Forward Exchange Rate Market", Journal of Monetary Economics, 43, 435-456.

EVANS, M.D. AND LYONS, R. (2001), "The Microstructural Approach of Exchange Rates", Chapter 8, MIT Press.

FRANKEL, J.A. AND FROOT, K.A. (1990), "Interpreting Tests of Forward Discount Bias Using Survey Data on Exchange Rate Expectations", Quarterly Journal of Economics, 104, 139-161.

FLOOD, R. (1991), "Microstructure theory and the foreign exchange market", Federal Reserve of St Louis Review, 73, 52-70.

FLOOD, R. AND ROSE, A.K. (1999), "Understanding Exchange Rate Volatility without the Contrivance of Macroeconomics", Economic Journal, F660-F672

FRENKEL, M., PIERDZIOCH, CH. AND STADTMANN, G. (2002), « The interventions of the European central bank : effects, effectiveness and policy implications » , Mimeo, University of Koblenz, July.

GALATI, G. AND MELICK, W. (1999), "Perceived Central Bank Interventions and Market Expectation: an Empirical Study of the yen/dollar Exchange Rate", 1993-1996, BIS Working Paper n°77, October, www.bis.org.

GALATI, G. AND MELICK, W. (2002), “Central Bank Interventions and Market Expectations”, BIS Paper n°10, April.

ITO, T. (1990), “Foreign Exchange rate Expectations: Micro Survey Data”, American Economic Review, 80, 434-439.

ITO, T. (2002), “Is foreign exchange intervention effective? The Japanese experiences in the 1990s”, NBER working paper 8914, April.

KIM, S-J., KORTIAN, T. AND J. SHEEN, (2001), “Central Bank Intervention and Exchange Rate Volatity-Australian Evidence”, Journal of International Financial Markets, Institutions and Money, 10 (210), 381-405.

LEWIS, K. (1995), “Are Foreign Intervention and Monetary Policy Related, and Does it Really Matter?”, Journal of Business, 68 (2), 185-214.

LYONS, R. (2001), “The Microstructural Approach to Exchange Rates”, MIT Press.

MACDONALD, R. (1992), “Exchange Rate Survey Data: A Disaggregated G-7 Perspective”, Manchester School of Economic and Social Studies, 60, 47-62.

MACDONALD, RONALD AND IAN W. MARSH (1996), “Foreign Exchange Market Forecasters are Heterogeneous: Confirmation and Consequences”, Journal of International Money and Finance, 15 (5), 665-685.

MUNDACA, B.G. (2001), “Central Bank Interventions and Exchange Rate Bands”, Journal of International Money and Finance, 20, 677-700.

MUSSA, M. (1981), “The Role of Official Intervention”, Group of Thirty Occasional Papers,Group of Thirty, New York.

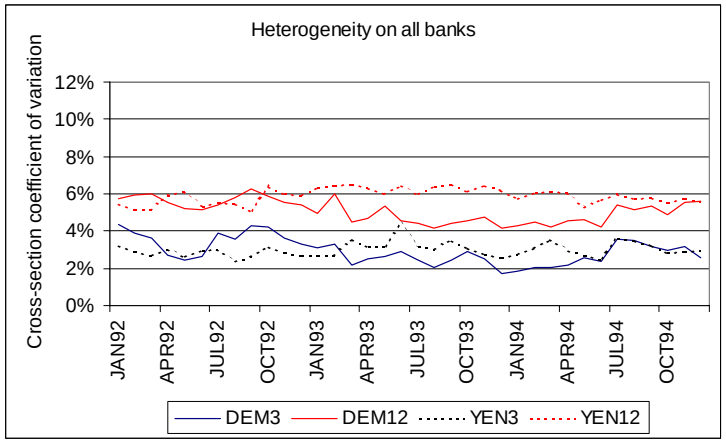
NARANJO, A. AND NIMALENDRAN, M. (2000), “Government Intervention and Adverse Selection Costs in Foreign Exchange Markets” , Review of Financial Studies, 13 (2), 453-477.

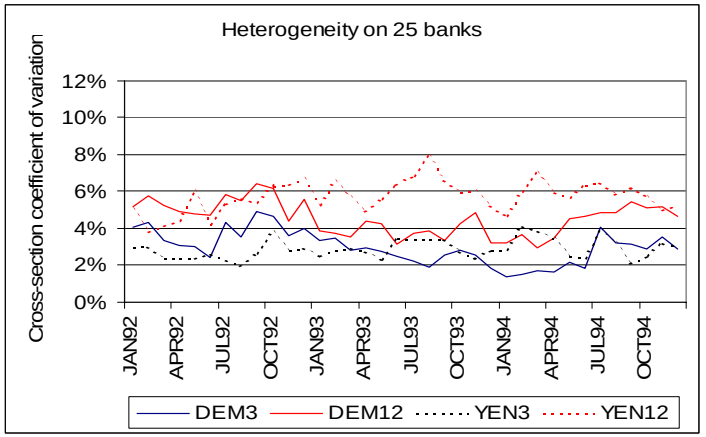
POPPER, H.A. AND MONTGOMERY, J.D. (2001), “Information Sharing and Central Bank Intervention in the Foreign Exchange Market” , Journal of International Economics, 55 (2°, 295-316.

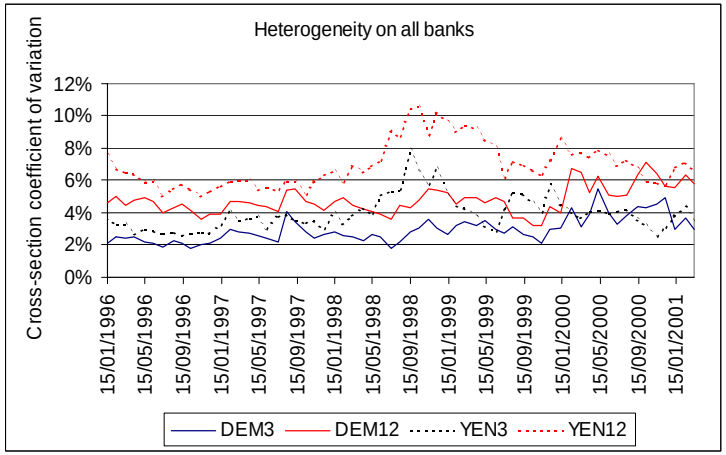
SARNO, L. AND TAYLOR, M.P. (2001), “Official Intervention in the Foreign Exchange Market: is it Effective and, if so, How Does it Work? ”, Journal of Economic Literature, 39(3), 839-868.

VITALE, P. (1999), “Sterilized Central Bank Interventions in the Foreign Exchange Market”, Journal of International Economics, 49 (2), 245-267.

Figure 1. Forecast heterogeneity







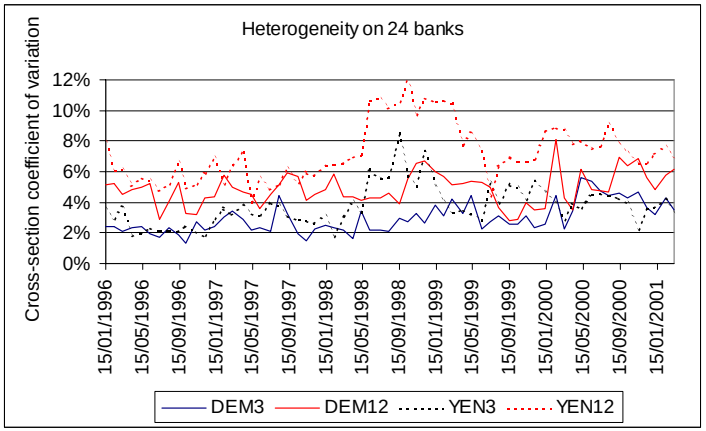


Figure 2: Official and reported interventions

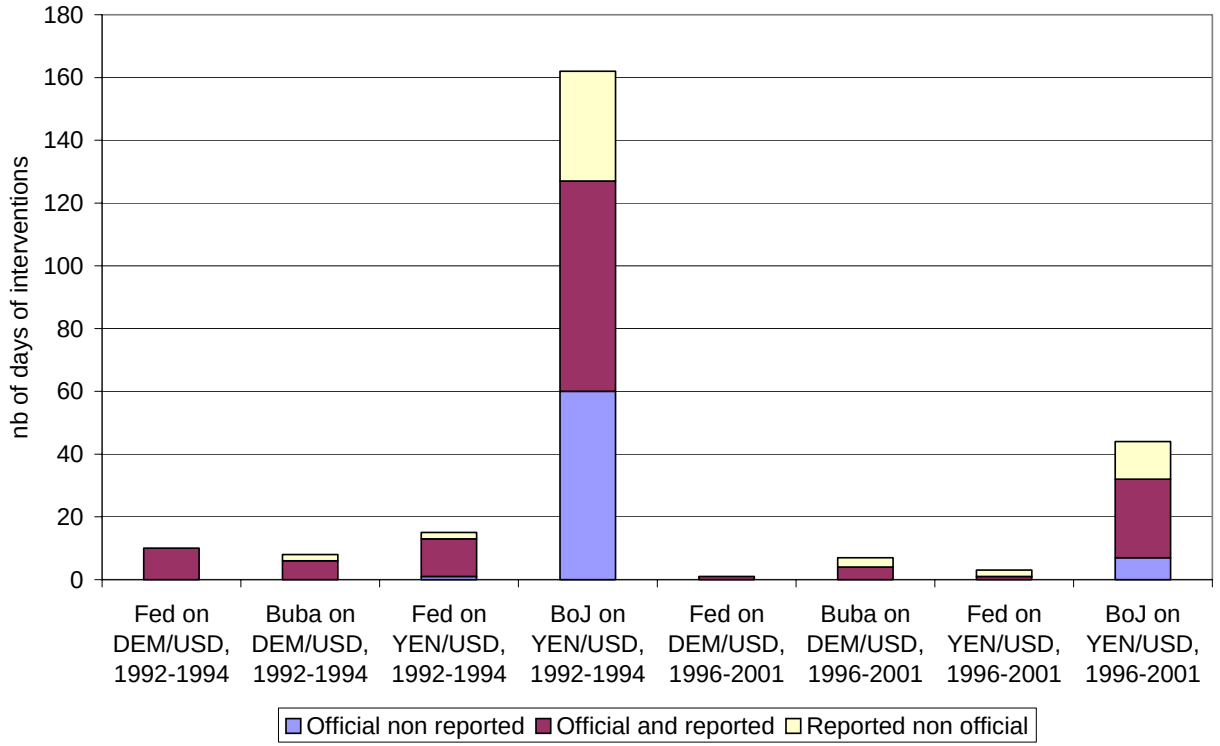


Table 1. Official interventions and rumours

	DEM-EUR/USD		YEN/USD	
	1992-1994	1996-2001	1992-1994	1996-2001
Official interventions	16	5	140	33
Of which: Federal Reserve	63%	20%	9%	3%
Of which: expected interventions	38%	100%	56%	55%
Rumours	63	185	285	300
Of which: false rumours	94%	97%	98%	94%

Sources: Federal Reserve Board, Japanese Ministry of Finance, Deutsche Bundesbank, European Central Bank, Reuters.

Table 2a: The impact of official interventions: Equation (1), 1992-1994

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	na	na	0.0267***	0.0258***	0.0482***	0.0426***	na	na	0.0272***	0.0275***	0.0610***	0.0579***
			[16.23]	[11.63]	[33.99]	[20.19]			[29.21]	[36.74]	[52.20]	[21.07]
OI	na	na	0.0029***	0.0026*	0.0018*	0.0047***	na	na	0.0001	0.0004*	-0.0002	0.0005
			[2.92]	[1.66]	[1.70]	[6.02]			[0.25]	[1.78]	[-0.59]	[1.28]
FR	na	na	0.0002	0.0005	-0.0001	0.00003	na	na	0.0003	0.0002	0.0001	-0.000
			[0.69]	[0.99]	[-0.22]	[0.09]			[1.19]	[0.87]	[0.50]	[-0.78]
DS	na	na	0.0122	0.0271	0.0249	0.0164	na	na	0.0045	0.0066	-0.0281**	-0.0067
			[0.75]	[1.36]	[1.63]	[0.99]			[0.29]	[0.35]	[-2.17]	[-0.27]
R^2	-	-	0.173	0.152	0.132	0.167	-	-	0.331	0.312	0.129	0.074

Notes : SURE estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets; ***, **, * for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 25 forecasters.
OI: nb of unilateral official interventions; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.

Table 2b: The impact of official interventions: Equation (1), 1996-2001

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	0.0203 ***	0.0200 ***	0.0294 ***	0.0302 ***	0.0497***	0.0506 ***	0.0235***	0.0213***	0.0375***	0.0339***	0.0712***	0.0742 ***
	[14.65]	[11.55]	[15.29]	[12.07]	[29.69]	[25.28]	[12.82]	[12.51]	[14.95]	[11.79]	[18.38]	[16.16]
OI	0.0041 ***	0.0034**	0.0052 ***	0.0062 ***	0.0078***	0.0082 ***	0.0006	0.0013	0.0007	0.0014	0.0014	0.0005
	[4.47]	[4.30]	[4.11]	[5.26]	[3.41]	[5.46]	[0.68]	[1.45]	[0.74]	[1.22]	[0.90]	[0.24]
FR	0.00007	-0.00009	0.00009	0.00002	-0.0001	-0.0003	0.00066**	-0.00051	0.0009***	0.00096**	-0.00002	0.00002
	[0.36]	[-0.54]	[0.38]	[0.13]	[-0.35]	[-1.08]	[2.52]	[-1.63]	[2.83]	[2.53]	[-0.04]	[0.05]
DS	-0.0374	0.0113	-0.0288	-0.0473	-0.0283	-0.0212	-0.0608**	0.0774***	-0.0872	-0.0700	-0.0499*	-0.0657*
	[-1.35]	[-0.25]	[-0.63]	[-0.91]	[-1.52]	[-1.10]	[-2.23]	[-3.63]	[-1.81]	[-1.22]	[-1.82]	[-1.81]
R^2	0.084	0.015	0.079	0.057	0.115	0.071	0.107	0.015	0.141	0.136	0.028	0.061

Notes : SURE estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets ; ***, **, * for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 24 forecasters.
OI: nb of unilateral official interventions; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.

Table 3a: The impact of reported interventions: Equation (2), 1992-1994

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	na	na	0.0267***	0.0257***	0.0481***	0.0424***	na	na	0.0278***	0.0268***	0.0611***	0.0576***
			[16.12]	[11.51]	[33.11]	[19.79]			[44.17]	[23.61]	[53.59]	[19.82]
RI	na	na	0.0023*	0.0027**	0.0017	0.0042***	na	na	0.0003	0.0001	-0.0003	0.0007**
			[1.74]	[1.99]	[1.57]	[3.68]			[1.22]	[0.05]	[-1.19]	[1.93]
FR	na	na	0.0002	0.0004	-0.0001	-0.0001	na	na	0.0004*	0.0003	0.0002	-0.0005
			[0.58]	[0.94]	[-0.25]	[-0.18]			[1.66]	[1.11]	[0.99]	[-1.17]
DS	na	na	0.0132	0.0278	0.0252*	0.0202	na	na	0.0032	0.0365	-0.0296**	-0.0037
			[0.81]	[1.40]	[1.66]	[1.18]			[0.21]	[1.53]	[-2.46]	[0.15]
R^2	-	-	0.152	0.136	0.122	0.128	-	-	0.231	0.045	0.129	0.094

Notes : SURE estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets ; ***, **, * for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 25 forecasters.
RI: nb of reported interventions; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.

Table 3b: The impact of reported interventions: Equation (2), 1996-2001

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	0.0202***	0.0199***	0.0293***	0.0300***	0.0497 ***	0.0508***	0.0238***	0.0215***	0.0376***	0.0339***	0.0712***	0.0740***
	[14.70]	[11.54]	[15.33]	[11.90]	[28.62]	[25.35]	[12.90]	[12.61]	[14.81]	[11.71]	[18.65]	[16.15]
RI	0.0040***	0.0032***	0.0056***	0.0053**	0.0051**	0.0090***	0.0005	0.0012	0.0006	0.0015	0.0027*	0.0013
	[3.18]	[2.78]	[3.511]	[2.55]	[2.18]	[4.90]	[0.60]	[1.40]	[0.70]	[1.26]	[1.87]	[0.55]
FR	0.0001	-0.0001	0.0001	0.0000	-0.00003	-0.0004*	0.0005**	0.0004	0.0007***	0.0009***	-0.00002	0.00013
	[0.24]	[-0.73]	[0.19]	[0.01]	[-0.12]	[-1.83]	[2.17]	[1.64]	[2.69]	[3.00]	[-0.40]	[0.27]
DS	-0.0350	0.0133	-0.0212	-0.0415	-0.0336	-0.0219	-0.0476**	-0.0704***	-0.0712	-0.0638	-0.0881**	-0.0741**
	[-1.27]	[0.29]	[-0.48]	[-0.80]	[-1.61]	[-1.12]	[-2.03]	[-3.24]	[-1.61]	[-1.26]	[-2.28]	[-2.19]
R^2	0.090	0.013	0.089	0.047	0.049	0.079	0.077	0.078	0.120	0.133	0.044	0.041

Notes : SURE estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets ; ***, **, * for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 24 forecasters.RI: nb of reported interventions;; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.

Table 4a: The impact of expected and unexpected interventions: Equation (3), 1992-1994

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	na	na	0.025***	0.025***	0.047***	0.042***	na	na	0.027***	0.027***	0.061***	0.587***
			[18.62]	[10.43]	[32.79]	[20.54]			[29.77]	[24.66]	[56.39]	[21.56]
EI	na	na	-0.0082	-0.0047	-0.0049	-0.0001	na	na	0.0001	-0.00002	-0.0001	0.0010***
			[-1.64]	[-0.67]	[-1.12]	[-0.02]			[0.24]	[-0.08]	[-0.50]	[2.63]
UI	na	na	0.0015***	0.0018***	0.0011***	0.0028***	na	na	0.0008	0.0002	-0.0002	-0.0007
			[4.80]	[3.30]	[2.85]	[7.16]			[1.58]	[0.37]	[-0.65]	[-1.09]
FR	na	na	0.0020**	0.0017	0.0010	0.0007	na	na	0.0003	0.0002	0.0010	-0.0006
			[2.21]	[1.35]	[1.37]	[0.58]			[1.23]	[1.03]	[0.55]	[-1.20]
DS	na	na	0.0159	0.0272	0.0229	0.0160	na	na	0.0046	0.0311	-0.0304**	-0.0018
			[1.00]	[1.39	[1.47]	[0.98]			[0.27]	[1.28	[-2.56]	[-0.09]
R^2			0.253	0.206	0.177	0.177			0.331	0.051	0.135	0.135

Notes : SURE estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets ; ***, **, * for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 25 forecasters. EI: nb of expected interventions; UI: nb of unexpected interventions; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.

Table 4b: The impact of expected and unexpected interventions: Equation (3), 1996-2001

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	na	na	na	na	na	na	0.0242***	0.0221***	0.0384***	0.0353***	0.0717***	0.0754***
							[12.91]	[13.06]	[14.90]	[12.20]	[18.52]	[16.02]
EI	na	na	na	na	na	na	0.0021	0.0040**	0.0035**	0.0048***	0.0031	0.0015
							[1.42]	[1.45]	[2.34]	[3.29]	[1.46]	[0.54]
UI	na	na	na	na	na	na	-0.0007	-0.0010	-0.0015	-0.0029***	0.0003	-0.0006
							[-0.72]	[-0.95]	[-1.56]	[-2.65]	[0.11]	[-0.17]
FR	na	na	na	na	na	na	0.0004*	0.0003	0.0006**	0.0007**	-0.0001	-0.00001
							[1.65]	[1.15]	[1.97]	[2.37]	[-0.24]	[-0.02]
DS	na	na	na	na	na	na	-0.0634**	-0.1021***	-0.0947**	-0.0933*	-0.057**	-0.083**
							[-2.24]	[-3.98]	[-2.08]	[-1.88]	[-2.14]	[-2.19]
R^2							0.093	0.124	0.141	0.184	0.037	0.051

Notes : OLS estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets ; ***, **, *for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 24 forecasters. EI: nb of expected interventions; UI: nb of unexpected interventions; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.

Table 5a: The impact of rumours: Equation (4), 1992-1994

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	na	na	0.0269***	0.0259***	0.0483***	0.042***	na	na	0.0278***	0.0265***	0.0607***	0.0578***
			[16.60]	[12.19]	[34.49]	[19.55]			[44.80]	[23.05]	[59.90]	[19.89]
RU	na	na	0.0005*	0.0007*	0.0001	0.0007***	na	na	0.0004***	0.0002	-0.0000	-0.0000
			[1.93]	[1.93]	[0.62]	[2.60]			[3.65]	[1.16]	[-0.40]	[-0.00]
DS	na	na	0.0147	0.0300	0.0263*	0.0229	na	na	0.0120	0.0456**	-0.0204**	-0.0040
			[0.91]	[1.51]	[1.68]	[1.29]			[0.82]	[2.07]	[-2.40]	[-0.182]
R^2			0.078	0.059	0.049	0.020			0.196	0.044	0.125	0.006

Notes : SURE estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets ; ***, **, * for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 25 forecasters. EI: nb of expected interventions; UI: nb of unexpected interventions; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.

Table 5b: The impact of rumours: Equation (4), 1996-2001

	DEM-EUR/USD						YEN/USD					
	1 month		3 months		12 months		1 month		3 months		12 months	
Sample	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub	All	Sub
Const	0.0202***	0.0198***	0.0294***	0.0301***	0.0495***	0.0504***	0.0240***	0.0218***	0.0378***	0.0341***	0.0710***	0.0739***
	[14.38]	[11.46]	[15.25]	[11.98]	[27.21]	[24.70]	[13.73]	[13.50]	[15.19]	[11.98]	[18.44]	[15.93]
RU	0.0001	-0.0000	0.0002	0.0002*	0.0001	-0.0002	0.0005**	0.0004**	0.0007***	0.0009***	0.0001	0.0002
	[0.75]	[-0.01]	[0.73]	[1.65]	[0.40]	[-0.47]	[2.25]	[1.96]	[2.77]	[3.56]	[0.19]	[0.50]
DS	-0.0394	0.0095	-0.0347	-0.0538	-0.0294	-0.0235	-0.0433*	-0.0585**	-0.0672	-0.0537	-0.0375**	-0.0680
	[-1.40]	[0.21]	[-0.76]	[-1.02]	[-1.52]	[-1.20]	[-1.67]	[-2.51]	[-1.47]	[-1.05]	[-1.43]	[-2.02]
R^2	0.046	0.001	0.037	0.029	0.034	0.007	0.073	0.072	0.116	0.143	0.021	0.046

Notes : SURE estimates; standard errors robust to heteroskedasticity (White correction) and to first order serial correlation; t-statistics under brackets ; ***, **, * for significance at the 1%, 5% and 10% levels respectively. All = all forecasters; Sub = sub-sample of 25 forecasters. EI: nb of expected interventions; UI: nb of unexpected interventions; FR: nb of false rumours; DS: absolute change of the interest-rate differential at the corresponding maturity.