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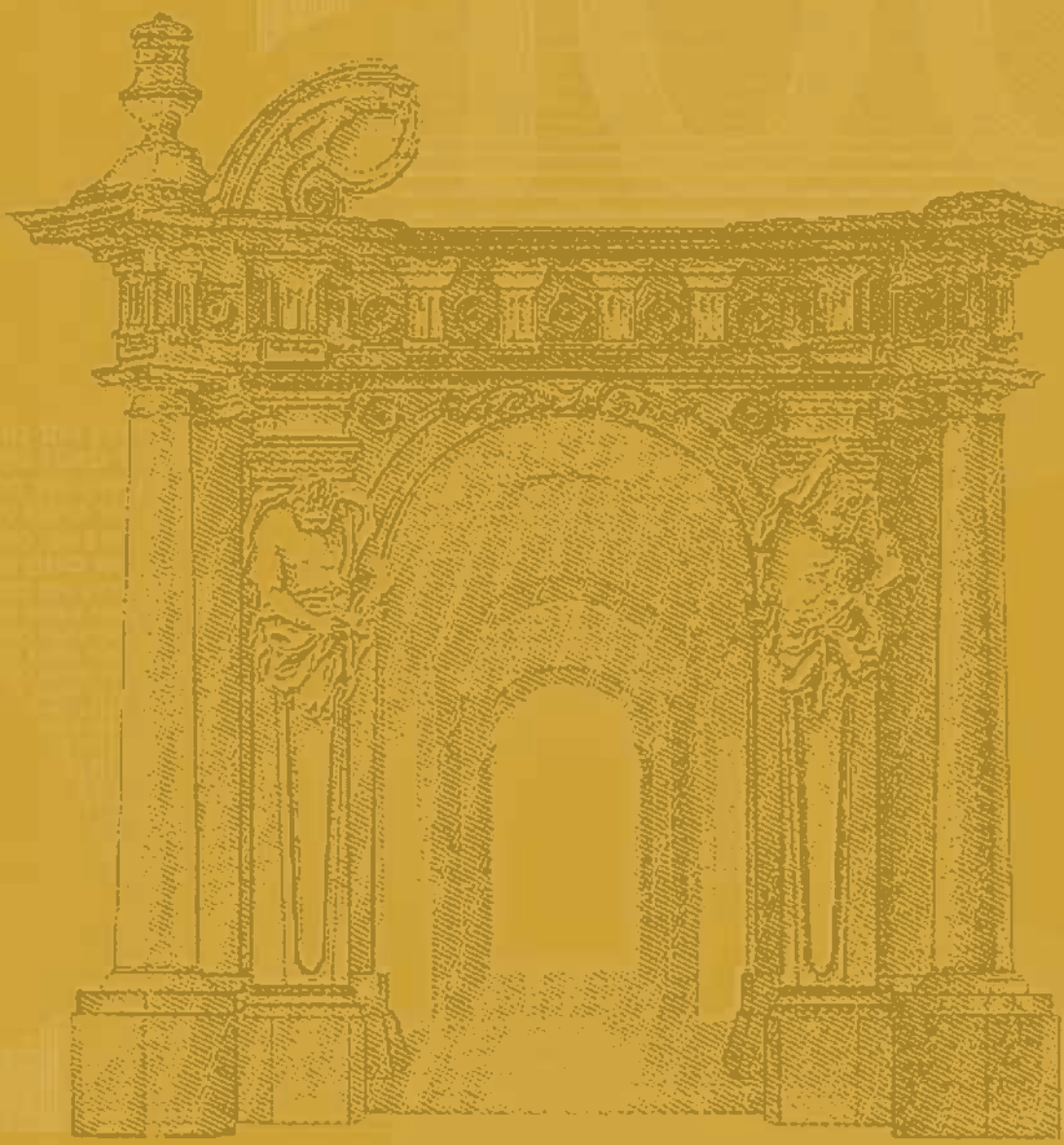
COMMUNICATION AND EXCHANGE RATE POLICY



by Marcel Fratzscher

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In 2004 all publications will carry a motif taken from the €100 banknote.

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CONTENTS

Abstract

This paper deals with the very short-term influence of "oral interventions" on the exchange rate of major currencies. The paper finds that official communication, as reported by wire services, are effective in influencing the US dollar-euro and yen-US dollar exchange rates in the desired direction on intervention days. Oral interventions are found to be substantially more effective if they deviate from the prevalent policy "mantra". They also tend to reduce market volatility whereas actual interventions raise volatility. A key result of the paper is that oral interventions are effective independently from the stance and direction of monetary policy as well as the occurrence of actual interventions. This suggests that oral interventions might constitute, on a short-term basis, an effective and largely autonomous policy tool.

JEL: E61; E58; F31.

Keywords: communication; exchange rate; intervention; policy; United States; euro area; Japan.

Non-technical summary

Exchange rate developments in the present floating exchange rate system are an issue of great sensitivity where the international co-operation through the G7 and G3 plays a subtle but important role. In the long run, there is no doubt that the fundamentals of the economies concerned and the credibility of their long-term economic and monetary policy are decisive for exchange rate developments. In the short to medium run, there is little doubt that the combination of policy action, verbal communication and perhaps intervention that can exceptionally be decided on the basis of a G7 consensus has had a significant influence over time.

This paper concentrates on the very short-term influence of communication or "oral interventions" – as perceived by the markets – namely on the very day of the communication. It does not deal with the longer-term influence of communication, nor does it address the differences between "oral intervention" which is in line with the statements of the G7, "oral intervention" which is the result of a lack of verbal discipline, or pure "noise" in terms of communication. There is little doubt that an important differentiation could be observed – over time – between these categories of "oral intervention". However, the purpose of the paper is to analyse the very short-term influence without discriminating between the various forms and complex nature of "oral interventions".

Overall, exchange rate policies in many economies have undergone a fundamental change since the mid-1990s. Monetary authorities in the United States and the euro area have shifted towards the use of official communication, i.e. public statements to convey their stance on exchange rates to the markets, while they have basically abandoned actual interventions, selling or purchasing foreign exchange only during two episodes since 1995. Only Japan has continued and even increased actual interventions and official communication in recent years.

Despite this policy shift, it is striking that much of the literature on exchange rate policies has continued to focus on actual interventions. The objective and intended contribution of the paper is to help fill this gap by assessing the effectiveness of official communication for exchange rates, and to compare it to that of actual interventions. Following the literature, effectiveness is defined as the systematic change of the exchange rate level and volatility in the desired direction on intervention days. It should be stressed that effectiveness therefore does not necessarily entail that interventions are successful, i.e. that they reach the policy-makers' ultimate objective.

The central question of the paper is whether the shift towards communication as the main policy tool has been an effective one. A key result is that oral interventions may constitute a largely autonomous policy tool in that their effectiveness does not depend on the presence of actual interventions or particular monetary policy conditions. One interpretation of this finding is that oral interventions influence financial markets not only by signalling future monetary policy decisions or actual interventions, but also by conveying private information that is relevant for the economy and for financial markets.

The paper also finds that foreign exchange interventions are particularly effective when they go against the existing policy mantra. This is especially the case for the United States, which has been particularly steadfast in its pursuit of a strong-dollar policy over the past decade. Oral and actual intervention policies are also found to be more effective if they are co-ordinated across countries, if they occur in periods of high market volatility and if they go in the same direction as past exchange rate trends. Moreover, oral interventions tend to reduce exchange rate volatility, whereas actual interventions mostly increase volatility. This reflects and confirms the fundamental difference between these two types of interventions.

1 Introduction

Exchange rate policies in many economies have undergone a fundamental change since the mid-1990s. Monetary authorities in the United States and the euro area have shifted towards the use of official communication, i.e. public statements to convey their stance on exchange rates to the markets, while they have basically abandoned actual interventions, selling or purchasing foreign exchange only during two episodes since 1995. Only Japan has continued and even increased actual interventions and official communication in recent years.

Given this policy shift, it is striking that much of the literature on exchange rate policies has continued to focus on actual interventions.[1] Communication policy has been acknowledged to play a seminal role in improving the effectiveness of policy and the economy's overall performance (e.g. Blinder 1998, Bernanke 2004). Nevertheless, there has yet been no systematic attempt to assess the role of communication policies for exchange rates, while still only few studies have focused on communication and monetary policy.

The objective and intended contribution of the paper is to help fill this gap by assessing the effectiveness of official communication for exchange rates, and to compare it to that of actual interventions. Following the literature, effectiveness is defined as the systematic change of the exchange rate level and volatility in the desired direction on intervention days. It should be stressed that effectiveness therefore does not necessarily entail that interventions are successful, i.e. that they reach the policy-makers' ultimate objective. Official communication and actual interventions share the same fundamental characteristics in that both may follow an objective, but that they may also lead to undesired effects as financial markets may speculate against them or misinterpret the authorities' intentions. To emphasise these common features, the terms official communication and oral interventions are therefore used interchangeably throughout the paper. It should also be stressed that the objective of the paper focuses narrowly on the technical aspects of the effects of official communication and actual interventions on exchange rates.

Moreover, the paper does not deal with the longer-term influence of communication, nor does it address the differences between "oral intervention" which is in line with the statements of the G7, "oral intervention" which is the result of a lack of verbal discipline, or pure "noise" in terms of communication. The purpose of the paper is to analyse the very short-term influence without discriminating between the various forms and complex nature of "oral interventions".

[1] Sarno and Taylor (2001) and Edison (1993) provide comprehensive surveys and assessments of the literature on actual interventions in the 1980s and 1990s.

The paper develops a novel dataset, based on wire service releases of Reuters News obtained from Factiva as the source, to measure and classify daily oral interventions by policy-makers in the United States, the euro area and Japan. Using strict classification criteria, the statements are transformed into an indicator function, i.e. categorised as advocating a stronger currency, a weaker exchange rate, or as ambiguous. This dataset, together with data for official purchases and sales of foreign exchange, allows conducting a systematic comparison of oral interventions and actual intervention policies for the period 1990-2003.

The central question of the paper is whether the shift towards communication as the main policy tool has been an effective one. Using daily data, the empirical results show evidence that oral interventions by the United States, the euro area/Germany and Japan have indeed exerted a significant effect on the daily yen-dollar and the dollar-euro exchange rates. The evidence indicates that (a) oral interventions are substantially more effective if they deviate from the prevalent policy mantra; (b) they have a smaller effect on the level of the exchange rate if they attempt to lean against the wind of the exchange rate trend; (c) interventions are much more effective in conditions of large market uncertainty; and (d) if they are co-ordinated across countries. Actual interventions are also found to be effective in several cases, with the results being in line with those generally found in the literature.[2]

In addition to influencing the level of the exchange rate, a second potential objective of intervention policies is to reduce market volatility, as for instance expressed by G7 policy-makers in the 1987 Louvre Accord. An important result of the paper is that oral interventions tend to reduce exchange rate volatility, while actual interventions mostly increase volatility.[3] This result emphasises the fundamental difference of these two types of interventions: oral interventions generally aim to provide public information about the desired direction and/or level of the exchange rate, thereby tending to reduce uncertainty, whereas actual interventions are mostly conducted in secret, thus often raising market uncertainty.

What policy lessons can be derived from the findings of the paper? In addition to the portfolio balance channel for actual interventions, analysed in detail by the seminal work of Dominguez and Frankel (1993a,b), oral and actual interventions influence the exchange rate through the signalling channel (Mussa 1981). This channel entails that interventions influence asset prices by signalling to the markets either (1) private information of the monetary

[2] While time-series work based on daily or intra-daily models of exchange rates find mixed evidence, event study methodologies generally find robust evidence for significant intervention effects (Humpage 1999, Ito 2002, Fatum and Hutchison 2003).
[3] The finding that actual interventions increase volatility is widely confirmed by the literature. See for instance Baillie and Osterberg (1997).

authorities about relevant economic fundamentals, (2) decisions about future monetary policy, and/or (3) future intervention policies.

A key finding of the paper is that oral interventions have a significant effect on exchange rates also in periods when they neither are supported by actual interventions nor point in the same direction as monetary policy. This suggests that oral interventions are effective partly because market participants perceive them to contain relevant information about the state of the economy. This evidence has important policy implications as it implies that oral interventions may constitute an effective and largely autonomous policy tool.

The paper is structured as follows. Section 2 provides a brief background of the transmission channels of interventions and the literature on communication policies. Section 3 outlines the methodology for identification and classification of oral intervention policies and actual interventions. The empirical methodology and findings of the benchmark model are presented in section 4. Section 5 then assesses under what conditions oral and actual interventions are effective tools. Conclusions and a discussion of open questions follow in section 6.

2 Transmission channels and time consistency of interventions

How do actual and oral interventions work? And how are they used? In principle, the literature has focused on three broad channels: the portfolio balance channel, the signalling channel and a co-ordination channel.

In the *portfolio balance channel*, actual foreign exchange interventions - both when sterilised and when non-sterilised - alter the relative supply of domestic and foreign financial assets. This induces a change in the price of these assets, thereby affecting a change in the relative value of the currencies involved. In their seminal work, Dominguez and Frankel (1993a, 1993b) present empirical evidence for some effectiveness of official interventions through the portfolio balance channel for the 1980s. However, the portfolio balance channel is likely to have become less relevant over time. This may in part to be due to, first, the rapid integration of global financial markets over the past decade, which has made financial assets of different countries better substitutes, and second, the enormous increase in the size of foreign exchange market volumes (Sarno and Taylor 2001).

Much of the literature has therefore focused on the role of the *signalling channel*. In this channel, oral communications or actual interventions affect expectations of investors and asset prices by either signalling private information of the monetary authorities about relevant

economic fundamentals and/or revealing the authorities' intentions about future policy. The term signalling channel was coined by the influential work of Mussa (1981), who argues that actual foreign exchange intervention may indeed have influenced exchange rates through this channel in the 1970s.

More recently, increased focus has been on the role of communication for monetary policy. Blinder (1998) and Bernanke (2004) argue that successful communication is crucial for ensuring the effectiveness of monetary policy itself. A monetary authority usually controls only a single interest rate, the overnight rate, while it has only indirect influence over those asset prices that really matter for the economy, which are long-term interest rates, stock prices and exchange rates. These asset prices are highly dependent on market expectations and the credibility of the authority. Communication is so crucial for the success of monetary policy precisely because it has an important influence on expectations and credibility.

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

By contrast, Vitale (2003) argues that an alternative solution to this time consistency problem is for the central bank to conduct actual foreign exchange interventions. He argues that this is an effective solution because an actual FX intervention is most transparent and because it is potentially costly, thereby ensuring the credibility of the authority among market participants.

As to the third channel, communication policies may affect asset prices via a *co-ordination channel*. This channel implies that public statements by monetary authorities function as a co-ordination device that induces market views to converge and move in a particular direction. Morris and Shin (2002) and Amato, Morris and Shin (2003) argue that communication is a "double-edged" instrument in that it not only conveys information but also serves as a focal point for beliefs and expectations. The danger, according to these two papers, is that communication may be too dominant by suppressing the formulation of private beliefs, which are in turn crucial information for the effective implementation of monetary policy. The presence of a co-ordination channel in foreign exchange markets has also been suggested by

Sarno and Taylor (2001), although no empirical or theoretical work has been undertaken so far to analyse this channel.

Finally, there has been remarkably little empirical work on the role and effectiveness of communication policies, with two notable exceptions. Guthrie and Wright (2000) for New Zealand and Kohn and Sack (2003) for the United States provide an assessment of the effectiveness of communication on monetary policy. Both papers find that communication can indeed be a rather effective monetary policy instrument in these two countries.

While there has been work on the effects of actual FX interventions, no work so far has emerged that analyses the role and the effectiveness of official communication for exchange rates. The objective of this paper is to address this issue, providing an empirical analysis for the United States, the euro area and Japan.

3 The data: Identifying oral interventions and actual interventions

3.1 Identification of oral intervention policy

What constitutes an oral intervention, and how can it be measured? The objective of the identification of oral interventions is to obtain as complete as possible a list of public statements about the domestic exchange rate by relevant policy-makers in the United States, Germany/euro area and Japan. Oral interventions may comprise three types of statements: speeches, interviews and public testimonies. In order to ensure that these public statements were also available to market participants in financial markets, one of the most commonly used wire services, *Reuters News*, was chosen for extracting all news releases for the period 1 January 1990 to 30 June 2003. These releases were obtained through Factiva. *Reuters News* has the advantage of being one of the most comprehensive wire services, reporting on and disseminating all major news in a timely fashion, usually within a short timeframe after a public announcement. This allows using a daily frequency for the analysis of the effects of oral interventions on exchange rates, taking exchange rate quotes at 18.00 EST, i.e. closing prices of the New York markets. Several caveats of the data should be underlined. In particular, some public statements may not be covered, or may to some extent contain Reuters' interpretation, and hence the list of statements may not constitute a complete list of official communications but only a list of statements as reported by Reuters. Moreover, other statements, such as G7 statements, are not included if they can generally not be attributed to a single country's policy-makers alone and do not refer to an individual currency.

The search criteria used are (a) the name or the title of the policy-maker, and (b) the word "exchange rate" or the name of the domestic currency. One issue is who the relevant policy-makers are. For the United States, exchange rate policy lies in the realm of the US Treasury Department. Hence primarily statements of the Treasury Secretary and the Deputy Treasury Secretary are included. Extending the analysis to other officials, such as the Undersecretaries of the Treasury and of the Federal Reserve does not add many observations. Federal Reserve officials have made remarkably few public statements about the US dollar. For instance, *Reuters News* yields only 7 wire news articles of statements of Federal Reserve Chairman Greenspan about the US dollar over the entire 1990-2003 period.[4]

By contrast, for Germany and the euro area, exchange rate policy has been *de facto* in the domain of the respective central banks. For the euro area, the Treaty specifies a close co-ordination between the ECB and the Eurogroup, which both share the responsibility for official exchange rate communication. However, the ECB alone is in charge of actual foreign exchange interventions, with the overarching aim being the maintenance of price stability. Moreover, exchange rate communication is de facto mostly conducted by members of the ECB Governing Council (ECB Monthly Bulletin 2001, page 59). Therefore all the statements are extracted from *Reuters News* of the members of the Bundesbank Zentralbankrat for the period 1990 to 1998, and of the ECB Governing Council members since 1999. Finally, Japan's exchange rate policy officially lies in the realm of the Ministry of Finance, although members of the Bank of Japan's Policy Board have tended to make regular statements about the exchange rate. Hence for Japan the dataset of oral interventions includes statements of the senior officials of both institutions, i.e. the Finance Minister and the Vice Finance Minister for International Affairs as well as the Governor and the two Deputy Governors of the Bank of Japan.[5]

[4] Most of the statements of Mr. Greenspan were supportive of a strong dollar. The only exception was a report on 2 April 1991 that "chairman Alan Greenspan is concerned about the dollar's recent strength and believes it undermines chances of an economic recovery in the U.S." The US dollar depreciated by 0.9% against the mark and by 1.5% against the yen on that day.

[5] An interesting note relates to the importance attached by markets to Mr. Eisuke Sakakibara, Japan's Director General of the International Finance Bureau and Vice Finance Minister in the second half of the 1990s, who in media circles was often referred to as "Mr. Yen". His statements about exchange rate developments almost always received close scrutiny from financial markets. For instance, on 21 June 1999, Mr. Sakakibara stated in a press conference: "…we do not want a premature strengthening of the yen." The yen fell by 1.7% against the US dollar on that day. As another example, on 21 April 1998 *Reuters* quotes Mr. Sakakibara's reply to a question of reporters as: "… excessive yen weakness has caused a rise in trade surplus in goods and services. In that sense, it is not desirable." The yen appreciated by 0.6% against the US dollar on that day.

A crucial issue is how to classify the statements in terms of their content and meaning. For this purpose, the statements IO_t are categorised as either advocating a stronger domestic currency ("strengthen"), a lower exchange rate ("weaken"), or as being "ambiguous" in the following way:

$$IO_t = \begin{cases} +1 & if\ "strengthening"\ oral\ statement \\ -1 & if\ "weakening"\ oral\ statement \\ 0 & if\ "ambiguous"\ oral\ statement \end{cases}$$

This classification is a judgmental one and clearly in some cases difficult to make. Table 1 shows this classification of all the oral interventions by the authorities since 1990. Two important points should be noted. First, the classification is done in a mechanical way, i.e. all statements are classified based on their language content and not based on their effect and importance for asset prices. Second, the only statements that are not classified and left out from the dataset are those that occurred on days of monetary policy meetings of the respective central banks or in monetary policy testimonies to the respective parliaments. It was also checked whether exchange rate statements take place during release days of relevant macroeconomic data. It is important to control for such events because the news content of monetary policy statement or data releases may have a dominant effect on those days.

Table 1: Oral FX interventions (IO), 1990 - 2003

	USA			Germany / euro area			Japan		
	strengthen	weaken	ambiguous	strengthen	weaken	ambiguous	strengthen	weaken	ambiguous
Number of intervention days									
1990 - 2003	125	2	28	77	14	23	40	71	26
1990 - 1994	18	1	14	13	0	4	27	16	7
1995 - 1998	31	0	5	3	11	4	12	4	4
1999 - 2003	76	1	9	61	3	15	1	51	15

Sources: Reuters News, author's categorisation.

While it proves relatively straightforward to distinguish between "strengthening" and "weakening" statements, it is sometimes not clear whether or not to classify a statement as "ambiguous". To quote Robert Rubin (2003), the US Treasury Secretary between January 1995 and July 1999:

> *"I became very adept at simply repeating the mantra - except in those rare instances when we deliberately used a slight shading, always built around commitment to a strong dollar, to convey a message. For example, my saying "a*

strong dollar is in our national interest, and we have had a strong dollar for some time now" created great excitement at a press briefing, as it was construed to mean that we wouldn't mind seeing the dollar remain strong but soften somewhat. However, I would never give any explanation for such a change beyond my prepared phraseology."

The statement by Mr. Rubin suggests that small changes to the language about exchange rate developments are often done intentionally to "convey a message" and can have a large effect on financial markets. In this case, the classification scheme would have coded the mentioned statement as "ambiguous" although the intention was to weaken the US dollar.

Given this difficulty to assign "ambiguous" statements, two other classifications are tested. The first one implies dropping the ambiguous statements from the data, thus treating them just as if they had not occurred. The second and the preferred option is to treat "ambiguous" statements as deviations from the predominant policy mantra, as seems implicit in Rubin's comment. Hence the alternative classification is to treat "ambiguous" statements as "weakening" oral interventions for the United States and for Germany/the euro area, while classifying them as "strengthening" interventions for Japan in periods when it has advocated a weaker yen.[6] This is the preferred option I chose, and the empirical analysis below is based on this measure of oral interventions.

Figures 1-3 show the distribution of the oral interventions during the period January 1990 through June 2003, with a circle indicating an oral intervention in favour of a stronger domestic currency, and a square for a weaker exchange rate. For the United States, it is striking also from Table 1 that authorities almost never seem to have made statements advocating a weaker US dollar, which stresses the persistence of a strong-dollar policy during most of the period. An exception to this rule may have existed in the early 1990s, when US oral interventions are mostly ambiguous, favouring neither a stronger nor a weaker US dollar.

[6] As will be discussed below, the only period when Japanese authorities expressed support for a stronger yen was in 1990-1992 and briefly in late 1997/early 1998. However, few ambiguous statements occurred during that period, and the empirical results proved robust to classifying differently the ambiguous statements in this period.

Figure 1: USD/EUR exchange rate and US oral interventions

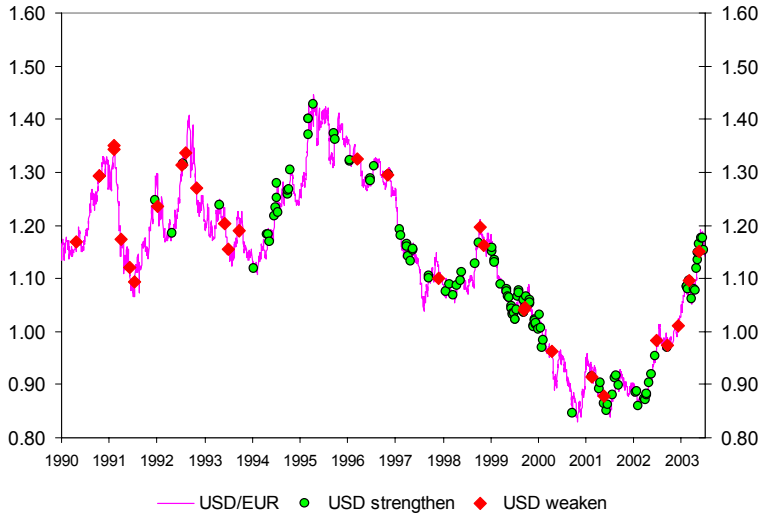


Figure 2: USD/EUR exchange rate and euro area / German oral interventions

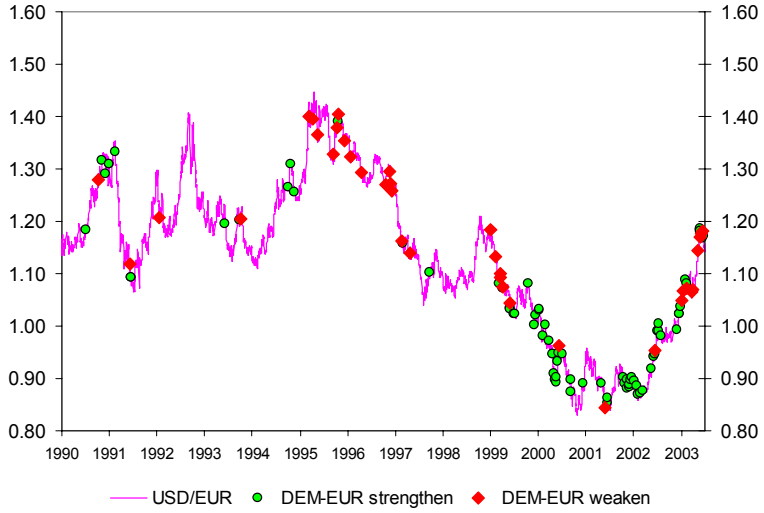
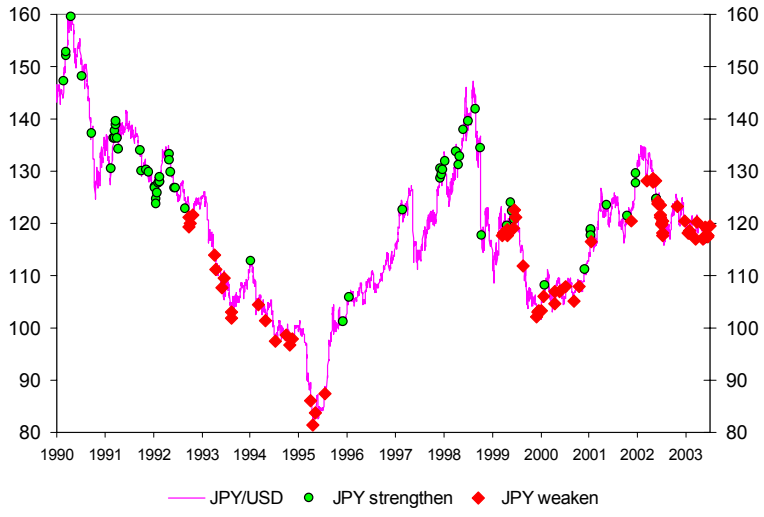


Figure 3: JPY/USD exchange rate and Japanese oral interventions



There seem to have been a shift or at least a confirmation of a "strong-dollar policy" in the United States with the Clinton Administration in 1993, and in particular the appointment of Robert Rubin as Treasury Secretary in 1995. An interesting finding of the oral interventions shown in Figure 1 is that oral interventions in favour of a strong US dollar continued also in periods in which the US dollar was already valued relatively highly, such as in early 1998 and in particular in 2000 and 2001 when the US dollar peaked against the euro.

For Germany, authorities also mostly promoted a stronger mark, with the exception of 1995-96 when repeated statements were made favouring a weaker mark (Figure 2). This finding seems sensible as the mark reached its peak against the US dollar in the first half of 1995. For the euro area, authorities have been supporting a strong euro quite persistently since 1999. Nevertheless, they seemed to have deviated somewhat from that policy in early 1999 after the launch of the euro and in 2003 after the euro had risen significantly against the US dollar. This can be seen from the relatively larger number of ambiguous statements about the value of the euro during those periods.

Finally, Figure 3 suggests that Japanese authorities shifted their oral intervention policy regime several times in the 1990s. In the early 1990s when the yen fluctuated between 120/130 and 160 to the US dollar, most oral interventions favoured a stronger yen. After a significant appreciation above 120 yen/US dollar in early 1993, oral interventions pushed for a weaker yen until 1996. When the yen depreciated in 1996 and 1997, Japanese policy-makers seem to have made almost no statements about exchange rate policy. However, when the yen depreciated beyond 130 and 140 yen/US dollar in 1998, authorities again supported a stronger yen. After a subsequent significant strengthening of the yen, policy-makers in Japan have been persistently promoting a weaker yen since 1999.

In summary, two central conclusions emerge. First, one can derive from oral interventions distinct regimes of exchange rate policy in the G3. This suggests that policy-makers have indeed had an exchange rate policy that they have communicated to the markets. The second conclusion is that there are distinct differences in exchange rate policies across the G3. The United States has very persistently pursued a strong US dollar policy, even during periods of a relatively high dollar. German and euro area authorities also followed a policy supporting strong domestic currencies, though this pursuit seems to have been somewhat less adamant than that of US authorities. By contrast, Japan's policy-makers shifted policy regimes several times during the 1990s, and since 1999 have been advocating a policy of a weaker yen.

3.2 Actual foreign exchange interventions

The analysis is extended to test also for the role and effectiveness of actual foreign exchange interventions, i.e. actual purchases or sales of foreign exchange. The data for the actual interventions is publicly available from the respective central banks, and includes both the days when they occurred as well as the amounts and currencies against which they took place. Data for the United States and Germany is available back to the early 1980s and 1970s, respectively. For Japan, actual intervention data starts in April 1991.

As Table 2 shows, for Japan and Germany most actual foreign exchange interventions occurred against the US dollar, although there have been some instances in which Japanese authorities also intervened against the mark or the euro. In 1997, Japanese authorities bought Indonesian rupiah on a few occasions. Germany in some cases intervened in support of ERM currencies in the early 1990s with the ERM interventions generally being much larger than those vis-à-vis the US dollar. For the United States, the Federal Reserve intervened both against the yen and the mark, sometimes vis-à-vis both currencies on the same day. The average daily intervention amounts over the sample period were USD 284 million for the United States, USD 1.59 billion for Germany / the euro area, and USD 1.55 billion for Japan.

Figures 4-6 offer an insight into the timing and the direction of the interventions by the central banks since 1990. The circles indicate when the respective central bank sold foreign currencies in order to strengthen the domestic exchange rate, and the squares when it purchased foreign exchange. A striking finding is that the Federal Reserve and the Bundesbank basically stopped intervening in foreign exchange markets in 1995 after intervening often heavily and repeatedly in prior years. After 1995, the Federal Reserve and the ECB were only twice active in foreign exchange markets. By contrast, the Bank of Japan intervened frequently in the markets, in particular in 1994-96, and again in recent years. In 2003, the Bank of Japan bought foreign exchange at an order of magnitude of 24.2 trillion yen or roughly USD 178 billion.

Overall, the often increased use of oral interventions, as discussed above, coupled with the almost complete cessation of actual purchases and sales of foreign exchange in the markets indicates that there has been a regime shift in the conduct of exchange rate policies at least in two of the three economies.

Figure 4: USD/EUR exchange rate and US actual interventions

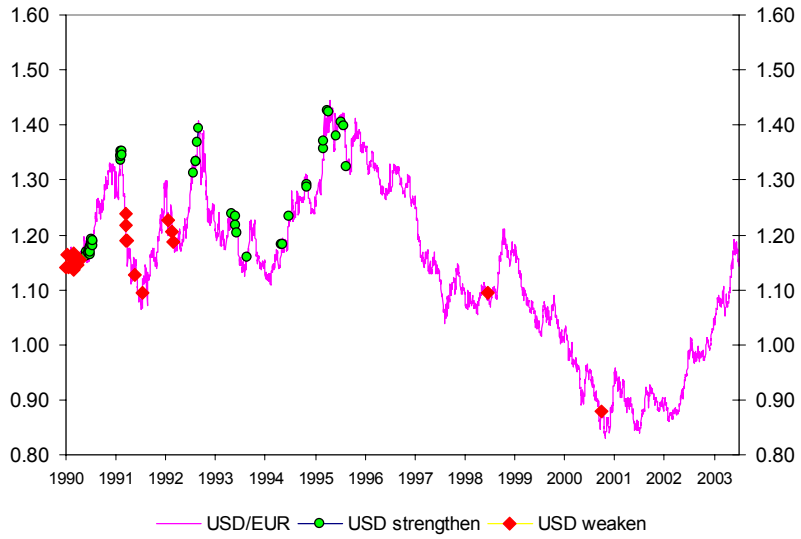


Figure 5: USD/EUR exchange rate and Euro area / German actual interventions

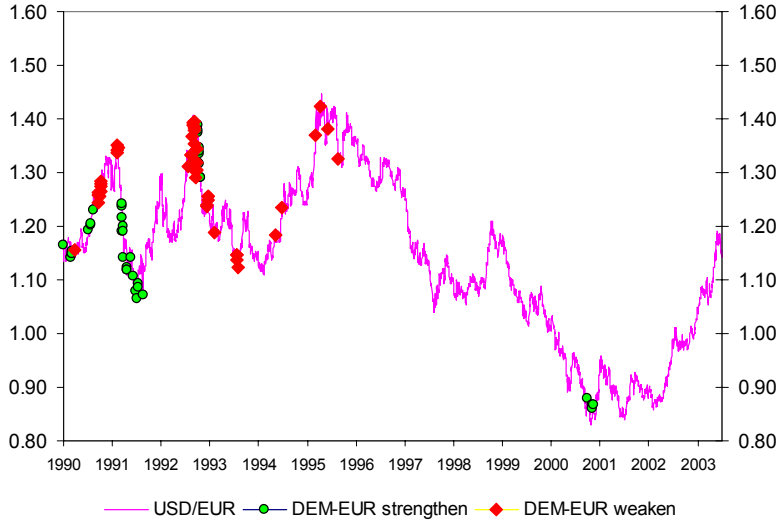
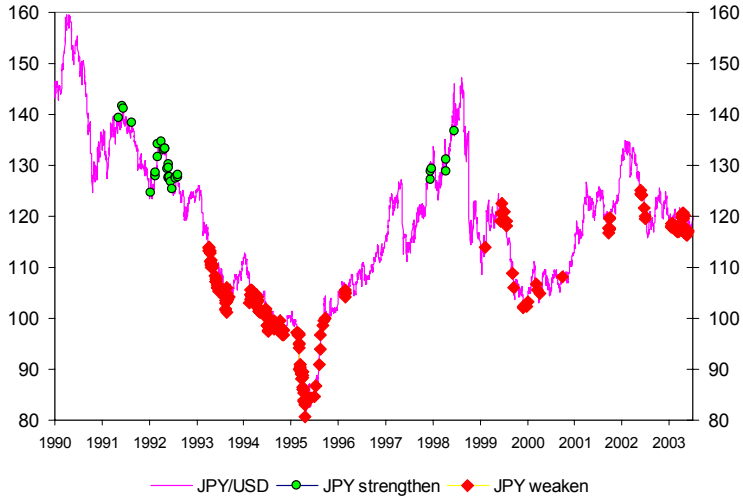


Figure 6: JPY/USD exchange rate and Japanese actual interventions



4 Benchmark model and results

4.1 Empirical methodology and hypotheses

The exchange rate is commonly modelled in a standard asset-pricing framework, in which the log exchange rate s_t reflects the discounted value of private agents' expectations about future fundamentals f_{t+i}:

$$s_t = (1-\theta)\sum_{i=0}^{\infty}\theta^i \; E_t(f_{t+i}\,|\,\Omega_t) \tag{1}$$

with θ as the discount factor and Ω_t the information set available to agents at time t. What an official intervention I_t, either an actual intervention or an oral intervention, does is to add to the information set Ω_t.

Through the portfolio balance channel, actual interventions affect current fundamentals f_t by altering the relative supply of domestic and foreign assets, thus inducing a change in the price of these assets and in the relative value of the currencies involved (e.g. Dominguez and Frankel 1993a,b).

By contrast, in the signalling channel, the effect of either actual or oral interventions functions by altering expected *future* fundamentals f_{t+i}. As interventions may either signal changes in future monetary policy m_{t+i}, or alternatively signal information of the monetary authorities about other relevant fundamentals g_{t+i}, the basic asset-pricing framework focusing on the effect of interventions can thus be formulated as

$$s_t = (1-\theta)\sum_{i=0}^{\infty}\theta^i \; E_t(m_{t+i}, g_{t+i}\,|\,\Omega_t, I_t) \tag{2}$$

Therefore, a test of the hypothesis that official interventions affect the exchange rate in essence implies testing that

$$s_t = (1-\theta)\sum_{i=0}^{\infty}\theta^i \; E_t(m_{t+i}, g_{t+i}\,|\,\Omega_t, I_t) \neq (1-\theta)\sum_{i=0}^{\infty}\theta^i \; E_t(m_{t+i}, g_{t+i}\,|\,\Omega_t) \tag{3}$$

or, in other words, actual and oral interventions at time t contain relevant information such that it alters the exchange rate s_t.

To test this hypothesis, the empirical model for the effects of actual interventions IA_t and oral interventions IO_t is formulated as

$$\Delta s_t^{USD/EUR} = \alpha_1 + \beta_1^{EA} IA_t^{EA} + \beta_1^{US} IA_t^{US} + \gamma_1^{EA} IO_t^{EA} + \gamma_1^{US} IO_t^{US} + \delta_1 \left(i_t^{US} - i_t^{EA} \right) + \sum_d \chi_1^d W_t^d + \varepsilon_{1,t} \quad (4a)$$

$$\Delta s_t^{YEN/USD} = \alpha_2 + \beta_2^{JA} IA_t^{JA} + \beta_2^{US} IA_t^{US} + \gamma_2^{JA} IO_t^{JA} + \gamma_2^{US} IO_t^{US} + \delta_2 \left(i_t^{US} - i_t^{JA} \right) + \sum_d \chi_2^d W_t^d + \varepsilon_{2,t} \quad (4b)$$

with $\varepsilon \sim (0, h_t)$, Δs_t as the change in the log exchange rate of the US dollar-euro or the yen-US dollar, IA_t as the actual foreign exchange interventions vis-à-vis the respective currencies (in US dollar billion) and IO_t the oral interventions.[7] The model controls for effects of interest rate differentials between the United States vis-à-vis the euro area and Japan, respectively, to control for differences in monetary policies, and for day-of-the-week effects W_t.[8]

The daily exchange rate series exhibit non-normality, negative skewness, excess kurtosis and serial correlation. The process of exchange rate changes is modelled in an exponential GARCH (EGARCH) framework, following Nelson (1991), to account for these characteristics of the data. Moreover, choosing an EGARCH specification implies that no non-negativity constraints on the coefficients of the conditional second moments need to be imposed. The conditional variance equation of the EGARCH(1,1)[9] is thus modelled as

[7] Including only contemporaneous effects of interventions and interest rates differentials proved sufficient, while lagged values were generally not significant, thus confirming the efficiency of the foreign exchange market in immediately incorporating interventions on the same day. Also lagged exchange rate changes proved not significant.

[8] Interest rates are three-month money market rates. For the day-of-the-week dummies, significant effects were found in some cases only for the Monday and Friday dummies. The estimates for the interest rate differentials are mostly correctly signed, but are not shown for space reasons.

[9] Also EGARCH models with higher-order lags were tested and showed that the EGARCH (1,1) model is sufficient to address the non-normality of the data. Moreover, using a standard FIGARCH specification did not yield qualitatively different results from the EGARCH(1,1) model employed here. Moreover, it has been argued by Beine, Bénassy-Quéré and Lecourt (2002) that a fractionally integrated GARCH (FIGARCH) model is a more appropriate way than a standard GARCH (1,1) model to formulate the conditional variance. However, using a standard FIGARCH specification did not yield qualitatively different results from the EGARCH(1,1) model employed here.

$$\log(h_{1,t}) = \tau_1 + \omega_1\left(\left|\frac{\varepsilon_{1,t-1}}{\sqrt{h_{1,t-1}}}\right| - \sqrt{2/\pi}\right) + \phi_1 \log(h_{1,t-1}) + \kappa_1\left(\frac{\varepsilon_{1,t-1}}{\sqrt{h_{1,t-1}}}\right) + \eta_1^{EA}\left|IA_t^{EA}\right| + \eta_1^{US}\left|IA_t^{US}\right| + \chi_1^{EA}\left|IO_t^{EA}\right| + \chi_1^{US}\left|IO_t^{US}\right| + \sum_d \xi_1^d W_t^d \quad (5a)$$

$$\log(h_{2,t}) = \tau_2 + \omega_2\left(\left|\frac{\varepsilon_{2,t-1}}{\sqrt{h_{2,t-1}}}\right| - \sqrt{2/\pi}\right) + \phi_2 \log(h_{2,t-1}) + \kappa_2\left(\frac{\varepsilon_{2,t-1}}{\sqrt{h_{2,t-1}}}\right) + \mu_2^{JA}\left|IA_t^{JA}\right| + \mu_2^{US}\left|IA_t^{US}\right| + \lambda_2^{JA}\left|IO_t^{JA}\right| + \lambda_2^{US}\left|IO_t^{US}\right| + \sum_d \xi_2^d W_t^d \quad (5b)$$

where the conditional variances of the US dollar-euro exchange rate ($h_{1,t}$) and the yen-US dollar exchange rate ($h_{2,t}$) are expressed as a function of the past variance (h_{t-1}) and innovations (ε_{t-1}), the absolute values of oral interventions IO_t and actual interventions IA_t, as well as the day-of-the-week effects W_t. The model is estimated using the log likelihood estimation function

$$L(\varphi) = -\left(\frac{T}{2}\right)\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\left(\ln|H_t| + \varepsilon_t' H_t^{-1}\varepsilon_t\right)$$

with H_t as the time-varying conditional variance-covariance matrix, φ the vector of parameters of interest and T the number of observations.

Table 3: Hypotheses of effectiveness of actual and oral interventions

	US dollar - euro		**Yen - US dollar**	
	conditional mean	**conditional variance**	**conditional mean**	**conditional variance**
credible signal I_t	$\beta_1^{EA}, \gamma_1^{EA} > 0$ $\beta_1^{US}, \gamma_1^{US} < 0$	$\mu_1^{EA}, \lambda_1^{EA} \leq 0$ $\mu_1^{US}, \lambda_1^{US} \leq 0$	$\beta_2^{JA}, \gamma_2^{JA} < 0$ $\beta_2^{US}, \gamma_2^{US} > 0$	$\mu_2^{JA}, \lambda_2^{JA} \leq 0$ $\mu_2^{US}, \lambda_2^{US} \leq 0$
not credible or ambiguous signal I_t	$\beta_1^{EA}, \gamma_1^{EA} = 0$ $\beta_1^{US}, \gamma_1^{US} = 0$	$\mu_1^{EA}, \lambda_1^{EA} > 0$ $\mu_1^{US}, \lambda_1^{US} > 0$	$\beta_2^{JA}, \gamma_2^{JA} = 0$ $\beta_2^{US}, \gamma_2^{US} = 0$	$\mu_2^{JA}, \lambda_2^{JA} > 0$ $\mu_2^{US}, \lambda_2^{US} > 0$

Having formulated the model, the hypotheses to be tested can be summarised as in Table 3. First, in an efficient market setting, an actual intervention to sell foreign exchange or an oral intervention in support of the domestic currency that is credible, i.e. when markets believe

that it conveys true and relevant signals about economic fundamentals or future monetary policy, should lead to a corresponding appreciation of the domestic currency. Second, a credible intervention should help lower market uncertainty and hence reduce exchange rate volatility. And third, an intervention that is not credible is expected to have no significant effect on the level of the exchange rate while raising uncertainty and volatility.

4.2 Benchmark results

The starting point of the empirical analysis is to estimate the model of equations (4) - (5) over the full sample period 1990-2003. Overall, Table 4 shows that both actual interventions and oral interventions have generally been effective in influencing the level of the US dollar - euro and yen - US dollar exchange rates. All signs of these effects are as expected, and as formulated in Table 3.

Table 4: Effectiveness of actual interventions and oral interventions, 1990-2003

	conditional mean equation				conditional variance equation			
period:			alternative definition[1]				alternative definition[1]	
1 Jan. 1990 - 30 Sept. 2003	coef.	*std.error*	coef.	*std.error*	coef.	*std.error*	coef.	*std.error*
A. US dollar - euro exchange rate								
US oral intervention IO^{US}	-0.124 ***	*0.047*	-0.101 **	*0.049*	0.016	*0.016*	0.016	*0.016*
Ge/EA oral intervention $IO^{GE/EA}$	0.198 ***	*0.056*	0.242 ***	*0.060*	-0.031	*0.021*	-0.031	*0.021*
US actual intervention IA^{US}	-0.044	*0.127*	0.027	*0.069*	0.050	*0.052*	0.001	*0.020*
Ge/EA actual intervention $IA^{GE/EA}$	1.536 ***	*0.389*	0.150 **	*0.069*	0.556 ***	*0.134*	0.074 ***	*0.017*
Interest rate differential[2]	-0.005	*0.004*	-0.006	*0.004*	-0.002	*0.003*	-0.003	*0.003*
LR test[3]	8.356 ***		7.566 ***					
B. Yen - US dollar exchange rate								
US oral intervention IO^{US}	0.149 ***	*0.053*	0.137 **	*0.059*	-0.016	*0.017*	-0.006	*0.017*
Ja oral intervention IO^{JA}	-0.155 ***	*0.051*	-0.199 ***	*0.056*	-0.008	*0.017*	-0.028	*0.018*
US actual intervention IA^{US}	1.287 ***	*0.267*	0.140 **	*0.064*	0.822 ***	*0.119*	0.072 ***	*0.020*
Ja actual intervention IA^{JA}	-0.059 ***	*0.013*	0.007	*0.037*	-0.007 *	*0.004*	0.010 *	*0.006*
Interest rate differential[2]	0.007	*0.006*	0.006	*0.005*	-0.004	*0.004*	-0.005	*0.004*
LR test[3]	8.223 ***		7.994 ***					

Notes:
***,**,* indicate significance at the 99%, 95%, 90% levels, respectively.
[1] Alternative definition for IO is the one excluding "ambiguous" statements, as explained in the text,for IA it is an indicator function +1 for purchases and -1 for sales of domestic currency.
[2] Interest rate differential for US dollar - euro exchange rate is the difference of 3-month money market rates in the United States minus the one in the euro area, and correspndingly for the yen - US dollar exchange rate.
[3] LR test is test whether model with intervention variables has a higher explanatory power than the model without intervention variables. ***, **, * show significance of acceptance of the LR test.

As to oral interventions, German / euro area interventions, on average, lead to a 0.2% change of the US dollar - mark/euro exchange rate on the day of the statement. The effects of US and Japanese oral interventions are somewhat smaller at around 0.15%, but still highly significant

statistically. These findings are robust to using the alternative definition of oral interventions, which excludes the ambiguous policy statements (columns 3 & 4, Table 4).

As to actual interventions, these also mostly have a significant effect on exchange rates. However, the differences across economies are very substantial. For instance, a USD 1 billion sale of foreign exchange by German / euro area authorities has been associated with a 1.5% appreciation of the mark or euro, whereas US actual interventions seem to have had no significant effect on the US dollar - mark / euro. By contrast, the effect of US actual interventions on the yen - US dollar has a magnitude of 1.3%, while the effect of a Japanese USD 1 billion actual intervention is substantially smaller at -0.059%. These results for the yen-US dollar are similar to those found in Ito (2002) for a shorter time period.

A further finding is that actual interventions have mostly increased the conditional variances of the exchange rates. By contrast, oral interventions have in most cases decreased the volatility of exchange rates, though in the benchmark results presented here the point estimates are not statistically significant (columns 5 through 8, Table 4). The result that actual interventions increase volatility is confirmed by the evidence shown in the literature.[10]

It is imperative to stress an important point here. This point is that an intervention is defined to be "effective" if it leads the exchange rate in the desired direction on the day when it occurs. Effectiveness may therefore not necessarily imply that an intervention is "successful" in the sense that (a) it alters the course of the exchange rate also in the medium- to long term and (b) it achieves the ultimate long-run objective of the policy-maker. For instance, an intervention may be effective in moving the currency in the desired direction but still be unsuccessful in e.g. stabilising the exchange rate below or above a certain level. The key point is that intervention policies for two reasons cannot be assessed on the basis of how "successful" they are. First, we usually do not know what the precise objective of the intervention is. And second, we do not know what the relevant counter-factual is, i.e. how the exchange rate would have evolved in the medium-term if no interventions had taken place.

What one can attempt to measure is the permanence of the effect of the intervention. First, lagged interventions in model (4)-(5) are not significant, confirming that financial markets are efficient in incorporating information on the day when they become available. Second, the model (4)-(5) was tested using lower-frequency data of 2-day, 1-week, 2-week etc. intervals. I

[10] See e.g. Baillie and Osterberg (1997), which is consistent with the work on dynamic effects of FX interventions, using market microstructure and order flow models that analyse data at different time

find that the magnitude of the point estimates for both oral and actual interventions are very similar for 2-day intervals and sometimes also for 1-week intervals, but that these estimates become statistically insignificant when moving beyond 2-day or 3-day intervals.[11] This is what one would expect since markets continuously price-in so many other news that this "noise" does not allow measuring the true permanent effect of interventions.

Therefore, the only statistically valid inference one can make is about the *impact effect* of interventions, or what I call effectiveness. Nevertheless, what matters for the success of an overall intervention strategy is also the frequency and, in case of actual interventions, the magnitude of interventions, i.e. the cumulated impact effects. A compelling example is the small estimated coefficient for Japanese actual interventions on the yen-US dollar exchange rate of -0.059. This estimate suggests that the Japanese authorities need to purchase about USD 17 billion to weaken the yen by 1%. Given that the Bank of Japan purchased foreign exchange of roughly USD 178 billion in 2003, the estimated coefficient suggests that, ceteris paribus, Japanese interventions in 2003 moved the yen about 11% lower against the US dollar. Although the true effect of these interventions may have been different since the effectiveness of interventions varies depending on factors such as market conditions, trends, co-ordination etc., a detailed analysis of which follows in the next section, the purpose of this example is to make the important point that oral and actual intervention policies can indeed exert a sizeable influence on overall exchange rate developments in the medium-term.

Several sensitivity and robustness checks were conducted. First, various dynamic specifications of model (4)-(5) were tested by including lags of past interventions as well as of past exchange rate changes. None of these lags are generally significant. Second, testing for time effects shows that the effectiveness of oral interventions generally rose slightly over the period 1990-2003, though these time effects are small and not statistically significant. Third, the effects of oral interventions by the "main" policy-makers - i.e. US Treasury Secretary, Japan's Minister of Finance, Bundesbank President, ECB President - are mostly somewhat larger, but this difference is again usually not statistically significant. Fourth, there is also no compelling evidence for size effects, i.e. that large actual interventions have a larger point estimate than small interventions.

In summary, oral interventions and actual interventions have indeed been effective in influencing exchange rate developments. Oral interventions are not only relatively effective

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horizons (Peiers 1997, Evans and Lyons 2002, Dominguez 2003) and the work on the relevance of macroeconomic news for exchange rates by Andersen, Bollerslev, Diebold and Vega (2003).

[11] These results are not shown for reasons of brevity, but are available from the author upon request.

compared to actual interventions, but they generally tend to lower uncertainty and volatility in the markets whereas actual interventions have generally raised currency volatility.

5 Conditions for effectiveness

The literature on actual FX interventions has shown that monetary authorities frequently pursue particular strategies with their interventions. The question I turn to now is therefore when and under what conditions foreign exchange interventions are effective.

For this purpose, I extend the EGARCH model (4)-(5) in order to be able to test for alternative hypotheses within the EGARCH model:

$$\begin{aligned}\Delta s_t^{USD/EUR} &= \alpha_1 + \beta_{11}^{EA}(IA_t^{EA}\ D_{H0}^{EA}) + \beta_{12}^{EA} IA_t^{EA} + \beta_{11}^{US}(IA_t^{US}\ D_{H0}^{US}) + \beta_{12}^{US} IA_t^{US} \\ &+ \gamma_{11}^{EA}(IO_t^{EA}\ D_{H0}^{EA}) + \gamma_{12}^{EA} IO_t^{EA} + \gamma_{11}^{US}(IO_t^{US}\ D_{H0}^{US}) + \gamma_{12}^{US} IO_t^{US} \\ &+ \delta_1\left(i_t^{US} - i_t^{EA}\right) + \sum_d \chi_1^d W_t^d + \varepsilon_{1,t}\end{aligned} \tag{6}$$

$$\begin{aligned}\log\left(h_{1,t}\right) &= \tau_1 + \omega_1\left(\left|\frac{\varepsilon_{1,t-1}}{\sqrt{h_{1,t-1}}}\right| - \sqrt{2/\pi}\right) + \phi_1 \log\left(h_{1,t-1}\right) + \kappa_1\left(\frac{\varepsilon_{1,t-1}}{\sqrt{h_{1,t-1}}}\right) \\ &+ \eta_{11}^{EA}\left|IA_t^{EA}\right| D_{H0}^{EA} + \eta_{12}^{EA}\left|IA_t^{EA}\right| + \eta_{11}^{US}\left|IA_t^{US}\right| D_{H0}^{US} + \eta_{12}^{US}\left|IA_t^{US}\right| \\ &+ \chi_{11}^{EA}\left|IO_t^{EA}\right| D_{H0}^{EA} + \chi_{12}^{EA}\left|IO_t^{EA}\right| + \chi_{11}^{US}\left|IO_t^{US}\right| D_{H0}^{US} + \chi_{12}^{US}\left|IO_t^{US}\right| + \sum_d \xi_1^d W_t^d\end{aligned} \tag{7}$$

where the only extension to (4)-(5) is the introduction of an interaction term with a dummy DH0 to test for various hypotheses of interest - e.g. whether interventions have a larger effect on the level or volatility of the exchange rate in times of high exchange rate deviations from PPP (D_{H0}=1). Hence the null hypotheses H_0 shown in the tables of the results are $\beta 11 + \beta 12 = 0$, $\gamma 11 + \gamma 12 = 0$ in the conditional mean equation (6), and $\eta 11 + \eta 12 = 0$, $\chi 11 + \chi 12 = 0$ for the conditional variance equation (7). The model for the yen-US dollar exchange rate is formulated analogously.

A first question is whether interventions are more or less effective if they deviate from the prevalent policy mantra. The intuition is as follows. For instance, a US oral intervention in support of a strong-dollar policy may have little news content in that it provides little or no new information to the markets. A statement that deviates from the strong-dollar policy, however, may have a much larger effect if markets perceive it to question or even to alter the

existing policy stance. A similar argument applies to Germany / the euro area which have mostly followed a strong-mark/euro policy. The issue is somewhat more difficult for Japan, which has mostly followed a "weaker-yen" policy during the past 14 years, though there were some periods - from 1990 to 1992 and briefly in late 1997/early 1998 - when Japanese authorities intervened in favour of a stronger yen, as discussed in section 2 above. For Japan, deviations from the mantra are therefore defined as interventions to strengthen the yen, except for 1990-92 and late 1997/early 1998 when these are interventions to weaken it.

Table 5: Deviations from the exchange rate mantra

		cond. mean eq.			cond. variance eq.		
		H_0: deviation H_1: no deviation			H_0: deviation H_1: no deviation		
		coef.	***std.error***	***sig.***	**coef.**	***std.error***	***sig.***
A. US dollar - euro exchange rate							
US oral intervention IO^{US}	H_0:	-1.162 ***	*0.238*	+	0.349 ***	*0.125*	+
	H_1:	-0.041	*0.053*		-0.013	*0.019*	
Ge/EA oral intervention $IO^{GE/EA}$	H_0:	0.380 ***	*0.113*	+	0.070	*0.063*	
	H_1:	0.197 **	*0.077*		-0.010	*0.023*	
US actual intervention IA^{US}	H_0:	-0.954 ***	*0.277*	+	-0.105	*0.152*	+
	H_1:	-0.197	*0.129*		0.220 ***	*0.055*	
Ge/EA actual intervention $IA^{GE/EA}$	H_0:	1.725 ***	*0.581*		0.428 ***	*0.132*	+
	H_1:	1.175 **	*0.556*		1.540 ***	*0.283*	
B. Yen - US dollar exchange rate							
US oral intervention IO^{US}	H_0:	0.872 ***	*0.211*	+	-0.049	*0.112*	
	H_1:	0.081	*0.063*		-0.023	*0.019*	
Ja oral intervention IO^{Ja}	H_0:	-0.217 **	*0.099*		0.039	*0.029*	+
	H_1:	-0.199 ***	*0.066*		-0.098 ***	*0.023*	
US actual intervention IA^{US}	H_0:	0.465 ***	*0.150*	+	0.309 ***	*0.048*	
	H_1:	-0.062	*0.277*		0.492 ***	*0.125*	
Ja actual intervention IA^{Ja}	H_0:	-0.121 **	*0.047*		0.018	*0.017*	
	H_1:	-0.056 ***	*0.013*		-0.002	*0.004*	

Notes:
***,**,* indicate significance at the 99%, 95%, 90% levels, respectively.
+ indicates whether coefficients of H0 and H1 are significantly different from each other at the 90% level.
For US, Ge/EA: deviations are negative IO or IA, i.e. aiming at depreciating the domestic currency.
For Ja: deviations are mostly positive IO or IA, i.e. aiming at appreciating the domestic currency.

Table 5 reveals that interventions that deviate from the mantra have mostly a significantly larger effect on exchange rates. This effect is particularly strong for the United States: A statement that fails to support a strong-dollar policy on average leads to a 1.2% depreciation of the US dollar against the euro and 0.9% depreciation against the yen. By contrast, oral

interventions in favour of the US dollar have the correct sign but do not have a statistically significant effect on the exchange rate. For Germany / the euro area and Japan a similar finding emerges in that interventions are more effective if they oppose the prevalent exchange rate mantra. The differences in the effects, however, are much smaller than those for the United States. An oral intervention opposite to the mantra leads on average to a 0.38% change in the euro exchange rate and to a 0.22% change in the Japanese yen.

Moreover, deviations from the exchange rate mantra have a comparatively much bigger effect if these deviations are oral interventions. This can be seen by comparing the size of the coefficients of deviations with those that are in line with the mantra (called "no deviation" in the table). As an order of magnitude, for the US an oral intervention against the mantra has the same effect on the US dollar exchange rate as a USD 1.2 billion actual intervention against the euro and USD 1.9 billion actual intervention against the yen. Overall, the results emphasise the remarkable effectiveness of oral interventions if they occur against the prevalent policy stance.

Second, the literature on actual FX interventions has shown that monetary authorities respond to exchange rate developments, either focusing on achieving a particular level, reducing deviations from what authorities believe are sustainable levels or lowering volatility. The literature finds that many central banks attempt "leaning-against-the-wind" interventions in that they try to reverse or at least stop a particular exchange rate trend that is considered undesirable (Sarno and Taylor 2001).

The results with regard to exchange rate developments (Table 6) show that leaning-against-the-wind interventions are not effective on the level, and moreover tend to increase currency volatility (model 1). Except for US actual interventions, there is also little evidence that interventions are more effective if they occur when deviations from PPP are large (model 2).[12] However, interventions have often significantly larger effects when previous exchange rate uncertainty has been relatively high (model 3).[13] The overall effects of the different interventions are mostly quite similar across countries.

[12] Deviations from PPP are deviations from the average real exchange rate against the US dollar for the euro area and Japan, and a trade-weighted real exchange rate against euro and yen for the United States.
[13] Exchange rate volatility is measured as the variance of the exchange rates during the past two weeks or one month. An alternative way to test for the hypothesis is to use a GARCH-in-mean type of model, where the volatilities are $h_{1,t}$ and $h_{2,t}$ from the conditional variances are used directly. The results, however, are robust to the different definitions and time windows.

Third, the literature has shown that authorities may use actual interventions to signal the timing and direction of future monetary policy. There is also evidence that central banks in the 1980s have intervened after a monetary policy change in order to reverse some of the undesired exchange rate effects from the changes in monetary policy (Lewis 1995, Kaminsky and Lewis 1996, Bonser-Neal, Roley and Sellon 1998).

The findings with regard to monetary policy (Table 7) broadly confirm that interventions tend to be more effective if they are consistent with the direction of the monetary policy (model 4). In particular, the results indicate that actual interventions are more effective if they are consistent with the changes in the last monetary policy meeting (model 6) and consistent with changes in the next meeting (model 5). This implies, for instance, that interventions are more likely to be effective if they promote a stronger exchange rate when central banks have raised interests rates in the last meeting or will do so in the next meeting. However, no such systematic differences exist for oral interventions, an important point to which I will return below.

Fourth, the literature on actual interventions has found that monetary authorities tend to co-ordinate their actual interventions across countries to raise the effectiveness of the signal (e.g. Bonser-Neal and Tanner 1996). But co-ordination may not only occur across countries. Actual interventions may also be co-ordinated with oral interventions, both domestic and internationally.

Concerning the co-ordination of interventions (Table 8), actual interventions are generally more effective if they follow an oral intervention in the same direction, while oral interventions are more effective if they are preceded by actual interventions (model 8). Oral and actual interventions also have stronger effects if they are co-ordinated across countries (model 9). By contrast, actual interventions have the largest impact on exchange rates when they are not preceded by other actual interventions in the previous weeks, both for the US dollar - euro and the yen - US dollar (model 7). What this may suggest is that such interventions are more effective if they come relatively more unexpected, i.e. if they occur for the first time after a period without interventions, rather than following several previous interventions.

A key finding is that oral intervention policies are effective independent mostly from whether they are in same direction or in the opposite direction of past or future monetary policy changes (models 5 and 6 in Table 7). Oral interventions also have a significant impact on the level and volatility of exchange rates independent of whether or not they are co-ordinated

with domestic actual interventions or with foreign oral intervention policies (models 8 and 9 in Table 8). Overall, this suggested that oral interventions tend to be a rather autonomous policy tool, in the sense that whether they have a significant influence on exchange rates does not depend on the support of actual interventions or certain monetary policy conditions.

In summary, the effectiveness of oral interventions and actual interventions crucially depends on the conditions and circumstances under which they take place. The findings imply that (a) interventions are substantially more effective if they deviate from the prevalent policy mantra; (b) they hardly ever have an effect on the level of the exchange rate if they attempt to lean against the wind of the previous exchange rate trend; (c) interventions are much more effective under large market uncertainty; and (d) if they are co-ordinated across countries.

A final and highly important result concerns the volatility effects of interventions. A striking finding is that for most of the nine models, plus the test for deviations from the exchange rate mantra, oral interventions almost always tend to reduce exchange rate volatility. By contrast, actual interventions mostly increase volatility. This is a key difference that is striking from the comparison of oral interventions with actual interventions. It emphasises and confirms the fundamental difference of these two types of interventions: oral interventions generally aim to provide public information about the desired direction and/or level of the exchange rate, thereby tending to reduce uncertainty, whereas actual interventions are mostly conducted in secret, which may raise market uncertainty.

6 Conclusions

The past decade has witnessed a fundamental regime change in exchange rate policies among many economies. The United States and the euro area have basically abandoned actual interventions in foreign exchange markets and have shifted almost entirely towards the use of official communication, or oral interventions, to convey to markets their views about exchange rates, while Japan has intensified both oral and actual intervention policies.

The central objective of the paper has been to assess the effectiveness of oral interventions, and to compare it to that of actual interventions. Following the literature, effectiveness is defined as the systematic change of the exchange rate level and volatility in the desired direction on intervention days. A key result is that oral interventions may constitute a largely autonomous policy tool in that their effectiveness does not depend on the presence of actual interventions or particular monetary policy conditions. One interpretation of this finding is

that oral interventions influence financial markets not only by signalling future monetary policy decisions or actual interventions, but also by conveying private information that is relevant for the economy and for financial markets.

The paper also finds that foreign exchange interventions are particularly effective when they go against the existing policy mantra. This is especially the case for the United States, which has been particularly steadfast in its pursuit of a strong-dollar policy over the past decade. Oral and actual intervention policies are also found to be more effective if they are co-ordinated across countries, if they occur in periods of high market volatility and if they go in the same direction as past exchange rate trends. Moreover, oral interventions tend to reduce exchange rate volatility, whereas actual interventions mostly increase volatility. This reflects and confirms the fundamental difference between these two types of interventions.

The paper constitutes only a first step for improving our understanding of the role of official communication for exchange rates. Many open questions remain for future research, in particular the analysis of the channels through which official communication affects asset prices. A central issue that distinguishes oral interventions and actual interventions is the way they are perceived by financial markets. Actual interventions have been shown to face a time consistency problem in that governments cannot credibly commit to a particular exchange rate policy due to the fact that they have multiple objectives (e.g. Obstfeld 1996). Actual interventions may therefore trigger speculative behaviour by investors, which may explain why actual interventions are mostly conducted in secret.

Oral interventions are not subject to this problem but may face a different type of time inconsistency. This time inconsistency implies that it may be more difficult to establish credibility and a track record as markets may realise that policy-makers have an incentive to convey false or imprecise information in order to move markets in a desired direction without actually having to change policy. For monetary policy communication, this point has been made convincingly by Goodfriend (1986) and Stein (1989). A further drawback of oral interventions is that they may sometimes be misinterpreted and thus trigger market reactions that are undesired by policy-makers.

Overall, the paper is an attempt to fill the gap in the literature on the role and importance of official communication for exchange rates. The empirical focus on oral interventions may prove to be an important one for determining whether the regime shift in exchange rate policies in the United States and the euro area over the past decade has been a successful one. Ultimately, the analysis of oral interventions may help us learn and better understand what

monetary authorities can do – or could do better – to communicate to the markets and to the public their views about the appropriate evolution of exchange rates and underlying fundamentals.

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Table 2: Summary statistics for actual FX interventions (IA), 1990 - 2003

A. US Federal Reserve

	all interventions			DEM / EUR		YEN		others	
	all	buy FX	sell FX	buy FX	sell FX	buy FX	sell FX	buy FX	sell FX
Number of intervention days									
1990 - 2003	84	27	57	9	40	21	18	0	10
1990 - 1994	74	25	49	8	34	20	10	0	10
1995 - 1998	9	1	8	0	6	1	8	0	0
1999 - 2003	1	1	0	1	0	0	0	0	0
Magnitude of interventions (average, USD million)									
1990 - 2003	284	202	323	247	259	154	408	--	73
1990 - 1994	203	125	242	90	209	121	404	--	73
1995 - 1998	821	833	819	--	542	833	413	--	--
1999 - 2003	1500	1500	--	1500	--	--	--	--	--

B. Bundesbank / ECB

	all interventions			USD		ERM	
	all	buy FX	sell FX	buy FX	sell FX	buy FX	sell FX
Number of intervention days							
1990 - 2003	87	43	44	14	26	29	18
1990 - 1994	79	39	40	10	22	29	18
1995 - 1998	4	4	0	4	0	0	0
1999 - 2003	4	0	4	0	4	0	0
Magnitude of interventions (average, USD million)							
1990 - 2003	1591	2589	617	212	234	3737	1169
1990 - 1994	1709	2811	634	129	195	3737	1169
1995 - 1998	419	419	--	419	--	--	--
1999 - 2003	447	--	447	--	447	--	--

C. Bank of Japan

	all interventions			USD		DEM / EUR		others	
	all	buy FX	sell FX	buy FX	sell FX	buy FX	sell FX	buy FX	sell FX
Number of intervention days									
1990 - 2003	278	251	27	238	38	19	0	5	0
1990 - 1994	131	104	27	104	27	1	0	0	0
1995 - 1998	59	59	0	48	11	0	0	5	0
1999 - 2003	88	88	0	86	0	18	0	0	0
Magnitude of interventions (average, USD million)									
1990 - 2003	1554	1697	223	1617	1008	489	--	113	--
1990 - 1994	385	427	223	426	223	47	--	--	--
1995 - 1998	1706	1706	--	1434	2936	--	--	113	--
1999 - 2003	3192	3192	--	3158	--	513	--	--	--

Sources: US Federal Reserve, Bundesbank, Bank of Japan, Reuters.
Note: Amounts for the actual interventions of the ECB were not announced. The numbers used here are those reported by Reuters News, based on financial market reports.

Table 6: The signalling channel: exchange rates

		conditional mean equation						conditional variance equation					
		(1) past exchange rate trend		(2) deviation from PPP		(3) exchange rate volatility		(1) past exchange rate trend		(2) deviation from PPP		(3) exchange rate volatility	
		H_0: leaning-against-wind H_1: leaning-with-wind		H_0: large deviation H_1: small deviation		H_0: high H_1: low		H_0: leaning-against-wind H_1: leaning-with-wind		H_0: large deviation H_1: small deviation		H_0: high H_1: low	
		coef.	*std.error sig.*	coef.	*std.error sig.*	coef.	*std.error sig.*	coef.	*std.error sig.*	coef.	*std.error sig.*	coef.	*std.error sig.*
A. US dollar - euro exchange rate													
US oral intervention IO^{US}	H_0:	0.006	*0.065* +	-0.134 *	*0.078*	-0.284 ***	*0.059* +	0.044	*0.031*	0.027	*0.023*	0.010	*0.023*
	H_1:	-0.285 ***	*0.072*	-0.116 **	*0.057*	0.033	*0.079*	-0.019	*0.033*	0.013	*0.017*	0.019	*0.023*
Ge/EA oral intervention $IO^{GE/EA}$	H_0:	-0.009	*0.093* +	0.207 ***	*0.073*	0.300 ***	*0.076* +	-0.021	*0.044*	-0.011	*-0.022*	0.032	*0.032* +
	H_1:	0.333 ***	*0.073*	0.194 **	*0.090*	0.122	*0.088*	-0.008	*0.034*	-0.013	*-0.028*	-0.045 *	*0.025*
US actual intervention IA^{US}	H_0:	0.190	*0.158* +	-0.642 ***	*0.183* +	-0.252 **	*0.121*	0.216 ***	*0.059* +	0.330 ***	*0.077* +	0.242 ***	*0.062* +
	H_1:	-1.257 ***	*0.201*	-0.166	*0.116*	-0.584	*0.405*	0.039	*0.088*	0.007	*0.064*	0.013	*0.089*
Ge/EA actual intervention $IA^{GE/EA}$	H_0:	0.017	*0.485* +	1.402 ***	*0.405*	1.637 ***	*0.309* +	0.709 ***	*0.150* +	0.867 ***	*0.158* +	0.540 ***	*0.110* +
	H_1:	2.831 ***	*0.476*	1.939 ***	*0.558*	0.067	*0.272*	0.250	*0.223*	0.144	*0.155*	7.732 ***	*2.381*
B. Yen - US dollar exchange rate													
US oral intervention IO^{US}	H_0:	0.017	*0.082* +	0.108	*0.071*	0.248 ***	*0.067* +	-0.034	*0.031*	-0.048 *	*0.026*	0.039	*0.026* +
	H_1:	0.301 ***	*0.073*	0.229 ***	*0.078*	0.063	*0.087*	-0.062 **	*0.025*	-0.036 *	*0.019*	-0.135 ***	*0.028*
Ja oral intervention IO^{Ja}	H_0:	0.082	*0.084* +	-0.101	*0.074*	-0.217 ***	*0.065* +	-0.027	*0.021*	-0.036	*0.022*	0.015	*0.023* +
	H_1:	-0.551 ***	*0.067*	-0.204 ***	*0.071*	-0.059	*0.077*	-0.082 *	*0.043*	-0.035 *	*0.021*	-0.147 ***	*0.034*
US actual intervention IA^{US}	H_0:	0.155	*0.193*	0.616 ***	*0.151* +	0.842 ***	*0.185* +	0.429 ***	*0.056* +	0.412 ***	*0.051* +	0.605 ***	*0.085* +
	H_1:	0.471 ***	*0.121*	-0.803	*0.621*	-0.030	*0.110*	0.194 **	*0.086*	-0.278	*0.200*	-0.083	*0.129*
Ja actual intervention IA^{Ja}	H_0:	-0.042	*0.027* +	-0.045 ***	*0.015* +	-0.068	*0.080*	0.070 ***	*0.010* +	0.001	*0.004* +	0.198 ***	*0.030*
	H_1:	-0.264 ***	*0.007*	-0.121 ***	*0.025*	-0.101	*0.144*	-0.153 ***	*0.005*	-0.015 *	*0.009*	0.209 ***	*0.071*

Notes: ***,**,* indicate significance at the 99%, 95%, 90% levels, respectively. + indicates whether coefficients of H_0 and H_1 are significantly different from each other at the 90% level.

(1) Leaning-against-the-wind means that IO or IA occur in the opposite direction of exchange rate trend of past two weeks, i.e. an intervention to strengthen the domestic currency when the currency has weakened or an intervention to weaken it when it has strengthened during the past two weeks. Leaning-with-the-wind implies the opposite.
(2) "Large deviation" means that IO or IA occur when level of exchange rate deviates more than its period median from the PPP exchange rate; "small deviation" implies the opposite.
(3) "High" means that IO or IA occur in periods when exchange rate volatility has been high, i.e. above its median value, in the past two weeks, and "low" when the intervention happens during periods of low volatility.

Table 7: The signalling channel: monetary policy

		conditional mean equation						conditional variance equation					
		(4) direction of monetary policy			(5) if change in next monetary policy meeting			(6) if change in last monetary policy meeting			(4) direction of monetary policy			(5) if change in next monetary policy meeting			(6) if change in last monetary policy meeting		
		H_0: leaning-against-wind H_1: leaning-with-wind			H_0: same direction H_1: opposite direction			H_0: leaning-with-wind H_1: leaning-against-wind			H_0: leaning-against-wind H_1: leaning-with-wind			H_0: same direction H_1: opposite direction			H_0: leaning-with-wind H_1: leaning-against-wind		
		coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*
A. US dollar - euro exchange rate																			
US oral intervention IO^{US}	H_0:	-0.048	*0.102*		-0.174 **	*0.071*		-0.109 *	*0.063*		0.026	*0.017*		0.058 *	*0.030*		0.054 ***	*0.021*	+
	H_1:	-0.071	*0.138*		-0.079	*0.064*		-0.128 *	*0.074*		0.000	*0.026*		-0.019	*0.047*		-0.027	*0.022*	
Ge/EA oral intervention $IO^{GE/EA}$	H_0:	0.165 **	*0.074*		0.153 *	*0.083*		0.270 ***	*0.092*		0.046	*0.032*		-0.187	*0.141*	+	0.079 **	*0.037*	+
	H_1:	0.414 **	*0.209*		0.241 ***	*0.082*		0.214 **	*0.086*		-0.041 *	*0.023*		0.001	*0.119*		-0.034	*0.023*	
US actual intervention IA^{US}	H_0:	-0.244	*0.578*		-0.348 ***	*0.107*		-1.156 ***	*0.296*	+	0.431 ***	*0.156*	+	0.064	*0.061*	+	0.349 ***	*0.107*	+
	H_1:	-0.562 *	*0.344*		-0.242	*0.226*		-0.082	*0.120*		0.043	*0.076*		0.328 ***	*0.078*		0.107 **	*0.048*	
Ge/EA actual intervention $IA^{GE/EA}$	H_0:	-0.446	*0.359*	+	1.608 ***	*0.315*		1.719 ***	*0.306*		0.920	*0.653*		0.588 ***	*0.127*		0.466 ***	*0.112*	+
	H_1:	2.881 ***	*0.500*		1.968	*2.594*		0.694	*2.659*		0.144	*0.316*		0.744	*0.594*		2.831 ***	*0.620*	
B. Yen - US dollar exchange rate																			
US oral intervention IO^{US}	H_0:	0.049	*0.178*		0.169 **	*0.072*		0.078	*0.072*	+	-0.069	*0.045*		-0.054 ***	*0.019*		-0.079 ***	*0.024*	+
	H_1:	0.218 **	*0.094*		0.127 *	*0.070*		0.270 ***	*0.094*		-0.074 **	*0.031*		-0.018	*0.027*		0.031	*0.023*	
Ja oral intervention IO^{Ja}	H_0:	-0.530	*0.566*		-0.158 **	*0.068*		-0.343 ***	*0.107*		0.258	*0.203*		-0.080 ***	*0.022*	+	0.039	*0.031*	+
	H_1:	0.089	*1.373*		-0.155 **	*0.075*		-0.155 **	*0.066*		0.258 ***	*0.100*		0.022	*0.024*		-0.077 ***	*0.021*	
US actual intervention IA^{US}	H_0:	0.079	*0.399*		0.165	*0.114*	+	1.042 ***	*0.163*	+	-0.103	*0.191*		0.107	*0.067*	+	0.757 ***	*0.096*	+
	H_1:	0.496	*0.364*		0.615 ***	*0.219*		0.179	*0.165*		-0.334 ***	*0.100*		0.607 ***	*0.066*		0.209 ***	*0.049*	
Ja actual intervention IA^{Ja}	H_0:	3.737 ***	*1.282*	+	-0.056 ***	*0.013*		-0.069	*0.066*		-2.472 ***	*0.716*	+	-0.002	*0.004*		0.185 ***	*0.019*	+
	H_1:	0.149	*0.101*		-0.121 **	*0.048*		-0.007	*0.275*		0.066 ***	*0.021*		0.018	*0.017*		-0.491 **	*0.207*	

Notes: ***,**,* indicate significance at the 99%, 95%, 90% levels, respectively. + indicates whether coefficients of H_0 and H_1 are significantly different from each other at the 90% level.

(4) Leaning-against-the-wind means that IO or IA occur in the opposite direction of current monetary policy trend, i.e. an intervention to strengthen the domestic currency during an easing cycle or an intervention to weaken it during a tightening cycle. Leaning-with-the-wind implies the opposite.

(5) "Same direction" means that IO or IA occur in the same direction of the change in the next monetary policy meeting, i.e. an intervention to strengthen the domestic currency when the central bank will raise interest rates in the next meeting or an intervention to weaken it when the central bank will lower interest rates. "Opposite direction" implies the opposite.

(6) Leaning-against-the-wind means that IO or IA occur in the same direction of the change in the last monetary policy meeting, i.e. an intervention to strengthen the domestic currency when the central bank has raised interest rates in the last meeting or an intervention to weaken it when the central bank has lowered interest rates. Leaning-with-the-wind implies the opposite.

Table 8: Co-ordination of interventions

		conditional mean equation						conditional variance equation					
		(7) coordination with past IO or IA			(8) coordination with domestic IO - IA			(9) coordination with foreign IO - IA			(7) coordination with past IO or IA			(8) coordination with domestic IO - IA			(9) coordination with foreign IO - IA		
		H_0: coordination H_1: no coordination			H_0: coordination H_1: no coordination			H_0: coordination H_1: no coordination			H_0: coordination H_1: no coordination			H_0: coordination H_1: no coordination			H_0: coordination H_1: no coordination		
		coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*	coef.	*std.error*	*sig.*
A. US dollar - euro exchange rate																			
US oral intervention IO^{US}	H_0:	-0.130 *	*0.064*		-0.364 **	*0.164*	+	-0.369 **	*0.154*	+	0.014	*0.018*		0.255 ***	*0.064*	+	0.014	*0.075*	
	H_1:	-0.108	*0.067*		-0.089 *	*0.050*		-0.107 **	*0.054*		0.026	*0.046*		0.015	*0.013*		0.024	*0.022*	
Ge/EA oral intervention $IO^{GE/EA}$	H_0:	0.222 ***	*0.087*		0.575	*0.385*		0.118	*0.132*		-0.038	*0.025*	+	0.270 **	*0.129*	+	-0.023	*0.067*	
	H_1:	0.170 **	*0.080*		0.190 ***	*0.058*		0.191 ***	*0.072*		0.062	*0.043*		-0.012	*0.018*		-0.011	*0.023*	
US actual intervention IA^{US}	H_0:	-0.251	*0.256*		-0.172	*0.152*		-0.251 **	*0.123*	+	0.606 ***	*0.129*	+	0.172 **	*0.072*		0.186 ***	*0.053*	
	H_1:	-0.393 ***	*0.089*		-0.279	*0.224*		1.018	*0.757*		-0.097	*0.079*		0.271 ***	*0.080*		0.397 **	*0.191*	
Ge/EA actual intervention $IA^{GE/EA}$	H_0:	0.959	*0.746*		1.681 ***	*0.558*	+	1.885 **	*0.734*		0.461 ***	*0.221*		4.039	*5.009*		0.895 ***	*0.190*	+
	H_1:	1.780 ***	*0.359*		-0.016	*0.050*		1.167 ***	*0.436*		0.699 ***	*0.193*		0.339 **	*0.135*		0.346 *	*0.194*	
B. Yen - US dollar exchange rate																			
US oral intervention IO^{US}	H_0:	0.162 **	*0.076*		0.568 ***	*0.135*	+	0.109	*0.124*		-0.099 ***	*0.022*	+	0.120 **	*0.055*	+	-0.114 ***	*0.029*	+
	H_1:	0.126	*0.089*		0.109 *	*0.059*		0.170 ***	*0.061*		0.169 ***	*0.043*		-0.043 **	*0.017*		-0.023	*0.021*	
Ja oral intervention IO^{Ja}	H_0:	-0.234 ***	*0.075*	+	-0.231 ***	*0.080*		-0.245 ***	*0.089*		-0.087 ***	*0.021*	+	-0.110 ***	*0.028*	+	-0.093 ***	*0.033*	
	H_1:	-0.043	*0.078*		-0.105	*0.066*		-0.254 ***	*0.074*		0.126 ***	*0.037*		0.020	*0.023*		-0.069 **	*0.029*	
US actual intervention IA^{US}	H_0:	0.276	*0.304*		1.003 ***	*0.202*	+	1.596 ***	*0.367*	+	0.441 ***	*0.098*		0.527 ***	*0.099*	+	0.207	*0.164*	
	H_1:	0.296 ***	*0.116*		0.241	*0.186*		0.305 *	*0.168*		0.288 ***	*0.069*		0.032	*0.085*		0.303 ***	*0.051*	
Ja actual intervention IA^{Ja}	H_0:	0.120	*0.090*	+	-1.268 ***	*0.191*	+	-0.133 ***	*0.046*	+	0.231 ***	*0.098*		0.155	*0.143*		0.033 ***	*0.012*	+
	H_1:	-0.168 **	*0.086*		-0.099 ***	*0.022*		0.345	*0.268*		0.210 ***	*0.079*		-0.019 **	*0.008*		0.242 ***	*0.022*	

Notes: ***,**,* indicate significance at the 99%, 95%, 90% levels, respectively. + indicates whether coefficients of H_0 and H_1 are significantly different from each other at the 90% level.

(7) Co-ordinated intervention means that, in case of IO, IO is preceded by at least one other domestic IO in same direction in previous two weeks. In case of IA, it implies that IA is preceded by at least one other domestic IA in same direction in previous two weeks.

(8) Co-ordinated intervention means that, in case of IO, IO is preceded by at least one IA in same direction in previous two weeks. In case of IA, it implies that IA is preceded by at least one IO in same direction in previous two weeks.

(9) Co-ordinated intervention means that, in case of IO, IO is preceded by at least one IO in same exchange rate direction by foreign authority in previous two weeks; and analogously in case of IA.

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