DO INTERACTIONS BETWEEN POLITICAL AUTHORITIES AND CENTRAL BANKS INFLUENCE FX INTERVENTIONS? EVIDENCE FROM JAPAN

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Abstract

In the United States, Japan and the Euro Zone, FX interventions are institutionally decided by specific political authorities and implemented by central banks on their behalf. Bearing in mind that these specific political authorities and central banks might not necessarily pursue the same exchange rates objectives, the model proposed in this paper takes account explicitly of this institutional organisation to examine its effects on FX intervention activity. The empirical relevance of our theoretical model is assessed by developing a friction model on the Japanese experience between 1991 and 2004 which reveals how the magnitude of that country’s FX interventions is the outcome of the Japanese Ministry of Finance’s trade-off between attaining its own exchange rate target and one of the Bank of Japan’s.

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1 Introduction

The literature on determinants of foreign exchange (FX) interventions (Edison, 1993; Dominguez and Frankel, 1993; Almekinders and Eijffinger, 1996; Baillie and Osterberg, 1997; Sarno and Taylor, 2001 and Ito and Yabu, 2004) and studies focusing on the specific impact of these interventions on the exchange rate dynamic (Bonser-Neal and Tanner, 1996; Dominguez, 1998, 2003; Beine et al., 2002, 2003 and Beine and Laurent, 2003) generally consider that the FX intervention activity is exclusively the responsibility of central banks. This should be seen as a convenient simplification since, in several countries (e.g. the United States, Japan and the Euro Zone), FX interventions are rather decided by specific political authorities whereas central banks solely play the role of agent by implementing transactions orders in the FX market, remaining, however, totally independent to conduct the monetary policy.

An important characteristic of such institutional structure is that political authorities in charge of FX interventions and central banks do not necessarily share the same exchange rate objectives. The former, for political reasons, may be more concerned about encouraging economic growth on short-term horizons, while the latter may have objectives more in line with the general stance of their monetary policies and the necessity of achieving long term stability of prices. The fact that each institution faces losses if the exchange rate is inconsistent with their respective objectives, raises the question of knowing whether or not political authorities, as decision-taking institutions, are affected by central banks’ interests and, if so, how and to what extent.

The sensitiveness of political authorities to central banks’ losses potentially influences the occurrence and characteristics of FX interventions. Indeed, general features of political authorities’ optimal strategy of intervention are presumably different depending on the compatibility of their respective exchange rate targets. Should their objectives be compatible, a consensus between the two institutions on the measures to be adopted on the FX market may emerge, conducting to the use of large, frequent, internationally coordinated and highly visible interventions. On the contrary, if these objectives are incompatible, political authorities may be more reluctant to intervene. As indeed their actions may hurt central banks’ interests, political authorities would rather opt for small, infrequent, unilateral and weakly visible interventions.

Consequences of the institutional organisation underlying the FX activity are potentially deep. The aim of this paper is then to analyse how the intervention decision process is affected by interactions between political authorities in charge of the FX policy and central banks. Therefore, we extend the reaction function developed by Ito and Yabu (2004) by elaborating a theoretical model of interactions that we assess econometrically with a friction model for the Japanese interventions over the period 1991-2004. It allows explaining how the amount of currency bought or sold is endogenously decided on by the Japanese Ministry of Finance as the outcome of a trade-off between achieving its own objectives and the Bank of Japan’s.
The paper is organized as follows: section two presents the theoretical model of interaction between political authorities and central banks, the econometric approach is presented in section three, the fourth section contains the results of the empirical procedure while section five concludes.

2 The interaction model

2.1 Institutional aspects

Political organisation

In many countries, the monetary policy *stricto sensu* is in the hands of central banks while FX interventions are controlled by specific political authorities that order central banks to implement actual transactions (currency purchasing or selling operations) on the FX market.\(^1\) It is in particular the case in the United States where FX interventions are decided by the U.S. Treasury and implemented by the Federal Reserve Bank of New York (Fed).\(^2\) It is also the case in Japan, where the Bank of Japan (BoJ) only executes the orders of the Japanese Ministry of Finance which controls FX interventions.\(^3\) In the Euro Zone, agreements on the exchange rate system for the euro and general orientations of the FX policy are the responsibility of the Economic and Financial Affairs Council (ECOFIN).\(^4\) On this basis, interventions on the FX market are carried out by the European Central Bank (ECB) as the core of the European System of Central Banks. The statutes, however, impose a strong constraint on FX policy decisions as they should be fully consistent with the general stance of the ECB’s monetary policy and in particular with the price stability objective.\(^5\) So far, all ECB’s interventions have been carried out outside any agreement or general orientation from the ECOFIN as these «would only be drawn up under exceptional circumstances» as indicated by the European Council itself (Scheller, 2004). Nevertheless, the European institutional framework is similar to that of the United States and Japan.

An essential characteristic of the institutional structure described along the preceding lines is that the Ministry and the central bank do not necessarily have the same exchange rate targets elaborated from their respective objectives. For instance, the Ministry, for pure political and electoral arguments, may encourage export-oriented activities to boost economic growth. Objectives like these may be achieved

\(^1\)For simplicity we will refer to the «Ministry of Finance», the «Ministry» or just the «MoF» as being that political authority.

\(^2\)The Fed’s website (http://www.ny.frb.org/education/fx/role.html) indicates that: «The U.S. Treasury has the overall responsibility for managing the U.S. government’s foreign currency holdings. [...] If the Treasury feels that there is a need to weaken or strengthen the dollar, it instructs the Federal Reserve Bank of New York to intervene in the FX market as Treasury’s agent».

\(^3\)The BoJ’s website (http://www.boj.or.jp/en/about/basic/etc/faqkainy.htm) reports that: «In Japan, the Minister of Finance is legally authorized to conduct intervention [...] The Bank of Japan, as the agent of the Minister of Finance, executes foreign exchange intervention operations [...]».

\(^4\)The ECOFIN is composed of Economics and Finance Ministers of the European Union Member States. It is one of the configurations of the the European Union Council.

\(^5\)On the ECB’s website (http://www.ecb.int/ecb/orga/tasks/html/foreign-exchange.en.html) we find that: « [...] The ECOFIN Council can conclude formal agreements on an exchange rate system for the euro [and] can formulate general orientations for the [...] exchange rate policy. [...] Both these institutional procedures must, however, be without prejudice to the primary objective of maintaining price stability. [...] In the absence of formal agreements or general orientations, the [ECB] may decide, if and when needed, to conduct foreign exchange interventions». 

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by favoring the depreciation of the domestic currency. The central bank, on the other hand, consistently with the dynamic of economic fundamentals, may pursue aims more in line with the general stance of its monetary policy and the necessity of ensuring the long term stability of prices. Obviously, such a policy would be inconsistent with an excessive depreciation of the domestic currency. It clearly appears, then, that exchange rate targets of the Ministry and the central bank may be different, mainly because their objectives are elaborated over different time horizons.

The political organisation underlying the FX intervention activity just described involves two institutions that are obviously concerned with exchange rate issues. However, only the Ministry of Finance has the ultimate power of deciding corrective measures on the FX market. As exchange rate targets of these institutions may not be consistent, the critical question is whether or not the Ministry, as the decision-taking institution, takes the central bank’s objectives into account when elaborating its FX interventions. We discuss this point below.

**Interactions**

Several arguments justify that the Ministry of Finance is not indifferent to the central bank’s objectives giving, then, room for an analysis of their interactions. A first obvious reason is the gain in credibility that could be obtained by the Ministry if it could signal the market that its actions are backed by the central bank. Indeed, credibility may enhance the signal conveyed by an intervention improving, then, its effectiveness. It would certainly be hard for the Ministry to obtain that support if it acted without any consideration for the central bank’s interests. Another justification is the eventuality for the Ministry to see the effects of its interventions weakened by the central bank if they adopt inconsistent measures leading to an ineffective policy mix. This may occur, for instance, when the Ministry tries to depreciate the domestic currency if, at the same time, the central bank adopts restrictive monetary measures. In this case, the underlying argument is the necessity of achieving a minimal level of policy coordination between the Ministry and the central bank to enhance the effectiveness of interventions. A last argument one may think of, while extreme, is the commitment of the Ministry to preserve the central bank’s independence for the conduct of the monetary policy. Indeed, a too aggressive undervaluation policy may trigger inflation, that, eventually, will affect the central bank’s policy if its main objective is to maintain stability of prices. From these elements, then, it seems safe to assume that the Ministry of Finance takes care of the central bank’s objectives.

As long as the Ministry is actually concerned by the central bank’s interests, the degree of compatibility between their exchange rate targets is another important factor that ultimately may influence general features of FX interventions and makes the definition of the optimal level of intervention far from trivial. Targets may be thought as being compatible if currencies purchases or sales reduce the deviation of the

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6See Appendix A for a graphical intuition on the question of targets compatibility.
exchange rate with respect to the Ministry’s and the central bank’s target simultaneously. Therefore, as an effective intervention not only will improve the Ministry’s situation but also the central bank’s, there is an additional incentive for the Ministry to intervene. This may lead to the elaboration of strong measures in order to maximize interventions effectiveness. Consistently with the signalling framework (Mussa, 1981) and the portfolio balance channel (see Edison, 1993 for a comprehensive description), strong measures may take the form of large, frequent, internationally coordinated and highly visible interventions (Dominguez and Frankel, 1993; Dominguez, 1998; Beine et al., 2002, 2004). On the other hand, targets are incompatible if a purchase or sale of currency reduces the deviation of the exchange rate with respect to one of the targets and increases the deviation with respect to the other. In this case, the Ministry cannot improve its situation without damaging the central bank. In turn, it may be more reluctant to intervene or, at least, may try to minimize the impact of its FX operations by using small, infrequent and unilateral interventions to preserve the central bank. The incompatibility of objectives of the Ministry and the central bank may also trigger the use of secret interventions, as evoked by Dominguez and Frankel (1993) and Chiu (2003). In particular, Beine and Bernal (2006) empirically show that the use of secret interventions tend to be more frequent when interventions are designed to move the exchange rate away from the fundamental rate, consistently with the theoretical framework of Vitale (1999).

In the following sections, we formally examine how the Ministry takes its intervention decisions and in particular how the amount of interventions is endogenously decided on as the outcome of its interactions with the central bank in a context where their exchange rate targets may be different and incompatible.

### 2.2 Interventions in an interaction framework

**Loss functions**

We elaborate an interaction model for an economy where interventions on the FX market are decided by the Ministry of Finance and just implemented by the central bank. That is, the central bank acting solely as Ministry’s agent in the conduct of the FX policy. However, it remains completely independent to conduct the monetary policy. This is totally consistent with the framework described in the previous section. We consider that both the Ministry and the central bank will face losses if the exchange rate level \( s_t \) is deviated with respect to their exchange rate targets (respectively denoted by \( \bar{s}_t^{mf} \) and \( \bar{s}_t^{cb} \)) that are known by both institutions.\(^7\)

To take into account these elements, consistently with general models of interaction (see Brock and Durlauf, 2001), our modelization strategy is based on the incorporation of the central bank’s losses into the Ministry’s total loss function and to minimize it under an exchange rate dynamic constraint. To formalize this process we start from a traditional quadratic loss function for both the central bank

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\(^7\)Note that all exchange rates are taken in log and indicate the domestic price of the foreign currency.
and the Ministry of Finance. Equations (1) and (2) respectively represent the central bank’s and the Ministry of Finance’s expected losses that depend upon $\Omega_{t-1}$ which is the information set available to both institutions and market participants at the end of date $t - 1$.

$$E_{t-1}[L^b_t|\Omega_{t-1}] = E_{t-1}[(s_t - \bar{s}^b_t)^2|\Omega_{t-1}]$$  \hspace{1cm} (1)

$$E_{t-1}[L^{mof}_t|\Omega_{t-1}] = E_{t-1}[(1 - \alpha)(s_t - \bar{s}^{mof}_t)^2 + \alpha L^b_t|\Omega_{t-1}]$$  \hspace{1cm} (2)

The central bank’s loss increases more than proportionally with both positive and negative deviations of the exchange rate with respect to $\bar{s}^b_t$. While, according to our modelization strategy, the Ministry of Finance’s expected loss, is actually the sum of two terms. The first term, $(1 - \alpha)(s_t - \bar{s}^{mof}_t)^2$, symmetrically rises with positive and negative deviations of the current exchange rate with respect to the Ministry’s target. The second term, $\alpha L^b_t$, is just the central bank’s loss. The interaction parameter $\alpha$ is the weight given by the Ministry to the central bank’s losses relatively to deviations with respect to its own target. The form of the Ministry’s loss function implies that as long as $\alpha > 0$, its losses can be positive even if $s_t = \bar{s}^{mof}_t$ as long as $\bar{s}^{mof}_t \neq \bar{s}^b_t$. That is, an increase of the central bank’s losses affects the Ministry’s total losses. This, eventually, will impact the Ministry’s interventions decisions. We show this point below.

**Exchange rate dynamics**

As in Ito and Yabu (2004), we assume the authorities to believe that the exchange rate is driven by a random walk. If an intervention is decided at time $t$, it contemporaneously affects the exchange rate. The process is described by equation (3), where $\varphi$ captures the impact of an intervention on the exchange rate and $\epsilon_t$ is a white noise. $I_t > 0$ (resp. $I_t < 0$) is a domestic currency purchasing (resp. selling) operation. An intervention of either sign will be effective if $\varphi < 0$.

$$s_t = s_{t-1} + \varphi I_t + \epsilon_t$$  \hspace{1cm} (3)

Equation (3) supposes that the impact of an intervention on the exchange rate is proportional to the amount of the intervention. This is consistent with the portfolio balance approach but may not necessarily apply to the signalling framework. However, as the focus of our analysis is on how the size of

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8A justification for the symmetry of the central bank’s loss function is the adoption by monetary authorities of an inflation targeting strategy (on this point, see Walsh, 2003). An excessive undervaluation (resp. overvaluation) of the domestic currency with respect to $\bar{s}^b_t$ may, indeed, trigger inflation (resp. deflation) and justify corrective measures.

9At first sight, that the Ministry cares about undervaluations as much as about overvaluations with respect to $\bar{s}^{mof}_t$ might be misleading. If its objective is just to depreciate the domestic currency consistently with some political objectives. Nevertheless, this symmetry is justified by the fact that, by not controlling the depreciation of its currency, a country raises the risk of seeing the net benefits of the depreciation to be fully canceled by an increase of the price of imported goods. This is fully in line with the so-called Marshall-Lerner condition (for details, see Sarno and Taylor, 2002).
an intervention is decided and not directly on the nature of the information transmitted to the market, the random walk specification is convenient. Other approaches to the exchange rate dynamic may have been considered. In particular, Almekinders and Eijffinger (1996) use a GARCH specification to take into account the fact that interventions have an influence on both the exchange rate level and volatility. Implementing this idea would require finding an appropriate measure of the volatility target. Baillie and Osterberg (1997) consider the average conditional variance as a potential candidate for such a measure. Nevertheless, in our framework, as our focus is on differences existing between the Ministry and the central bank and, as it is not clear why they should have different volatility targets, we prefer to exclude the volatility issue. An alternative way of describing the exchange rate dynamic is proposed by Kearns and Rigobon (2004) who base their approach on a generalized version of the uncovered interest parity relation which is a convenient way to introduce expectations of market participants. Such a modelization complication is necessary to evaluate effectiveness of interventions which is beyond the scope of our work.

Optimal intervention

Minimizing losses constrained by the assumed exchange rate dynamic yields equation (4) which is the Ministry of Finance’s reaction function where $I^*_t$ is the optimal amount of intervention.

$$I^*_t = -\frac{(1-\alpha)(s_{t-1} - \bar{s}_t^{mof})}{\varphi} - \frac{\alpha(s_{t-1} - \bar{s}_t^{cb})}{\varphi}$$

Equation (4) describes how the Ministry of Finance reacts to combined deviations of the exchange rate with respect to its own and the central bank’s target. It predicts that large deviations from targets induce large interventions and this is particularly consistent with the portfolio balance approach.\textsuperscript{10} Furthermore, our solution generalizes the reaction function of the model without interactions obtained by Ito and Yabu (2004) which can be recovered by fixing $\alpha = 0$.\textsuperscript{11} This clearly appears by noticing that in our model of interaction, interventions can occur even if the exchange rate is not different from the Ministry’s target (i.e. $s_{t-1} = \bar{s}_t^{mof}$) as long as it is different from the central bank’s (i.e. $s_{t-1} \neq \bar{s}_t^{cb}$). This was not the case in the framework without interactions where no intervention could occur as long as the exchange rate was consistent with the Ministry’s target.

Interpreting appropriately equation (4) requires discussing the case where the Ministry’s and central bank’s target are compatible and the case where they are not. If targets are compatible, a situation that may arise is that the exchange rate is undervalued with respect to both targets (i.e. $s_{t-1} > \bar{s}_t^{mof} > \bar{s}_t^{cb}$). In that case, as $s_{t-1} - \bar{s}_t^{mof} > 0$ and $s_{t-1} - \bar{s}_t^{cb} > 0$, equation (4) predicts corrective currency purchases. Moreover, as long as $\alpha > 0$, these purchases are larger than in the case where no interactions are

\textsuperscript{10}Assuming that the size of an intervention constitutes by itself a share of the information provided to the market makes equation (4) also consistent with the signalling channel theory.

\textsuperscript{11}Imposing $\alpha = 0$ is equivalent to assume the Ministry to be indifferent to the central bank’s objectives. In both cases, the interaction parameter is eliminated.
considered because the Ministry has an additional incentive to intervene as its actions not only will improve its situation but also the central bank’s. On the other hand, if targets are incompatible, we may encounter a situation where the exchange rate is overvalued with respect to the Ministry’s target and undervalued with respect to the central bank’s target (i.e. \( \pi_{t}^{mof} > s_{t-1} > \pi_{t}^{cb} \)). In this case, while \( s_{t-1} - \pi_{t}^{mof} < 0 \) requires currency sales, \( s_{t-1} - \pi_{t}^{cb} > 0 \) calls for currency purchases. Then, the sign and magnitude of the intervention will depend on the trade-off between the achievement of its own target and the central bank’s faced by the Ministry of Finance.

An important feature of equation (4) is that it implicitly supposes that there are no costs related to interventions. \( I^{*} \) corresponds, then, to the shadow intervention level, that is, the level of intervention that would be decided on by the Ministry of Finance if it was not reluctant to intervene on a continuous basis. This, however, is not the case as actual interventions only occur if benefits of interventions are larger than related costs. While benefits associated to an intervention are basically the opportunity of correcting an inappropriate exchange rate dynamic, costs are of diverse types. They have been discussed by Almekinders (1995) who broadly distinguishes pure bureaucratic costs (i.e. related to the decision process itself) and financial costs (i.e. related to the loss that could occur if a currency purchase (resp. sale) was not followed by an actual currency appreciation (resp. depreciation)). Credibility losses induced by an ineffective intervention may also been taken into account as the responsible authority may not be indifferent to loosing its credibility in the eyes of the market or its foreign counterparts for not being able to correct an undesirable currency dynamic.

Reluctancy of authorities to intervene is a stylized fact characterising the intervention activity on FX markets. Indeed, during the period 1985-1995, the U.S. and Germany respectively intervened on 7.5% and 9.1% of trading days on the DM/USD market. After 1995 and in particular since the introduction of the euro in 1999, the U.S. only intervened once on the EUR/USD market on September 2000. Still on the EUR/USD market the ECB only intervened on 4 occasions to support the euro. Finally, on the YEN/USD market, while the U.S. were present only during the period 1991-1998 on barely 1.2% of trading days, Japanese authorities stepped into the market on about 10% of trading days between 1991 and 2004 where they stopped their interventions. This last observation should, however, be nuanced for the very end of the period, as, between 2003 and 2004, the Japanese Ministry of Finance intervened on about 40% of trading days.

3 The econometric approach

3.1 A friction model of FX interventions

The linear econometric model implied by the optimal solution in equation (4) takes the form of equation (5) where \( I_{t} \) is the amount of actual interventions, \( X_{t} \) is the percent deviation of the exchange rate with
respect to the Ministry’s target (i.e. \(100 \times (s_{t-1} - s^m_{t-1})\)), \(Z_t\) is the percent deviation of the exchange rate with respect to the central bank’s target (i.e. \(100 \times (s_{t-1} - s^b_{t-1})\)), \(\beta_1\) and \(\beta_2\) are their respective coefficients as defined in equation (4), \(\beta_0\) is a constant and \(\nu_t \sim N(0, \sigma^2)\) is a random error term.

\[
I_t = \beta_0 + \beta_1 X_t + \beta_2 Z_t + \nu_t
\]  

(5)

Equation (5) can be directly estimated by OLS (Ito, 2003). However, because of the usual large proportion of days of no-intervention with respect to days where interventions were conducted, the estimation of equation (5) by OLS techniques would provide inconsistent and biased toward zero estimates. Two main econometric techniques have therefore been proposed to cope with this issue. Almekinders and Eijffinger (1996) use a friction model to analyse U.S. interventions on the DM/USD and YEN/USD markets and German interventions on the DM/USD market between February 1987 and October 1989. Ito and Yabu (2004) make an ordered probit analysis of Japanese interventions on the YEN/USD market from April 1991 to December 2002. Both techniques are well suited to analyse the FX intervention activity as they allow the estimation of a no-intervention band that traduces implicit costs related to interventions. However, as the dependent variable in the ordered probit approach is an indicator function, we opted for a friction model that not only explains when interventions occur but also their magnitude.

Friction models belong to the censored regressions models family. They were first introduced by Rosett (1959) who presented them as a generalisation of the two-limit tobit model. The particularity of these models is that they modelize a process characterized by a dependent variable only responding to large variations of the exogenous variables.\(^{12}\) In other words, there is a mass point at particular limiting values of the exogenous variables that determine a no-effect band. For a discussion of the technical aspects of friction models see Maddala (1983), while, a presentation of the economic relevance of these models to the study of FX interventions can be found in Neely (2005a,b).

Equation (6) constitutes the econometric model estimated in this paper by the maximum likelihood method.\(^{13}\) \(I_t, \beta_1, \beta_2, X_t\) and \(Z_t\) are defined as previously. \(\Theta_1 < 0\) and \(\Theta_2 > 0\) replace the constant of equation (5) and respectively correspond to the lower and upper limiting values determining the no-intervention band. Finally, \(\eta_t \sim N(0, \sigma^2)\) is a random error term.

\[
I_t = \begin{cases} 
I^*_t - \Theta_1 + \eta_t = \beta_1 X_t + \beta_2 Z_t - \Theta_1 + \eta_t & \text{if } I^*_t < \Theta_1 \\
0 & \text{if } \Theta_1 \leq I^*_t \leq \Theta_2 \\
I^*_t - \Theta_2 + \eta_t = \beta_1 X_t + \beta_2 Z_t - \Theta_2 + \eta_t & \text{if } \Theta_2 < I^*_t 
\end{cases}
\]  

(6)

The friction model of equation (6) clearly depicts that actual interventions only occur when the shadow intervention level reaches the thresholds \(\Theta_1\) or \(\Theta_2\). These thresholds, then, determine the no-

\(^{12}\)See Figure 3 in Appendix B for an illustration.

\(^{13}\)See Appendix C for the likelihood function.
intervention band the width of which traduces the reluctance of authorities to intervene arising from the existence of costs related to interventions.

### 3.2 The data

**Interventions and daily exchange rate**

The dependent variable of the friction model (denoted $I_t$ in equation (6)) is built using Japanese interventions amounts on the YEN/USD market from April 1991 to March 2004. Positive values indicate yen purchases while negative ones correspond to yen sales. Daily data on Japanese interventions (i.e. precise dates of interventions, currencies involved and transactions amounts) are publicly available from the Japanese Ministry of Finance website.\(^{14}\) As shown in Table 1, the Japanese case is particularly interesting because of the huge variability both in frequency and intensity of their intervention policy.\(^{15}\)

Daily exchange rate measures used in this paper (denoted by $s_t$ in variables $X_t$ and $Z_t$ of equation (6)) were gathered from the U.S. Federal Reserve website and are noon buying rates in New York.\(^{16}\) The quotation time is convenient as it ensures that an intervention occurs after the record of the rate. The rate may, then, be safely used as a determinant of interventions as long as authorities operate during Japanese business hours which is consistent with the evidence provided by Dominguez (2004).

**Ministry of Finance target**

Ito (2003) documented that all Japanese sales (resp. purchases) on the YEN/USD market were carried out below (resp. above) 125 yens per dollar from 1991 to March 2001. This rate is not simply the result of an empirical observation from Ito (2003). By examining news reports obtained through the Factiva

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\(^{14}\)http://www.mof.go.jp/english/elc021.htm

\(^{15}\)E. Sakakibara was the Director General of the International Finance Bureau in charge of the exchange rate policy at the Japanese Ministry of Finance. He was known to have adopted a policy of sporadic and massive interventions and originated the structural break in the Japanese FX policy suggested by the data.

\(^{16}\)http://www.federalreserve.gov/releases/h10/Hist/
database, we found news emanating from both Japanese officials and market participants indicating that the level of 125 yens per dollar is crucial to understand the Japanese FX policy for the period of interest.\textsuperscript{17} In 1991 and 1992, the yen was particularly weak against the dollar. This was a major concern for the G-7 countries that urged Japan to take measures to correct the situation and to push the yen at a level of about 125 yens per dollar. Japanese authorities reacted then to support the yen (from the 33 yen purchasing operations conducted by Japan in the period of interest, 27 occurred between 1991 and 1992). After that episode, interestingly, market’s perception of the Japanese FX policy did not change drastically. Even at the end of the period, market participants still perceive the level of 125 yens per dollar as being the so-called \textit{line in the sand} at which interventions occur.\textsuperscript{18} Therefore, assuming the exchange rate target of the Japanese Ministry of Finance to be at around 125 yens per dollar seems reasonable.\textsuperscript{19} Then, in variable $X_t$ in equation (6), $x_{t}^{\text{MoF}}$ denotes the log of 125 yens per dollar and this target rate is assumed to be constant all over the period analyzed in this study.

**Central bank target**

Due to the liquidity trap and deflation characterising the Japanese economy in the last years, the price stability issue may not be the major concern of the Bank of Japan the main objective of which is certainly to stimulate the economy by letting prices rise. Then, the exchange rate level consistent with the BoJ’s objectives may not be so different from the Ministry of Finance’s as FX policy measures designed to depreciate the yen against the dollar may enhance economic growth by boosting exportation activities. However, Fatum and Hutchinson (2004) show that the BoJ adopted monetary policy measures consisting on a rapid money base growth to help the economy in the early 2001 and that this explicit strategy was not influenced by MoF’s massive interventions in 2003 and 2004, that is, there are no elements indicating that the BoJ stopped sterilizing MoF’s interventions. Furthermore, the empirical evidence on Japan indicates that effectiveness of their interventions is limited to short horizons. Then, FX interventions and monetary measures are not perfect substitutes. This may explain why the BoJ preferred to fight deflation by using pure monetary instruments instead of currency depreciation (Fatum and Hutchinson, 2002, 2006).

Therefore, consistently to its long term objectives related to the fulfillment of an appropriate monetary policy and to the need of avoiding financial instability, we assume the Bank of Japan’s exchange rate target to correspond to the fundamental equilibrium rate.\textsuperscript{20} Several measures of this equilibrium rate are presented in the literature, the most common being the purchasing power parity (PPP) rate (see Sarno

\textsuperscript{17}Factiva grants access to news reports from a variety of sources like Reuters and Dow Jones. For more details, see http://www.factiva.com

\textsuperscript{18}See Appendix D for some examples of these news reports.

\textsuperscript{19}It should be noted that establishing a numeric exchange rate target for the Ministry of Finance is particularly difficult given that its communications on this issue are very infrequent. Then, despite there are strong arguments pleading for the use of the 125 yens per dollar rate as being that target, it should be seen, however, as a proxy.

\textsuperscript{20}This is consistent with the BoJ’s statutes (http://www.boj.or.jp/en/type/exp/about/expboj.htm).
and Taylor, 2002 for an introduction of this topic). In this paper, we opted for the fundamental rate developed by Bénassy-Quéré et al. (2004) who propose an estimated rate level consistent with a global equilibrium between the G-20 countries. $\pi^{eb}_t$ holds then for the log of Bénassy-Quéré et al. (2004)’s equilibrium rate in variable $Z_t$ of equation (6). Figure 1 depicts the evolution of the fundamental YEN/USD rate between 1991 and 2004. It clearly followed an appreciating path. This is fully consistent with the overall increase of the Japanese real trade balance during that period.\footnote{Statistics on the Japanese real trade balance are available on the BoJ’s website (http://www.boj.or.jp/en/theme/research/stat/bop/rei/index.htm).}

Figure 1: YEN/USD rate between 1991 and 2004, MoF’s and BoJ’s target

![Graph showing YEN/USD rate between 1991 and 2004]

Note: For the period from April 1991 to March 2004 on the YEN/USD market, the plain line denotes the Japanese Ministry of Finance’s target ($s^{mof}_t$), the dashed line is the Bank of Japan’s target ($s^{cb}_t$) and the doted line represents the annual average yen per dollar exchange rate ($s_t$).

Data partition

Interestingly, as illustrated in Figure 1, the Ministry of Finance’s target (the plain line) is not consistent with the fundamental equilibrium level estimated by Bénassy-Quéré et al. (2004) (the dashed line). This gives support to the discussion on divergences of exchange rate objectives of the Ministry and the central bank. More precisely, while, for roughly the first half of the sample, the Ministry’s and central bank’s targets were often compatible, for the second half they are not, especially at the very end of the period. Then, given that, according to the consumer price index, the Japanese economy entered in a phase of price deflation in 1997, the Ministry of Finance’s trade-off between achieving its own and central bank’s objectives became certainly tough at that moment.\footnote{Statistics on the Japanese consumer price index are available on the Japanese Ministry of International Affairs and Communications website (http://www.stat.go.jp/english/data/cpi/index.htm).} That all 128 interventions conducted between 2003 and 2004 were yen selling operations confirms this: the Japanese Ministry of Finance clearly tried to weaken the yen against the dollar despite it was already undervalued with respect...
to the fundamental equilibrium (Beine and Bernal, 2006 identify this as the major determinant of the use of secret interventions). Therefore, to have a precise idea of the Ministry of Finance’s behaviour in an interaction framework, along with estimations over the full period, we conducted separate estimations on 1991-1996 and 1997-2004 sub-periods respectively corresponding to a pre-deflation and a deflation episode for the Japanese economy.

4 Results

Maximum likelihood estimations of our model’s independent variables \( X_t \) and \( Z_t \), tolerance thresholds \( \Theta_1 \) and \( \Theta_2 \) and standard deviation of the random error term \( \sigma \) are reported in Table 2. To accurately assess the empirical relevance of our model, we conducted separate estimations of a pre-deflation and a deflation episode respectively corresponding to sub-periods 1991-1996 and 1997-2004 that are reported in «1991-1996» and «1997-2004». Estimates for the whole sample corresponding to period 1991-2004 are in «1991-2004». Moreover, specifications (1), (3) and (5) correspond to the estimation of a reaction function without interactions. These are introduced in specifications (2), (4) and (6). Finally, the estimated value of the structural parameters of the model and some diagnostic statistics are provided at the bottom of the table.

Estimates of the model with interactions reported in (2), (4) and (6) outperform all specifications without interactions in (1), (3) and (5) as shown by the likelihood ratio test. This supports the model of interaction proposed in this paper. Positive and negative thresholds, respectively denoted by \( \Theta_1 \) and \( \Theta_2 \), are highly significant for all specifications. They determine the no-intervention band traducing the authorities reluctance to intervene because of interventions related costs (Almekinders, 1995). Furthermore, \(|\Theta_1| > |\Theta_2|\) indicates that currency selling operations of Japanese authorities involved larger amounts than their yen purchasing operations. On the whole, our results are also characterized by a high level of significance of variables \( X_t \) and \( Z_t \) respectively indicating that the Japanese Ministry of Finance indeed reacts to deviations of the exchange rate with respect to its own and BoJ’s targets.

The full sample estimation reported in specification (6) suggests that deviations with respect to the Ministry of Finance’s target are fought (i.e. the coefficient of \( X_t \) is positive), while, deviations with respect to the

---

23 The massive use of secret interventions by Japanese authorities in the last years documented by Beine and Lecourt (2004) and Beine and Bernal (2006) (i.e. about 80% of official interventions between 2003 and 2004 were secret) raises the general question of how transparent is the Japanese exchange rate policy. This important point is addressed by Gnabo and Lecourt (2005) who analyse different concepts of transparency by defining appropriate indexes. Interestingly, their statistics robustly show a dramatic decrease of the transparency in the early 2003 for Japan.

24 We conducted an ADF and a KPSS test on variables \( I_t, X_t \) and \( Z_t \). While the first is clearly stationary, the last two are not. In a linear model, this would eventually cause inference troubles. However, given the non-linear structure of the friction model the potential problems, if any, caused by the non-stationarity are not so clear. Moreover, to the best of our knowledge, there exits no particular analysis of this issue for friction models. Solving this technical point is beyond the scope of this paper and we left it for a future work.

25 OLS estimates of the linear model described by equation (5) were used as trivial starting values for the maximum likelihood process. These results are not reported here for the sake of brevity.

26 The sign of \( X_t \) and \( Z_t \) coefficients is consistent with the OLS estimates, however, their magnitude is larger as OLS estimates are biased toward zero.
Table 2: Estimates of the friction model for Japanese interventions for the 1991-2004 period

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>$X_t$ (deviation w.r.t. Ministry’s target)</td>
<td>7.91***</td>
<td>3.83***</td>
<td>48.64***</td>
</tr>
<tr>
<td></td>
<td>(0.82)</td>
<td>(1.20)</td>
<td>(5.76)</td>
</tr>
<tr>
<td>$Z_t$ (deviation w.r.t. central bank’s target)</td>
<td>-</td>
<td>6.71***</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(1.74)</td>
<td>(12.04)</td>
<td>(1.46)</td>
</tr>
<tr>
<td>$\Theta_1$ (negative threshold)</td>
<td>-347.79***</td>
<td>-412.54***</td>
<td>-1420.50***</td>
</tr>
<tr>
<td></td>
<td>(26.70)</td>
<td>(35.00)</td>
<td>(113.36)</td>
</tr>
<tr>
<td>$\Theta_2$ (positive threshold)</td>
<td>327.69***</td>
<td>265.69***</td>
<td>2022.222***</td>
</tr>
<tr>
<td></td>
<td>(25.06)</td>
<td>(26.38)</td>
<td>(75.57)</td>
</tr>
<tr>
<td>$\sigma$ (standard deviation)</td>
<td>169.16***</td>
<td>170.03***</td>
<td>766.08***</td>
</tr>
<tr>
<td></td>
<td>(10.20)</td>
<td>(10.28)</td>
<td>(50.97)</td>
</tr>
<tr>
<td>$\alpha$ (interaction parameter)</td>
<td>-</td>
<td>0.64</td>
<td>-</td>
</tr>
<tr>
<td>$\phi$ (intervention impact parameter)</td>
<td>-0.12</td>
<td>-0.09</td>
<td>-0.02</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-1491.24</td>
<td>-1482.90</td>
<td>-1649.73</td>
</tr>
<tr>
<td>Likelihood ratio test</td>
<td>-</td>
<td>16.68***</td>
<td>-</td>
</tr>
<tr>
<td>Observations</td>
<td>1452</td>
<td>1452</td>
<td>1814</td>
</tr>
</tbody>
</table>

Note: Estimations were conducted over two sub-periods respectively corresponding to a pre-deflation episode («1991-1996») and a deflation episode («1997-2004») according to the Japanese consumer price index evolution. The Chow-type test proposed by Greene (2000) supports the data partition. Results for the whole sample are also provided («1991-2004»). (1), (3) and (5) are the estimates of the friction model without interactions. These are introduced in (2), (4) and (6). $\alpha < 0$ means that the estimated value of the parameter is negative meaning that the Ministry’s losses decrease when the central bank’s losses increase, a situation that may arise if targets are incompatible. This is equivalent to the economic assumption of perfect indifference of the Ministry to the central bank’s interests (i.e. $\alpha = 0$). Standard errors are reported between brackets and *** denotes significance at the 1% level. The estimation were obtained using Eric Dubois’ GROCER (c) econometric package for SCILAB (c) INRIA-ENPC (a powerful, free and open source matrix-oriented software).
equilibrium rate are encouraged (i.e. the coefficient of $Z_t$ is negative). These results are in line with a policy designed to maintain the yen depreciated with respect to the fundamental rate at a level of about 125 yens per dollar (consistently with Ito, 2003). Nevertheless, this supposes $\alpha = 0$, which is in contradiction with the intuition of the interaction model that the Ministry of Finance internalizes central bank’s losses. However, these results should be considered with great caution as the Chow-type test proposed by Greene (2000) suggests that the sample partitionment into a pre-deflation and a deflation episode is relevant. We examine this point in specifications (2) and (4).

Specification (2) contains the estimation of the interaction model for the 1991-1996 sub-period corresponding to the pre-deflation episode. The positive coefficient of $X_t$ shows that the Japanese Ministry of Finance positively reacts to deviations with respect to the 125 yens per dollar rate. More precisely, a one percent increase of $X_t$ induces a 3.83 billion yens purchase. Contrary to specification (6), the coefficient of $Z_t$ is positive and indicate that a one percent depreciation of the yen with respect to the fundamental equilibrium triggers a 6.71 billion yens purchase. For this sub-period, the intuition of the model of interaction is then supported. That is, the Ministry internalizes central bank’s losses conducting it to have an additional incentive to adopt corrective measures if targets are compatible (i.e. $X_t$ and $Z_t$ are of the same sign) and to be more reluctant to intervene when they are not (i.e. $X_t$ and $Z_t$ are of opposite signs). This is confirmed by $\alpha = 0.64$ that traduces the important weight given by the Ministry of Finance to deviations with respect to the fundamental rate rather than to the 125 yen per dollar rate, moderating, then, the view of Ito (2003).

Estimates for the 1997-2004 sub-period which refers to the deflation episode, are in specification (4). As $X_t$ and $Z_t$ coefficients are of opposite signs, we recover the interpretation of the full sample estimation. A one percent depreciation of the yen with respect to the Ministry of Finance’s target induces a purchase of 176.69 billion yens while a one percent depreciation of the yen with respect to the fundamental equilibrium causes a sale of 108.95 billion yens. The Japanese Ministry of Finance’s policy is, for this sub-period, clearly designed to maintain the yen at an undervalued level from the fundamental equilibrium. This supports Beine and Bernal (2006)’s finding on the arguments underlying the use of secret interventions. Furthermore, as $\alpha = 0$, the Ministry of Finance does not appear to be concerned by the central bank’s losses which contradicts the model of interaction. An interpretation of this result, suggested by the conjuncture of the Japanese economy at that particular time, is the priority given by the Ministry of Finance to stimulate the domestic economic activity through a weak yen policy.

27Mathematically, the estimated value of $\alpha$ is negative, which indicates that the Ministry’s losses decrease with central bank’s losses increases. This may arise when targets are incompatible as the Ministry cannot improve its situation without damaging the central bank. In our case, it is economically equivalent to assume the Ministry’s perfect indifference to the central bank’s interests, that is, $\alpha = 0$. 

5 Conclusion

In many countries, the FX intervention policy is in the hands of a particular political authority (i.e. the Ministry of Finance). Whereas the central bank solely plays the role of agent by implementing transactions orders in the FX market, it remains, however, totally independent to conduct the monetary policy. In this paper we describe a theoretical model of interaction between the Ministry of Finance and the central bank whose exchange rate objectives are not necessarily the same. While the Ministry of Finance’s policy is supposed to be related to the short run objective of stimulating the economy by artificially depreciating the domestic currency, the central bank’s objectives are thought to be more in line with the long term necessity of achieving stability of prices according to the general stance of its monetary policy. Our theoretical framework supposes that as long as the Ministry of Finance is not indifferent to the central bank’s objectives and when they can be conciliated, there is an additional incentive for the Ministry of Finance to adopt corrective measures. On the other hand, if these objectives cannot be conciliated, the Ministry will be more reluctant to intervene given that its policy will be the outcome of a trade-off between the achievement of its own and the central bank’s objectives.

To investigate the empirical relevance of the interaction framework, we define a friction model of intervention using the Japanese experience on the YEN/USD market for the period between 1991 and 2004. The Japanese Ministry of Finance’s exchange rate target is assumed to be 125 yens per dollar (consistently to the observation of Ito, 2003) and the Bank of Japan’s target is supposed to be the fundamental exchange rate equilibrium. We identify two sub-periods of interventions respectively corresponding to a pre-deflation (1991-1996) and a deflation episode (1997-2004). Results on the first sub-period support the intuition of the Ministry of Finance internalizing central bank’s losses and adapting its actions in accordance. On the other hand, estimations on the second episode do not confirm that behaviour. Instead, the Ministry of Finance’s policy is clearly oriented toward aggressively depreciating the yen with respect to the fundamental rate to stimulate the economic activity, supporting, then, the explanation of Beine and Bernal (2006) on the use of secret interventions at that time.

The model of interactions analysed in this work is limited to the case of domestic agencies (i.e. the Japanese Ministry of Finance and the Bank of Japan). This approach could be extended to incorporate interactions with foreign counterparts. While the exercise is theoretically obvious, empirically it is not. Determining appropriate exchange rate targets for each involved institution may not be possible, at least with currently available data. Nevertheless, this clearly constitutes an interesting topic for further research.
Appendix

A Compatibility and incompatibility of targets

Figure 2: Compatibility or incompatibility of exchange rate targets

Note: $s_t$ is the current exchange rate, $\overline{s}_t^{mof}$ and $\overline{s}_t^{cb}$ are the Ministry’s and central bank’s target respectively. The rates design the domestic price of foreign currency. Black arrows (resp. grey arrows) correspond to domestic currency operations designed to reduce the deviation of $s_t$ with respect to $\overline{s}_t^{mof}$ (resp. $\overline{s}_t^{cb}$).

Figure 2(a) illustrates the case where the exchange rate is undervalued with respect to the Ministry’s and central bank’s target. As the currency operation needed to reduce the deviation with respect to $\overline{s}_t^{mof}$ (i.e. a currency purchase represented by the black arrow) goes in the same direction than the one needed to decrease the deviation with respect to $\overline{s}_t^{cb}$ (i.e. a currency purchase represented by the grey arrow), targets are compatible. The case where targets are incompatible is represented by Figure 2(b) which illustrates a situation where the exchange rate is overvalued with respect to $\overline{s}_t^{mof}$ and undervalued with respect to $\overline{s}_t^{cb}$. Here, the operation needed to reduce the deviation with respect to $\overline{s}_t^{mof}$ (i.e. a currency sale represented by the black arrow) goes in the opposite direction than the one needed to reduce the deviation with respect to $\overline{s}_t^{cb}$ (i.e. a currency purchase represented by the grey arrow). Clearly, if targets are compatible, the Ministry’s actions can improve both its situation and the central bank’s, whereas, if incompatible, the Ministry is unable to improve its situation without damaging the objectives of the central bank.

B Graphical illustration of a friction model

Figure 3 illustrates the process modelized by the friction model estimated in this paper. The dependent variable only reacts to large changes of the independent variables. That is, actual interventions ($I_t$)
will occur only if the shadow intervention ($I_t^*$) reaches the limiting values $\Theta_1$ and $\Theta_2$ that define the no-intervention band. Economically, that means that actual interventions will occur only if benefits of intervening (e.g. the correction brought to the exchange rate dynamic) are larger than related costs (e.g. the bureaucratic cost of the decision process).

Figure 3: Process estimated by a friction model

Note: Actual interventions ($I_t$) only occur if the shadow intervention level ($I_t^*$) reaches $\Theta_1$ and $\Theta_2$.

C Likelihood function of the friction model

Equation (7) is the likelihood function of the friction model estimated in this paper. For a very clear introduction to the technical aspects related to the estimation of friction models, see Maddala (1983) and Neely (2005a,b). $\Theta = (\Theta_1 \Theta_2)'$ corresponds to the matrix of negative and positive thresholds defining the no-effect band, $\beta$ is a vector of parameters to be estimated, $y$ is the dependent variable vector, $x$ is the independent variables matrix, $\phi$ is the standard normal distribution density function, $\Phi$ is the standard normal distribution cumulative function and $\sigma$ is the standard deviation of the random error term.

\[
L(\Theta, \beta, \sigma | y, x) = \prod_{y_t < 0} \frac{1}{\sigma} \phi \left( \frac{y_t + \Theta_1 - x_t \beta}{\sigma} \right) \\
\times \prod_{y_t = 0} \left[ \Phi \left( \frac{\Theta_1 - x_t \beta}{\sigma} \right) - \Phi \left( \frac{\Theta_2 - x_t \beta}{\sigma} \right) \right] \\
\times \prod_{y_t > 0} \frac{1}{\sigma} \phi \left( \frac{y_t + \Theta_2 - x_t \beta}{\sigma} \right)
\]
D News reports sample

The sample of news reported in Table 3 were obtained using the Factiva database. The research was conducted using «Bank of Japan», «Ministry of Finance», «Finance Minister», «yen», «dollar», «target» and «objective» as keywords for every trading day between April 1991 to March 2004. They clearly illustrate the crucial role played by the 125 yen per dollar rate to understand the Japanese intervention strategy during the period of interest from the perspective of both the Japanese authorities and market participants.

Table 3: Sample of news reports

<table>
<thead>
<tr>
<th>Date</th>
<th>Source</th>
<th>Relevant text of the news report</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 February 1992</td>
<td>Tokyo Financial Wire</td>
<td>«A senior Ministry of Finance official suggested that a foreign exchange rate considered acceptable [...] was 124-125 yen/dollar»</td>
</tr>
<tr>
<td>6 March 1992</td>
<td>Reuters News</td>
<td>«Japan’s Finance Minister Tsutomu Hata [...] said that the Group of Seven would prefer a dollar rate of 124 to 125 yen»</td>
</tr>
<tr>
<td>17 December 1997</td>
<td>Reuters News</td>
<td>«[A senior banker] said the BOJ could push the dollar further to about 125 yen level»</td>
</tr>
<tr>
<td>20 May 2002</td>
<td>Market News Int.</td>
<td>«Traders appear ready to test the Bank of Japan’s and Ministry of Finance’s intervention line in the sand, seen somewhere near 125 yen»</td>
</tr>
</tbody>
</table>

Note: These news reports indicate the importance given by authorities and the market to the exchange rate level of 125 yens per dollar. This makes reasonable the use of that level to measure the Japanese Ministry of Finance’s target for the 1991-2004 period.
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