

Central Bank Intervention in the FX Market

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Plan of the talk

Outline of the lecture

- With monetary policy, central bank interventions in the FX markets is one of the traditional instruments used by central banks for stabilization purposes.
- Focus on direct purchases and sales of foreign currency carried out by monetary authorities.
- General overview of the use of direct central bank interventions in the FX markets.
- Some examples of questions raised in this course:
 - how do CBs intervene ? ,
 - how much do they purchase or sell ? ,
 - why to intervene ?
 - does it work ? Or is it counterproductive ? .

Plan of the talk

- II. The practice of central bank interventions and some stylized facts
- III. The research questions
- IV. The underlying theory
- V. Effectiveness of central bank interventions
- Objectives and reaction functions
- The evidence about the direct impact : levels, volatility, intradaily analysis
- Efficiency revisited : beyond the contemporaneous impact
- VI. Additional issues : the secret intervention puzzle and interventions in emerging markets
- Reading list

Part II. The practice of central bank interventions

definition of CBIs

- what is a central bank intervention (CBI) ? → needs some definition first of what is and what is **not** a CBI.
- Different types of interventions
- Some related concepts like sterilization and order flows
- Stylized facts for the major CBs
- Most of the talk illustrated on interventions of the **major CBs** (Fed, ECB, BoJ) and for **floating exchange rates** → Adjustable pegs not covered here (EMS, ...)

Definitions

definition of CBIs

- the topics: the use of direct central bank interventions in the foreign exchange markets
- What is direct central bank interventions (CBIs)?
- Direct purchases or sales of foreign currency made by the central bank **on the spot market** with the explicit **aim of influencing the dynamics** of the exchange rate.
- It excludes purchases or sales of currency for pure transaction purposes, for instances on behalf of the government (called passive interventions).
- It also excludes purchases or sales of currency for portfolio rebalancing (ex: China).
- → raises the issue of the motivations for interventions

definition of CBIs

- It also excludes interventions in the derivative (forward) market ; most major central banks report not to be involved in the forward market
- Some exceptions however
- Asiatic central banks such as the Bank of Thailand in 1997 to support the Baht;
- Bank of Mexico has written (=sold) put options in dollars to accumulate reserves.
- the Honk Kong Monetary Authorities have studied the possibility of using derivatives (Quarterly Bulletin, August, 2000)
- Basically : **CBIs=high-frequency spot foreign exchange activities for the sake of influencing exchange rate.**

Types of interventions

Types of interventions

- Interventions classified in different dimensions:
- Number of banks involved
- perception of the market
- Sterilization process
- size
- Frequency and data availability

Coordinated vs unilateral operations

- Coordinated operations : interventions conducted by two (or more) central banks the same day on the same market and in the same direction
- as opposed to **unilateral operations** : only one single bank involved in the transaction
- Most recent example : coordinated support of the ECB, the Federal reserve, the BoJ, the Bank of Canada, the BoJ of the Euro against the dollar on the 22nd of September 2000.
- very few examples of simultaneous interventions in opposite direction (Fed and BoJ in the early 90's)

Coordinated vs unilateral operations

Proportion of coordinated operations (%)

period	Fed (DEM)	Fed (YEN)	ECB (BB)	BoJ
85-87	72	-	26	-
85-91	44.6	-	42	-
91-95	12.5	33.3	14.2	4
95-now on	100	100	25	0.3

Coordinated vs unilateral operations

- 2 major agreements between the major CBs to foster coordination
- September 85 : Plaza Agreement : favours cooperation to induce depreciation of USD.
- February 1987 : Louvre Agreement : favors cooperation to smooth exchange rate volatility.
- These two agreements led to more cooperation, especially between the Fed and the Bundesbank
- After 91, the Fed became increasingly reluctant to intervene (see later on) but favoured coordination
- Coordination more costly but lead to more efficiency (see later on also)

Secret-official-reported

- Dimension: does the market know that the CB is in the market ?
- Several cases → several types
- Starts from **official data** : operations that actually took place
- Official data provided by the central banks (see later on)
- How to know whether market is aware or not ? Through news collected from newswire reports; e.g. Factiva database (www.factiva.com) → if clear report that perceived → **reported intervention** ;
- **if not secret intervention**

Classification by perception

	Market detects	Market does not detect	Market expects
intervention occurs	reported interv	secret interv	expected interv
intervention does not occur	false rumour	-	unrequited interv

Secret-official-reported

- Concept of **Unrequited interventions** introduced by Dominguez and Panthaki (2005) → measure of expectations from newswire reports (Reuters) in the preceding days
- Secret interventions : here restrictive definitions in the sense that interventions the CB wanted to be secret **and** undetected by the market
- Secret interventions : why ? → Secret intervention puzzle (see later on in additional puzzles)
- Cross-dependence: usually, coordinated intervention almost always reported (Beine and Lecourt, 2004).
- False rumours : numerous, especially in the YEN/USD market (Beine, Benassy and McDonald, 2006; Gnabo and Lecourt, 2005)

Sterilization

- Sterilized operations: purchases (sales) of foreign currency need to sterilize through sales (purchases) of bonds to banks in order to neutralize the impact on the monetary base
- if sterilized, instrument independent from monetary policy
- If not, interaction between exchange rate policy and monetary policy →

Sterilization

Monetary authorities' stylised balance sheet

Assets	Liabilities
<i>Net Foreign assets (NFA)</i> Gold Foreign exchange	<i>Monetary Base (M)</i> Currency in circulation Reserve liabilities to commercial banks
<i>Net domestic assets (NDA)</i> Government securities Loans others	<i>Net worth (NW)</i> spending surpluses net interests and capital gains

Sterilization

- remind that : $M = NFA + (NDA - NW) = NFA + DC$
- intervention involves purchase (sale) of foreign currency to a initial positive (negative) variation of net foreign assets ($\Delta NFA > 0$)
- For instance : BoJ purchases USD against Yens
- if intervention not sterilized \rightarrow equivalent increase in M .
 \rightarrow room for a **monetary channel of exchange rate policy**
- If sterilized, opposite sales or purchases of securities to commercial banks (e.g. BoJ sells government bonds to sterilize purchases of USD) : $\Delta DC = -\Delta NFA \rightarrow$
 $\Delta M = 0$. \rightarrow if impact of interventions, through other channel than the pure monetary channel.

Sterilization

- Neely (2001): most major CBs report to sterilize their interventions
- Small exception : BoJ over the recent period (2003-2004)
- Unclear why non sterilization (Fatum, Hutchinson, 2005). Related to the particular situation of Japan (liquidity trap)? Sales of yens to boost exports but also to increase the monetary base since the interest rates were almost at zero (liquidity trap).

reasons for sterilization

- In most major countries, CBIs undertaken by CBs but decided by governments → sterilization as a guarantee for **CB independence** in monetary policy → government does not influence the stance of monetary policy
- Allows to have separate instruments → illustration of the **Timbergen rule** : as many instruments as the number of policy goals.

Size

- Large-scale versus small-scale interventions
- Before 1995, size of interventions negligible wrt to market turnover
- Example : no Fed intervention $>$ 1 billion USD (compared to daily turnover of \pm 1 trillion USD)
- Break with the BoJ policy (Ito, 2003) : Sakakibara period : 1996-2002 with less frequent but large-scaled interventions
- Record : purchase of 2.8 trillion of yens (about 22 billions of USD) on April 9, 1998 by the BoJ
- As an example : coordinated intervention in september 2000: the Fed bought 2.4 (3) billions of Euros (USD)
- In general, perception that the usual size of interventions is small wrt to market turnover.

Operation process

- How to conduct a FX operation → requires some knowledge of the FX markets structure (see Lyons, 2001)
- Different types of agents
- **Customers** : give orders of sales and purchases of foreign currencies : firms, banks, ..., **central bank**
- usual procedure: orders proceeded by **dealers** of big commercial banks
- orders matched through
- direct trading among dealers : inter-dealers market

Operation process

- through **brokers** that facilitate the matching procedure
- recent tendency : Electronic Brokerage System (Reuters 2000-2 EB system) which tends to increase the market share (between 48% and 66% of transactions in 2001 (Bis, 2001)) .
- advantage of the broker system : anonymous quotes (Melvin and Wen, 2004) → important for **secret interventions** .
- In the usual procedure with direct trading, the CB can require that the operation remains secret or not → the commercial banks have strong incentives not to disclose the information if it is explicitly required.

Operation process: timing

- Each CB has its own network of commercial banks → usually domestic banks → tendency to operate on its own local markets and during the domestic opening business hours;
- Dominguez (1999) reports the timing of CBIs carried out by the Fed
: **Intradaily distribution of reported Fed interventions.**
- → the bulk of interventions is located between 7.00 and 15.00 EST → suggests that the Fed intervened using network of US commercial banks
- Exceptions : choosing the timing might be a **strategic issue** : BoJ intervened outside Japanese time to conceal interventions.

Operation process : timing

- Problem: the major CBs (Fed, ECB and BoJ) do not disclose (or did not keep) the exact timing (and the number of) their FX operations; the only available information is the **the date**
- Nevertheless, timing captured through the time stamps related to the **reported or perceived interventions** (Dominguez, 2003)
Time distributions of Fed reported interventions (GMT).
- Of course, also interventions outside the business hours (BoJ over the recent period).

Decision process

- Central bank intervention : misleading term. Why ?
- in most major countries, the decision is not taken by the central bank but **by the Ministry of Finance**
- In Japan: the BoJ is the agency of the government : decision of intervention taken by the Ministry of Finance
- In the US: Treasury also involved in the decision: the financial means are equally shared between the Fed and the treasury
- In Europe : the ECB de facto makes the decision but de jure, FX policy belongs to the Commission;
- → potential conflicts of interest between the institutions and problem of time inconsistency of interventions. → Bernal (2006) specifically studies the consequences for effectiveness.

Stylized facts

Historical perspective

- Before 1992, major CBs did not disclose daily amounts of interventions.
- → researchers had to use **proxies** to interventions
- One candidate : Daily or monthly changes in foreign exchange reserves → 2 main drawbacks
- Exchange rate policy carried out in almost real time : CBs react to up-to-date information (daily or even intradaily information)
- Neely (2000) shows that these are **bad proxies** of CBIs → plenty of reasons why reserves evolve over time.
- Move to more transparency : release of official data → Fed in 1993, BB in 1994 and BoJ in 2000 (history after 1991).

The data

- Data made available by the major CBs at different times and with different type of information;
- Official dates are often available but not always to external researchers
- Size not always disclosed
- Intradaily timing not always available or disclosed
- Table summary for major CBs

Data Sources

Bank	Data	Size	intra-daily	source
US Fed	1983-now	yes	no	FX reports
Bundesbank	1985-1998	yes	no	bilateral
ECB	1999-now	yes ^a	no	unclear
BoJ	1991-now	yes	no	web site
Bank of England	no	no	no	-
Bank of Canada	yes ^a	yes ^a	yes ^a	bilateral
Bank of Swiss	yes ^a	yes ^a	yes ^a	bilateral
Bank of Australia	1983-now	yes	no	bilateral

a:not available or not directly available to external researchers

Frequency of intervention

Number of official intervention days.

period	Fed (DEM)	Fed (YEN)	ECB (BB)	BoJ
85-87	22	22	62	36 ^a
85-91	199	170	250	169 ^b
91-95	16	21	14	175
96-onwards	1	1	4	168

^aReported interventions as official data are unavailable for this period

^bReported interventions as official data are unavailable for this period

Features from the data

- See graphs of the intervention activity of the 3 major central banks (purchases of USD);
- official interventions of the Fed;
- official interventions of the Bundesbank;
- official interventions of the BoJ;
- **Clustering behaviour of central bank activity** → succession of periods of heavy activity followed by quiet periods

Features identified from the data

- Clusters partly reflect costs of intervention
- also reflect persistence in determinants of central bank activity (misalignment, trends, volatility, ...): see later on;
- almost no instance of opposite trades by 2 central banks (exception BoJ and Fed early 90's) ;
- over the recent period, the BoJ makes the whole show → stopped on March 16, 2004.
- **increasing reluctance to intervene** for the Fed and the ECB: might be related to doubts about **effectiveness** . Are these doubts supported by the findings of the literature ?

Features identified from the data

- Size : for the Fed and the BB, small increase over time of interventions → in line with the increase of daily market turnover; → typical size remains modest wrt to daily turnover
- For the BoJ : change in regime in 1996 : inception of Sakakibara → less frequent interventions but with larger amounts
- Biggest amount : June 1998 more than 20 billion of USD.

Part III. Research questions

Effectiveness

- **Key question : effectiveness of the CBIs** . Does it work?
- CBIs involve important costs. Among others:
- Risk of financial losses on the operations
- Cost in terms of resources devoted to the conduct of the operations
- Cost in terms of credibility if it fails to deliver the desired effects

Effectiveness

- The effectiveness issue in turn raises the issue of
- **Defining effectiveness** ; what are the typical goals of the CBs ?
- **Identification of the effects** . What are the effects on the exchange rate dynamics ? How long does it last ? Are there collateral desired or undesired effects ? Are the effects similar across types of intervention ?
- What are **the main channels** through which CBs will affect the value of the exchange rate ? Does size matter ?

Motivation

- Another key question : what are the **determinants of interventions** ?
- Answers important in order to
- define effectiveness → allows to give evidence on the goals pursued by monetary authorities.
- solve the statistical issue of **simultaneity or reverse causality** : CBIs are supposed to have an effect on the dynamics of exchange rate but the evolution of exchange rate determine whether the CBs intervene or not.

Other issues

- **Secret intervention puzzle** . Why do some CBs (like the BoJ) prefer to intervene secretly ?
- **Interaction** between exchange rate and monetary policy: how does it influence the way intervention is conducted and/or its impact ?
- Interventions in the derivative market (not addressed here)

Part IV. Underlying theory

The question

- Key question : through which channel do CBIs influence the dynamics of exchange rate (if they do)?
- basically, 3 to 4 different channels
- Depends on whether interventions are sterilized or not.

Unsterilized interventions

- If interventions are not sterilized, purchases or sales of foreign currency lead to **changes in the relative money stocks and\ or relative interest rates** → affect the exchange rate
- the monetary model of determination of exchange rate states that the value of exchange rate depend on the differential in money growth, interest rates and outputs.
- For instance (BoJ) : purchase of USD → $\Delta+$ money growth wrt foreign money stock → depreciation of the yen.
- this channel is not operative for sterilized interventions → not to consider seriously in the empirical literature

Sterilized interventions

- One can start from the following exchange rate equation : $s_t = z_t + \delta[E_t(s_{t+1}|\Omega_t) - s_t]$ where z_t is the current fundamentals and Ω_t the information set.
- basically, two channels
- one influencing z_t : **portfolio-balance channel**
- One influencing future expected values of the exchange rate : **expectation or signalling channel**

Portfolio channel

- Sterilized interventions.
- one key condition: assets denominated in different currencies are imperfect substitutes
- Purchases of foreign currency will change the relative supply of domestic to foreign asset → **change in the relative value of the domestic currency** as traders will require a higher risk premium to hold the re-balanced portfolio

Portfolio channel

- Implications: in the short run, temporary rise of volatility until dealer inventories have fully absorbed the liquidity shock
- key condition: size of intervention should be significant wrt to market turnover. → Given usual size of operations (except maybe BoJ during Sakakibara period), size is very small wrt to market turnover → sheds doubts on the portfolio channel as the operative channel for major exchange markets

Portfolio channel

- Indirect evidence : Evans and Lyons (2001) : argue that when interventions are secret, their effects might be similar to private trades → support for the portfolio channel → allows to some quantification of the effects but under strong assumptions.
- Other interests: for emerging markets with low liquidity, portfolio channel might be operative (see Disyatat and Galati, 2005 on interventions of the Czech National Bank)

Signalling channel

- Also works for sterilized interventions
- Key condition : interventions should be perceived by market participants → does not work for secret interventions

- Introduced by Mussa (1981)

- Solving the previous equation gives :

$$s_t = \frac{1}{(1+\delta)} \sum_{j=0}^{\infty} \frac{\delta^j}{(1+\delta)^{j+1}} E_t(z_{t+j}) + \left(\frac{\delta}{(1+\delta)}\right)^{t+j+1} E_t(s_{t+j+1})$$

- δ : discount factor; s_t spot exchange rate; z_t : variables thought to influence exchange rate (interest rates, money stocks, ...); Ω_t : public information set at time t

Signalling channel

- By conveying some information about future values of z_t or s_t , interventions tend to affect s_t ;
- also called **expectation channel** : expectation based on future fundamentals (e.g. monetary policy) or not based on fundamentals
- Implications : if interventions are informative, they could lead
- to long-run variation in exchange rate volatility (to the extent that intervention affects $E_t(z_{t+j})$ persistently
- possibly negative effects on volatility (even though short run increase): decrease in uncertainty
- If message is unclear, this might lead to increase in volatility

Signalling channel

- In general, support for a signalling channel : Dominguez (1998)
- Direct test : to work on expectations and see if expected values are directly influenced by interventions
- First strand : using expected moments like implied volatility extracted from option data : Galati and Melick (1999), Bonser-Neal and Tanner (1996), Dominguez (1998), Beine(2002), Morel and Teileitche (2005)
- Second strand : using survey data (Beine, Bénassy and Mac Donald, 2005).

Variant of the signalling channel

- One variant : **coordination channel (Sarno and Taylor, 2001)** .
- Idea : period of large deviation of exchange rate from equilibrium value : period of bubbles of the like; periods in which trend following agents (chartists) have more weight than fundamentals-based agents (fundamentalists)
- In this period : public interventions can coordinate expectations of agents and draw their attention that the degree of misalignment is very high → change the expectations of agents and increase the proportion of fundamentalists.
- Using a Markov-switching model, Beine, De Grauwe and Grimaldi(2005) and Reitz and Taylor (2006) find support for that (see later on).

Microstructure theory

- Per se, microstructure theory does not identify a separate channel.
- → Defines the whole process by which central bank intervention might have an impact
- Central bank intervention = customer order given to dealers → increase in the order flow → potential portfolio balance effect
- If intervention is known : change in inter dealers transactions → signalling impact of interventions : use of central bank trades as a source of information → complement the initial portfolio balance effect.
- See Lyons(2001, ch.7) for more on this. See Vitale (1999) for an explicit framework based on the microstructure approach;

Part V : effectiveness of intervention policy

The impact of CBIs

Issues

- Different issues related to the impact
- Effectiveness of interventions → raises the issue of the traditional objectives (in theory and in practice).
- Direct impacts on the exchange rate dynamics : returns and volatility.
- Issue of how to measure the impact : approaches and measures

1. Objectives and reaction functions

Traditional objectives of CBIs

Dominguez (1998) summarizes 4 different objectives : 2 major ones and 2 minor ones;

- **Influencing the levels of exchange rate** : most frequent objectives of CBI's
- Ex: Recent period : BoJ aimed at depreciating the yen by purchasing dollars
- Recent concerted interventions on the Euro in 2000 : aimed at supporting the value of the Euro
- Post Plaza (1985) : concerted operations to drive the USD down to value more in line with fundamentals.
- EMS (adjustable pegs) → interventions to stabilize levels wrt to central parity (Brandner, Grech and Stix, 2000).

Traditional objectives of CBIs

- **Smoothing exchange rate volatility** ;
- Idea : reducing volatility on the ground that volatility means uncertainty in the market; uncertainty viewed as detrimental by some central banks;
- Examples : Bank of Canada in the 90's : automatic intervention rule : intervention if $\text{daily return} > |0.01|$ → explicit aim of smoothing exchange rate volatility
- Post Louvres (1987) : concerted operations to lower volatility which was considered excessive (exchange rate levels seen as in line with fundamentals).
- Decreasing volatility is often stated as the **official motivation** of recent intervention → official justification of the Fed wrt to the 2000 intervention on the Euro.

Objectives in terms of volatility

- one exception **The noise trading channel** (Hung, 1997);
- Idea : Increasing volatility might be desirable under some specific circumstances : depreciating currency ;
- → secret intervention to increase intervention and to restore a two-way bet for traders ; traders see that as endogenous to market and (re)consider the possibility of an appreciation.
- → Difficult to test in practice.

Other (minor) objectives

- Interventions to rebuild foreign exchange reserves after a period of intense intervention.
- Example : practice of the Reserve Bank of Australia in the 90's : see Kim et al. (2000) on this.
- Intervention on behalf of another central bank.
- example : intervention of the ECB in 1999 on behalf of the BoJ → recorded as a CBI of the BoJ (The BoJ asked the ECB's traders to proceed to purchases of USD)

Reaction functions

- The question of objectives in practice → issue of the determinants of interventions → reaction functions
- One of the first paper : Almekinders and Eijffinger (1994) : $| I_t | = | I_t^* | + c_1$; I_t^* : shadow value of intervention
- $I_t^* = b_0 + b_1 f(s_t) + b_2 \sigma_{t-i}^2 + \epsilon_t$
- c_1 reflects fixed costs of conducting some intervention : $I_t \neq 0$ only if $| I_t^* | > c_1$, 0 otherwise;
- Fixed costs : costs of conducting some interventions due to implementing trading desks, costs related to potential losses, cost in terms of credibility and coordination costs → in line with the coordination channel.
- → intervention less frequent than implied by the pure determinants (shadow intervention) → friction model

$f(s_t)$?

- $f(s_t)$? $\rightarrow (s_t - \bar{s}_t)$, \bar{s}_t being (the log of) an average of s_t over some recent period (7, 30 or 100 days)
- $s_t - \bar{s}_t$ captures deviation from recent trend \rightarrow leaning against (with) the wind policy
- intervention when there has been a depreciating (appreciating) trend \rightarrow characterizes very often the behavior of the major central banks : Bundesbank and Fed (Almekinders and Eijffinger, 1994), BoJ (Ito, 2002; Ito and Yabu, 2004;) : reaction to past trend \rightarrow might explain the poor effectiveness of such an instrument.
- Extension : monetary authorities have different targets depending of horizon (definition of the trend) \rightarrow Frenkel, Pierzoch and Stadtmann (2004) using Bank of Swiss data : 3 different targets : long run , medium run (25 days) and short run (1 day)

$f(s_t)$: misalignment

- $f(s_t)$? $\rightarrow (s_t - s_t^f), s_t^f$ being (the log of) the fundamental equilibrium exchange rate \rightarrow goal : reducing misalignement
- issue : s_t^f is unobserved \rightarrow very often PPP value as a proxy for equilibrium value
- for the Bank of Swiss, Frenkel, Pierzoch and Stadtmann (2004) show evidence that long run goal was to bring Swiss Frank closer to PPP

$f(s_t)$: CB target

- Does the CB always target s_t^f ? → **no**
- Case of BoJ : s_t^T definitely different from s_t^f (regardless the issue of measurement of s_t^f)
- Ito (2003): s_t^T close to 125 yens /USD
- s_t^f in the range of 100 yens (Benassy et al., 2004)
- Bernal (2006) : one explanation of the discrepancy is that the decision is taken by the Ministry of finance
- Issue : the CBs do not often reveal s_t^T (see also Vitale (1999) on that).

Reaction to (past) volatility (σ_{t-i}^2)

- Related issue : how to measure exchange rate volatility? → see later on
- Mixed results : unclear whether major Banks react to past volatility : Baillie and Osterberg (1997) : no using a GARCH approach; Beine et al. (2002) : yes using a FIGARCH approach;
- Results different across CBs, across measures and over time.
- methodological issue : generated regressors : σ_{t-i}^2 is not observed but estimated.

Reaction to (past) volatility

- Another issue : what kind of volatility to take into account
- Past volatility or expected volatility ?
- If monetary authorities are forward looking, use of expected volatility
- Desirable extension since most of the analysis use past estimated volatilities. → see later on for estimating expected volatility.

2. Direct impact of interventions

Starting point

- Starting point of the literature : Dominguez (1998)
- Investigation in **a classical econometric framework.**
- Analyse the **daily** impact of interventions on the two first moments
- Typical model of analysis :
- Impact on first moment $r_t = \beta_0 + \sum_{i=1}^N \beta_i I_{i,t} + \epsilon_t$
- Impact on second moment:

$$\sigma_t^2 = \sigma_0 + f(\sigma_{t-1}^2, \epsilon_{t-1}) + \sum_{i=1}^N \gamma_i | I_{i,t} |$$

Impact on first moments (daily frequency)

Impact on first moment

- β_i : impact of intervention of type i on the daily return of exchange rate
- Criterion of effectiveness : does the intervention move the exchange rate in the desired direction : are the β_i 's > 0 ?
- Restrictive criterion but rules out arbitrary definition
- No distinction between unilateral and concerted operations : Baillie and Osterberg (1997), Dominguez (1998)
- Explicit distinction between unilateral and concerted operations : Beine, Laurent and Lecourt (2003) → solves collinearity problems (correlations over 0.4 if no distinction between types of operations) .

Methodological issues

- Time quotations → make sure that CBIs occur before s_t is set
- How to define $I_{i,t}$? Amounts or dummies capturing CB's presence → dummies better because
 - capture signalling impacts of CBI's
 - involved amounts of interventions very modest wrt to market turnover (no room for portfolio effects)
- Issue also on the fact that total size refers to total daily purchase or sale → daily amounts splitted into some number of order flows → number might be varying and furthermore unknown.

Impact on first moment

- Results : very weak support in favor of effectiveness
- In general, most β_i 's are not different from zero
- When different from zero, β_i 's < 0 → counterproductive effects of interventions. Example : unilateral Bundesbank interventions found to be counterproductive (Beine et al., 2002);
- How to interpret these counterproductive results ? → **poor signalling effect** of interventions (ex: inconsistency with monetary policy)
- Another interpretation : if leaning against the wind → depreciation trend not reversed → associated negative impact even with no effect.

Issue: reversed causality

- Problems of **reversed causality** : the decision to intervene is not independent on the value of $r_t \rightarrow$ inconsistency of OLS estimates \rightarrow need to use other approaches than OLS to have more robust evidence
- Simple illustration from Neely (2005b)
- Suppose a two-dimension process for the change in exchange rate ΔS_t and intervention I_t with Gaussian errors :

$$\begin{pmatrix} 1 & -\beta \\ -\delta & 1 \end{pmatrix} \begin{pmatrix} \Delta S_t \\ I_t \end{pmatrix} = \begin{pmatrix} u_r \\ u_I \end{pmatrix} \quad (1)$$

Issue: reversed causality

- The reduced form is :

$$\begin{pmatrix} \Delta S_t \\ I_t \end{pmatrix} = \frac{1}{1 - \beta\delta} \begin{pmatrix} u_r + \beta u_I \\ u_I + \delta u_r \end{pmatrix} \quad (2)$$

- Now assume $\beta = 0$: intervention has no effect on exchange rates and $\sigma_{rl} = 0 \rightarrow$ correlation ρ between ΔS_t and I_t is : $\frac{\delta\sigma_r}{\sqrt{\delta^2\sigma_r^2 + \sigma_I^2}}$
- The conditional expectation of ΔS_t on I_t is : $E[\Delta S_t | I_t] = \rho \frac{\sigma_r}{\sigma_I} I_t \rightarrow$ **the OLS coefficient will capture the sign of the Intervention policy** .
- Example : if $\delta < 0$: leaning against the wind policy \rightarrow correlation and regression coefficient will be negative \rightarrow **conclusion in terms of lack of effectiveness although intervention is neutral.**

Issue: reversed causality

- Need to overcome this problem
- Natural idea : to find IV variables for I_t : variables correlated with interventions but not with $\Delta S_t \rightarrow$ challenge.
- Alternative : structural approaches \rightarrow 2 approaches with advantages and drawbacks : system estimation with identifying restrictions and system estimation with restriction identification (IV estimation)

First approach : Kearns and Rigobon

- One solution (Kearns and Rigobon, 2004) : estimating the full system with objectives of interventions and identification restrictions (change in intervention regimes) for 2 exchange rate market : YEN-USD and AUD-USD)
- 3 equations : exchange rate return as a function of I_t ; Shadow value of I_t (I_t^*) and I_t as a function of I_t^* through a friction model

First approach : Kearns and Rigobon

- 2 regimes with respect to (the frequency) and the size of interventions captured through change in the threshold of intervention → number of moment conditions multiplied by 2
- 10 moment conditions and 8 parameters → system identified
- → find that
- interventions of the BoJ or the Bk of Australia were effective in the sense that they move the exchange rate in the desired direction within the day
- interventions tend to lean against the wind, i.e. react to contemporaneous changes in the exchange rate
- Drawback : most of parameters are supposed to be the same in the two intervention regimes → at least for the BoJ, strong assumption : size matters for effectiveness

Second approach : Neely (2005)

- Structural VAR model with identification restriction
- $I_t = \delta_p r_{pm,t} + \delta_a r_{am,t} + A_1 X_t + u_{i,t}$ for $I_t \neq 0$;
- $r_{pm,t} = a_0 + A_0 X_t + u_{pm,t}$;
- $r_{am,t} = \rho r_{pm,t} + \beta I_t + a_2 + A_2 X_t + u_{pm,t}$
- Identification restriction is that macro news impacts contemporaneously the change in the exchange rate (A_0 and A_2 different from zero) but **not the decision to intervene** ($A_1 = 0$).
- → putting this restriction amounts to use macro news as instrument of interventions in the estimation of intervention reaction function.

Second approach : Neely (2005)

- → extends the model to a non linear framework with friction model for intervention → more complicated
- Main results : **identification method and nature of the model (linear or not) matters a lot** : for the linear model, evidence of zero impact of interventions and leaning against the wind; for the non linear model, identification method matters : effectiveness or even perverse effect
- Main conclusion : **identification method and specification** definitely matter

Issue: non linear effects (other types)

- Impacts on r_t might be conditional upon
- **Size** : Beine and Szafarz (2005) allows for different effects depending on the daily amount involved in BoJ interventions → more virtuous impact for large-scaled interventions after 1995 → signal might depend on size
- Explains why mixed results obtained for BoJ when not conditioning for size and that the findings seem to be sample-dependent.
- **Secrecy or not** expect less impact on r_t if unperceived
- **whether supported by communication policy** : more virtuous impact on r_t when concerted interventions are justified by official statements (Beine, Janssen, Lecourt, 2004) (see later on)

Impact on first moments (intra-daily frequency)

Extension: intra-daily frequency

- One drawback of previous work : interventions can have some very short-run effects → needs to look at intradaily effects of interventions
- The extension to intradaily frequency raises several additional issues :
- Accounting for intradaily seasonality (see later on volatility effects)
- Exact timings of interventions : not always available → 3 approaches

intra-daily frequency : real time data

- When available, use **exact timings of interventions (real time data)** : → Payne and Vitale (2004) for Bank of Swiss of interventions : find that interventions have a virtuous effect that last for about 15 to 30 minutes.
Drawback : relatively small market
- Payne and Vitale account for coordinated interventions : different notion : simultaneous interventions of the BB and the Fed : the bank of Swiss often follow BB and Fed
- Puzzle of Payne and Vitale (2004) : reaction of s_t **15 minutes before intervention** → explained by the fact that the SNB leant with the wind → strengthened an existing trend

intra-daily frequency : reports

- Use **timings of reported interventions** (Dominguez, 2004)(news extracted from Reuters) → also finds short-run effectiveness of Fed, BB and BoJ interventions over 1985-2000
- Significant impact on the returns with maximum impact within 1 to 2 hours; but for Fed interventions, mean reversion
- 2 drawbacks of reported interventions
- Ignore **secret interventions** → might ignore about 20 % of interventions; important for the BoJ interventions after 2000 (see later on)

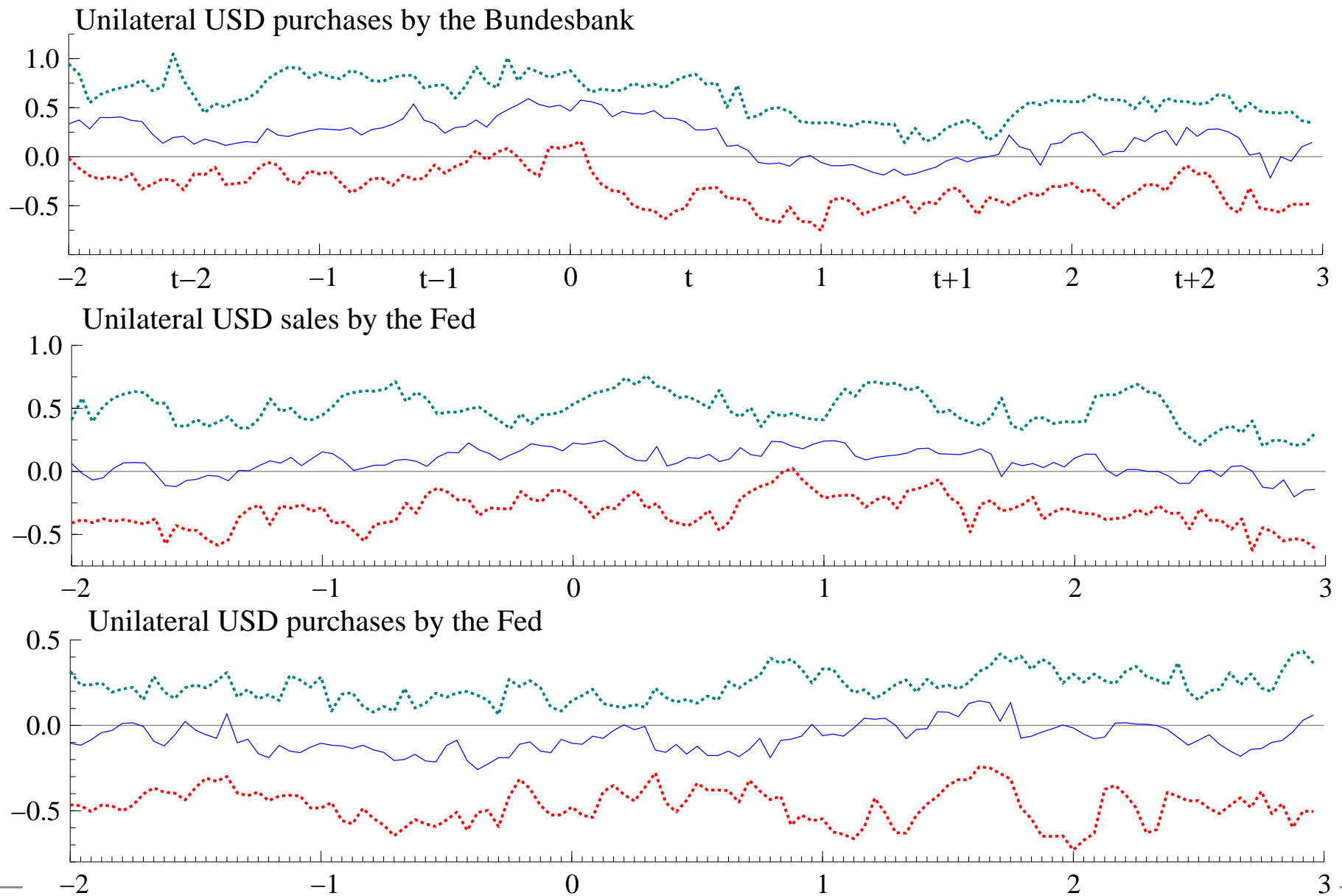
intra-daily frequency : reports

- The timing can be **misleading** : the used hour depends on the release time of the news → traders can keep information for strategic reasons → evidence that reaction **before** the news of intervention → unclear if it is due to traders' expectations or to wrong timing of news.
- Using the SNB data, Fischer (2005) shows that in the case of the timings of reports inconsistent with real time data:
- In general, reports capture first intervention but not always subsequent → **underestimation** of the number of actual transactions
- **Significant time differences** between first SNB intervention and first Reuters report → might be over 3 hours and **significant heterogeneity** across episodes

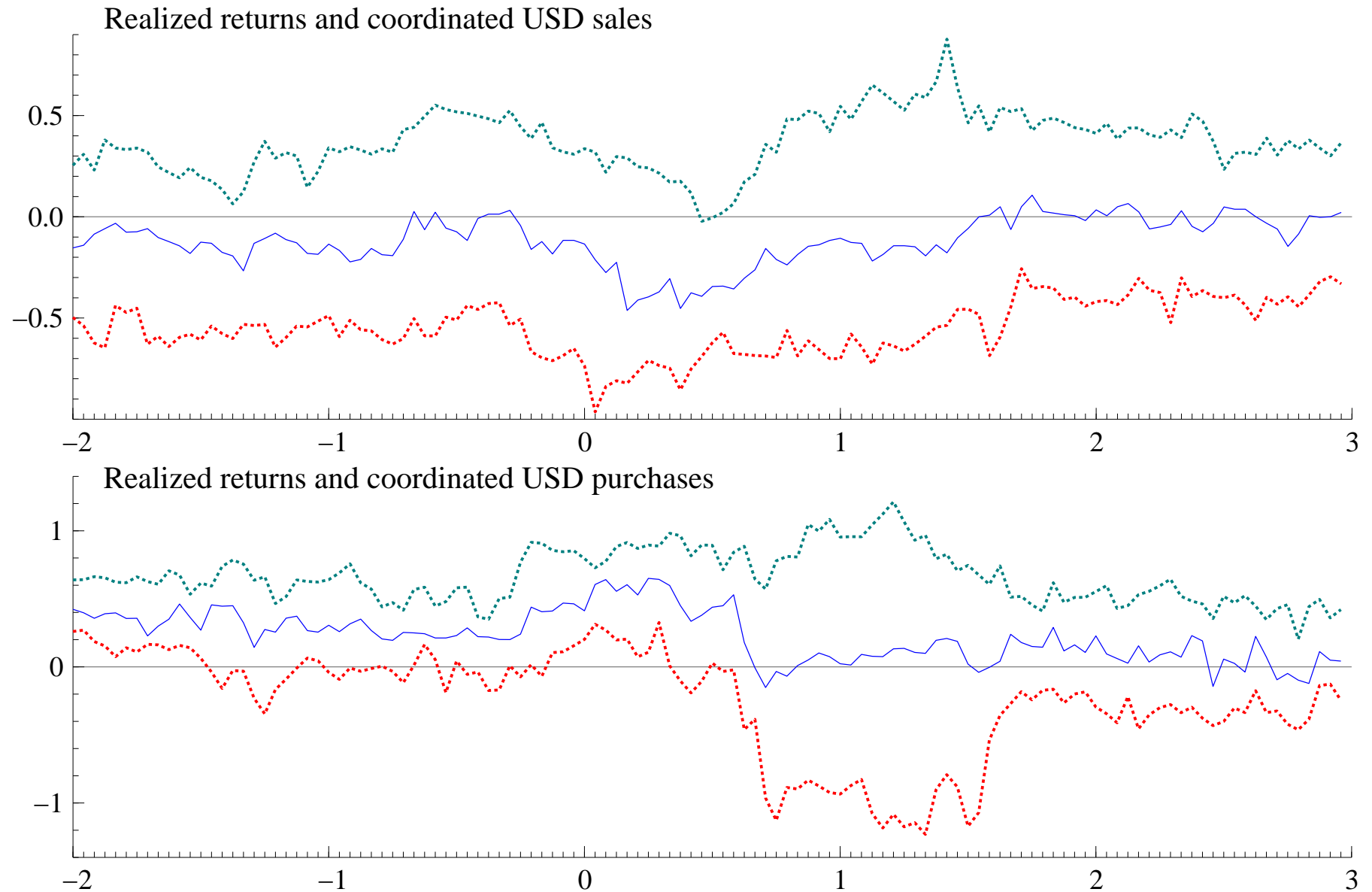
intra-daily frequency : agnostic

- **agnostic view** (Beine, Laurent, Palm, 2004): use 1-hour rolling windows on the days of interventions and look at the dynamics of moments over the full course of the day (boxplots)
- Look on the DEM-USD market over 1989-2003 period
- No clear dynamics of first moments, except weak virtuous effects of concerted interventions.
- Note : not totally agnostic : for coordinated interventions, timing most plausible during the overlap period (simultaneous opening of European and US markets)

Intradaily effects on returns



Intradaily effects on returns



Impact on second moment (daily frequency)

Impact on second moment

- Question : does intervention have some effect on market uncertainty γ_i : impact of intervention of type i on the volatility of exchange rate
- Issue : volatility is not observed \rightarrow has to be measured
- 2 categories : expected (ex ante) volatility or observed (ex post) volatility
- expected volatility might be better to capture full signalling impacts of interventions

Impact on ex post second moment

Impact on ex-post second moment: Garch

- Look at impact on **observed** volatility
- Issue : short-run volatility is not directly observed → need to be estimated
- Most common approach (Dominguez, 1998; Baillie and Osterberg, 1997 : GARCH approaches : contemporaneous volatility driven by past volatility level (σ_{t-1}^2) and volatility innovations (ϵ_{t-1}^2):
$$\sigma_t^2 = \sigma_0 + \beta\sigma_{t-1}^2 + \lambda\epsilon_{t-1}^2 + \sum_{i=1}^N \gamma_i | I_{i,t} |$$
- Main finding : γ_i **mostly significantly positive** , especially for concerted operations : one of the most robust finding of the empirical literature

The GARCH approach : findings

- If effects, only $I_{i,t}$ or $I_{i,t-1}$ significant → suggest that effects are short living, at most 24 hours
- Direction : γ_i **mostly significantly positive** , → interventions in general tend to raise uncertainty: one of the most robust finding of the empirical literature (but there are exceptions, see later on)
- Effect more important for concerted operations, less for unilateral interventions

Illustrations

- Tables from Beine, Benassy and Lecourt (2002)
- results for
- DEM and YEN against the USD
- Concerted and unilateral operations
- GARCH and FIGARCH modeling for the conditional variance
- Tables from Beine et al. (2002).

The GARCH approach : direct extensions

- Extending the GARCH specification to capture features of the exchange rate volatility process
- **Fractionally Integrated GARCH** (Beine, Benassy, Lecourt, 2002) to capture long memory : show that impact of interventions on volatility is more significant
- Kim et al., 2005 : **Asymmetric GARCH** : also slightly different results wrt GARCH specification
- → shows that the parametric model used to capture the dynamics of volatility has an impact on the findings → calls for **a model-independent measure of volatility** → idea of Beine, Laurent, Palm, 2004 using integrated of realized volatility : $\sigma_t = \sum_{i=1}^N r_{i,t}^2$ where $r_{i,t}$ is the i -interval exchange rate return of day t .

The GARCH approach : direct extensions

- Beine, Laurent, Lecourt (2003) (2 major markets, 1985-1995) question the result by breaking down the volatility process into two **volatility regimes** :

$$y_t \mid \Omega_t \sim \Delta(\mu, \sigma_1^2) \text{ if } s_t^* = 1 \quad (3)$$

$$y_t \mid \Omega_t \sim \Delta(\mu, \sigma_2^2) \text{ if } s_t^* = 2 \quad (4)$$

- The transition probabilities between the volatility regimes is supposed to be affected by the interventions through logistic specification
- → show that the impact of concerted operations on volatility depends on the regime; positive impact on the probability of switching in the low volatility and in the high volatility → consistent with signalling channel
- → asymmetric effects of interventions in terms of volatility.

The GARCH approach : direct extensions

- split the interventions by size (Kim et al., 2000 for instance on AUS; Beine and Szafarz, 2005 for BoJ interventions) → impact different for large scale interventions : related to signalling channel but also to portfolio channels
- Distinction between initial and successive interventions (Kim et al., 2002; Beine, Laurent, Palm, 2005) : impact not so different

Ex post volatility : extensions

- Initial findings have given rise to extensions in several directions :
- intradaily analysis to capture microstructure effects of CBIs
- impact on cross moments

Impact on second moment (intra-daily frequency)

intradaily approaches

- Initial work : Dominguez, 2004 : using 5 minutes data and reported interventions; use 2 different measures : GARCH measures and realized volatility with de-seasonalization procedure → shows that impact of Fed interventions on volatility is of short duration (15 to 2 hours);
- **volatility effects Dominguez (1999);**
- → shows that impact of Fed interventions on volatility is of short duration (15 minutes to 2 hours);

Issue : de-seasonalization

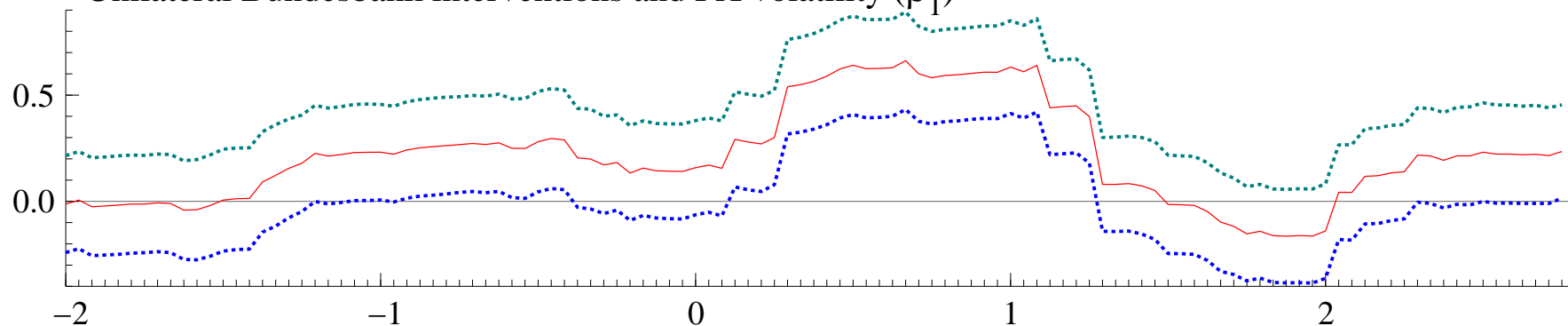
- You need to account for seasonality patterns in volatility
- U shaped pattern of FX volatility in relation with trading activity
- Several methods available → not covered here
- One simple approach is a dummy approaches : dummy variables are averages of the n intra-daily averages of $|r_{t,n}|$ (length of intervals : $24 * 60/n$ minutes over the number of available days)
- variants : use only non intervention days to avoid picking up effects of interventions
- Variant : account for day-of-the-week effect
- Still unclear whether de-seasonalization method matters for the results.

intradaily approaches: implications

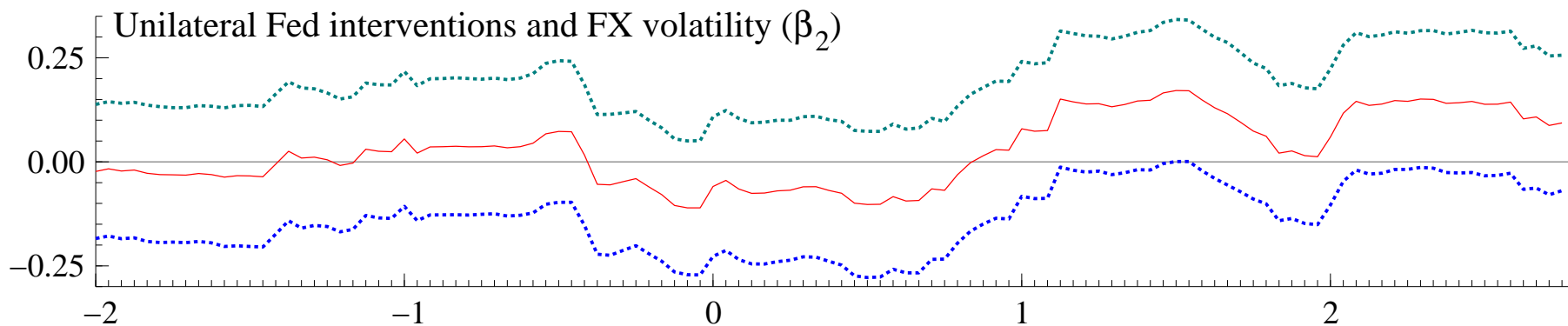
- Beine, Laurent, Palm, 2004 : use daily realized volatilities using hourly return and roll over the full course of the day (advantage: do not have to de-seasonalize) → show that significant impact for concerted operations lasting between 1 and 3 hours → in line with Dominguez (2004)
- Complement evidence that **if any, intervention effects do not last very long, at least in a policy making perspective** .
- Implication for modelling : the choice of the quoting time is important to capture effects of CBIs.
- support microstructure models either based on inventory building or response to order flows.

Daily realized volatility

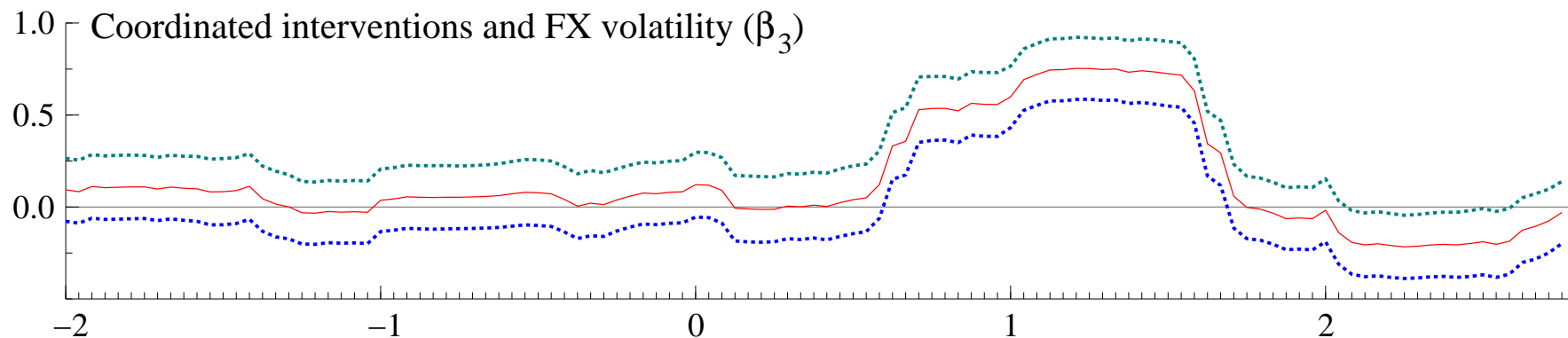
Unilateral Bundesbank interventions and FX volatility (β_1)



Unilateral Fed interventions and FX volatility (β_2)



Coordinated interventions and FX volatility (β_3)



Extensions of ex post second moments

Multivariate approaches

- Initial work : Beine, 2004 : use Multivariate GARCH model (DEM-USD and YEN-USD) to capture
- impact on **cross momemnts** :

$$y_{1,t} = b_1 + \delta_1 x'_{t-1} + \epsilon_{1,t}$$

$$y_{2,t} = b_2 + \delta_2 x'_{t-1} + \epsilon_{2,t}$$

$$h_{11,t} = \gamma_{11} + \alpha_{11} \epsilon_{1,t-1}^2 + \beta_{11} h_{11,t-1} + \psi_{11} |x'_{t-1}|$$

$$h_{12,t} = \gamma_{12} + \alpha_{12} \epsilon_{1,t-1} \epsilon_{2,t-1} + \beta_{12} h_{12,t-1} + \psi_{12} |x'_{t-1}|$$

$$h_{22,t} = \gamma_{22} + \alpha_{22} \epsilon_{2,t-1}^2 + \beta_{22} h_{22,t-1} + \psi_{22} |x'_{t-1}|$$

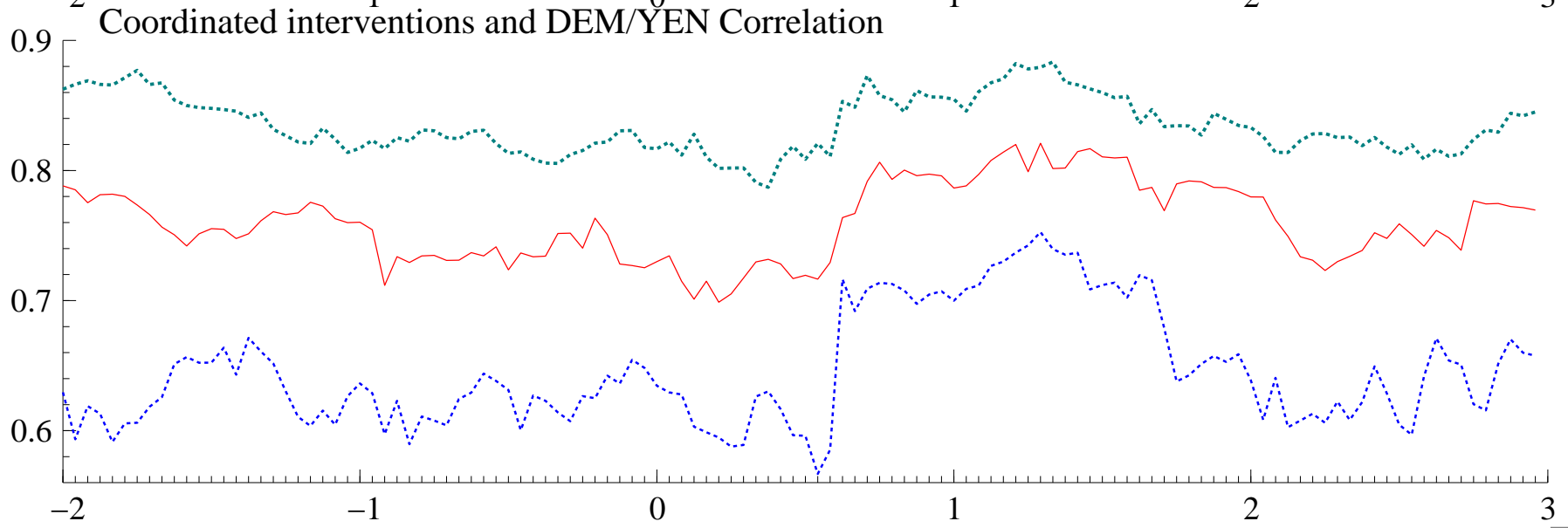
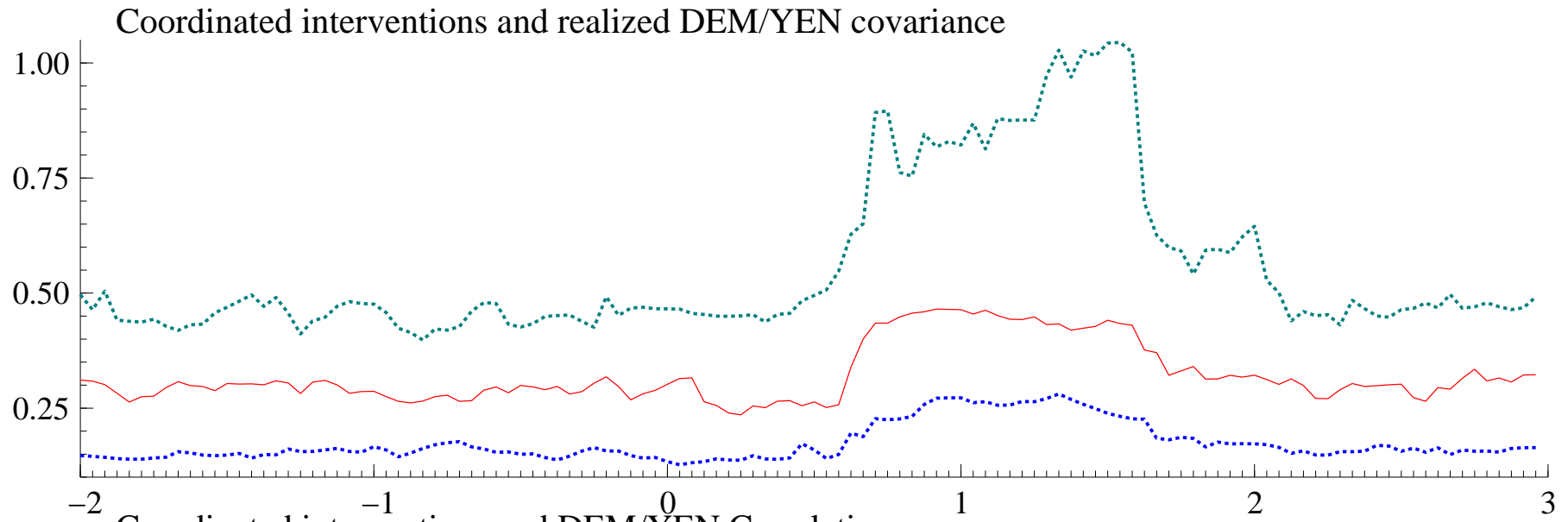
$$\epsilon_t | \Omega_t \sim N(0, H_t)$$

- important parameter(s) : ψ_{12}

Multivariate approaches

- → shows that concerted operations tend to raise covariance ($\psi_{12} > 0$ and correlations of exchange rates, especially in the YEN-USD markets (not the best model for correlations though)
- → might be useful for portfolio selection : accounting for this indirect effects allows to find better diversified portfolios as the correlations (and volatilities) are better predicted
- more or less confirmed by Beine, Laurent, Palm, 2004 using realized covariance and realized correlation → coordinated interventions lead to increase in cross moments of YEN/USD and DEM/USD exchange rate returns

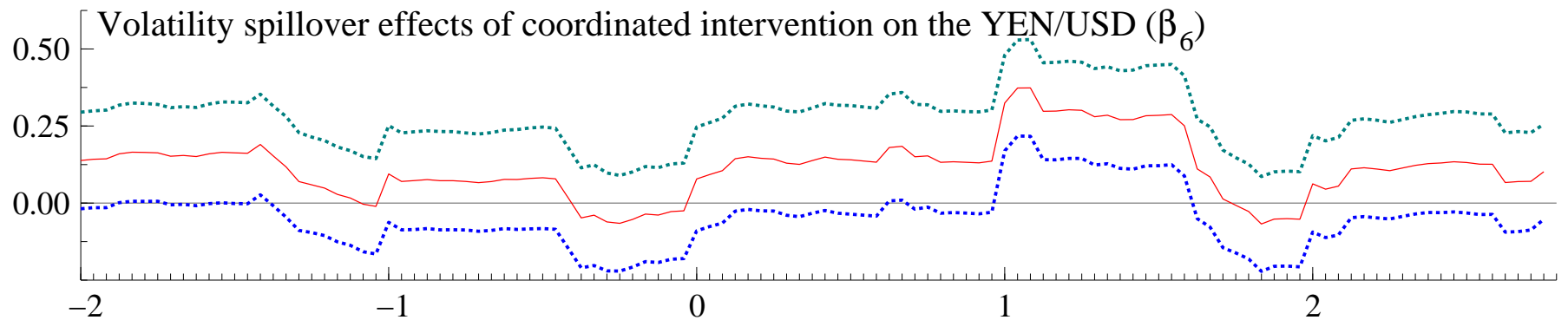
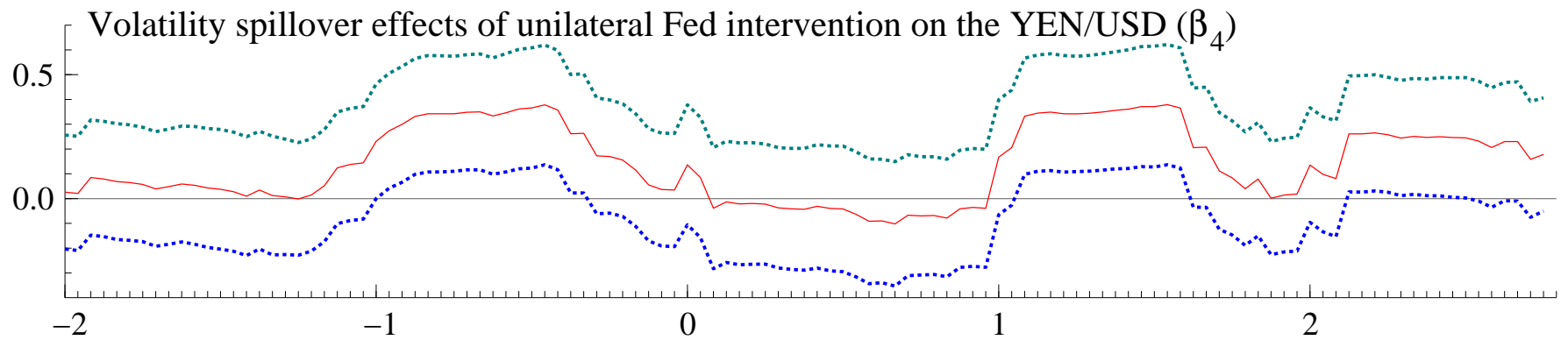
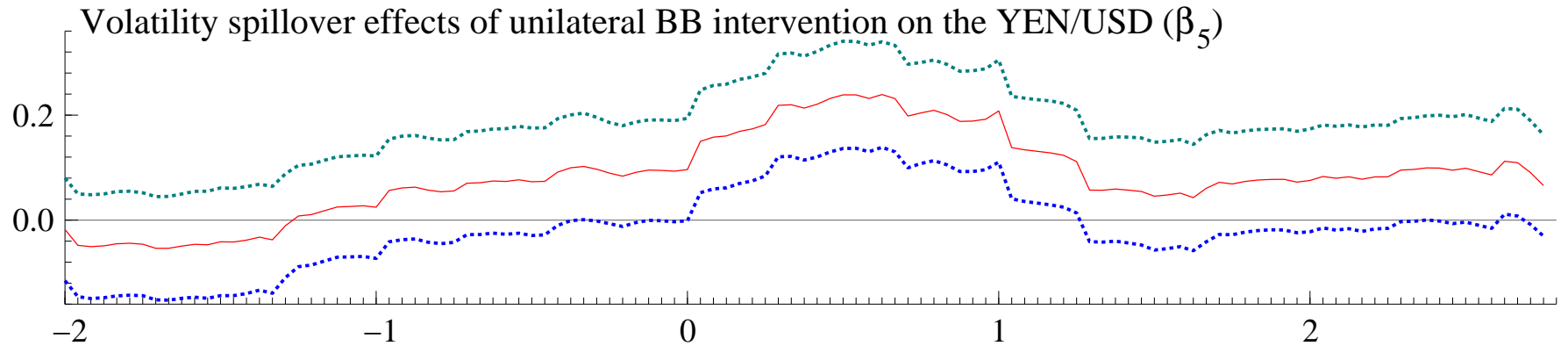
Daily realized cross moments



Multivariate approaches

- **volatility spillovers** : positive impact on volatility on another exchange rate market: confirmed by Beine, Laurent, Palm, 2004
- Show that news and order flows from a particular market have important informational content for other markets (in line with Evans and Lyons (2002))
- Applications of multivariate approaches to capture impacts of interventions on other markets → Kim et al. (2005) to capture effects on interest rates using Multivariate EGARCH model

Daily volatility spillovers



Impact on *ex-ante* second moment

impact on expected volatility

- Looking at the impact on expected volatility allows to test for the signalling hypothesis
- If interventions have a signalling content (clear or not) → agents revise their expectations → change the expected volatility
- Usual approach : use implied volatility extracted from option prices :
- Implied volatility = expected volatility at the horizon corresponding to maturity of the options (e.g. 1 month)

implied volatility

- Computation (Black and Scholes):

$$C = [F_0 e^{-r\tau} \Phi(d_1) - K e^{-r\tau} \Phi(d_2)] ,$$

$$d_1 = \ln(F_0/K) / (\sigma \sqrt{\tau}) + (\sigma \sqrt{\tau} / 2) ,$$

$$d_2 = d_1 - (\sigma \sqrt{\tau}) \quad (5)$$

- C : option premium ; K : strike price ; F_0 : value of spot exchange rate ; r risk free interest rate (differential between domestic and foreign interest rates) ; σ implied standard deviation; d_1 and d_2 are constants related to the normal distribution; τ is time to maturity.
- Everything is observed except $\sigma \rightarrow$ possible for given values of C, K, F_0 and r to find estimates of σ ; using P the observed premium, find value of σ such that $C = P$.

implied volatility

- Illustration : evolution over time of implied volatilities of DEM/USD and YEN/USD at a one month maturity (source : Beine, 2003)
- Implied volatility of DEM/USD 1 month.
Implied volatility of YEN/USD 1 month.
- Large swings of expected volatilities ; most value range between 8 and 20% on an annual basis with periods of increased volatilities
- Usually, implied volatilities lead ex post volatilities but are not an unbiased predictor of ex post volatilities.

implied volatility

- Natural extension : recover the whole expected distribution of exchange rate (Galati and Melick, 1999; Galati et al. 2005; Morel and Teileitche (2005)) → allows to investigate the impact of news and CBIs on expected first, second and third moments
- Third moment can be a measure of the higher propensity of agents to put more weight on an appreciation or depreciation of the currency.
- Technical drawbacks: difficult to estimate properly fourth moment (Kurtosis), different approaches give quite different results; need to have a lot of good quality data wrt to option prices → main hurdle to overcome.

impact on expected volatility

- early work : Bonser-Neal and Tanner, 1996; Dominguez, 1998 on USD-DEM; Galati and Melick, 1999 on YEN-USD (using reported BoJ interventions)
- In general, also find support of a positive impact of interventions , especially for concerted operations
- results might be sample-dependent : negative during post-Louvre period : understandable as intervention policy changes over time

Extensions

- Breakdown between volatility regime using non linear MS models (Beine, 2003) → finds asymmetric impact on expected volatility (consistent with ex post results)
- Using expected moments to explain intervention policy (Galati and Melick, 1999 ; Galati et al. 2005): did not find particular pattern explaining frequency of interventions for BoJ; nevertheless, issue of generated regressors (densities are estimated)

Impact on third and fourth moments

Issue

- Dynamics of third and fourth moments can be definitely interesting
- Third moment : gives some information on the **asymmetry** of the distribution; for instance, if expected distribution, give an indication on the weight put by the market on the specific direction of the exchange rate.
- Fourth moment (Kurtosis) : gives an indication on the probability of **extreme events** (appreciations or depreciations) in excess of the probability given by a Gaussian distribution → related to issue of risk management through measurements of the Value at Risk (Var).
- Interest for looking at the impact of CBIs on these third and fourth moments

Ex ante

- Extension of implied volatility : looking at higher expected moments using the recovered whole distribution : Galati and Melick (1999 and 2003)
- In general, few impact on first and third moment (investigation on fourth moment constrained by the density estimating techniques)
- Show that expected asymmetry might also be a determinant of intervention → room for extending the traditional reaction functions.
- Issue : quality of the option data : need a collection of options with different strike prices and for which enough trading volume → not always possible

Ex post higher moments

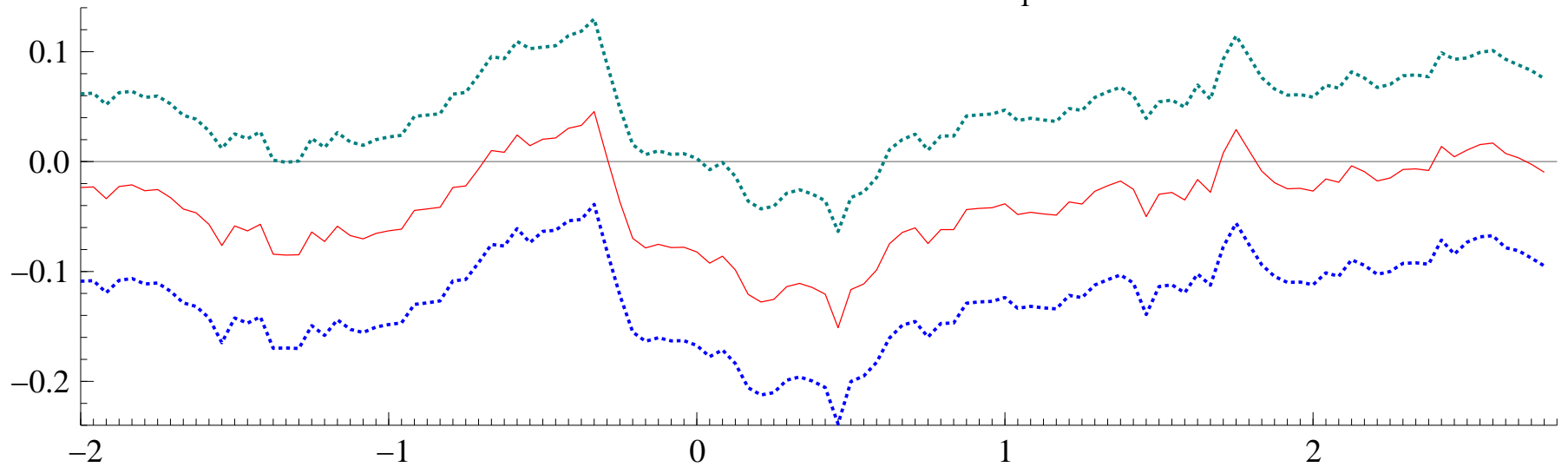
- Extension almost impossible using parametric models
- See Hansen(19954) with a 3-moment GARCH modelling → difficult to extend to put dynamics in the moment equations
- Interesting alternative : using realized third moment (Beine, Laurent and Palm, 2004) :

$$Sk_{t,\theta} = \frac{\sum_{j=0}^{23} r_{t,\theta-j}^3}{\left(\sigma_{t,\theta}^2\right)^{3/2}}. \quad (6)$$

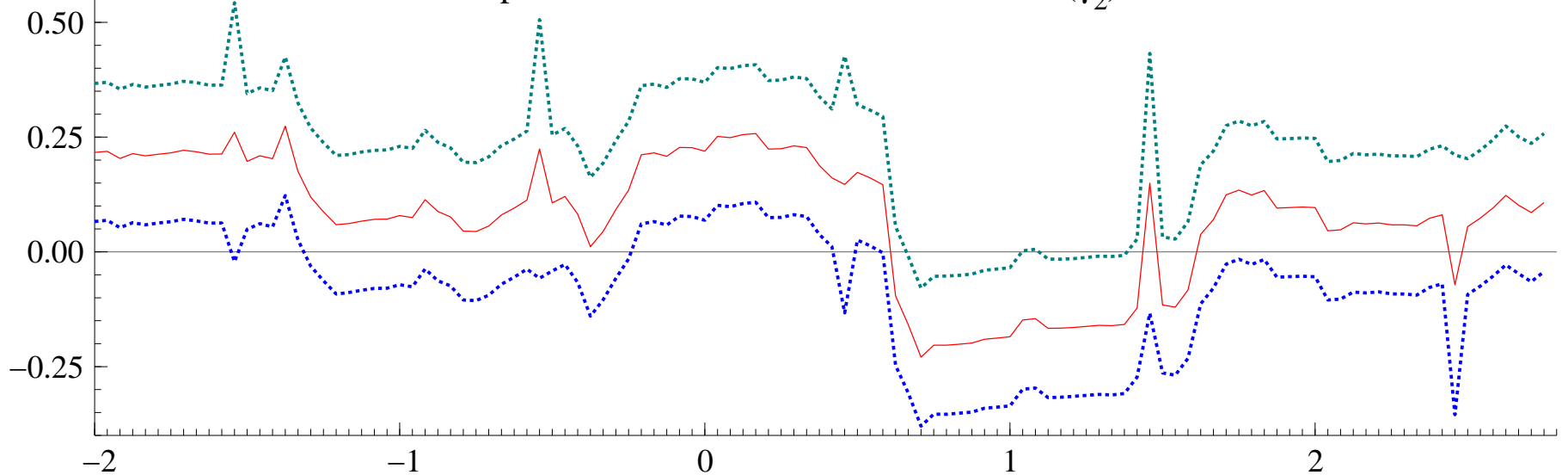
- Using regression analysis, look at how they evolve on days of interventions

Impact on realized 3rd moments

Effect of coordinated USD sales on the EUR/USD Skewness (γ_1)



Effect of coordinated USD purchases on the DEM/USD Skewness (γ_2)



Ex post third moment

- Moderate evidence that impact on 3rd moments
- Moderate virtuous impact of coordinated purchases of USD in the DEM/USD market → move the distribution more towards higher probability of USD appreciation
- Nevertheless : few occurrences → result to take with caution
- Extension : introduce estimates of ex post higher moments in reaction functions.

3. Effectiveness revisited

effectiveness and regression analysis

- Direct impact of CBIs is only one way to gauge effectiveness
- Advantage : natural criterion and straightforward implementation
- Nevertheless : restrictive view of central bank objectives
- Criteria of success might be more complex → success evaluation is conditional upon the implicit objective → move to other analysis.

effectiveness and regression analysis

- **CB's horizon might be longer** : beyond the day or the week → look at medium-run effectiveness
- Neely (2004) argues that effectiveness if the CB acts as a long-term speculator
- Survey of Neely (2001) on 18 different CBs : significant proportion of CBs claim that their policy horizon is beyond 2 or 3 days
- Significant proportion does not pay attention to pure short-run effectiveness.

alternative approaches

- Here, presentation of 2 alternative approaches
- Investigation based on microstructure approach : interventions in interaction with chartist and fundamentalist traders
- Investigation based on **events study** (widely used in empirical finance) → allows more flexible criteria of success.

Noise and fundamentalist traders

Noise trading framework

- Idea that there are 2 types of agents in the FX markets
- Fundamentalists : see the exchange rate (s_t) converging to **long run fundamental value** → PPP value, equilibrium exchange rate,
- Noise traders : use past interventions to forecast future values of s_t → Dynamics of s_t depends on the proportion of both types of agents
- **effectiveness criterion** : The CB succeeds in driving the value of s_t closer to the fundamental value → induce FX agents to behave more as fundamentalist traders

Findings

- Recent empirical investigations : Beine, De Grauwe, Grimaldi (2005); Reitz and Taylor (2006)
- Use Markov Switching regimes → chartist regime and fundamentalist regime
- Proportion of each type depends on interventions
- Beine, De Grauwe, Grimaldi (2005): using bi-weekly data : find that **coordinated interventions lowered the proportion of chartists**
- Important as chartist regime is found to be destabilizing : chartist are trend-following agents.

Findings

- Reitz and Taylor (2006) : quite the same findings at the daily frequency but also **depends on the degree of deviation of s_t from equilibrium value**
- → Restored some evidence in favor of **medium run effectiveness** .

Event studies

Idea

- Idea : Look at evolution of exchange rate moments following **an event** (Fatum, 2002)
- An event does not necessarily correspond to a single intervention but to a set of clustered interventions → advantage : if successive interventions have different impacts compared to initial interventions, then allows to capture the advantage of multiple operations
- Other advantage : the horizon of the CB might be beyond the day → look at medium run effectiveness
- Related issue : what is the typical horizon of the CB exchange rate policy → see Neely (2001) : survey of 18 CB → significant proportion ($> 40\%$) with horizon > 1 day

Idea

- Other advantage : allows to **more flexibility in the success criterion**
- 1st criterion : ΔS_t (caution: interval=1 event, not 1 time period : does the exchange rate move in the right direction)
- 2nd criterion : change in the slope of the trend : $r_t > r_{t-1}$ (r_{t-1} is pre-event return) \rightarrow might be an objective when periods of very low credibility
- 3rd criterion: Volatility smoothing $|r_t| < |r_{t-1}| \rightarrow$ consistent with an important objective of some central banks

Idea

- Papers that follow this approach
- Initial paper / Fatum (2002) : shows that based on the 3 criteria, the DEM interventions of the Bundesbank were successful
- Extension : Morel and Teileitche (2005) apply this approach to expected exchange rates : forward exchange rates and implied volatilities → conclude in favor of effectiveness also
- Extension : Fatum and King (2005) apply also this approach to the interventions of the Bank of Canada at an intradaily frequency

Assessment

- While interesting, the approach presents several drawbacks
- Definition of an event depends on the choice of **the event window length** : number of non intervention days between 2 interventions that belong to the same event.
- Fatum (2002) : length varies from 2 to 15 days → difficult to know if 15 days is realistic → ends up with large event windows and low number of events
- The size of the window will depend on the Bank but also will vary over time : see regime change of the BoJ after inception of Sakakibara

Assessment

- Some kind of **endogeneity** in the definition of an event
- Suppose the case of a CB intervening until objective is reached and then stops → bias in favor of successful event : **the length of the event might depend on the success it-self**
- Unclear how to deal with this problem of endogeneity in an event study framework.

Summing up

Conclusion on effectiveness

- What can we conclude in terms of effectiveness
- Picture is still unclear
- Initial literature focusing on the short run impact does not support in general effectiveness and emphasizes even adverse effects (volatility)
- Recent extensions more positive in favor of effectiveness because
 - previous problems of endogeneity
 - look at very short-run (intradaily) impact → raises the question of relevance of this finding for CBs
 - definition of an efficient operation is restrictive
- → still an open question.

Part VI : Additional issues of exchange rate policy

Additional issues

- effectiveness is definitely the most important issue
- Nevertheless, other issues of interest related to intervention effects of intervention policy .
- See a couple of other issues

selection

- Selected issues
- **Secrecy puzzle** : why do some CBs favor secret (discreet) interventions ?
- **Interventions in emerging markets** : can we expect different results?
- Actual interventions vs oral interventions
- Interventions and trading rules : is it possible to take advantage of interventions ? → not covered here.

Secret intervention puzzle

Puzzle

- Remind : importance of the **signalling channel** → to have a virtuous impact, interventions should be known by the public → difficult to understand why some recent CBs intervene secretly → puzzle (Sarno and Taylor, 2001)
- Does it occur in practice ? **yes**
- Beine and Lecourt (2004) provide estimates
Tables from Beine Lecourt 2004.
- In the 80's : high proportion of secret interventions from the Fed and the Bundesbank but **move towards more transparency** → almost no secret interventions now

Puzzle

- For the Boj : recent period shows that **BoJ favoured secret interventions** → high proportion and significant number of secret operations
- Updates after June 2003 : **more than 80 % of secret interventions and more than 100 secret interventions** over the 2003-2004 period (see Beine and Bernal, 2006 for the update) **Tables from Beine Bernal, 2006.**
- Caution : share of **undetected interventions** → the **intended secret interventions can be even higher**

Theory: credibility

- Why to use secret interventions ? → several theoretical explanations from various literatures : see Chiu, 2003 and Beine and Bernal, 2006 for synthesis
- Related to credibility : if **low credibility** → weak signal → better to hide interventions and rely only on portfolio effects that can have significant impact through order flows (Lyons, 2001, Ch.7)
- if high credibility and perceived probability of success low → secret interventions in order to preserve credibility
- Past success might be a proxy for level of credibility

Theory : institutional structure

- Interaction between government (Ministry of Finance) that makes the decision and the CB that implements the operation
- Structure observed for Japan, US and to a lesser extent ECB (see Bernal, 2006)
- If decisions of the government inconsistent with general policy of the CB, → CB prefers unknown intervention to avoid bad signalling → difficult to test because institutional structure does not change over time

Theory : inconsistency with target

- If target of the CB/government is **inconsistent with equilibrium exchange rate**
- Ex: Japan in the recent period (1995-2004)
- Government wants to favor weak exchange rate to boost exports
- CB purchased dollars with unsterilized operations to boost money stock (liquidity trap, quantitative easing policy)
- In this case, incentive to use secret interventions as the CB cannot claim that it is for correcting exchange rate disequilibria (most often used official statement of CBs)
- practical hurdle : identification of the CB's target → CB do not often reveal their target

Theory : noise trading channel

- Noise trading channel (Hung 1997) : CB can intervene secretly to induce some dynamics in the exchange rate → for instance, if currency is on a depreciating trend, break the trend or create volatility to restore a 2-way bet
- If the source of the variation of s_t is unknown, the change in the dynamics can be considered as endogenous → traders can change their view → incentive to hide intervention
- one indirect way to test → see if secret interventions is more frequent when currency is depreciating

Empirics

- First hurdle : identify secret and reported interventions;
- Second hurdle : sufficient proportion of secret interventions
- Additional hurdles : value for targets of the CB, value of equilibrium exchange rate , → Very limited empirical literature
- Only one paper (up to now) : Beine, Bernal (2006) : use BoJ exchange rate policy 1991-2004.

Findings

- Findings of Beine and Bernal (2006)
- No support for a relationship between past successes and secrecy
- Strong support for impact of the inconsistency of exchange rate policy wrt aim of correcting exchange rate misalignments → BoJ favored too a weak yen
- No support (very undirect testing however) for noise trading channel

Extensions.

- 2 main limitations of Beine and Bernal (2006)
- explain undetected interventions → interventions that the CB wanted to be secret **and** that remained undetected → disentangle the different kinds (3 categories vs 2)
- decision to intervene or not might influence choice of secrecy or not
- → Nested Logit estimation with decision tree explaining
- interventions vs no interventions
- Choice of secrecy : public or secret interventions
- for secret interventions : detected and undetected.
- on going work : Beine, Bernal, Gnabo, Lecourt (2006)

Interventions in emerging markets

gap in literature

- Major part of the literature devoted to developed countries: US, Japan, Europe, EMS, Canada, Australia, Switzerland
- Nevertheless, CB active in a couple of emerging countries : Turkey, Czech Republic, Mexico, Asian countries like Thailand, Taiwan, Korea
- Reasons of academic interest ? → the channels of influence might be quite different from those operating for industrialized countries

Channels

- due to the small turnover → room for a **portfolio balance effect** of cbis; substitutability between foreign and domestic assets is lower → room for higher portfolio effects
- CBsability to convey **signals** about future monetary policy depends on credibility → need higher amounts to signal policy → less probability for signalling effects
- Microstructure effects : stronger informational advantage about future fundamentals in EMEs → intervention might reveal such info and thereby influence market expectations (Humpage (2003));
- FX markets less deep, more regulated → stronger informational advantage about market conditions and positions and larger relative size of intervention → expected microstructure influence stronger;

Emerging literature

- Synthesis provided by Disyatat and Galati (2005)
- Mixed results in terms of levels
- Very mixed results on volatility : evidence of negative or insignificant impact on volatility
- Evidence of microstructure effect in the Czech Krona market from impact of order flows.
- Heterogeneity of results reveals heterogeneity in market structures, in practices (ex: CNB : mixed of discreet and transparent policies), differences in credibility, ...

Actual interventions vs oral interventions

Literature

- Data suggest that major central banks
- Intervene much less now than in the past
- Communicate much more
- Better quality in communication
- Substitution between oral and actual interventions ?

Substitution hypothesis

- Fratzscher (2006, JIMF) supports the **substitution** hypothesis
- Oral interventions of the G3 CBs tend
- to move the exchange rate in the desired directions
- affect exchange rates over a 6 month horizon
- lower FX volatility

Complements hypothesis

- Beine, Jansen, Lecourt (2007) look at the **interaction** between oral and actual interventions (same day) (G3 on the 2 major markets)
- They find that statements
- lower the case for counterproductive interventions in terms of levels
- lower the probability of volatility increases as a result of interventions
- not inconsistent with the substitution hypothesis → oral interventions are a powerful instrument.

Other topics

Other non addressed topics

- **Interventions and trading rules** : can agents make money from interventions (Le Baron, 1999; Neely, 2002) ?
- Le Baron (1999) : interventions generate inefficiencies from which trading rules can profit → Neely (2002) shows that trading rules are activated before interventions and that interventions **respond to abnormal conditions** from which trading rules profit;
- Related issue : is intervention profitable for the CB ? See Ito(2003) for some calculations for the BoJ (1991-2002)

Other non addressed topics

- Interventions through option markets : advantages, practices, ...;
- interventions in fixed exchange rate regimes : mainly evidence from the EMS
- interventions in interaction with monetary policy (Kaminsky and Lewis, 1996) : does intervention signal future monetary policy ? → not very often.
- Interventions and communication policy : substitutes (Fratzscher, 2004) or complements (Beine, Janssen, Lecourt, 2005) ?

References

- [1] Almekinders, G.J., and S.C.W. Eijffinger, 1994, Daily Bundesbank and Federal Reserve Informations: Are They a Reaction to Changes in the Level and Volatility of the USD/DM-Rate?, *Empirical Economics*, 19, 111-130.
- [2] Almekinders, G.J., and S.C.W. Eijffinger, 1996, A Friction Model of Daily Bundesbank and Federal Reserve Interventions, *Journal of Banking and Finance*, 20, 1365-1380.
- [3] Andersen, T.G., T. Bollerslev, F.X. Diebold, and P. Labys, 2001, The Distribution of Realized Exchange Rate Volatility. *Journal of the American Statistical Association*, 96, 42-55.
- [4] Bhattacharya, U. and P. Weller, 1997, The Advantage to Hiding one's Hand: Speculation and Central Bank Intervention in the Foreign Exchange Market, *Journal of Monetary Economics*, 39, 251-277.
- [5] Baillie, R.T., and W.P. Osterberg, 1997, Why do Central Banks Intervene ?, *Journal of International Money and Finance*, 16 (6), 909-919.
- [6] Bank for International Settlements, 2004, Triennial Central Bank Survey of Foreign Exchange and Derivatives Market

Activity in April 2004, Bank for International Settlements, September.

- [7] Beine, M., 2003, Volatility Expectations and Asymmetric Effects of Central Bank Interventions in the FX Market, *Journal of the Japanese and International Economies*, 2003, 17 (1), 55-80.
- [8] Beine, M., 2004, Conditional Covariances and Direct Central Bank Interventions in the Foreign Exchange Markets, *Journal of Banking and Finance*, 28, 1385-1411.
- [9] Beine, M., A. Bénassy-Quéré, and C. Lecourt, 2002, Central Bank Intervention and Foreign Exchange Rates: New Evidence from FIGARCH estimations. *Journal of International Money and Finance*, 21, 115-144.
- [10] Beine, M., A. Bénassy-Quéré, and R. McDonald, 2006, The Impact of Central Bank Intervention on Exchange-Rate Forecast Heterogeneity. Forthcoming in the *Journal of the Japanese and International Economies*.
- [11] Beine, M., and O. Bernal, 2006. Why do Central Bank Intervene Secretly ? Preliminary Evidence from the BoJ. Forthcoming in the *Journal of International Financial Markets, Institutions and Money*.

- [12] Beine, M., De Grauwe, P. and M. Grimaldi, 2005. The Impact of FX Central Bank Interventions in a Noise Trading Framework. CES IFO Working Paper 1520.
- [13] Beine, M., G. Janssen, and C. Lecourt, 2005, Should Central Bankers Talk to the FX Markets ?. SSRN Working Paper.
- [14] Beine, M., S. Laurent, and C. Lecourt, 2003, Central Bank Intervention and Exchange Rate Volatility: Evidence from a Switching Regime Analysis, *European economic Review*, 47, 891-911. .
- [15] Beine, M., S. Laurent, and F.C. Palm, 2004, Central Bank Intervention Assessed Using Realized Moments. Core Discussion Paper 2004/1.
- [16] Beine, M., S. Laurent, and F.C. Palm, 2004, Have Sequential Interventions of Central Banks in Foreign Exchange Been Effective. *De Economist*, 152(2), 297-308.
- [17] Beine, M., and C. Lecourt, 2004, Reported and Secret interventions in the Foreign Exchange Markets, *Finance Research letters*, 1 (4), 215-225.
- [18] Beine, M., and A. Szafarz (2005), Size matters : Evidence from BoJ Central Bank Interventions, University of Brussels, Mimeo.

- [19] Bernal,O. 2006, Do Interactions between Political Authorities and Central Banks Influence FX Interventions ? Evidence from Japan. University of Brussels Working Paper.
- [20] Bénassy-Quéré, A. , P. Duran-Vigneron, A. Lahrière-Revil, and V. Mignon, 2004, Burden Sharing and Exchange Rate Misalignments within the Group of Twenty. CEPII Working paper 2004-13.
- [21] Bonser-Neal, C., and G. Tanner, 1996, Central Bank Intervention and the Volatility of Foreign Exchange Rates : Evidence from the Options Market, *Journal of International Money and Finance*, 15 (6), 853-878.
- [22] Brandner,P., H. Grech and H. Stix (2000), The Effectiveness of Central Bank Intervention in the EMS: the Post 1993 experience, Paper presented at the Lille Conference, 2000 .
- [23] Chiu, P., 2003, Transparency versus Constructive Ambiguity in Foreign Exchange Intervention, BIS Working Paper 144.
- [24] Disyatat, P. and Galati, G., 2005, The Effectiveness of Foreign Exchange Intervention in Emerging Market Countries: Evidence from the Czech Koruna, BIS Working Paper 172.

- [25] Dominguez, K.M. (1998), Central bank Intervention and Exchange Rate Volatility, *Journal of International Money and Finance*, 17, 161-190.
- [26] Dominguez K.M., 1999, The Market Microstructure of Central Bank Intervention, NBER Working Paper 7337.
- [27] Dominguez K.M., 2003, The Market Microstructure of Central Bank Intervention, *Journal of International Economics*, 59, 25-45.
- [28] Dominguez K.M., 2004, When Do Central Bank Interventions Influence Intra-daily and Longer-Term Exchange Rate Movements, forthcoming in the *Journal of International Money and Finance*.
- [29] Dominguez, K.M., and J. Frankel, 1993, Does Foreign Exchange Intervention Work ?, Institute for International Economics, Washington, DC.
- [30] Dominguez K.M., and F. Panthaki, 2005, The Influence of Actual and Unrequited Interventions, paper presented at the Workshop on Central Banking, Namur, June.
- [31] Enoch, C., 1998, Transparency in Central Bank Operations in the Foreign Exchange Market, International Monetary Fund

- [32] Evans, M.D.D., and R.K. Lyons, 2001, Portfolio Balance, Price Impact, and Secret Intervention, forthcoming in *Financial Market Structure and Dynamics*, Bank of Canada.
- [33] Evans, M.D.D., and R.K. Lyons, 2002, Informational Integration and FX Trading, *Journal of International Money and Finance*, 21, 807-831.
- [34] Fatum, R., 2002, On the Effectiveness of Sterelized Foreign Exchange Intervention. *Canadian Journal of Economics*, 35(3), 556-567.
- [35] Fatum, R., and M. Hutchison, 2003, Is Sterelized Foreign Exchange Intervention Effective After All? An Event Study Approach, *The Economic Journal*, 113 (487).
- [36] Fatum, R., and M. Hutchison, 2005, Rules Versus Discretion in Foreign Exchange Intervention: Evidence from Official bank of Canada High Frequency Data, SCCIE Working Paper No. 04-24.
- [37] Fatum, R., and M. R. King 2005, Foreign Exchange Intervention and Monetary Policy in Japan, 2003-2004, Revised version of SSRN Working Paper n^o 642862.
- [38] Fischer, A. 2005. On the Inadequacy of Newswire Reports for Empirical Research on Foreign Exchange Interventions. Swiss National Bank Research Papers 2005-2.

- [39] Fratzscher, M. 2004. Communication and exchange rate policy. ECB Working Paper 363, May.
- [40] Fratzscher, M. 2006. On the Long-term Effectiveness of Exchange Rate Communication and Interventions, *Journal of International Money and Finance*, 25, 146-167.
- [41] Frenkel, M., C. Pierdzioch, and G. Stadtmann, 2004, Modelling the Intensity of Foreign Exchange Intervention Activity, Forthcoming in *Economics Letters*.
- [42] Galati, G., and W. Melick, 1999, Perceived Central Bank Intervention and Market Expectations: an Empirical Study of the YEN/Dollar Exchange Rate, 1993-1996, BIS Working Paper 77.
- [43] Galati, G., and W. Melick and M. Micu, 2005, Foreign Exchange Market Intervention and Expectations: The Yen-Dollar Exchange Rate, Forthcoming in the *Journal of International Money and Finance*.
- [44] Gnabo, J-Y and C. Lecourt, How transparent is the Intervention exchange Rate Policy of the Bank of Japan ? SSRN Working Paper 839188.
- [45] Hansen, B.E., 1994, Autoregressive Conditional Density Estimation, *International Economic Review*, 35, 705-730.

- [46] Humpage, O., 2003, Government Intervention in the Foreign Exchange Market, Federal reserve Bank of Cleveland, Working Paper 03-15.
- [47] Hung, J., 1997, Intervention Strategies and Exchange Rate Volatility: a Noise Trading Perspective, *Journal of International Money and Finance*, 16, 779-793.
- [48] Ito, T., 2003, Is Foreign Exchange Intervention Effective? The Japanese Experiences in the 1990's. In Paul Mizen (ed.), *Monetary History, exchange Rates and Financial Markets, Essays in Honour of Charles Goodhart*, volume 2, ChetelhamUK.; Edward Elgar Pub. London.
- [49] Ito, T., and T. Yabu, 2004, What Promotes Japan to Intervene in the Foreign Exchange Market? A new Approach to a Reaction Function. NBER Working paper No. 10456.
- [50] Kaminsky, G. and K. Lewis, 1996, Does Foreign Exchange Intervention Signal Future Monetary Policy ?. *Journal of Monetary Economics*, 37, 285-312.
- [51] Kearns, J. and R. Rigobon. 2004, Identifying the Efficacy of Central Bank Interventions: Evidence from Australia and Japan. Forthcoming in *Journal of International Economics*.

- [52] Kim, S-K, T. Kortian and J. Sheen, 2000. Central bank intervention and exchange rate volatility - Australian evidence, *Journal of International Financial Markets, Institutions and Money*, 10, pp. 381-405.
- [53] Kim, S-K and J. Sheen, 2005. Interventions in the Yen-Dollar Spot Market: A Story of Price, Volatility and Volume, forthcoming in *Journal of Banking and Finance*.
- [54] LeBaron, B., 1999. Technical Trading Rule Profitability and Foreign Exchange Interventions *Journal of International Economics*, 49(1), 126-143.
- [55] Lyons, R.K. 2001, *The Microstructure Approach to Exchange Rates*, MIT Press, Cambridge, Massachusetts.
- [56] McFadden, D. L. (1984), Econometric Analysis of Qualitative Response models, in *Handbook of Econometrics*, volume 2, ed. Z. Griliches and M.D. Intriligator, Amsterdam, North-Holland, 1395-1457.
- [57] Melvin, M. and Wen (2004), The choice of direct dealing or electronic brokerage in foreign exchange trading. Manuscript, Department of Economics, Arizona State University, Tempe, AZ.
- [58] Morel, C. and J. Teiletche (2004), Do Interventions in Foreign Exchange Markets Change Investors' Expectations ?

The Experience of Japan between 1992 and 2003. Paper presented at the Internal Seminar in Brussels, November 2004.

- [59] Mussa, M., 1981, The Role of Official Intervention, Group of Thirty Occasional Papers no. 6, Group of Thirty, New York.
- [60] Neely, C. J., 2000, Are Change sin Foreign exchange Reserves Well Correlated with Official Interventions ?. Federal Reserve Bank Of Saint Louis Review, September/October.
- [61] Neely, C. J., 2001, The Practice of Central Bank Intervention: Looking under the Hood, *Federal Reserve Bank of Saint-Louis Review*, 83(3).
- [62] Neely, C. J., 2002, The Temporal Pattern of Trading Rule Returns: Intervention does not Generate Trading Rule Profits, *Journal of International Economics*, 58, 211-232.
- [63] Neely, C. J., 2004, The Case for Foreign Exchange Intervention: The Government as a Long-term Speculator, *Federal Reserve Bank of Saint-Louis Working paper*, November.

- [64] Neely, C. J., 2005, Identifying the Effect of US Interventions on the Level of Exchange Rates, Federal Reserve Bank of Saint Louis Working Paper 2005-031B.
- [65] Neely, C. J., 2005, An Analysis of Recent Studies of the Effect of Foreign Exchange Intervention, Federal Reserve Bank of Saint Louis Working Paper 2005-03B.
- [66] Payne, R., and P. Vitale, 2003, A Transaction Level Study of the Effects of Central Bank Interventions on Exchange Rates, *Journal of International Economics*, 61, 331-352.
- [67] Reitz, S. and M.P. Taylor (2006), The Coordination Channel of Foreign Exchange Intervention: a Nonlinear Microstructural Analysis. University of Warwick, Mimeo.
- [68] Sarno, L., and M.P. Taylor, 2001, Official intervention in the foreign exchange market: is it effective and, if so, how does it work? *Journal of Economic Literature* 39(3), 839-868.
- [69] Stein, J., Cheap Talk and the Fed: A theory of Imprecise Policy Announcements, *American Economic Review* 79, 32-42. .
- [70] Vitale, P., 1999, Sterelized central bank intervention in the foreign exchange market. *Journal of Economic Literature* 49(3), 245-269.

[71] Wooldridge, J.M., 2002, *Econometric Analysis of Cross Section and Panel Data*, The MIT Press, Cambridge, Massachusetts.