Foreign Exchange Intervention: Theory and Practice

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Intervention Policy

- Any official sale or purchase of foreign assets against domestic assets in the foreign exchange market.
- This presentation will review the mechanics, theory and central bank objectives, and the empirical evidence in order to better understand how intervention works, when it does, and what circumstances are likely to lead intervention not to work.

The Mechanics of Intervention

- Non-sterilized Operations
- Sterilized Operations

Non-Sterilized Interventions

- Analogous to domestic open-market operations, in that they involve an increase or decrease in the monetary base.
  - Difference: instead of buying or selling domestic assets, interventions involve buying or selling foreign currency or foreign-currency denominated assets.

Central Bank Balance Sheet

A typical central bank holds 4 types of assets:

- Claims on foreign entities
  - Foreign money (M_F)
  - Foreign-currency denominated bonds (B_F)
- Gold (G)
- Claims on domestic entities
  - Home-currency denominated bonds (B_H)

Central Bank Balance Sheet

The liabilities of the central bank include:

- Monetary Base
  - Currency (M_H)
  - Required reserves held at the central bank (RR)
- Net Worth (NW)
  - (which varies with the market value of the central bank's assets)

Central Bank Balance Sheet

- The central bank's balance sheet identity (where P^G is the price of gold and e is the home relative to foreign currency exchange rate) can be expressed in nominal domestic-currency terms as:

$$P^G G + eB_F + B_H + eM_F = M_H + RR + NW$$

Non-Sterilized Interventions

- When a central bank makes a non-sterilized intervention operation it purchases (or sells) foreign currency (M_F) or foreign-currency bonds (B_F)
- and at the same time increases (or decreases) the domestic monetary base (M_H)

$$P^G G + eB_F + B_H + eM_F \uparrow = M_H \uparrow + RR + NW$$

Sterilized Interventions

- Sterilized interventions are a combination of two transactions.
  - A non-sterilized intervention (for example, by purchasing M_F and increasing M_H).
  - Sterilization: undoes the effects on the monetary base (M_H) by selling (or purchasing) a corresponding quantity of home-currency denominated bonds (B_H)

$$P^G G + eB_F + B_H \downarrow + eM_F \uparrow = M_H \uparrow\downarrow + RR + NW$$

Sterilized Interventions

- Net effect: change the ratio of home- to foreign-currency assets held by the public, with no change in the (home) monetary base.
- Countries that adhere to monetary or inflation targets are generally assumed to engage chiefly in sterilized intervention operations.
- In practice most countries claim to routinely sterilize their intervention operations.
  - This does not preclude the possibility that the authorities in these countries adjust monetary policy in order to achieve exchange rate objectives.

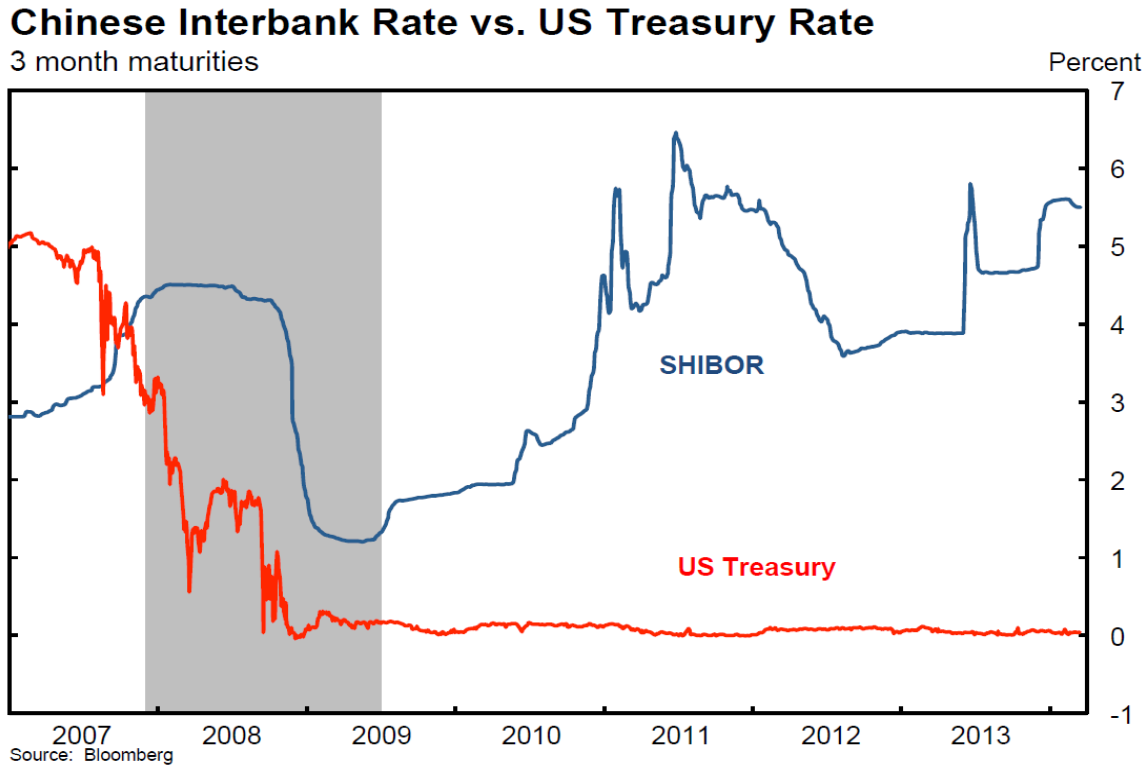
Can All Countries Sterilize?

- In practice it may be difficult for the monetary authority to offset fully the effects of a change in net foreign assets.
  - In countries with less developed financial markets the ability to sterilize may be constrained by the size and depth of the domestic bond market.
  - East Asian central banks often use FX swaps as sterilization instruments (after purchasing foreign currency in the spot market, the central bank implements a swap in which it sells the foreign currency spot and purchases it forward.)
- Monetary authorities may not be able to sterilize fully intervention operations in fixed exchange rate systems with some degree of capital mobility.
  - For example, if sales of domestic-currency assets attracts a capital inflow, the CB will be forced to buy more foreign assets, thereby offsetting any attempt to sterilize the original open-market asset sale.

Costs of Sterilization

- **Fiscal cost**: depends on the interest differential between the domestic and foreign assets.
- **Valuation risk**: The foreign reserve accumulation that results from these sorts of sterilization operations will expose the government to foreign exchange risk.
  - governments attempting to prevent a depreciation of their domestic currency will generally be selling foreign assets and purchasing domestic assets. The constraint in this case will be the size of the country's foreign reserves.

Costs of Sterilization: China



Note: US Treasury rates were typically higher than China's domestic interest rates before the global financial crisis; the interest rate spread has reversed sign and the gap has widened over time leading to much higher sterilization costs for the PBOC.

Source: Figure 2 in Chang, Liu and Spiegel, "Capital Controls and Optimal Chinese Monetary Policy" Federal Reserve Bank of SF Working Paper 2012-13, May 2014.

Valuation Losses: Switzerland

Cumulative Returns on Foreign Reserve Investments

	Currency reserves				
	Total in CHF	Gold in CHF	Foreign exchange reserves		
			Total in CHF	Currency return	Local return
2010	**-5.4%**	**15.3%**	**-10.1%**	-13.4%	3.8%
2011	**4.9%**	**12.3%**	**3.1%**	-0.8%	4.0%
2012	**2.3%**	**2.8%**	**2.2%**	-2.3%	4.7%
2013	**-2.5%**	**-30.0%**	**0.7%**	-2.4%	3.2%
2014	**8.0%**	**11.4%**	**7.8%**	2.6%	5.1%
2015	**-4.7%**	**-10.5%**	**-4.4%**	-5.6%	1.3%
2016	**3.8%**	**11.1%**	**3.3%**	-0.4%	3.7%
2017	**7.2%**	**7.9%**	**7.2%**	2.9%	4.2%
2018	**-2.1%**	**-0.6%**	**-2.2%**	-1.5%	-0.7%

SNB Press Release Jan 9, 2019: SNB's loss on foreign currency positions amounted to CHF 16 billion in 2018.

Theory: Channels of Influence

- Portfolio Balance
- Information (or Signaling)
- In DSGE models

Portfolio Balance Channel

- Key Assumptions:
  - Investors diversify their holdings among domestic and foreign assets as a function of expected returns and the variance of returns.
  - Foreign and domestic assets are imperfect substitutes (uncovered interest parity does not hold).
- Theory predicts that a change in the relative supply of foreign and domestic assets will require a change in expected relative returns.
  - For example, after a sterilized home-currency supporting intervention, investors will require a higher expected return on foreign assets to hold willingly the larger outstanding stock, leading to a depreciation of the foreign currency.

Portfolio Balance Channel

- Simple example:

  x= share of investors' portfolios allocated to foreign-currency denominated assets

  $(1-x)$= share allocated to domestic assets

  W= total wealth ($B_H+M_H+B_F+M_F$)

- If the relative number of domestic assets (B_H+M_H) increases (and assuming interest rates and the risk premium are held constant), then e will also increase (decrease), indicating a home currency depreciation (appreciation).

$$e = \frac{(B_H + M_H)x}{(B_F + M_F)(1-x)}$$

Portfolio Balance Channel

- Theory also suggests that sterilized intervention operations may alter the risk characteristics of foreign and domestic assets in the market portfolio, because investors will be more vulnerable to unexpected changes in the exchange rate.
- So that sterilized interventions may influence the equilibrium exchange rate via a change in the risk premia.

Portfolio Balance Channel

- If we take a broader view of the private sector's assets and liabilities as also including future net tax payments to governments (Ricardian equivalence), then changes in the risk premia due to sterilized interventions will not occur.
- Investor's portfolio exposure to risk of an exchange rate change will be fully offset by an equal sized change in tax exposure.

Portfolio Balance Channel

- Empirical Evidence
  - Some support for the imperfect substitutability of foreign and domestic assets (even between the U.S., Europe and Japan)
  - Little support for Ricardian equivalence.
- Even so, the stock of outstanding assets is huge for most AEs, and because the typical size of intervention operations is quite small ($300 million per day for the U.S.) it is unlikely that sterilized interventions have an economically meaningful influence on exchange rates through this channel.
- This channel may be more relevant for EMEs, some of which have large reserve portfolios relative to the stock of domestic bonds outstanding.

Information or Signaling Channel

- Operations may provide investors with "information" about the Central Bank's (or Government's) view of the appropriate exchange rate
  - may also provide a "signal" of future policy intentions (for example, future monetary policy).
  - may itself "buy credibility" for future policy intentions.
- As long as the information signaled through intervention policy is relevant and credible, it can potentially influence the exchange rate.
- However, if the information revealed involves own future policy intentions, then sterilized intervention should not be considered an additional independent policy.

Information or Signaling Channel

- Problems with the signaling hypothesis:
  - why use interventions when simple announcements or direct monetary policy changes could do the same job?
  - if interventions convey information why do some central banks continue to keep them secret (even ex post)?
- Advantages:
  - Interventions are timely and costly.
  - Mussa (1981) states "intervention policy may be more credible because it forces the central bank to put money where its mouth is…"

Under What Circumstances Can Sterilized Intervention Influence The Exchange Rate?

	Portfolio Balance Channel	Information/Signaling Channel
Underlying Assumption	assets are imperfect substitutes	The market believes that the monetary authority has more information about fundamentals than they do
Channel of Influence	risk premium	exchange rate expectations
Independent of Monetary Policy?	yes	Ambiguous (1) if the signal conveys information about future monetary policy - no (2) if the signal pricks a speculative bubble -- yes
Potential Size	very small	potentially quite large
Key to Success	the more assets are perceived to be imperfect substitutes (and no Ricardian equivalence)	(1) surprise factor (2) coordination with other CBs (3) visibility of initial operation

Intervention in DSGE Models

- Sterilized interventions have no impacts in standard open-economy DSGE models where UIP (uncovered interest parity) and the LOP (Law of One Price) hold.
- Papers that incorporate various financial frictions in DSGE models which allow for deviations from UIP (and LOP) provide a role for sterilized interventions (and capital controls) to mitigate financial distortions, examples:
  - Gabaix and Maggiori, "International Liquidity and Exchange Rate Dynamics" focus on the (sometimes limited) risk bearing capacity of financiers and financial imbalances to drive a wedge in UIP.
  - Chang, Liu and Spiegal, "Capital Controls and Optimal Chinese Monetary Policy" introduce a wedge in UIP with allows portfolio allocations by the central bank to influence the exchange rate.

Recent Modelling of Intervention

- Chang, R., "Foreign Exchange Intervention Redux," NBER WP 24463, March 2018.
  - Focus is on the circumstances when FXI changes the net credit position of the CB with domestic banks (sales of official reserves allows banks to increase the supply of credit to the private sector)
- Iovino, L. and D. Sergeyev, "Central Bank Balance Sheet Policies without Rational Expectations," CEPR Discussion Paper 13100, August 2018.
  - Expectations based on experimental evidence on behavior in strategic environments (gives role to FXI that does not exist with RE)
- Fanelli, S. and L. Straub, "A Theory of Foreign Exchange Interventions," MIT Research Paper 16-02, August 2016.
  - Small open economy model with limited capital mobility – interventions are part of the optimal planning policy

Empirical Approaches and Evidence

- Criteria for Success
- Time Series Evidence
  - Central Bank Reaction Functions
  - Intervention and Foreign Exchange Returns
  - Intervention and Foreign Exchange Volatility
- Event Study Evidence
- Intra-Day (Microstructure) Evidence
- Cross-section Evidence
- Regression discontinuity
- Counterfactual Comparisons

Simultaneity Issues

- The decision to intervene may not be independent of movements in exchange rates.
  - Indeed, interventions are most likely to occur in reaction to undesirable (from the government's point of view) exchange rate changes.
- The decision to intervene may also be part of a broader set of policy actions (monetary and/or fiscal policy, capital controls) potentially leading to overestimation bias for intervention.
- Studies using high-frequency data (daily or intra-daily) may be less likely to be subject to simultaneity bias (if we assume that the decision to intervene does not happen within the day), but they are unable to tell us if intervention has lasting effects.

Criteria for Success

- Operation should significantly influence either the relative price or the volatility of a currency in the appropriate direction.
- Definition of "significant influence"?
  - How large? How persistent?
  - How to compare actual behavior to what exchange rates would have been in the absence of intervention?
- Early non-parametric test approach: group intervention operations into "episodes" and test whether exchange rate movements during and after an episode are consistent with intervention objectives (Dominguez and Frankel, 1993; Fatum and Hutchison, 2003).
  - Concern: timing and duration of intervention episodes are likely to be endogenous
  - Results: interventions are generally effective in moving exchange rates in the appropriate direction.

Criteria for Success

- Approach taken in Fratzscher et. al (2019):
  - Ability of intervention to influence the direction of the exchange rate (exchange rate movement consistent with intervention during intervention episode)
  - Ability to smooth the path of the exchange rate (reduction in exchange rate change in the week after intervention relative to the week before the intervention)
  - Ability of intervention to stabilize the exchange rate in a narrow band (exchange rate within 2% band during intervention and during the next two weeks)
- 60% baseline success for influencing the direction of the exchange rate (higher if interventions are large, lean-with-the-wind, and are accompanied by oral intervention)
- 80% success (for smoothing and stabilizing in narrow band regimes)

Time Series Evidence

- Times series regression evidence on short-term effects of intervention is mixed.
  - Exchange rates sometimes move in the opposite direction from where central banks hope they will.
  - Longer-term movements in the exchange rates largely, however, seem to conform to central bank objectives (hard to make a causal case for this econometrically)

Central Bank Reaction Functions

- Rationales for intervention operations:
  - To influence trend movements in exchange rates
  - To calm "disorderly market conditions"
  - To rebalance or build foreign exchange reserve holdings
  - To support fellow central banks in their exchange rate operations
  - (Recent addition) To stabilize financial markets

Central Bank Reaction Functions

- Empirical evidence: very poor regression goodness of fit, in turn, suggesting that central bank objectives are difficult to quantify.
- Policies do seem to be ***episodic***: frequent interventions in some periods and then none in other periods (even when external circumstances repeat themselves).
- Operations largely "lean against the wind" to react against deviations from targets.

Profitability of Interventions

- Friedman's (1953) view: a central bank which is successful in stabilizing the exchange rate should make a profit at the expense of speculators, suggesting that unprofitable interventions are ineffective.
- Edison (1993) and others show, however, that profitable interventions may have no influence on exchange rates, suggesting that this criteria is flawed.
- Empirical evidence suggests that profits vary significantly according to the sample period considered, but generally intervention is profitable.

Intervention and Forex Returns

- It is standard to model exchange rates as forward looking processes that are expectationally efficient with respect to public information.
- Let e represent the spot exchange rate (domestic currency per unit of foreign currency) in log form, δ is the discount factor, z is a vector of exogenous driving variables, and Ω is the public information set. The current spot rate can be represented as:

$$e_t = (1 - \delta) \sum_{k=0}^{\infty} \delta^k E_t(z_{t+k} | \Omega_t)$$

Intervention and Forex Returns

- If intervention operations, denoted I, provide relevant information to the market, then they will enlarge the market's information set ($\Omega < \Omega + I$) and influence the spot exchange rate
  - For example, if a central bank intervention in support of the domestic currency "signals" future contractionary domestic monetary policy, the domestic currency will appreciate relative to the foreign currency (where, in this example, *I* represents an official purchase of domestic assets)

$$e_t = (1-\delta)\sum_{k=0}^{\infty}\delta^k E_t(z_{t+k}\,|\,\Omega_t) > (1-\delta)\sum_{k=0}^{\infty}\delta^k E_t(z_{t+k}\,|\,\Omega_t + I_t)$$

Roles of Credibility and Ambiguity

(Expected influence of an intervention in support of the domestic currency)

$\Delta s_t \mid I_t$ $var[\Delta s_t \mid I_t]$		EXCHANGE MARKET EFFICIENCY	
		s_t Efficient	s_t Inefficient
NATURE OF INTERVENTION SIGNAL	I_t Credible and Unambiguous	$\Delta s_t \mid I_t < 0$ $var[\Delta s_t \mid I_t] = 0$	$\Delta s_t \mid I_t < 0$ or $= 0$ $var[\Delta s_t \mid I_t] > 0$
	I_t Not Credible or Ambiguous	$\Delta s_t \mid I_t > 0$ or $= 0$ $var[\Delta s_t \mid I_t] > 0$	$\Delta s_t \mid I_t > 0$ or $= 0$ $var[\Delta s_t \mid I_t] > 0$

Unrequited Interventions

- When traders first learn of an intervention operation over the newswires, they may not know whether the information is substantiated or not.
- It is therefore possible for all intervention news (whether actual, false or unrequited) to have a short-term impact on exchange rates via the signaling channel.
- As soon as traders learn that intervention news is false or unrequited then we might expect returns and volatility to revert to their original levels.
- Alternatively, it may be that in periods when interventions are expected (even if they do not occur) that unrequited interventions serve to coordinate the market's view of exchange rate movements.

Unrequited Interventions

- In a study (co-authored with Freyan Panthaki)* we find that G3 unrequited intervention news (and even news of "no intervention") has a statistically significant influence on intra-day (usd-yen and usd-euro) exchange rate returns and volatility, suggesting that the expectation of intervention, even when governments (Japan and the Euro-zone) do not intervene, can affect currency values.
- It is not clear whether these results would also hold for developing countries where currency markets are less deep and the credibility of "news" (including government statements) may be lower.

*Dominguez, K. and F. Panthaki, "The Influence of Actual and Unrequited Interventions," International Journal of Finance and Economics, 12, 2007, 171-200.

Time-Series (IV) estimates of the effects of AE Interventions

- Dominguez and Frankel (1993) find that a $100 million purchase by the Fed leads to a 1.6% appreciation of the dollar
- Kearns and Rigobon (2005) find that a $100 million purchase of AUD by the Australian Central Bank leads to a 1.8% appreciation of the AUD, and a Bank of Japan purchase of $100 million JPY leads to a .2% appreciation of the JPY.

Event Study Approach

- Let *R* denote the exchange rate return series and *I* denote the signed intervention variables, then a general "event study" regression specification allows for tests for the impact and lagged effects of intervention (and other macro news)
- The specification can be adjusted to test whether market participants react to the intervention operations of different central banks similarly by including these operations separately in the regression.
- The possibility that certain market participants know about the interventions before others can be tested by looking for evidence of lead effects.
- In order to investigate the persistence of intervention's influence, a test for mean reversion can be constructed by checking whether the time lags on the *I*s sum to zero.

$$R_{t_i} - \overline{R_{t_i}} = \alpha_0 + \sum_k \sum_n \alpha_{1,n}^k I_{t_{i+n}}^k + \varepsilon_{t_i}$$

AE Event Study Evidence

- G3 intervention operations significantly influenced returns:
  - The identity of the intervening central bank matters, in that equal-sized operations across different banks have different effects.
  - The presence of a central bank in the market matters more than the size of the operation.
  - Initial interventions have larger effects than subsequent operations in the same episode.
  - There is evidence of mean reversion in returns subsequent to G3 interventions suggesting some initial over-reaction by the market.

BIS EME Project Results: Intraday Evidence during the GFC

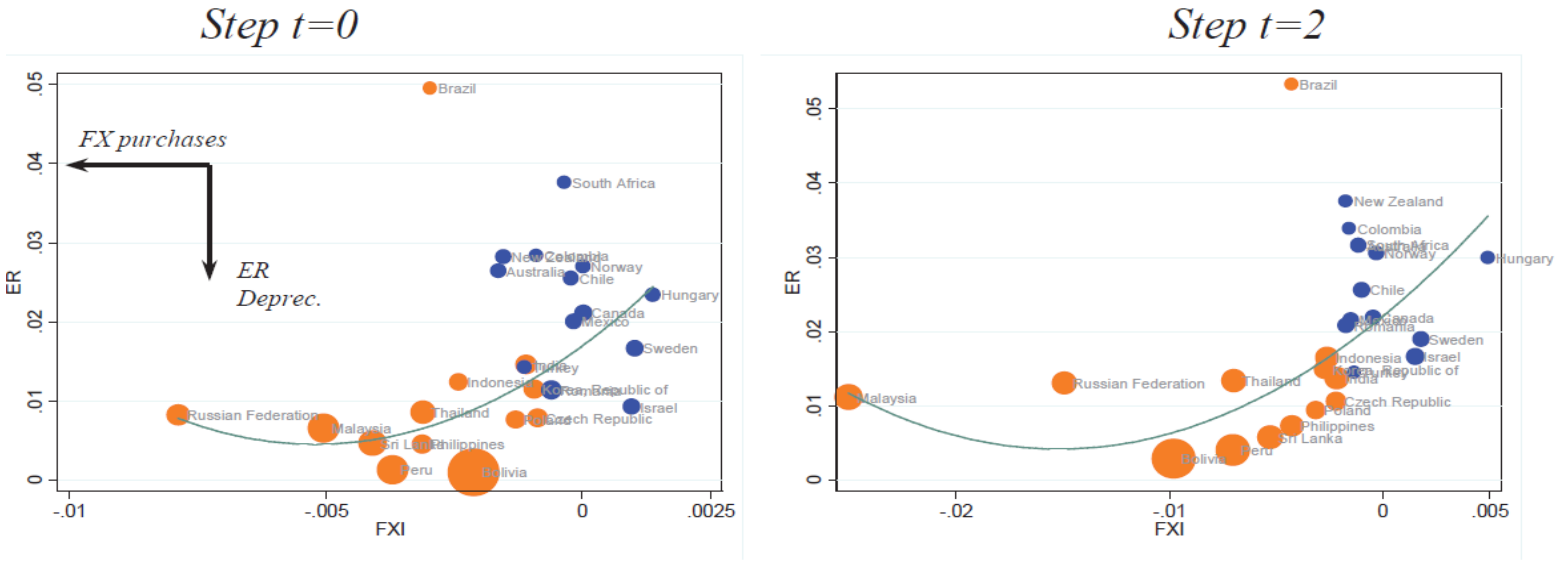
- Country Samples: Chile (2008-11) , Colombia (2007-11), Mexico (2008-11) and Peru (2009-11)
- Instruments used: Chile (daily reserve accumulation), Colombia (pre-announced dollar purchases of $20m per day), Mexico (min price and no min price dollar auctions), Peru (discretionary purchases and sales of dollars).
- Relative size of daily operations to daily market turnover: Chile (1.4%), Colombia (2.4%), Mexico (0.02%), Peru (31%).
- Empirical Tests: event-study style regressions of returns, volatility and turnover (Colombia) on intervention and controls for US macro surprises and a volatility seasonal
- Results: responses to US macro surprises were significant for all countries; rules-based interventions had little effect on returns or volatility (in keeping with objectives), Peru's discretionary operations had significant effects on returns.

AE Intra-day Effects of Intervention

- Dominguez (2003, 2006) examines the influence of G3 interventions on intraday returns and volatility over a seven year period and finds evidence of significant lead and impact effects.
- Cai et al. (2001) and Chang and Taylor (1998) find evidence of positive lead and impact effects of Japanese interventions on yen-usd volatility.
- Fischer and Zurlinden (1999), Fischer (2003), and Payne and Vitale (2003) all examine different aspects of the SNB data and generally find evidence of significant lead and impact effects of interventions on Swiss Franc returns and volatility

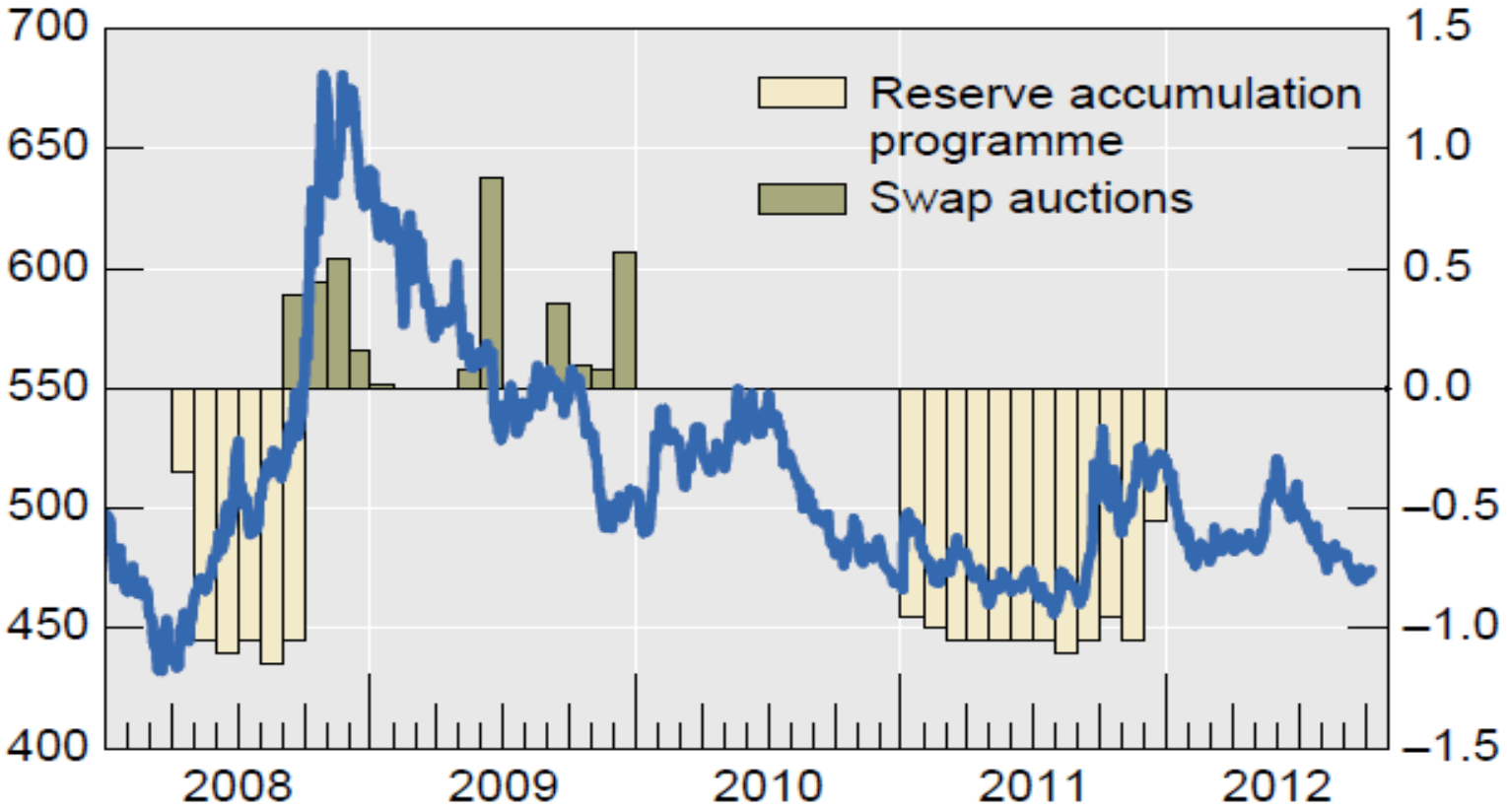
Cross-Section Evidence

- Blanchard, O., G. Adler, I. de Carvalho Filho, "Can Foreign Exchange Intervention Stem Exchange Rate Pressures from Global Capital Flow Shocks?" NBER WP 21427, July 2015.
- Approach: examine the effects of cross-country FXI responses to (exogenous) global capital inflows



Note: Cumulative FXI (in percent of annual GDP) and average ER responses at t=0 and t=2; Circles are inversely proportional to the standard deviation of the ER response. Floaters are colored blue; interveners are colored orange. The line illustrates a (weighted) quadratic fit.

Central Bank of Chile Operations



Peso/USD Movement Around April 10, 2008 Announcement

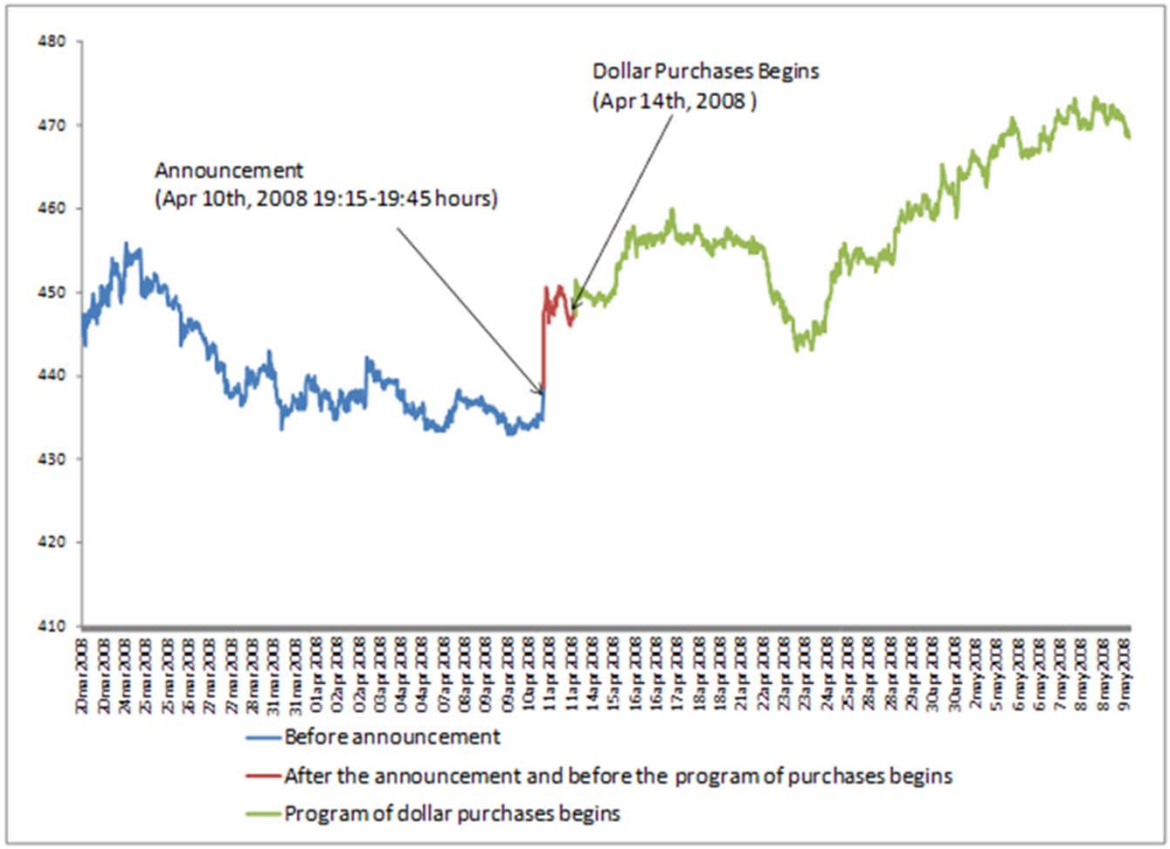


Figure 15 in P. Pincheira "Interventions and Inflation Expectations in an Inflation Targeting Economy," Central Bank of Chile, May 2013

Peso/USD Movement Around Jan 5, 2011 Announcement

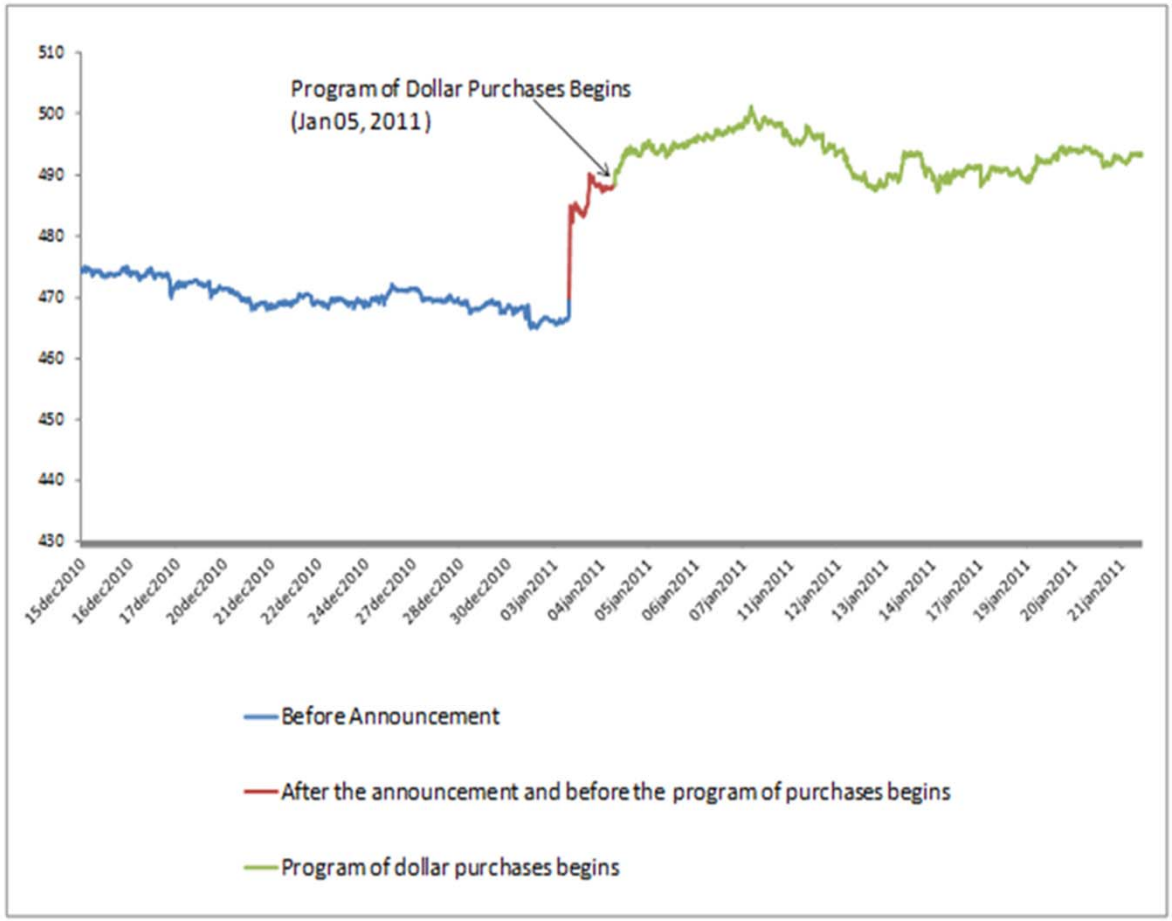


Figure 17 in P. Pincheira "Interventions and Inflation Expectations in an Inflation Targeting Economy," Central Bank of Chile, May 2013

Regression Discontinuity Approach

- Appropriate for cases where intervention policy is based on a cut-off rule that creates a localized quasi-experiment.
  - Allows identification of the impact of intervention by comparing days where the cut-off for triggering the rule is just met or just missed.
  - Idea is that the variation near the cut-off is (almost) randomly generated.
- Example of this type of rule-based policy: intervene whenever the nominal exchange rate exceeds a specific value or band.
- Kuersteiner, G., D. Phillips, M. Villamizar-Villegas, "Effective sterilized foreign exchange intervention? Evidence from a rule-based policy," Journal of International Economics, 113, 2018, 118-138.
  - Use this methodology to examine the effects of interventions by the Central Bank of Colombia from 2001 to 2012.

Counterfactual Matching Approach

- Involves constructing a synthetic control group that provides counterfactual exchange rate changes that can be compared to the exchange rate changes resulting from a specific intervention event.
- This methodology is not appropriate for studying the effect of frequent interventions, but it is well suited for an event-study setting where a large change in intervention policy is announced.
- The counterfactual uses data from other countries, with weights that are based on the pre-announcement co-movement with the currency of interest.
- If the intervention is in response to a common external shock the results may underestimate the true effect of the intervention program if some of the countries in the counterfactual group also intervened or put in place other policy responses to the shock.

Data and Evidence

- Daily operations
- Interventions in Derivative Markets
  - Case Study: Brazil
- Reserve Accumulation and De-accumulation

Recent Evidence on Intervention

- Foreign exchange intervention polices are widely used, both by countries that self-describe as floaters and countries that explicitly manage the value of their exchange rate (within broad and narrow bands).
- Survey evidence indicates that Central Banks believe that interventions are effective (at influencing currency values and trends).
- Intervention operations are most often used during turbulent periods, when market volatility is high, when countries experience unusually large capital inflows or outflows, when exchange rates move dramatically.

Intervention Descriptive Statistics

Indicator	Total	Free Floaters	Broad bands	Narrow Bands	Other
Number of country-regime observations[a]	43	6	14	17	6
Trading days covered	113,842	19,330	41,604	42,961	9,947
Share of days with FX intervention	19.1%	7.3%	9.3%	33.6%	20.7%
Share of these with FX purchase	76.1%	94.8%	73.5%	73.2%	63.6%
Share of these with FX sale	23.9%	5.2%	26.5%	26.8%	36.4%
Average daily volume on intervention day in million USD	44.3	59.2	42.7	27.1	157.7
Average daily volume of FX purchases in million USD	44.4	52.7	45.8	24.9	190.6
Average daily volume of FX sales in million USD	44.1	177.1	34.2	33.3	100.2
Average daily intervention size as share of GDP	0.05%	0.02%	0.03%	0.05%	0.10%
Average daily intervention size as share of daily traded fx volume[b]	4.6%	1.0%	5.2%	5.1%	6.5%
FX purchasing episodes[c]	2,388	70	551	1,491	276
FX sale episodes[c]	2,161	25	511	1,402	223
Average length of episode in days	4.5	9.2	3.5	4.8	4.4
Share of intervention episodes leaning with the wind	35.5%	25.3%	47.1%	33.3%	25.6%
Share of intervention episodes towards the fundamental	48.0%	40.0%	48.8%	48.2%	46.6%
Trading days covered in turbulent times	5,638	949	1,975	2,178	536
Share of days with FX intervention in turbulent times	22.5%	2.7%	9.2%	43.5%	20.7%

Time Period: 1995-2011; Countries: Argentina, Australia, Azerbaijan, Bolivia, Canada, Chile, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, EMU, Georgia, Hong Kong, Iceland, Israel, Japan, Kenya, Kyrgyzstan, Mexico, Moldova, New Zealand, Norway, Peru, Poland, Slovakia, South Africa, Sweden, Switzerland, Turkey, UK, US, and Venezuela.
Source: Fratzscher, M., O. Gloede, L. Menkhoff, L. Sarno, and T. Stöhr, "When Is Foreign Exchange Intervention Effective? Evidence from 33 Countries," American Economic Journal: Macroeconomics 2019, 11(1): 132–156. Table 2 on page 139.

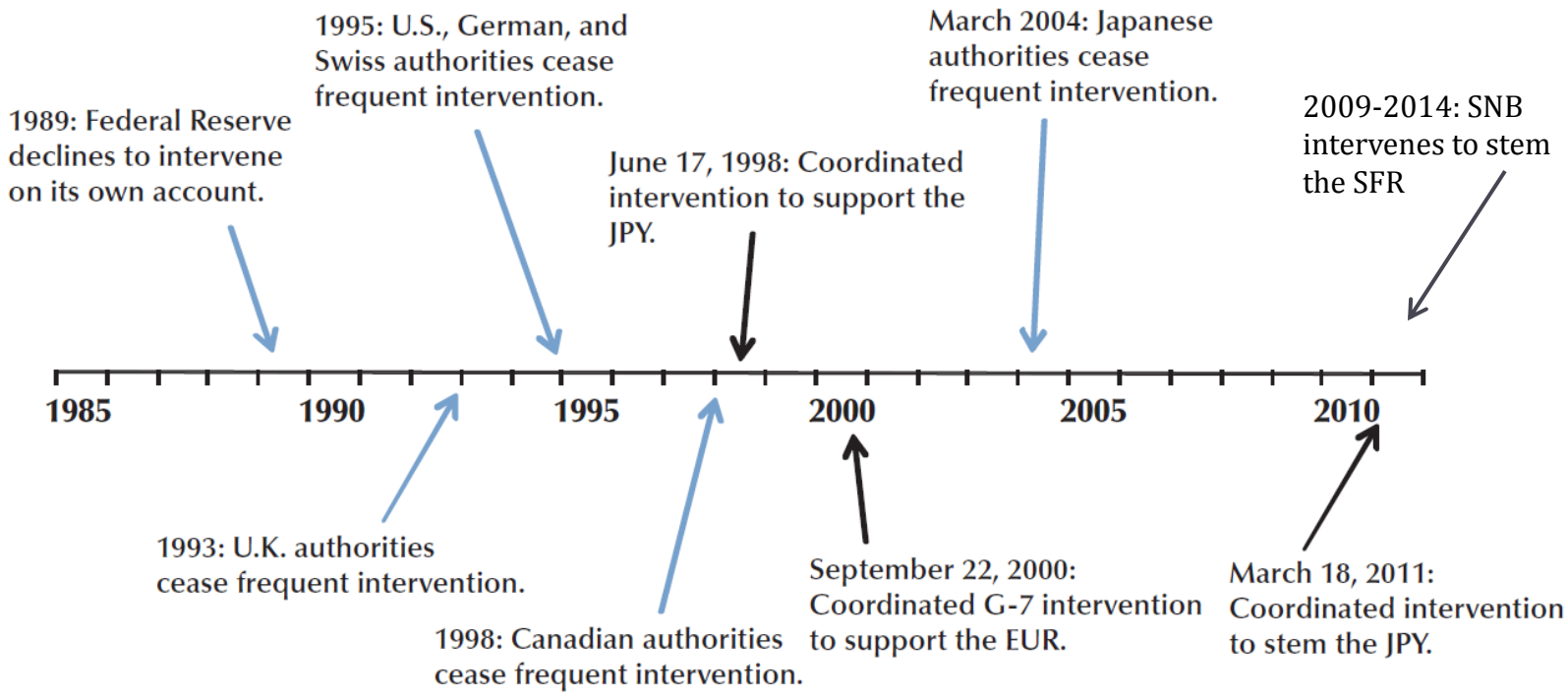
Daily Intervention Data

(http://research.stlouisfed.org/fred2/categories/32145?ob=lu&od=desc)

- Available via FRED:
  - Australia (1983-2006)
  - German (1976-1995)
  - Italy (1988-1998)
  - Japan (1991-2018)
  - Mexico (1997-2011)
  - Switzerland (1975-2001)
  - Turkey (2002-2019)
  - United States (1973-2003)
- Central Bank websites: Argentina, Chile, Georgia, Kyrgyz Rep., UK.

AEs Intervene Infrequently

Timeline of G-7 (and Swiss) Intervention Practices



EME Interventions

- A number of recent studies focus on intervention policy strategies of EMEs, during the exchange rate crises in the 1990s, during the global financial crisis, and as policy responses to recent AE policy changes.
- Although the AEs tend to intervene exclusively in the spot market, many EME countries intervene in derivative markets.
  - First Mover: Bank of Spain sold put options on the peseta to fight devaluation pressures during 1993.
  - Bank of Thailand used forward market purchases to shore up the baht in 1997.
  - Bank of Mexico sold put options on the usd to accumulate dollar reserves in the 1990s.
  - Other Latin American countries in the 1990s: Chile, Brazil, Peru
  - More recently a growing list of EMEs: Brazil, Colombia, India, Indonesia, Mexico, South Africa and Thailand

Brazil (during GFC)

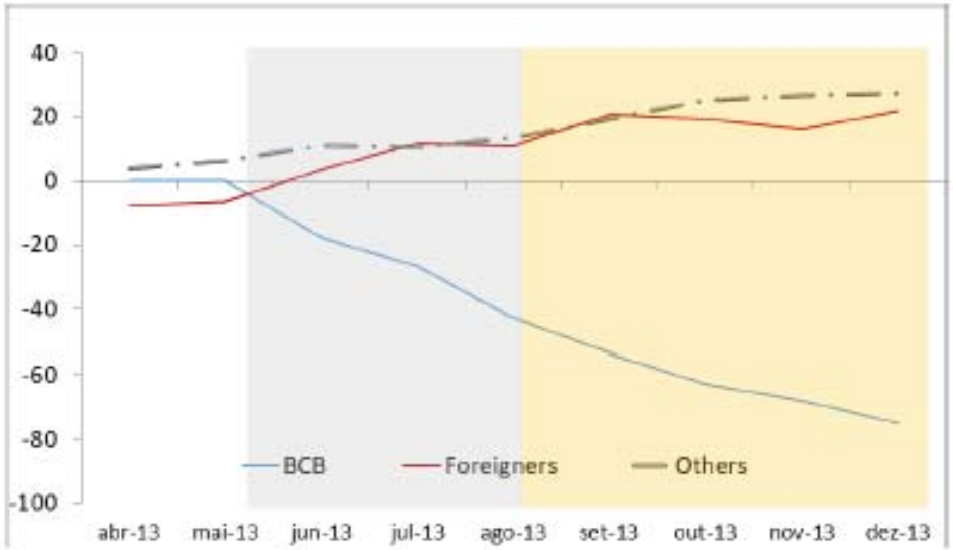
- During the Global financial Crisis the Brazilian Central Bank used a combination of: swaps, spot market auctions, repo market auctions, trade finance loans and forward market auctions to stabilize the BRL.
- Kohlscheen and Andrade (2014) find that the currency swaps carried out in the 2nd half of 2011 and during 2012 had a significant effect on the BRL/USD rate.
  - Kohlscheen, E., and S. Andrade, 2014, "Official FX Interventions Through Derivatives," Journal of International Money and Finance, Vol. 47, pp. 202–16.

Brazil (2013-2018)

- Brazil's BCB implemented the largest ever intervention program in the FX derivatives market in August 2013 (initially to counter-act capital outflows and BRL depreciation during the "Taper Tantrum")
- The open positions of the BCB in these derivatives summed to 7% of the Brazilian GDP (or 30% of its international reserves) in the peak of the program in 2015.
- This intervention program was considered successful and other EME central banks have recently adopted similar intervention programs (Mexico in February 2017 and Turkey in November 2017).

Brazil (2013)

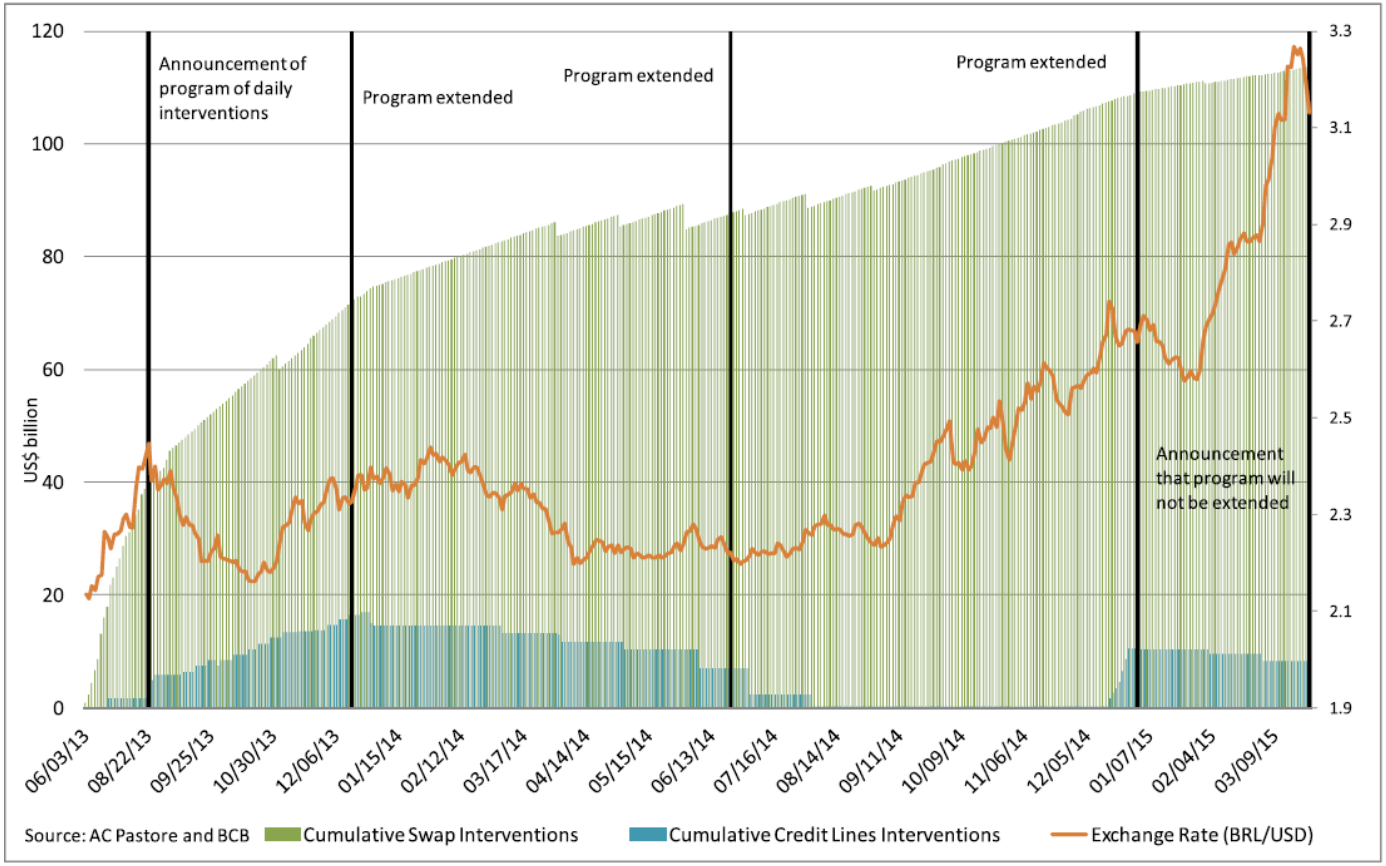
- BCB Objective: serve as a hedger-of-last-resort
- Intervention program: daily sales of USD 500 million worth of currency non-deliverable forwards (USD forwards settled in BRL, also known as BCB swaps).



Source: BMF Bovespa and CETIP. Gray area represents the time window between the tapering speech prior to the swaps program. The yellow are represents the first phase of the program. The values are in billions of BRL.

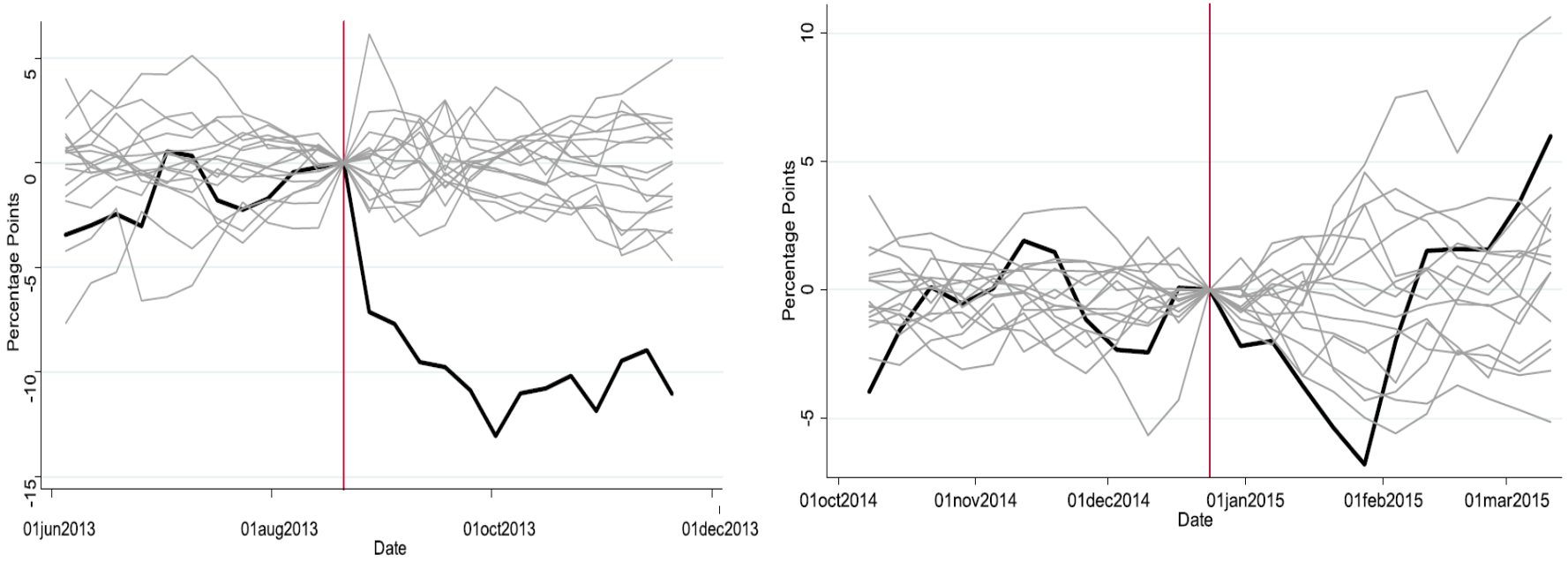
Source: Gonzalez, R., D. Khametshin, J. Peydró, A. Polo, "Hedger of Last Resort: Evidence from Brazilian FX Interventions, Local Credit, and Global Financial Cycles," CEPR Discussion Paper 12817, 2018, figure 2 page 28.

BCB Program announcements and extensions



Source: Chamon, M., M. Garcia, and L. Souza, "FX interventions in Brazil: a synthetic control approach". Journal of International Economics, 108, 2017, 157-168, figure 1 on page 159.

Lessons from Brazil: 2013 vs 2015



Chamon et al (2017): figures show the impacts of the first BCB announcement of the intervention program, and the announcement of the last extension of the program, on the level of the exchange rate and placebo tests using data from other countries as the counterfactual. LHS figure shows a sizable response of the exchange rate following the first announcement, but subsequent announcements of program extensions (as shown in RHS figure) do not show similar impacts.

Different Approaches to Intervention

- Brazil: discretionary operations, reported on BCB's website one week after the operation since Sept 2008; 2013-2015 daily sales of NDF contracts.
- Chile: pre-announced daily dollar purchases of USD 50m (discretionary intra-day timing)
- Colombia: 3-minute Dutch auctions of dollars, sales of USD 20m per day, discretionary timing: auctions announced 2 minutes in advance, unsold dollars are carried forward to the next day
- Mexico: auctions of dollars with a minimum price, 3 times daily at pre-announced times and daily amounts, bids made public at the end of each auction (auctions last 5min); discontinued in February 2016; February 2017 new auction with contracts similar to non-deliverable forwards that pay in pesos.
- Peru: discretionary operations, announced at start of intervention trades, amounts published daily at market close.

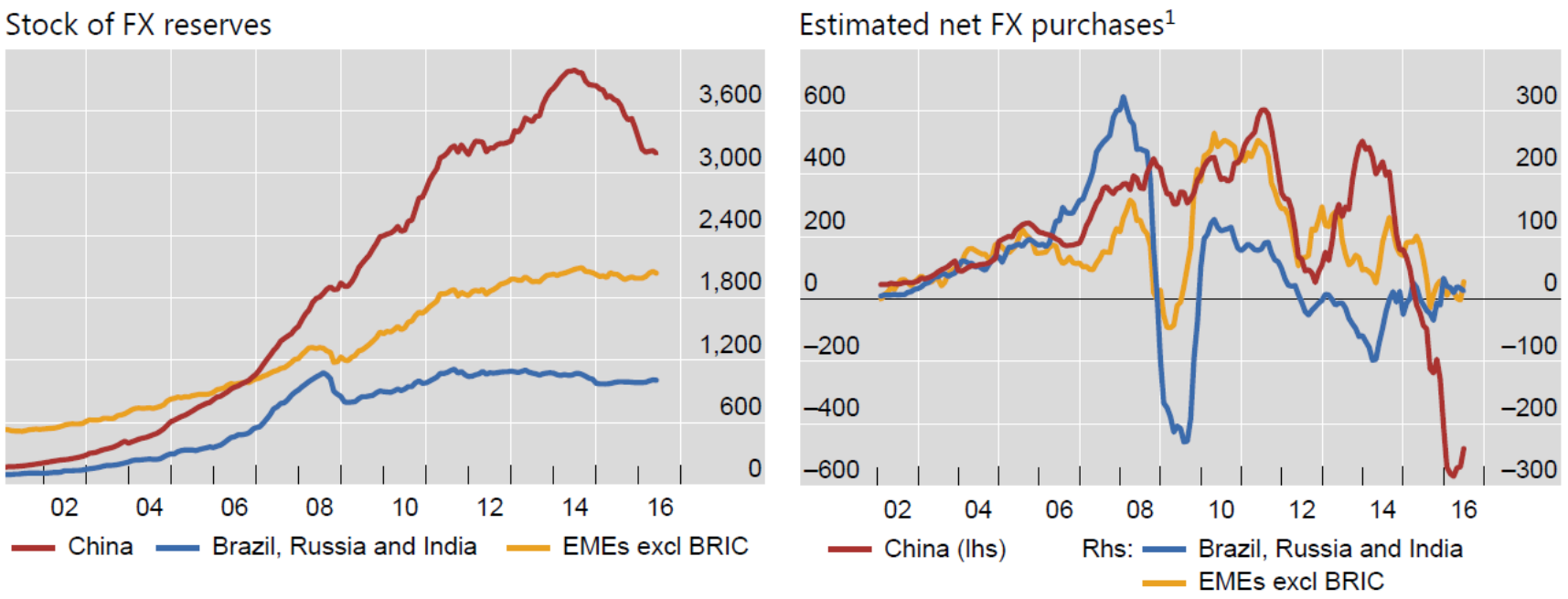
Spot and Derivative Instruments Used for Intervention

Instrument	Mechanism	Effects			Examples
		Provide hedge for FX exposure	Support FX market liquidity	Economise on use of FX reserves	
FX spot transaction	Central bank sells FX spot	Yes	Yes	No	
FX swap or FX repo	Central bank sells FX spot and purchases FX forward	Yes, against market risk or FX maturity mismatch	Possibly	Yes; only temporary supply of FX	Korea (FX swap), Brazil and Russia (FX repo)
Currency forward (non-deliverable, settled in local currency)[1]	Central bank pays domestic currency related to change in FX value	Domestic currency payment offsetting FX valuation losses	Possibly, if FX demand declines	Yes; no foreign currency payment	Brazil, Peru
FX index certificate	Central bank pays domestic currency equivalent of change in FX value	Domestic currency payment offsetting FX valuation losses	Possibly, if FX demand declines	Yes; no foreign currency payment	Peru
FX options	Central bank sells options to buy FX from its reserves if local currency depreciation exceeds threshold	Yes	Yes; supplies liquidity when demand for FX increases	Yes, partly. FX reserves sold only when market initiates purchases (ie options are exercised)	Colombia

Source: Domanski, D., E. Kohlscheen, and R. Moreno (2016). "Foreign exchange market intervention in EMEs: what has changed?," Bank for International Settlements (BIS) Quarterly Review, September, Table 2 on page 71.

Reserve Accumulation and Intervention:

(changes in reserves may overstate the size of FXI due to valuation effects)

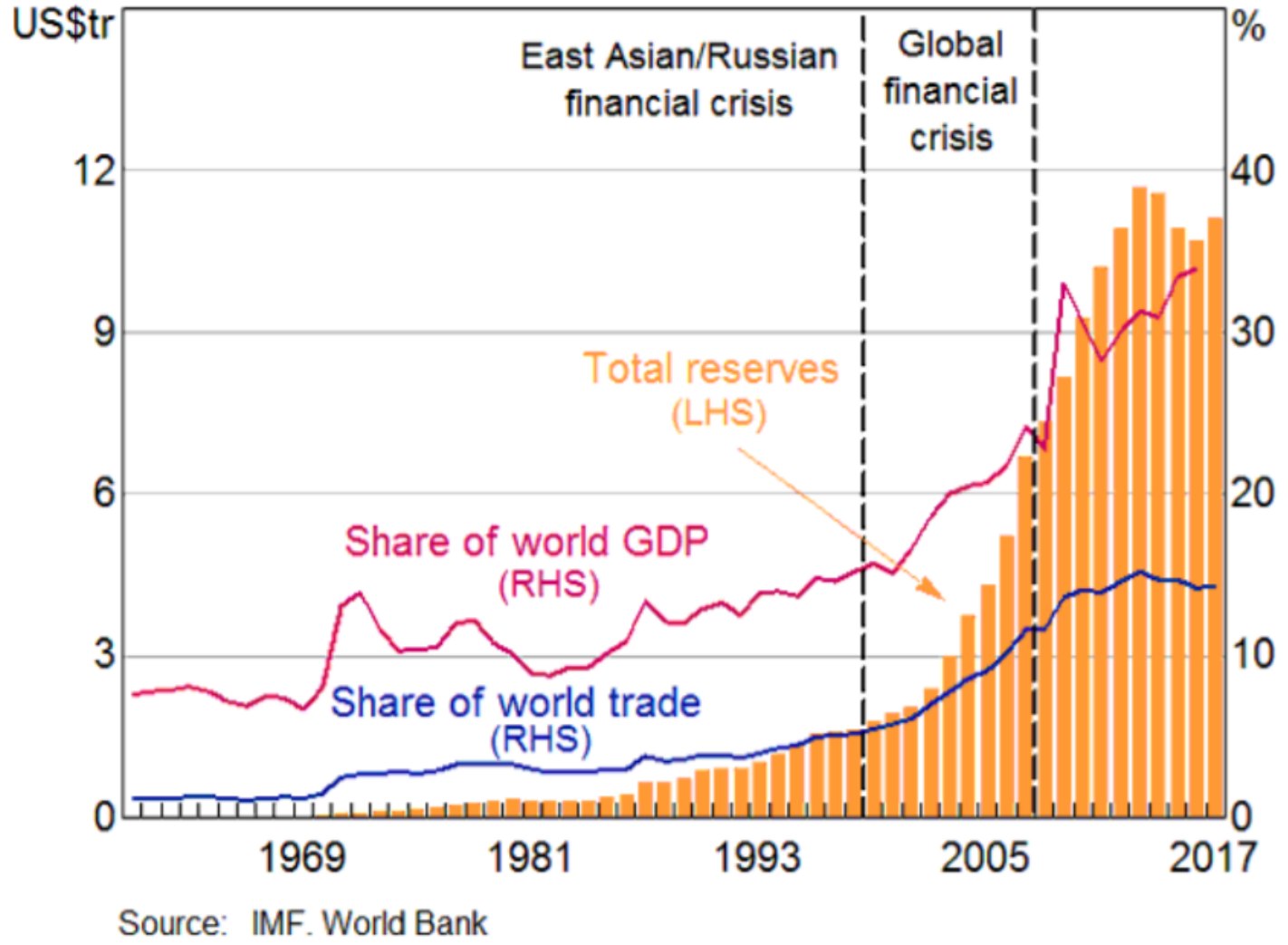


[1] Twelve-month moving sums. Based on actual intervention data whenever available; otherwise based on reserve variation net of valuation effects. Valuation gains and losses were computed based on the average currency composition for EMEs.

Sources: IMF, *Data Template on International Reserves and Foreign Currency Liquidity* and *International Financial Statistics*; national data; authors' calculations.

Source: Domanski, D., E. Kohlscheen, and R. Moreno (2016). "Foreign exchange market intervention in EMEs: what has changed?," Bank for International Settlements (BIS) Quarterly Review, September, Figure 1 on page 66.

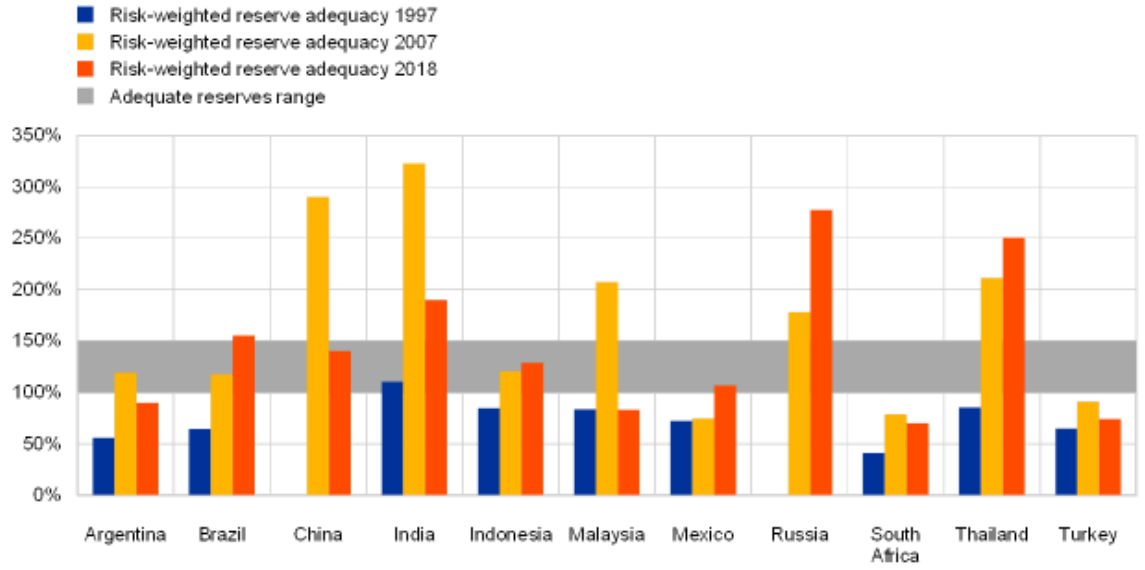
Global Foreign Reserve Holdings



Source: IMF. World Bank

Adequacy of Reserves in EMEs

(percentages)



Sources: IMF and ECB staff calculations.
Notes: Reserve adequacy is computed on the basis of the IMF risk-weighted methodology, i.e. as a function of exports (to capture potential losses of reserves due to a drop in external demand or to a terms-of-trade shock), short and long-term debt (as a measure of interest payments and rollover risk) and broad money (as a measure of the scope for capital flight). The measure accounts for the exchange rate regime and capital account openness. A metric between 100% and 150% indicates that reserves are adequate. Owing to unavailability of data on short-term debt on a remaining maturity basis, the data shown for 1997 for Brazil, Indonesia, Mexico, Turkey and Malaysia are actually for 2001, 2001, 2001, 1999 and 2001, respectively.

US Treasury Monitoring of (Excessive) Reserve Accumulation

	FX Reserves (% of GDP)	FX Reserves (% of ST debt)	FX Reserves (months of imports)
Switzerland	107%	68%	24.3
Taiwan	78%	257%	16.9
Korea	24%	324%	7.9
Japan	24%	42%	16.7
China	23%	279%	16.1
Brazil	18%	606%	19.4
India	14%	373%	7.9
Mexico	14%	331%	4.3
UK	4%	2%	1.8
Canada	4%	11%	1.5
Italy	2%	4%	0.8
France	2%	2%	0.7
Germany	1%	2%	0.3

Foreign exchange reserves as of Jun 2018.
Sum of rolling 4Q GDP through Q2-2018.
Short-term debt consists of gross external debt with original maturity of one year or less, as of the end of Q1-2018.
Sum of rolling 4Q imports of goods and services through Q1-2018.
Sources: National Authorities, World Bank, IMF

Source: October 2018 US Treasury Report, page 16

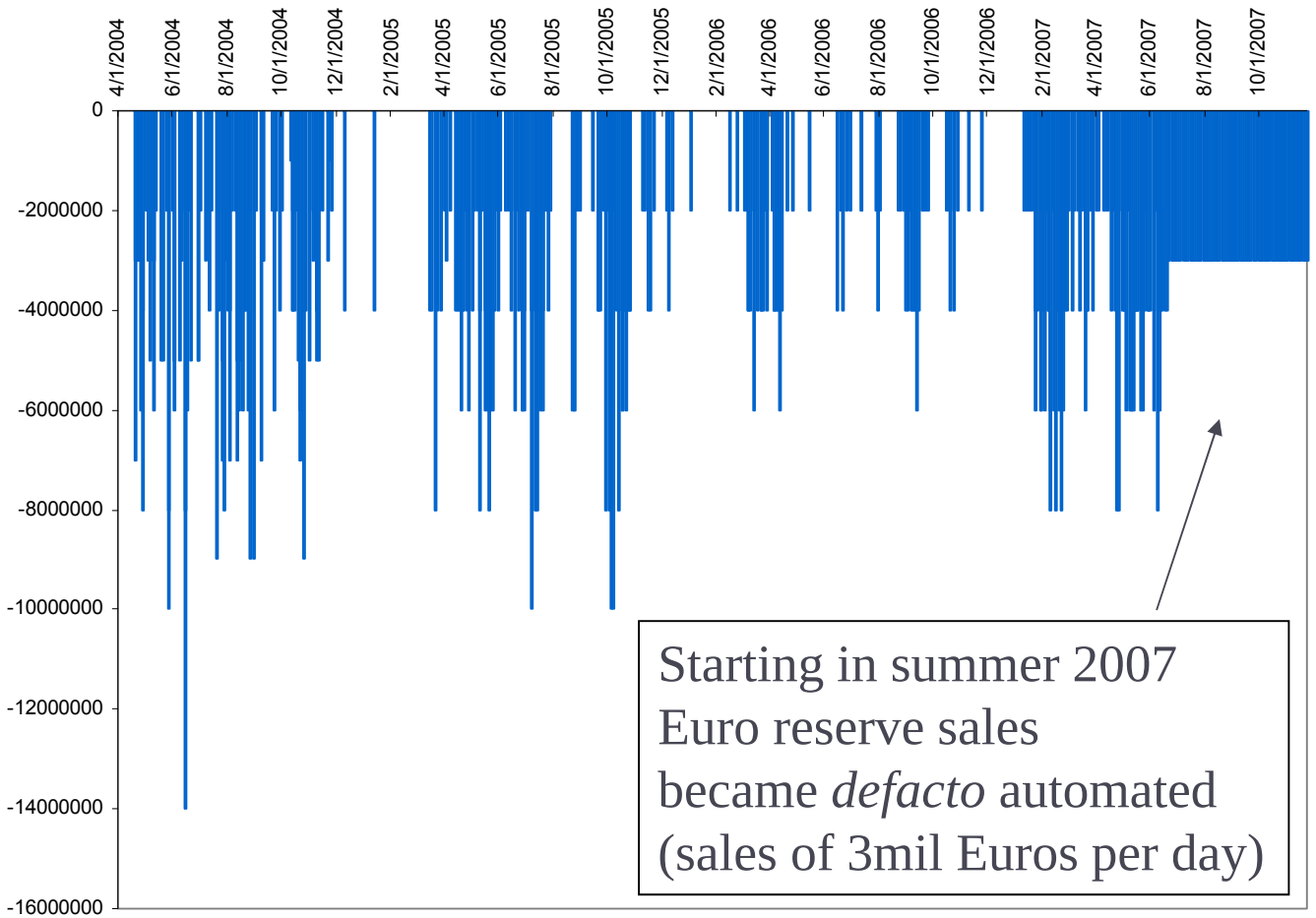
Do Sales of Foreign Exchange Reserves Lead to Currency Appreciation?

- Dominguez, Fatum and Vacek, in JMCB (2013)
- Case Study: Czech National Bank (CNB) Euro sales April 2004-2007
- CNB Objective: reduce euro reserves without influencing (appreciating) the CZK relative to the Euro

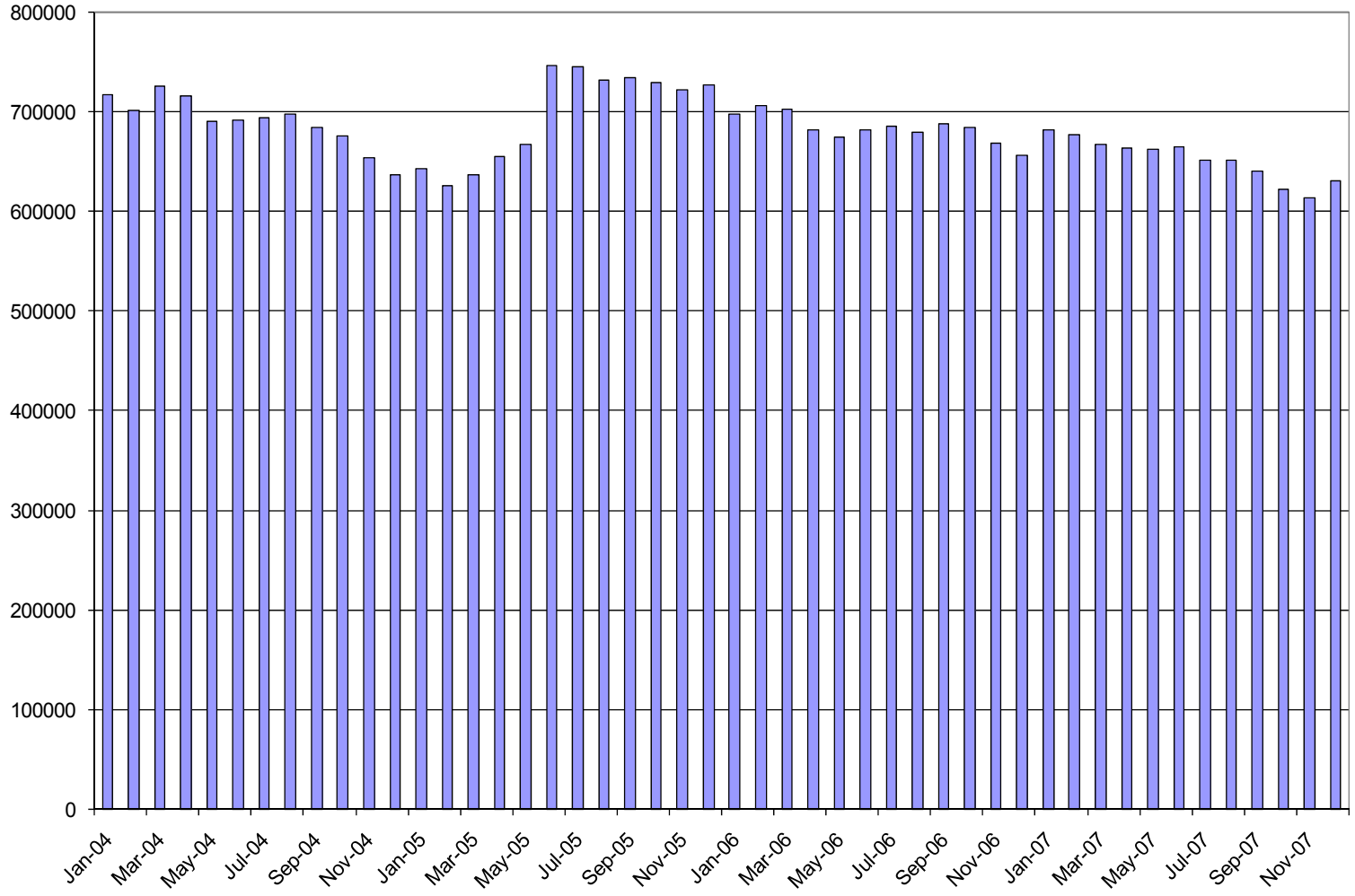
Do Sales of Foreign Exchange Reserves Lead to Currency Appreciation?

- While reserve accumulation in some countries is thought to be the byproduct of a government strategy to keep the international value of the domestic currency low in order to boost export growth, ***does it follow that reserve sales lead to domestic currency appreciation***?
- We test this hypothesis using unique intraday data on recent euro-denominated reserve sales by the Czech National Bank (CNB).

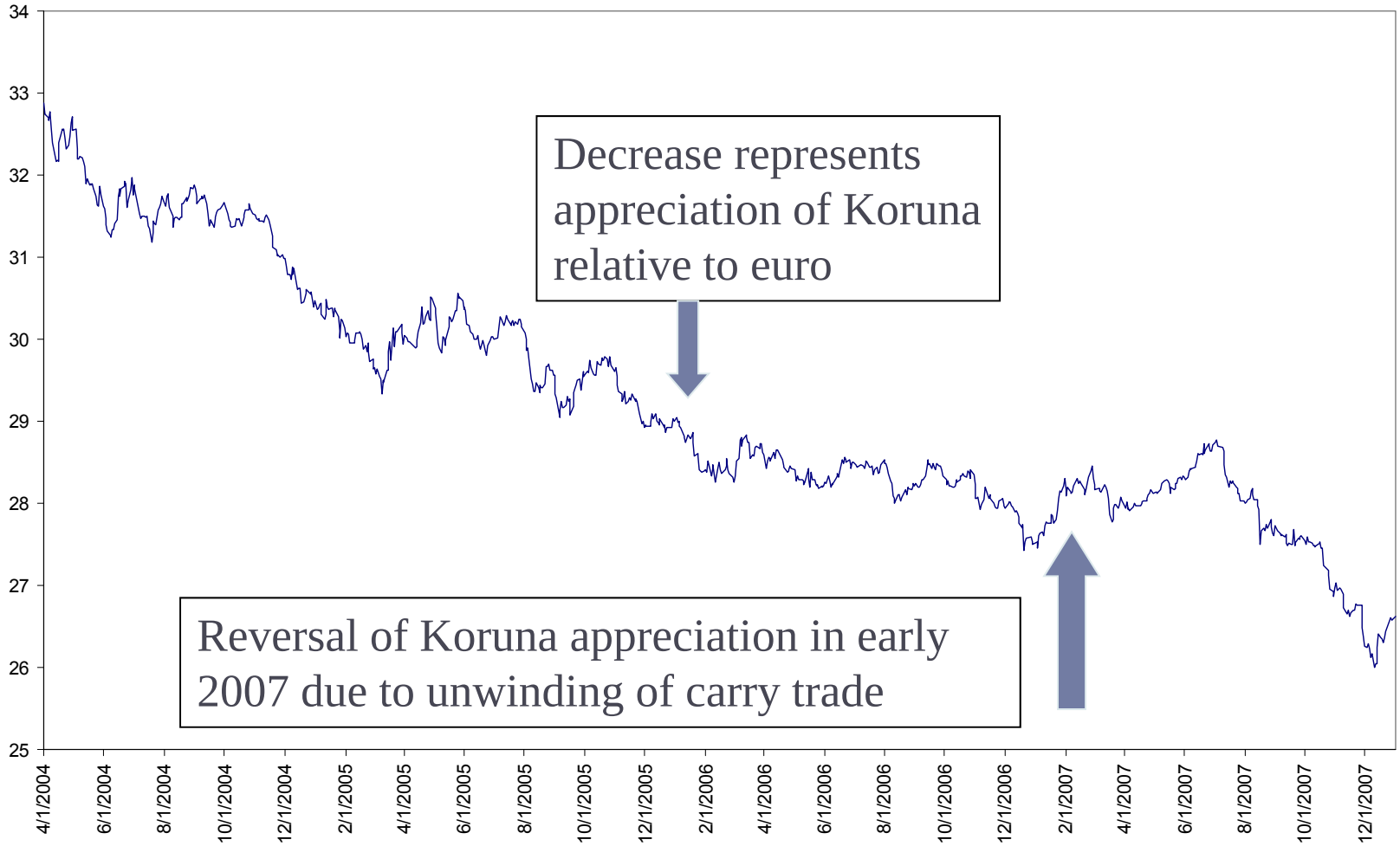
CNB Reserve (Euro) Sales



Czech Republic Forex Reserves (millions of koruna, 2004-2007)



Koruna-Euro Rate (April 2004-2007)



CNB Reserve Sales

- We find little evidence that reserve sales influenced the exchange rate when sales are carried out on a discretionary basis.
- By contrast, our results show that when these sales are carried out in a rules-based manner – identical amounts sold every business day – a significant appreciation of the domestic currency follows.
- The economic significance of this appreciation is not negligible.

Effects of CNB Reserve Sales

- Our estimates suggest that the effect of a daily sale by the Czech National Bank of €100 million in foreign reserves led to a .7% appreciation of the koruna relative to the euro in 2007.
- Our estimates of the effects of reserve decumulation by the Czech authorities are qualitatively similar to estimates in the literature of the effects of intervention in currency markets, even though the CNB explicitly did not intend to influence the value of the koruna with these operations.

Russian Central Bank Intervention

Study by Melvin, Menkhoff and Schmeling (JIE, 2010)

- Unique type of (automated) intervention: involves placing limit orders on an electronic limit order book to set an upper bound on the rouble price of a dollar
- Analysis covers 5 days of interventions in March 2002

Melvin, Menkhoff and Schmeling: Results

- Russian interventions increased exchange rate volatility (and spread) for the next few minutes, but *lowered* the degree of volatility over the day (compared to non-intervention days).
- Case study suggests that countries with large reserves *and* capital controls can implement a stabilizing crawling exchange rate band using strategic limit orders in electronic currency markets.

EME Intervention Policy Issues

- Does intervention affect the credibility of inflation-targeting?
- Should intervention be discretionary or follow rules? If rules, what kind of rules?
- What should guide the decision between spot versus forward (or other derivative) intervention instruments?
- Should CBs provide targeted FX provision to specific banks or engage in open-market FX intervention?
- Under what conditions is it appropriate to deploy intervention and capital controls jointly?

Rationale for FXI: Sudden/Large FX Movements May Impede Inflation-Targeting

- High pass-through of shocks to import prices may substantially impact inflation
  - If shocks are expected to be temporary they may provide incentives for FXI
- Different countries view the competing objectives differently: Brazil v Chile
  - both inflation-target
  - Brazil experiences large exchange rate movements and is an active intervener
  - Chile focuses more on inflation-targeting, FXI program is relatively small and rules-based

Should FX Intervention be discretionary or follow rules? If rules, what kind of rules?

- Rationale of rule-based systems:
  - signals that any change in foreign reserves will be limited and predictable
  - indicates no explicit intention to target the exchange rate
- Chile and Colombia: follow rules-based programs of pre-announced daily purchases of FX
- Mexico announced conditions under which it would intervene using rule-based auctions involving sales of $200 million per day – idea was to provide liquidity if needed.
  - scheme was abandoned in 2016 due to the perceived incentives it gave to speculators

What should guide the decision between spot versus forward intervention instruments? (or other derivatives)

- Using derivative markets allows CBs to:
  - provide hedges against FX risk
  - influence derivative market liquidity (improve spot/derivative market arbitrage)
  - may limit use of FX reserves if settled in local currency
- Brazil: has regularly used FX swaps (effectively NDFs) since 2002, key advantages:
  - settled in local currency: no direct impact on foreign reserves
  - less attractive/effective than spot FXI the higher is convertibility risk
  - fills market gap in longer term derivative instruments (serves as risk management insurance)

Spot v Forward FXI

- Intertemporal considerations:
  - Spot FXI: immediate FX provision
  - Forward FXI: provide FX at a pre-defined future point in time
  - Option-based FXI: provide FX during a certain, pre-specified period – thought to provide protection against large FX moves.
  - Repo and Swap-based FXI: provide FX for the duration of the repo or swap, providing a hedge against maturity mismatches in FX.

Should CBs provide targeted FX provision to specific banks or engage in open-market FX intervention?

- Systemically Important Banks (SIFIs) may require targeted FX provision under specific circumstances
- Even if FX provision facilities are not "targeted" bank take-up unlikely to be uniform
- Issue: targeted provision could be perceived as discriminatory (WTO compliant?)

Under what conditions is it appropriate to deploy FX intervention and CFM jointly?

- Capital flow management (CFM) may increase the efficacy of sterilized FXI by reducing foreign and domestic asset substitutability
- In the post GFC period EME firms are issuing more foreign-currency denominated debt, while EME sovereign debt is increasingly in local currency (with a larger fraction held by foreigners), implication:
  - Currencies and domestic financing conditions are more exposed to swings in capital flows
  - EMEs may need/want full access to all policy tools given these vulnerabilities
- Compliments or substitutes?
  - FXI is a more flexible policy tool

EME FXI Transparency

- Does transparency matter? Are certain "tactics" more likely to work?
  - There seems to be little consensus on whether (ex post) transparency is a good idea – most EMEs do not publicly provide daily data
  - Less emphasis on intervening during thin markets or in a peripheral part of the market (less intraday timing strategies).
  - Oral interventions (communications rather than financial transactions) less common, but announcements especially of new FXI programs, more common and effective.

When does intervention work?

- Recommendations made in Dominguez and Frankel (1993)
  - Surprise the market
  - Announce the policy (ex post)
  - Coordinate operations with other Central Banks

What circumstances are likely to lead intervention *not* to work?

- *Secrecy:* one of the puzzles in the intervention literature is why central banks often keep their intervention policies secret (even ex post).
  - Secret interventions can, in theory, influence exchange rates via the portfolio balance channel, but knowledge of the operation is essential for the signaling channel to be operative.
- *Policy inconsistency*: FXIs are unlikely to be effective when they are inconsistent with other government policies.
  - FXI in support of the domestic currency are unlikely to be effective if the monetary authority is at the same time pursuing an expansionary monetary policy

When is intervention a useful policy tool?

- During periods when exchange rate movements are at odds with fundamentals.
- When multiple countries believe that a change in a particular currency value is appropriate.
- As a last resort policy tool when more direct methods (monetary policy, fiscal policy, official announcements) have failed to achieve the desired exchange rate objective.
- In times of crisis to calm disorderly markets by reintroducing two-sided risk.

Exchange Rate Stabilization or Manipulation?

- Article IV of the IMF Articles of Agreement
  - Obligations Concerning Exchange Arrangements require that each member shall "avoid manipulating exchange rates or the international monetary system in order to prevent effective balance of payments adjustment or to gain an unfair competitive advantage over other members."

US Treasury Approach
under Omnibus Trade and Competitiveness Act of 1988

- Requires the Secretary of the Treasury to provide biannual reports on the international economic and exchange rate policies of the major trading partners of the United States.
- Under Section 3004 of the Act, the report must consider whether any foreign economy manipulates its rate of exchange against the U.S. dollar to prevent effective balance of payments adjustments or to gain unfair competitive advantage in international trade.

US Treasury Approach
under Trade Facilitation and Trade Enforcement Act of 2015

Currency manipulation criteria:

- bilateral trade surplus with the United States that is at least $20B
- current account surplus of at least 3 percent of GDP
- one-sided intervention (net purchases of foreign currency) conducted repeatedly and totaling at least 2 percent of GDP over a 12 month period

US Treasury Approach
under Trade Facilitation and Trade Enforcement Act of 2015

Monitoring List Criteria:

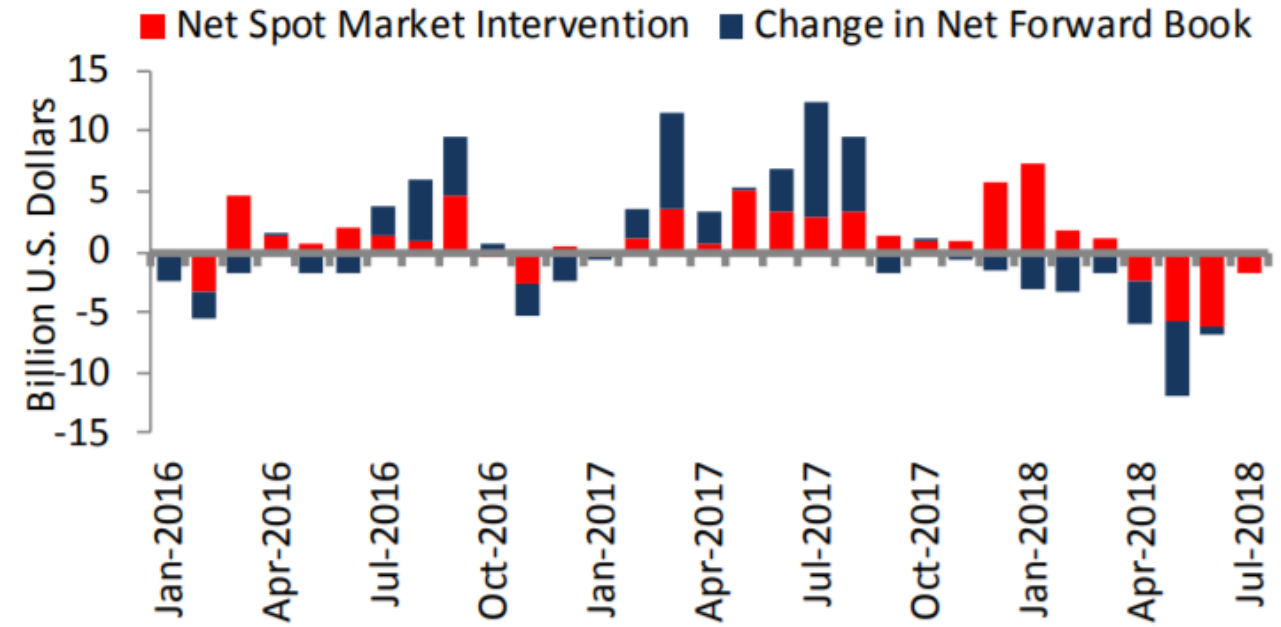
- an economy meeting two of the three manipulation criteria
- once on the Monitoring List, an economy will remain there for at least two consecutive Reports to help ensure that any improvement in performance versus the criteria is durable and is not due to temporary one-off factors
- As an added measure, the current administration will add and retain on the Monitoring List any major trading partner that accounts for a large and disproportionate share of the overall U.S. trade deficit even if that economy has not met two of the three criteria from the 2015 Act

- April 2018 Treasury Report Monitoring List: China, Japan, Korea, Germany, Switzerland and India

Newest Addition to Monitoring List: India

- India met two of the three Monitoring List criteria in the US Treasury April 2018 Report:
  - having a significant bilateral surplus with the United States
  - having engaged in persistent, one-sided intervention in foreign exchange markets
- India met one of the three criteria in the October 2018 Report:
  - having a significant bilateral surplus with the United States.
- The October 2018 Report notes for India:
  - there has been a notable decline recently in the scale and frequency of foreign exchange purchases.
  - "India must demonstrate that this improvement against the intervention criteria is durable before they will be removed from the Monitoring List" (page 31).

India's Intervention



Source: Reserve Bank of India

October 2018 Treasury Report (page 23): India met the forex intervention criteria (cumulative net purchases of foreign exchange exceeded 2 percent of GDP) in 2017, but because the RBI shifted to selling foreign exchange in the first half of 2018, India no longer meets the criteria in 2018.

US Treasury Designations 1988-2018

Country	Currency Manipulator	Monitoring List	Large Share of US Deficit
China	1992, 1993, 1994	2016, 2018	2017
Japan		2016, 2017, 2018	
Korea	1988, 1989	2016, 2017, 2018	
Taiwan	1988, 1989, 1992	2016, 2017	
Germany		2016, 2017, 2018	
Switzerland		2017, 2018	
India		2018	

https://home.treasury.gov/policy-issues/international/macroeconomic-and-foreign-exchange-policies-of-major-trading-partners

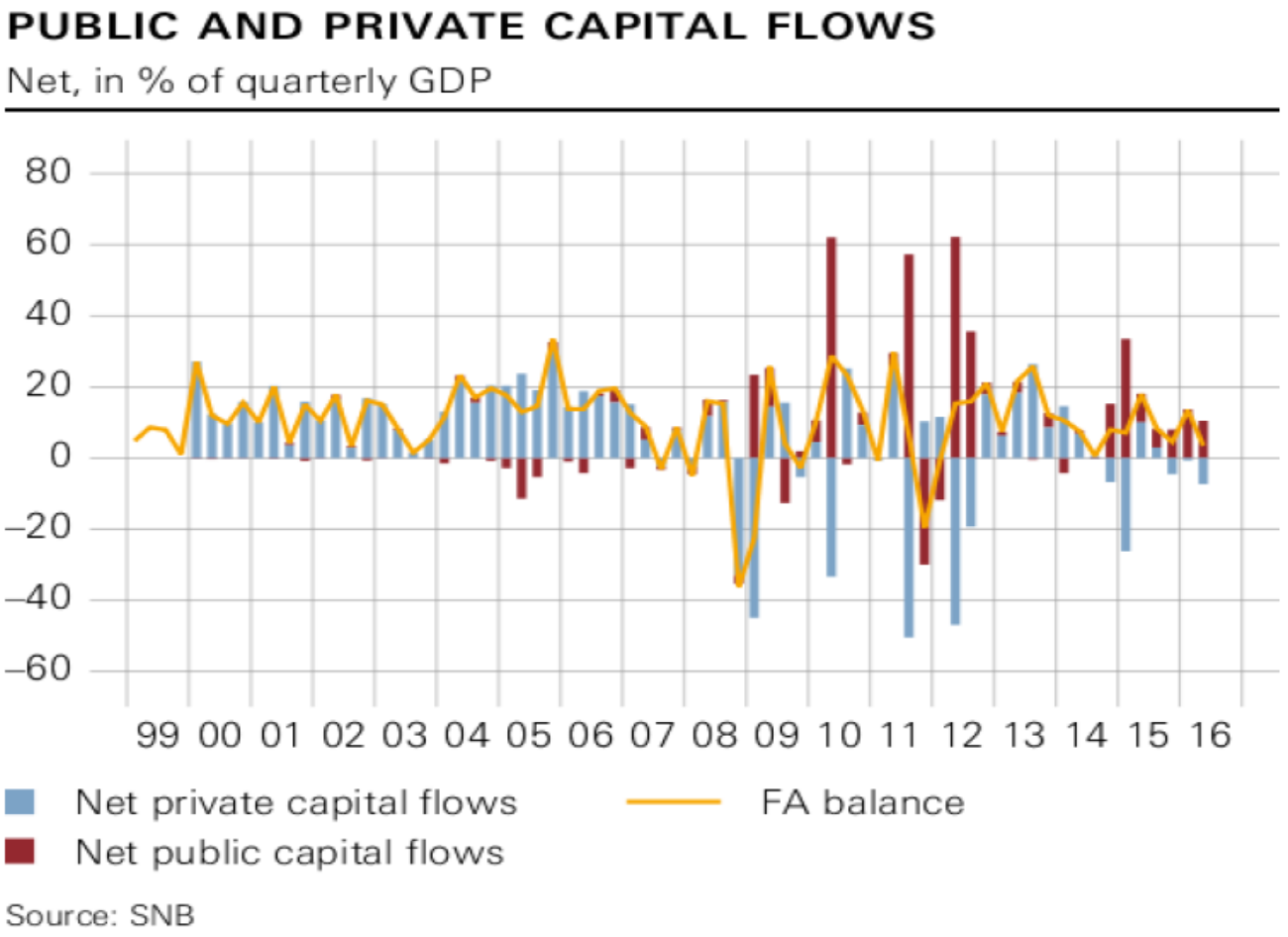
When is exchange rate management warranted?

- Economic theory suggests that when markets function efficiently free-floating exchange rates can serve as global automatic stabilizers.
  - The currencies of countries that experience negative demand or supply shocks will weaken, leading to a fall in export prices and an increase in competitiveness.
  - If just one country or a small group of countries experience the negative shock, the corresponding rise in counter-party currency values will generally be small as it will be spread across a large group of countries.
- If much of the world experiences the negative economic shock, the process of macroeconomic stabilization via unfettered exchange rate movements is less clear-cut.
  - When the negative shock is global, all countries will feel the need for depreciation, and no country will want the offsetting appreciation.
  - This is the scenario in which currency wars are most likely to develop, but exchange rate management is least likely to be effective.

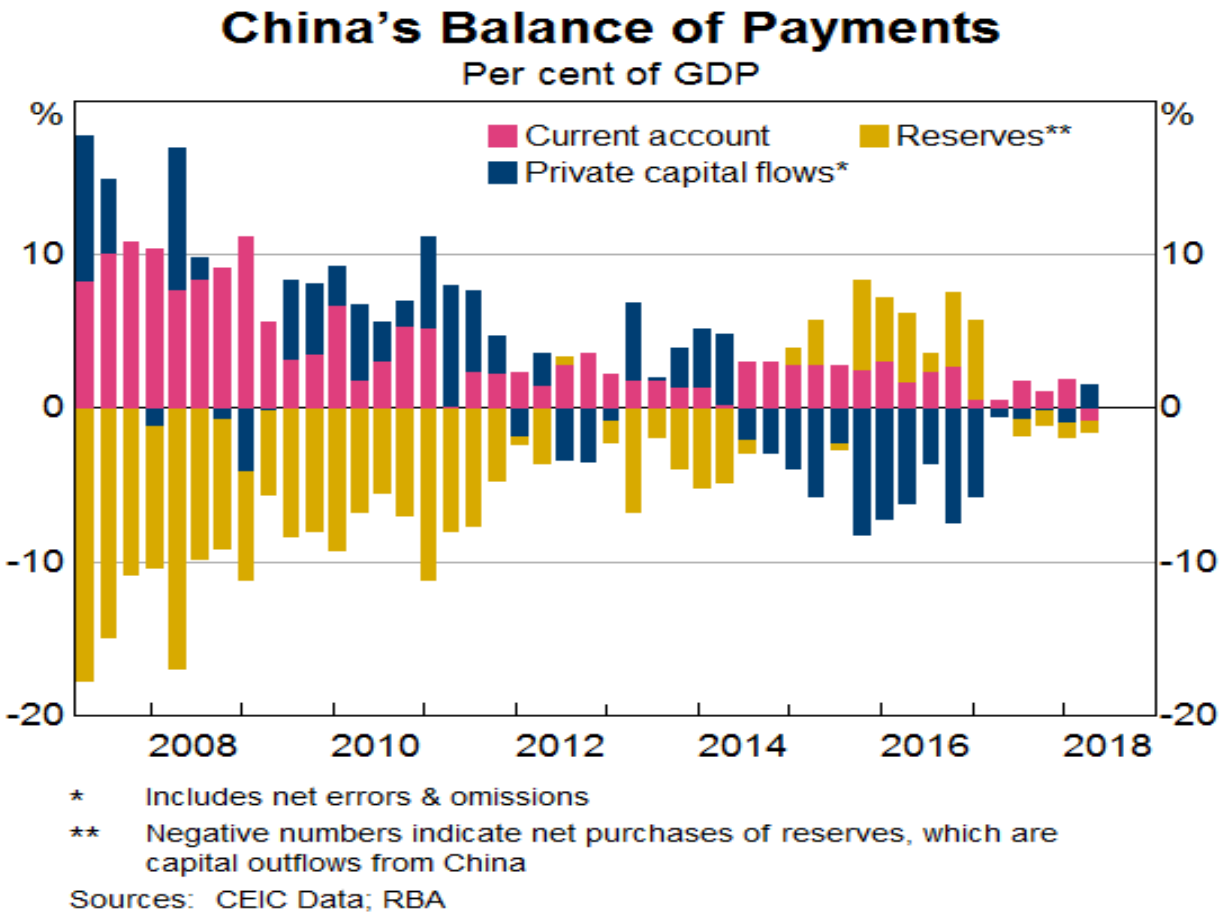
When is exchange rate management warranted?

- Another circumstance in which countries are often tempted to intervene in currency markets is when exchange rates are determined by international capital flows that seem disconnected to macroeconomic fundamentals.
- Switzerland's experience during the euro crisis is an example of this dilemma.
  - The Swiss franc appreciated dramatically as a result of safe-haven induced capital inflows, far beyond what most economists would judge as warranted based on Switzerland's economic fundamentals.
  - Concern over the effects of the Swiss franc appreciation on exporters led the Swiss National Bank to engage in massive intervention operations to stabilize the currency and stave off additional appreciation.
- Countries are also likely to be tempted to intervene in circumstances when they believe other countries are (unfairly) manipulating currency values.

SNB Interventions (countering private capital flows)



China's Interventions (recently countering private flows)



Can a country "manipulate" its currency over the long-term?

- *If capital is freely mobile*: an undervalued nominal exchange rate ought to boost exports, overheat the economy, and result in higher domestic prices. This would bring the real exchange rate back to an equilibrium value consistent with desired saving and investment.
- *If capital flows are controlled*: A central bank which buys international reserves and finances them by issuing domestic saving instruments can force the private sector to increase its net saving. Adjustment comes from the domestic interest rate, which can deviate from the world interest rate because of the capital controls.
  - with capital controls, a policy of reserve accumulation can determine the equilibrium real exchange rate by directly affecting the underlying balance of saving and investment.