

Review of papers on Exchange Rate interventions in the Indian context.

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Contents

Synopsis	2
Paper 01: Behera et.al., 2008	3
Key ideas	3
Intervention types – sterilized and non-sterilized.	4
Sterilized Intervention	4
Portfolio Balance method	4
Signalling Channel	5
Noise-trading Channel	6
Conditional Volatility of Exchange rates	6
In short	7
RBI's intervention	7
Data and Methodology employed in the paper	8
GARCH (1,1) model	9
Tests and estimates	9
Results and Conclusions from the paper.	11
American Repository Receipt	11
Working of ADRs	12
Types of ADRs	12
Global Repository Receipt	12
Paper 02: Mohanty 2013, BIS Papers #73	13
Exchange rate and the real economy	13
Exchange rate, financial development and stability	14
Exchange rate and monetary policy	15

Objective of intervention	15
Effectiveness of intervention	16
In short	17
Paper 03: RBI Occasional Papers Vol 33. 2012	18
Key ideas	18
Measurement of Volatility: 1993 -2013	18
Post exchange rate unification period. (March 1993 to July 1995)	18
Impact of Mexican Crisis (August 1995 to March 1996)	19
Impact of East-Asian Crisis (August 1997 to August 1998)	20
Global Financial Crisis (2008-09 to 2011-12)	20

Synopsis

This page reviews and finds insights from the following three papers on Central Bank Intervention in the foreign exchange market, under the Indian context. The papers are:

- Paper 01: Behera et al. 2008 on Policy effectiveness of Central Bank Intervention using time series data and the GARCH (1,1) model.
- Paper 02: BIS paper #73. 2013 on the issues pertaining to exchange rate movement, and its impact to real economy, financial stability and monetary policy.
- Paper 03: RBI occasional paper. Vol 33. 2012. On major volatility episodes in India and the appropriate responses and outcomes.

From this reading, I understood that the need for Central Bank to intervene in the foreign exchange market when there is demand-supply mismatch in domestic currency or to curb speculative pressures on exchange rate. Sudden surge in capital inflows or unanticipated slowdown in the same creates this change in capital flows. The different nature of crises in the past and the study of previous responses (Paper 03) indicates that the response strategy and extent is situation-dependent. The effectiveness of RBI's partially sterilized intervention to correct demand-supply mismatch in forex market through select public banks is unclear (Paper 01). I gather that the reason for this is that the Bank's prime objective is to reduce volatility than to change the direction of exchange rate movement.

According to time series data on variables such as RBI purchases and Sales, Interest rate differentials and inflation rate differential, and the GARCH model Paper 01 find that FII investments increase volatility and the Bank is in fact effective in reducing

this volatility in the short term. From Paper 02, I understand that there is difficulty in measuring intervention effectiveness for 1. Other factors such as fiscal policy, interest rates etc., are imperfectly controlled in empirical models. And 2. The long-term benefits of growth through intervention is difficult to measure. Another important facet is the idea of signalling mechanism – for correct signalling between the Bank and market participants is essential to avoid self-fulfilling speculative activities. There are three channels through which sterilized intervention is carried out – Portfolio Balance, Signalling and Noise-trading channels.

Some of my reading notes on the three papers follow.

Paper 01: Behera et.al., 2008

Title: Relationship between Exchange Rate Volatility and Central Bank Intervention: An Empirical Analysis for India. Behera, Narasimhan, Murty, 2008.

Link: <https://journals.sagepub.com/doi/10.1177/139156140700900103>

Key ideas

- Paper studies the effects of RBI intervention on exchange rate level and volatility.
- Uses monthly data from April '95 to Dec '06 (long time series data) and the GARCH (1,1) model. (Bollerslev 1986)
 - India-US bilateral nominal exchange rate.
 - RBI interventions – purchases, sales, net purchases.
 - India-US – interest rate differential and inflation rate differential.
 - Net FII investment in India.
- Finds that RBI intervention reduces volatility in Indian forex market. Does not reverse the trend movement of exchange rate.
- Also finds that Foreign Institutional Investor (FII) investments increase exchange rate volatility in India.
- Liberalization of the '90s allowed foreign capital inflows into India, especially in the form of private capital flows i.e., Foreign Direct Investment (FDI) and Portfolio Investment.
- 1992 – Integration of Indian and global financial markets, facilitated by

- FIIs entering Indian capital market, and
- Domestic companies raising foreign capital through:
 - * Global Depository Receipts
 - * American Depository Receipts
- Movement towards **full capital account convertibility**. Resulted in surge in forex inflows; Rupee appreciates; Also adds uncertainties to financial markets. Increases speculation in forex market.
- RBI intervenes in order to curb excessive fluctuations and correct misalignments.
- No unanimity about efficacy of Central Bank Intervention - Different in models & data studied yields different results.

Intervention types – sterilized and non-sterilized.

- Direct intervention is defined as the purchase of foreign currency assets by the Central Bank to influence exchange rate. There are other reasons for purchase and sale of foreign assets by the Central Bank.
- If interventions lead to increase in monetary base – non-sterilized interventions.
- If authorities simultaneously (with short time-lag) take steps to offset the effects of change in foreign asset holdings on monetary base – sterilized intervention.
- Non-sterilized intervention affects exchange rate because of changes in stock of the monetary base. The effect of sterilized intervention on exchange rate is dispute; it leaves the monetary base unchanged.

Sterilized Intervention

Sterilized intervention works through 3 channels:

1. Portfolio Balance Approach
2. Signalling Channel
3. Noise-trading Channel

Portfolio Balance method

- Domestic and foreign assets are assumed to be imperfect substitutes.

- Investors allocate portfolios to balance their risk against expected rate of return.
- But Central Bank intervenes – sells foreign currency assets – leads to excess supply of foreign currency and excess demand for domestic currency assets.
- To return to equilibrium, agents need to be compensated by a higher expected return on foreign currency assets. Takes the form of widening interest rate differentials and appreciation of domestic currency. – case where sterilized intervention affects exchange rate. But this has no empirical support.
- Obstfeld 1983 – found two different results.
- Rogoff 1984 – failed to find a statistically significant coefficient with the right sign for the portfolio balance variables.
- Dominguez and Frankel 1993 – favourable results of the hypothesis.
- Bhaumik and Mukhopadhyay 2000 – found the impact of intervention wasn't unclear.

Signalling Channel

- Assumes information asymmetry between market participants and the Central Bank. – refer Mussa 1981 paper on this.
- Intervention causes private agents to alter their exchange rate expectations.
- By buying foreign currency for domestic currency in forex, the Central Bank might signal an expansionary monetary policy. (due to increase in money supply).
- Market participants will then expect an easy monetary policy and would revise their expectations of future exchange rate. – Also reassess their expectations on future spot rates. (only if Central Bank's forex operations are perceived to be credible)
- Study if intervention correctly signals changes in monetary policy – take on Central Bank credibility.
 - Dominguez 1992 – Intervention conveys information of future monetary policy.
 - Klien and Rosengren 1991 – Impact of intervention declines with time.

- Kaminsky and Lewis 1996 – Regime-switching model used – inconclusive evidence to whether intervention correctly signals monetary policy changes.
- Fatum and Hutchinson 1999 – Fed interventions increased the conditional variance of Federal funds futures rate.
- Study the effects of expectations on future spot exchange rates.
 - Dominguez 1990 – used survey data on exchange rates as a proxy for future spot rate – found statistically significant impact of Fed and Bundesbank intervention.
 - Galati et al. 2005 – Currency options price data can be used as a proxy for market participants’ assessment of future exchange rate.

Noise-trading Channel

- Can operate even when intervention is carried out discreetly. – Doesn’t provide a signal to market participants. Nor does it large enough to alter relative supply of domestic and foreign currency assets.
- Central Bank intervention induces noise traders to buy or to sell currency.
- Central Bank can manipulate the exchange rate by entering in a relatively thin market and on a minute-by minute basis – here the exchange rate is determined by marginal demand and supply flow in forex market.
- Goodhart and Hesse 1993 – secret intervention to calm excessive volatility – circumstantial. Hung 1997 – Intervention success depends on timing and strategy of the Central Bank.

Conditional Volatility of Exchange rates

- World of finance is complex – impossible to study interventions through particular channels.
- Intervention is mainly for short-term stability – thus the effectiveness of interventions should look at short term movements only.
- To examine Central Bank intervention effectiveness
 - Direct study of conditional volatility of exchange rates – GARCH models
 - Implied volatility of exchange rates – currency option pricing models.

- Almekinders and Eijffinger 1994 – GARCH model – Bundesbank and Fed intervention unsuccessful in systematically reversing unwanted movements in mark-dollar and yen-dollar interest rates.
- Dominguez 1998 – secret intervention increases volatility, generally. (But is situation specific – effects can be positive or negative).
- Aguilar and Nydahl 2000 – bivariate GARCH, implied volatility approach – intervention has no significant effect for exchange rate level. Weak evidence for reduction in volatility.
- Doroodian and Caporale (2001) - ARCH(8)-M - significant impact of intervention on exchange rate levels and volatilities. But intervention led to increase in volatility.
- Pattanaik and Sahoo 2001 - calculated exchange rate volatility from the standard deviation of daily rupee-dollar rates over the month - RBI reduces exchange rate volatility – only through a small magnitude.
- Unnikrishnan and Ravimohan 2001 – ARCH – RBI intervention affects exchange rate level and volatility in expected directions – but coefficient low in mean equation.

In short

Opinion divided on effectiveness of Central Bank intervention of stabilizing exchange rate. There are three different channels of response. Response reduces exchange rate volatility by stopping speculative attacks on the currency. But response could also increase market uncertainty and encourage speculative attack on the currency only to cause much of the problem discussed here.

RBI's intervention

RBI intervenes secretly through select public-sector banks – corrects demand-supply mismatch in the forex market. Public sector banks would undertake deals in inter-bank market & RBI provides cover at the end of each day. RBI intervention is secret. RBI intervention is partially sterilized. Thus, the effectiveness of RBI intervention is unclear.

Data and Methodology employed in the paper

- Potential data sources: RBI Monthly Bulletin, Handbook of Statistics on Indian Economy, International Financial Statistics, Fed St. Louis, SEBI database.
- Variables: RBI intervention in forex market, exchange rate return, interest rate differential ($IntD$), inflation rate differential ($InflD$), net FII investment.
- Intervention variables: purchases (Pur), sales (Sal) and net purchases ($Invr$) of USD. All are in hundred million of rupees units.
- Exchange rate return: $Return_t = 100 \times (\ln S_t - \ln S_{t-1})$, where S is the spot exchange rate. Exchange rate movements affected by intervention (capital flows). But Jalan 2003 states trade deficit and economic growth are also contributors.
- FII is the net purchases of debt and equity by foreign institutional investors during a month in hundred million of rupees.
- Interest rate differential – $IntD$ – difference between Indian 91-days bill rate and US 3-month Treasury Bill rate.
- Inflation rate differential – $InflD$ – Difference between inflation rates of India and the US, calculated from Wholesale Price Index of India and CPI of US.
- Dummy variables – to account for the effect of 1997-98 crisis. ($VDum$) – which is 1 for high spikes in the exchange rate return and 0 otherwise. (Dum) – 1 pre-crisis time period, and zero for post-crisis period.
- Monthly data – 141 observations.
- RBI intervenes to correct demand-supply mismatch (difference between the purchase and sale transactions in the merchant segment of the spot market).
- RBI intervention affects exchange rate and its volatility by changing the market fundamentals, expectations of future fundamentals or policies & speculative bandwagons.

GARCH (1,1) model

$$Return_t = a_0 + a_1 Return_{t-1} + a_2 Pur_t + a_3 Sal_t + a_4 FII_t \quad (1)$$

$$+ a_5 IntD_t + a_6 InflD_t + a_7 VDum_t + \epsilon_t$$

$$\epsilon_t | \Omega_{t-1} \sim N(0, h_t) \quad (2)$$

$$h_t = b_0 + b_1 Invr_t + b_2 FII_t + b_3 Dum_t \quad (3)$$

$$+ b_4 VDum_t + \alpha \epsilon_{t-1}^2 + \beta h_{t-1}$$

where $b_0, \alpha, \beta > 0$ and $\alpha + \beta < 1$.

- The first equation above is the mean equation. Average return depends on its lag, Pur , Sal , FII , $IntD$, $VDum$. Random disturbance in
- Ω_{t1} represents lagged information available to all participants in forex market at t .
- Conditional volatility h_t depends on net purchases, FII and ϵ_{t-1}^2 and h_{t1} .
- Central bank intervention is effective if $a_2 > 0$ and $a_3 < 0$. That is the purchase of USD by RBI decreases dollar supply in forex market, forces rupee to depreciate, value of rupee decreases against dollar as purchases increases.
- Central bank intervention is effective if $b_1 < 0$, that is, an increase in net purchases of dollar lowers volatility of monthly rupee-dollar return.

Tests and estimates

- Verify stationarity of variables. Test the presence of unit roots of all variables using Dickey Fuller DF, Augmented DF and Phillips-Perron PP tests. Here, variables stationary at 1% of 5% significance.
- Trend of net FII and net purchases – non-stochastic.
- To check presence of volatility – check the distribution of exchange rate return time series. Positively skewed, leptokurtic – indicates presence of volatility in return series. – use Jarque-Bera JB test for the above.
- To test ARCH effect, apply OLS and obtain estimated residuals. Ljung-Box Q test for squared residuals – shows significant autocorrelation. – Exchange rate return series is a heteroskedastic martingale process; follows non-normal distribution.

- GARCH model. Assume normality of errors. – but coefficients insignificant – normality assumption doesn't hold – use Bollerslev–Woodbridge's (1992) quasi-maximum likelihood (QML) method. – uses the Berndt–Hall– Hall–Hausman (BHHH) numerical algorithm 1974.
- Recheck for absence of ARCH effects in residuals from GARCH – use LB-Q and ARCH-LM tests. – absence of ARCH effects not rejected here.
- From the paper, the parameter estimates:

Parameter Estimates of the GARCH (1,1) Model			
	<i>Coefficient</i>	<i>t-Statistic</i>	<i>P-Value</i>
Mean Equation			
<i>C</i>	0.54	2.71*	0.01
<i>Return</i> _{<i>t-1</i>}	0.37	6.21*	0.00
<i>Pur</i> _{<i>t</i>}	-0.00004	-5.97*	0.00
<i>Sal</i> _{<i>t</i>}	0.00006	5.34*	0.00
<i>FII</i> _{<i>t</i>}	-0.00005	-2.40*	0.02
<i>IntD</i> _{<i>t</i>}	-0.08	-2.06*	0.04
<i>InflD</i> _{<i>t</i>}	-0.06	-2.52*	0.01
<i>VDum</i> _{<i>t</i>}	0.44	2.27*	0.02
Variance Equation			
<i>C</i>	0.75	2.24*	0.02
ε_{t-1}^2	0.49	3.27*	0.00
<i>h</i> _{<i>t-1</i>}	0.15	2.67*	0.01
<i>Invr</i> _{<i>t</i>}	-0.00001	-2.28*	0.02
<i>FII</i> _{<i>t</i>}	0.00004	1.83**	0.07
<i>Dum</i> _{<i>t</i>}	-0.68	-2.06*	0.04
<i>VDum</i> _{<i>t</i>}	0.37	1.45	0.15
$R^2 = 0.13$		DW = 2.1	
Log likelihood = -150.45		Wald Statistic = 5.61 (0.02)*	
AIC = 2.38		SC = 2.71	
LM(8) = 7.83 (0.45)			

Notes: * significant at 5%.

** significant at 10%.

DW: Durbin Watson Statistic; AIC: Akaike Information Criterion.

SC: Schwartz Information Criterion; LM: Lagrange Multiplier.

Figure 1: Parameter estimates as found in the paper

Results and Conclusions from the paper.

- Mean equation: Coefficients of purchases and sales of RBI not as expected. In fact, $a_2 < 0$ and $a_3 > 0$ with high significance. – RBI intervention merely reduces degree of appreciation/depreciation instead of changing trend movements.
- Negative relationship between exchange rate return and FII investments – represents low exchange rate return during the period of large FII inflows.
- Variance equation: Talks about volatility. Intervention variable: $b_1 < 0$. Implies RBI intervention leads to decline in volatility of exchange rate.
- Appreciation of the rupee erodes India's export competitiveness. RBI's stated policy intention is to contain volatility as opposed to completely remove.
- FII investments increases volatility, RBI intervention reduces volatility in Indian forex market. Direction of relationship between exchange rate return and RBI intervention contradicts theory – attributed to RBI's prime objective to reduce volatility rather than change the direction of exchange rate movement.

Other terms and concepts:

American Repository Receipt

American Repository Receipt (ADR). It is a financial product – a certificate issued by American Depository Banks and is traded on NYSE, Nasdaq. etc. (Hayes, 2020).

- It is a negotiable certificate issued by a US depository bank representing a specified number of shares of investment in a foreign company's stock.
- The ADR is then traded on the US market like any other stock would trade.
- It is a feasible, liquid way for US investors to purchase stock in companies abroad, especially in emerging economies.
- Firms foreign to US are to benefit from ADRs because it makes it easier to attract American investors, without the hassle and cost of listing themselves on the US stock exchanges.
- **Popular ADR issuing banks:** Bank of New York Mellon (BNY), State Street (STT) and JPMorgan Chase (JPM).

Working of ADRs

- ADRs are denominated in USD and the underlying financial security is held by the overseas branch of a US financial institution (depository banks)
- ADR holders – the investors do not have to trade in foreign currency or have to worry about exchange rate fluctuations in the forex market – these securities clear through the US settlement systems.
- The US depository banks purchases shares on the foreign exchange market. It holds this stock as inventory and issues and ADR for domestic trading in the US- through NYSE, AMEX, Nasdaq and are also sold OTC.

Types of ADRs

- *Sponsored ADR* – When foreign companies comply with SEC regulations and follow US accounting procedures, then banks enter into a legal agreement, where the foreign companies bear the costs of issuing the ADR and retain control over it, while the bank handles the transactions with the investors.
- *Unsponsored ADR* – The certificate issued by the bank has no direct involvement or participation or even permission from the foreign company. Different banks could issue ADRs for the same company, with different ADR offerings having different dividends.
- In sponsored ADR, there is only one kind of ADR, issued by that bank which works with the foreign company.

Global Repository Receipt

Global Depository Receipt: Bank certificate issued in more than one country for shares in a foreign company. Global counterpart of the ADRs. (Chen, 2020)

- GDRs represent shares in a foreign company. Foreign branch of an international bank holds these shares and issues them to investors.
- GDRs are negotiable certificates traded in USD or Euros (EDRs). Hence investors can trade them in multiple markets – facilitate the trade of long-term debt and to generate capital.

Paper 02: Mohanty 2013, BIS Papers #73

Title: Market volatility and foreign exchange intervention in EMEs: what has changed? M S Mohanty, BIS Papers No. 73.

Link: <https://www.bis.org/publ/bppdf/bispap73.pdf>

Why does exchange rate movement raise issues for EMEs?

- Its impact on the real economy in EMEs.
- Its implications for financial development and stability
- Its consequences for monetary policy

Exchange rate and the real economy

- 1980s and '90s – lack of flexibility in exchange rate – exposed EMEs to risk of currency misalignment, financial instability.
- 2000s – EMEs started adopting flexible exchange rate regimes, inflation targeting – this smoothened volatility.
- Inflation targeting EMEs – exchange rates were shock absorbers.
- Reduced tolerance for currency mismatch + Exchange rate flexibility – allows countercyclical monetary policy.
- There is a threshold above which exchange rate volatility hurts the real economy.
 - In a cross-section of 52 EMEs
 - Exchange rate volatility statistically insignificant on long term growth.
 - No result in degree of development or in the income level.
 - U-shaped short-term relation between exchange rate and output volatility
 - up to a point higher exchange rate volatility reduces output volatility, but causes volatility beyond that point.
- Poland: Floating exchange rate helped reduce economic uncertainty in adverse shocks. But sharp exchange rate volatility lead to – use of zloty by investors as a proxy hedge currency – negative consequences for the economy.

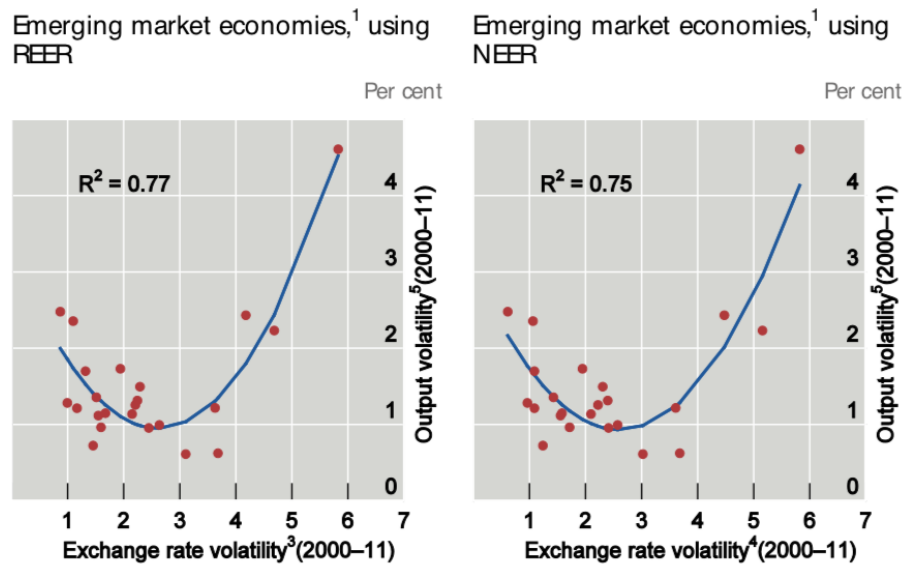


Figure 2: Exchange rate and real economy

Exchange rate, financial development and stability

- EM crises preceded by large currency mismatches and overvalues exchange rates – important for private sector's decision to borrow foreign currency.
- Flexible exchange rate hedging and local currency debt markets.
- Degree of market development influences choice of exchange rate.
- Increased exchange rate flexibility can help reduce currency mismatches.
- Intervention to restrict exchange rate flexibility can give a false sense of security for the private sector regarding financial risks.
- Lower exchange rate volatility leads to higher speculation about the future value of the currency. – Encourages investors to exploit the interest rate differential more aggressively (carry trade).
- Small shifts in investor portfolios can result in large capital flows and hence exchange rate volatility – need not guarantee financial market development.
- Credible peg of exchange rate regime can reduce short run exchange rate risks.
- Volatility:

- In both directions: there is an incentive for the private sector to hedge its exchange rate risk. Example – Thailand – greater exchange rate flexibility – increased demand for hedging instruments – rise in ratio of hedged liabilities to forex liabilities.
- One-sided exchange rate movements – reduces the private sector incentive to hedge forex risk – leads to speculative capital flows – adverse consequences for market volatility and financial development.

Exchange rate and monetary policy

- Forex intervention should be consistent with monetary policy. Why?
 - Any inconsistency impairs transmission mechanisms for monetary policy.
 - Persistent intervention creates risks for economy – high cost of intervention, expands central bank's balance sheet – large scale intervention to resist appreciation is financed by issuance of short-term debt by the central bank. Inflates central bank balance sheet – signals expansionary policy.
 - Need for appropriate communication – market perception of consistency required.
- Financial costs of forex intervention
 - Determined by domestic and foreign interest rate – measured using interest rate differential.
 - Reserve accumulation – high intervention – leads to lowered central bank credibility. Impair price stability function.
- Balance sheet effects of intervention
 - Average maturity of central bank securities – determines banking system liquidity – implications for transmission of sterilized intervention via banking lending channel.

Objective of intervention

- Main motive – maintaining monetary and financial stability – curb speculative pressures on exchange rate.
- Discourage sharp volatility in capital inflows and correct dysfunctional forex market by supplying liquidity from own reserves.

- Stabilizing inflation too, for decline in exchange rate passes through into consumer prices.
- Thus, smooth the trend path rather than to influence the level of exchange rate.
- Issues regarding investor behaviour and intervention strategy:
 - Intervention can help to break the momentum effect on the exchange rate. However, it is only possible if the flows are speculative or cyclical (as opposed to fundamental or structural).
 - Intervention decision depends on type of capital inflow. If it is of the form of FDI, then exchange rate should be allowed to find its new equilibrium.
 - If inflow is through portfolio: volatility depends on whether they're attracted by economy fundamentals or by cyclical or speculative motives. In case of latter free exchange rate movement encourages future volatility.
- Considering the externalities of intervention – questions unilateral intervention – for forex interventions divert flows from one EME to another – could result in zero-sum game.
- To insure country against external shocks, regional trade in local currencies to be strengthened.
- Most central banks intervened in spot market and preferred:
 - Transparent over secret intervention.
 - Reactive over pre-emptive intervention.

Effectiveness of intervention

- Varied views about the effectiveness of intervention
 - Can be judged by looking at market liquidity. How far did intervention insure orderly market conditions?
 - Other view: Does intervention help relieve depreciation pressure during panic episodes?
- While some argue that interventions have long-lasting effects on exchange rate volatility others opine that intervention can influence the exchange rate only temporarily.

- Factors accounting for weakness of any effect that intervention has on exchange rate:
 - Intervention works through signalling channel. After monetary policy controls, intervention may no longer have an independent effect on exchange rate.
 - Effectiveness of portfolio balance channel may have weakened for sterilized interventions affect bank credit.
- Effectiveness of intervention is difficult to measure:
 - Difficulty in measurement could lead to incorrect assessment of its effects.
 - Other factors affecting currency performance like fiscal policy, interest rates, capital account openness and prudential measures etc. – are imperfectly controlled in empirical models.
- Intended benefits of intervention difficult to measure:
 - Intervention effective if it promotes external price competitiveness, and
 - Allows countries to insure themselves against external shocks; thereby reducing external funding costs and promoting long term growth – these benefits are difficult to measure.
- Communication is key. Intervention may be perceived differently by the market participants than what is intended by the Central Bank.

In short

- EME Central bank interventions – small and short-lived effects on exchange rate.
- Persistent interventions – that is equilibrium shift in exchange rate – can lead to unintended effects – on exchange rate and on Central Bank's balance sheet (therefore of commercial and public-sector banks) – adverse effects for the macroeconomy.

Paper 03: RBI Occasional Papers Vol 33. 2012

Title: Major Episodes of Volatility in the Indian Foreign Exchange Market in the Last Two Decades (1993-2013): Central Bank's Response. Anand Prakash. 2012

Link: https://www.rbi.org.in/scripts/bs_viewcontent.aspx?Id=2849

Key ideas

- Forex Markets facilitate cross border trade, investment and financial transactions.
- In a market determined exchange rate system – excessive exchange rates volatility, out of line with economic fundamentals – can impose real costs on the economy –through its effects on international trade and investment.
- Pressures from foreign exchange markets could complicate the conduct of monetary policy.
- Adoption market-determined exchange rate in 1993 in India – heightened volatility.
- Exchange rate policy of RBI
 - maintaining orderly conditions in the foreign exchange market
 - to prevent the emergence of destabilising and self-fulfilling speculative activities and
 - allowing the exchange rate to reflect the macroeconomic fundamentals.

Measurement of Volatility: 1993 -2013

- Volatility of exchange rate – amount of uncertainty or risk involved with size of changes in currency's exchange rate.
- Heightened exchange rate volatility is computed through standard deviations of daily forex market returns that are then annualized.

The periods are briefly explained:

Post exchange rate unification period. (March 1993 to July 1995)

- Backdrop: Surge in capital inflows due to liberalization in capita account. Move towards market determined exchange rate system.

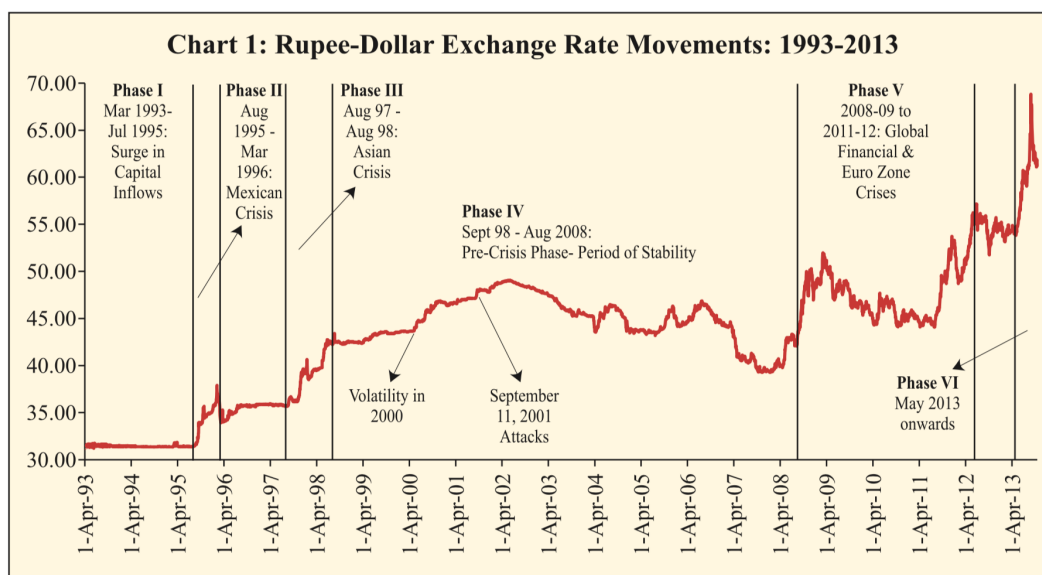


Figure 3: INR-USD exchange rate movement from the paper

- **Actions:** To maintain external competitiveness of exports and stability of the rupee, RBI intervened in spot market, purchased dollars and thereafter conducted open market operations to partially sterilize the expansionary impact on domestic liquidity.
- **Outcome:** India's forex reserves increased from 6.4B to 20.8 billion – representing 7-month import cover – period of prolonged stability in the range Rs.31.37 and Rs.31.65 per 1 US dollar.

Impact of Mexican Crisis (August 1995 to March 1996)

- **Backdrop:** Contagion of the Mexican currency crisis – sharp devaluation of Mexican peso in Dec 1994 on account of inappropriate policies, large CAD and weak macro-economic fundamentals, leading to sharp slowdown in capital inflows, and certain endogenous factors – accentuated the demand for dollar. The rupee had depreciated to Rs.36.48 per US dollar.
- **Action:** Rupee was overvalued in REER terms (REER – real effective exchange rate); imposition of interest surcharge on import finance, ease of CRR requirement, tightening export credit etc.
- **Outcome:** Stability in the range of Rs.34.28 to Rs.35.79 per US dollar.

Impact of East-Asian Crisis (August 1997 to August 1998)

- Backdrop: Challenges to exchange rate management due to
 - the contagion effect of the South-East Asian crisis,
 - economic sanction imposed by many industrialized nations after the nuclear explosion in Pokhran (India) in May 1998
 - downgrading of the sovereign rating of India by certain international rating agencies.
- Action: RBI intervenes in spot, swap and forward markets to manage expectations and bring forward premia down – had sold billions of USD – to the tune of \$3.1B. RBI's forward liabilities increased – but came down subsequently upon normalcy
- Stability returned and expectations of the market participants about further depreciation in the exchange rate of rupee were contained and also reversed to a certain extent.

Global Financial Crisis (2008-09 to 2011-12)

- Backdrop: Collapse of Lehman brothers and other investment banks. Fed bailing out AIG and its quantitative easing, operation twist, forward guidance etc.
- Large withdrawals of funds from the equity markets by the FIIs, reflecting the credit squeeze and global deleveraging,
- Resulted in large capital outflows during September-October 2008, with concomitant pressures in the foreign exchange market across the globe, including India.
- Action: RBI sold US dollar through agent banks. Rupee dollar swap facility for Indian banks was introduced – for comforting Indian banks in managing short term foreign funding requirements.
- RBI continues Special Market Operations (SMO) to meet forex requirements of OMCs. – liquidity neutral operations.