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Capital Flows, RBI Forex Intervention, and Monetary Policy Independence: The Case of India

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ABSTRACT

The rise and ebb of capital flows has buffeted the Indian economy. The Reserve Bank intervenes in the foreign exchange market to smoothen the volatility. Against this backdrop, this paper studies the management of exchange rate volatility and also the sterilisation of the surplus liquidity generated from the RBI intervention. With the adoption of flexible inflation targeting, liquidity management operations have undergone modification. In this context, this paper examines the effectiveness of sterilisation operations in this period. With the application of two-stage least squares, this paper finds out that the effectiveness of sterilisation operations has remained intact in this period, indicating that monetary policy independence is being maintained in the Indian economy.

JEL Classification: D53, G11, G41

KEYWORDS: *Forex Intervention, Monetary Policy Independence & Two-stage Least Squares.*

INTRODUCTION

Emerging market economies (EMEs) are making all efforts to attract capital to bridge the gap between saving and investment. However, the risks emanate when these volatile capital stops or reversal takes place from the emerging economies to the source countries. Also, these capital inflows occasionally lead to currency appreciation, asset price inflation, and over-consumption. The challenges of capital inflows and outflows are faced by almost all EMEs. As the savings are well below the investment, India's need for foreign capital is huge, but it also faces the same challenges as other EMEs face. The currency appreciation makes the export less competitive, makes the interest rate management oblivious to the inflation objective, generates financial instability.

The fall out of the south-east Asia currency crisis (1997) was a testament of the negatives of these types of flows. Short-term uncontrolled capital flows had created bubble in these economies. The effect of this crisis was so severe that the President of Indonesia was forced to resign as the domestic political situation became extremely difficult to manage. The economies of south-east Asia had fixed higher interest rate to allure the foreign investors to invest in these countries and generate profit. The capital flows led to high asset prices in many countries even if some of the countries were having fixed exchange rate while others were having current account deficit (CAD). Once the sentiment changed during the mid-1990s, individuals and corporates started defaulting on their borrowing obligations. It resulted in a situation, which disincentivised the foreign investors and subsequently they rushed to leave the countries, putting compounding pressure on their currencies. To fight the depreciating currencies, these countries hiked the interest rates, that created challenges for growth process, and finally forced the currencies to be floated in the face of falling forex reserves. For example, Thailand economy was growing at around 9 per cent, with inflation around 3-4 per cent, and Thai bhat was at 25 bhat to one US dollar. Once the crisis set in, Thai Bhat was allowed to float, it was trading around 56 Thai Bhat per US dollar.

The Urjit Patel committee report (2014) has highlighted the importance of capital flows, monetary policy making and forex intervention in the context of taper tantrum of 2013. The excerpt from the report are given below:

"Faced with sudden capital outflows and adverse ramifications, several EMEs, including India, had to temporarily alter their conduct of monetary policy in addition to other measures. Some countries used short-term interest rates as the first line of defence, while others focused more on managing liquidity. Some countries employed forex interventions in the spot and/or the forward market, while others relied more on forex swaps. Most countries resorted to capital account management, using a combination of measures to encourage capital inflows and discourage or temporarily restrict capital outflows."

This was a perfect case of how erratic capital flows generated challenges for any of the EMEs. However, India was not affected by these, as the restrictions on the entry of FIIs into the Indian shores combined with a perpetual CAD allowed it to manage the inflow of capital to it. To manage capital flows,

countries like South Korea implemented the withholding tax, and capital gains tax on the purchase of bonds by foreigners, Thailand withdrew tax exemption on foreign investment in government securities, Brazil applied higher reserve requirements on Banks' dollar positions (IMF,2010 and Kohli, 2011).

One of the upshots of the flow of capital to the EMEs is the appreciation pressure on the domestic currencies. The appreciation of the currency makes the exports uncompetitive. To minimise this the central banks in EMEs intervene in the forex market. The Central bank intervention in the forex market adds to the forex reserve and reduces the external sector vulnerability of the domestic economy. The result of the central bank intervention is that a lot of liquidity gets injected into the domestic money market. The abundant liquidity in turn fuels inflationary pressure in the domestic economy. In this milieu, to protect their economies from the adverse impact of capital inflows, the EMEs occasionally go for the application of various controls over the capital flows.

The sterilisation is undertaken through various types of instruments, and the instruments range from cash reserve ratio, market stabilisation scheme (MSS), open market operation (OMO), and reverse repo or standing deposit facility (SDF). The floating of securities to mop up extra liquidity also increases the yield in the securities market which again acts as an attractive factor for foreign capital. The resultant capital inflow creates pressure on the exchange rate that in turn forces the central banks to go for forex intervention. The liquidity generated from the intervention operation acts as an inflationary factor in the economy, forcing the central bank to sterilise, and in the process creating stress on securities yield. Over time, it becomes a vicious circle and adds to the challenges of monetary policy making. In India's case, the CAD combined with restrictions on foreign capital accessing the Indian markets has given leeway to Indian policymakers to manage the policy trilemma of independent monetary policy, stable exchange rate, and capital flows.

Many countries have taken recourse to capital controls to manage the inflow of capital. This type of situation mostly arises when the AEs face low growth and ultra-low interest scenarios while the EMEs witness fast growth in higher interest rate scenarios. The impossible trinity issue dating back to Robert Mundell, says "an open economy has to choose between capital flows, stable exchange rate and independent monetary policy". When an economy allows foreign capital, it lands in a situation where it has to choose between a stable exchange rate or pursuing independent monetary policies. In India's case, capital account openness has followed a cautious and gradual path. Limits are placed on the participation of FPIs in their operation in the debt market. Further, Indian corporates also face the regulation of minimum maturity period and maximum interest rate while accessing ECBs. Short-term capital flows are also controlled by various regulations. Further, the high growth of the Indian economy always increases its absorbing capacity of foreign capital. RBI has followed an approach that combines intervention, sterilisation, partial expansion of the monetary base, exchange rate flexibility, liberalisation of inflows and outflows. The RBI as per the dynamics of the domestic economy undertakes policies to safeguard against adverse consequences of the opening of the economy.

The RBI adopted the flexible inflation targeting framework (in 2016) to put a check on the prices and used many instruments in this endeavour. Among these, sterilisation of excess liquidity is one of the options. Since it has been used whenever the situation warrants, studying its efficacy in the changed times would add new insights. Generally, the efficacy of sterilisation is studied through two coefficients: the *sterilisation coefficient* and the *offset coefficient*. While the sterilization coefficient indicates the proportion of money created by the intervention getting mopped up in the sterilisation process, the offset coefficient indicates the amount of capital flows that come in with the rise in the interest rate due to the sterilisation process. In the past, there have been many studies on this aspect of the Indian economy. However, there have been few studies for the post-flexible inflation targeting (FIT) period. The liquidity management policies have been modified during this period. The present study examines whether these measures are effective in creating space to practise independent monetary policies. In this context, the efficacy of sterilisation is examined here.

The paper evolves in the following lines: Section II reviews the literature on it, Section III presents the stylised fact, Section IV goes for empirical analysis, and Section V draws the conclusion.

LITERATURE REVIEW

Many studies at the international and the national level have studied intervention, sterilisation and monetary independence. The essence of some of these studies are given below.

At the international level, Ljubaj *et al* (2010) attempted to examine the extent to which the Croatian National bank (CNB) sterilised the capital inflows, also to what extent its sterilisation activities spurred additional capital. Rising rates due to the sterilisation operation of the CNB contributed to the additional capital inflows. There has been no reduction in the efficiency of sterilisation due to rise in capital inflow while strong capital inflow was found to be an after-effect of stable macroeconomy, growth, openness, liberalisation measures, *etc*. These are arrived from the calculation of both, the monetary policy reaction function and capital flow equation, with the use of two-stage least squares method. The empirical finding points that the CNB was not going for full sterilisation, though sterilisation was strong. It is observed that the CNB responded with more stringent measures such as reduction in net domestic assets and net foreign assets to contain the effect of higher monetary multiplication. The result shows that growth in Croatian economic activity is accompanied by monetary expansion. To maintain exchange rate stability by intervention in the forex market, and again through using various instruments to control the expansion

of money supply to meet its goal of keeping inflation low, the CNB managed to maintain relative autonomy, notwithstanding the liberalisation of capital flows. A similar attempt to study the effect of sterilisation in select South-Asian economies was done by Cavoli and Rajan (2015). This study goes beyond the calculation of sterilisation. It is concerned with examining if sterilisation is able to maintain the interest rate at the level that existed before the capital inflow happens and also, differentiates between complete and incomplete sterilisation. In the case of compete sterilisation, the interest rate remains at the level existing at pre-capital inflow, not below it. For most of the economies studied, sterilisation level is high but incomplete. The interest rate does not stay at pre-sterilisation level. Further, capital inflow and foreign interest rates tend to influence the domestic interest rate. It is seen that sterilisation cannot fully keep the domestic economy insulated from rise and ebb of global liquidity. There is a direct relationship between sterilisation and the interest rate, but it is not enough to maintain the interest rate at the same level. Clements and Kamil (2009) is another exercise to assess the effects of capital controls in Colombia in 2007 with regard to capital flows and exchange rate dynamics. The controls could become successful in reducing the external borrowings but could not become successful in reducing the total volume of non-FDI flows. The paper could not find any evidence in favour of capital controls moderating appreciation of Colombia's currency, or in the direction of showing that it helped in gaining more independence on monetary policy. The evidence is in favour of controls having increased the exchange rate volatility. It calls for more research to assess the effects of capital controls on financial stability.

There are many studies on the issue of sterilisation and monetary policy independence, in the Indian markets. The essence of these studies is highlighted below.

In the Indian context, Pattanaik 1997 was one of the earliest attempts on the subject of sterilisation. The move to a market-determined exchange rate after the liberalisation process made the objective of a stable exchange rate an important one. The paper highlighted that monetary policy independence was sacrificed, as the intervention was used to prevent the significant appreciation of the exchange rate. The difficulty in managing the exchange rate to keep it stable has emerged as an obstacle in the capital account convertibility process. The offset coefficient remains low and holding large forex reserves has insignificant importance in terms of opportunity costs hence the quasi-fiscal costs associated with it put a limit on the prevention of the exchange rate appreciation by the policy makers. With further integration of the economy and a rise in the offset coefficient, it may make the sterilised intervention ineffective. It says that greater exchange rate flexibility is likely to bring greater monetary policy independence, but it would create a situation where the export sector would demand compensation for the decline in the profit arising out of the appreciation of the exchange rate. Raj *et al* (2018) studied the effect of sterilisation in the context of India and concluded that intervention operations conducted by the RBI have helped the RBI to keep the growth of reserve money aligned with the requirements of a growing economy. The paper shows that the impossible trinity issue is much alive in putting a challenge to the Indian policy maker. The decision to go for forex intervention is based on forex market volatility, generation of liquidity, government securities market conditions, and forward premia prevailing in the forex market. The paper infers that the effectiveness of sterilisation decreases with the increase in the openness to capital flows or with a rise in sustained sterilisation operations, and it creates fresh challenges to the independence of monetary policy operations.

The global integration of India's financial markets has generated multiple challenges with regard to the macroeconomic management of the Indian economy. These challenges are arising due to the policy objective of meeting multiple goals such as high growth, better CAD, conducive exchange rate, attracting capital inflow for financing investment, low inflation, desired level of monetary and credit growth, holding adequate reserves, and minimising financial fragilities. The Indian experience in managing the trade-offs between these objectives is analysed by Sengupta and Sengupta (2013). To meet multiple objectives, a cautious and gradual approach to the capital account liberalisation has been adopted, where certain types of flows are prioritised. India has always adopted an intermediate approach with regard to managing the impossible trinity-independent monetary policy, stable exchange rate, and free flow of capital. It has followed an asymmetric intervention in the forex exchange market, in which appreciation is resisted and it resulted in accumulation of reserves. But the intervention has never been accompanied by complete sterilisation, leading to a stage witnessing a large increase in monetary aggregates and perk up of inflation. Post-2004, the sterilisation coefficients have remained significant. Between 1998-2004, a 60 per cent rise in net foreign assets (NFA) was offset by a reduction in net domestic assets (NDA), while during the period 2004-2010, a 30 per cent rise in NFA was offset by a reduction in NDA. Post-2004, the Reserve Bank allowed the money supply to rise along with a concomitant rise in NFA and relaxation of capital controls.

Kohli (2011) attempted to study the issue of trilemma in the context of the Indian economy for the period after the global crisis. It highlights the capital account management strategies adopted in the various periods leading to the global financial crisis. Having restrictions/limits on capital flows helped the policymakers in India to manage the open-economy impossible trinity and attain the objectives of exchange rate and price stability. Of late, it became evident that India's capital controls have been effective in helping achieve autonomy in monetary policy independence. Hutchison (2012) examines the trilemma between financial liberalisation, exchange rates, and monetary policy using the framework of Aizenman *et al* (2010a, 2010 b). Here, trilemma indices are constructed for every objective of policy making such as Monetary Policy Independence, Stability of Exchange

Rate, and Openness of Capital Account for India. The policy trade-offs have changed with the increasing integration of India with the outside world. Simultaneously, it has reduced the space for independent monetary policy-making or exchange rate stability. It has brought out other challenges such as higher inflation for India. Also, greater integration has been associated with generating higher volatility in inflation. Alternatively, greater exchange rate stability has given benefits in the form of lower inflation volatility. Chakraborty (2016) analysed the pattern of capital flows into India from 1993 to 2012 and dealt with how the policy tri-lemma was managed in a period characterised by liberal capital inflows. The global crisis brought in notable changes in the level of dominance of factors responsible for capital flows. Before the crisis, the real effective exchange rate (REER) and foreign exchange reserves (FER) were the most influential factors determining the capital flows to India, while the current account deficit (CAD) became more important after the crisis. It was seen in the paper that the independence of monetary policy was maintained in the pre-crisis period. Majumdar and Nag (2017) tries to decode the impossible trinity in the case of India. With the use of quarterly data from 1991 to 2015, the presence of trilemma constraint was seen over a longer period, but short-run deviations from this constraint were visible. The Reserve Bank's intervention in the forex market helped in the successful relaxation of this constraint. The priority of the policy mix has changed over the years: there has been an increase in capital account openness, while exchange rate stability has been sacrificed. The efficiency of the trilemma is dependent on financial stress, financial development, forex intervention, and liquidity in the economy. The study found that inflation gets reduced with higher monetary policy independence, while high growth and large output gap come with stability in the exchange rate and openness in the capital account. Mohan and Kapur (1999) in their study show that in India's case, judicious use of options has helped it to manage capital accounts and monetary management. It highlights the active management of capital accounts, particularly debt flows, then tighter regulations for financial intermediaries to access foreign debt flows, exchange rate flexibility, continuous building of financial markets, pre-emptive tightening of credit flows to sectors having high growth of credit, also modifying the institutional framework for monetary policy are the factors responsible for maintenance of financial and price stability. In India, middle solutions for the impossible trinity were carried out with capital account management and flexible exchange rates. Many instruments have been used in this regard. This paper advocated for monetary policy not to focus on narrow inflation targeting goals. It was argued that the use of multiple instruments would support the management of volatility and the maintenance of financial stability.

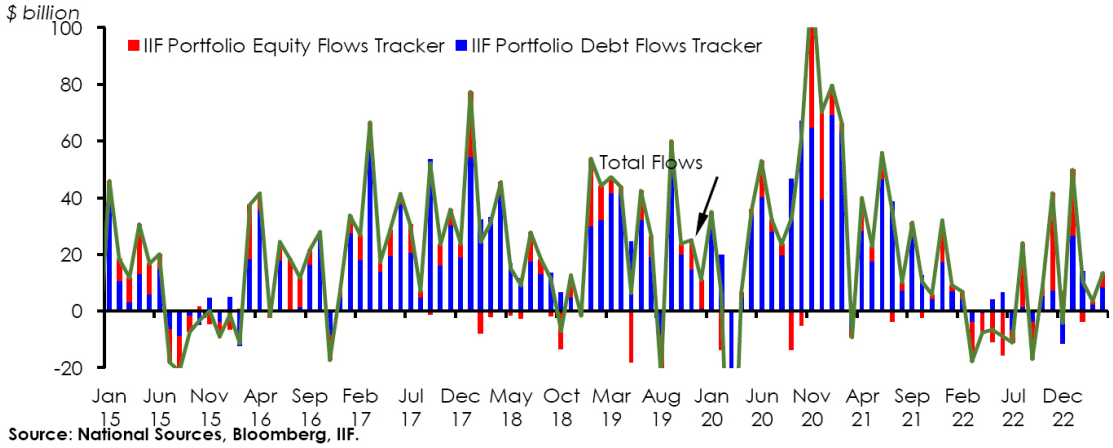
Kohli (2015) is another attempt to examine if the adequacy of reserves helps in reducing the volatility in the forex market particularly in the context of international integration of an economy, market-determined exchange rate, and presence of global imbalances. It compared the period around 2010 when there was a near absence of intervention, with the earlier period when there was active intervention. Its key finding is adequacy of reserves reduces the exchange rate volatility, and it particularly acts in the form of boosting sentiment and confidence through active intervention in the market.

All these papers have been carried out in the period before the RBI went for flexible inflation targeting (FIT). With the implementation of this framework, inflation targeting gets primacy over other macroeconomic management. The liquidity management operations have also been modified to achieve this objective. Hence, this study examines forex operations, and the efficacy of sterilisation in achieving monetary independence, in the context of the Impossible trinity. It also looks into the movement of various aspects of the impossible trinity in the Indian case.

STYLISED FACTS

Monetary policy in advanced economies affects the portfolio flows to EMEs. The events in AEs also influence the flows to EMEs. The occasional turbulences in these economies buffet the financial system in the EMEs. The 1997 South-East Asia currency crisis, the 2008 Global financial crisis, and the taper tantrum have all come with vicissitudes of capital flows unravelling before us. Even the release of high jobs figures in the US in February 2018 affected the capital flows to EMEs, in the expectation of a rate hike by the US Fed (Chart 1).

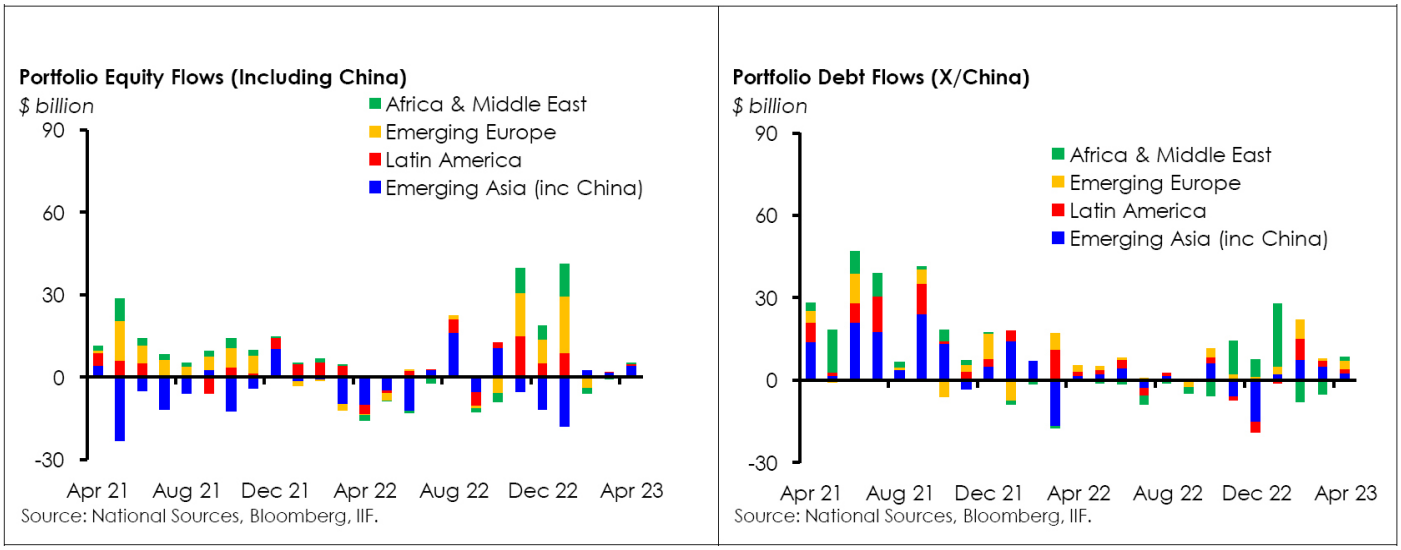
Chart 1: IIF Tracker: Total Portfolio Flows into Emerging Markets



Source: National Sources, Bloomberg, IIF.

Though the chart covers a small period, the pattern appears the same over a longer period. Around the middle of 2022, various emerging regions of the world witnessed outflows of both equity and debt flows. There are also occasions when the outflows from one region are matched by inflows to other regions. In these circumstances, the regional events overtake the global events. For example, during taper tantrums, while EMEs like India were witnessing capital outflows, Pakistan was receiving capital flows, which was attributed to the high interest rate being offered by its government securities market (Chart 2).

Chart 2: Portfolio Flows to Various Regions of the World

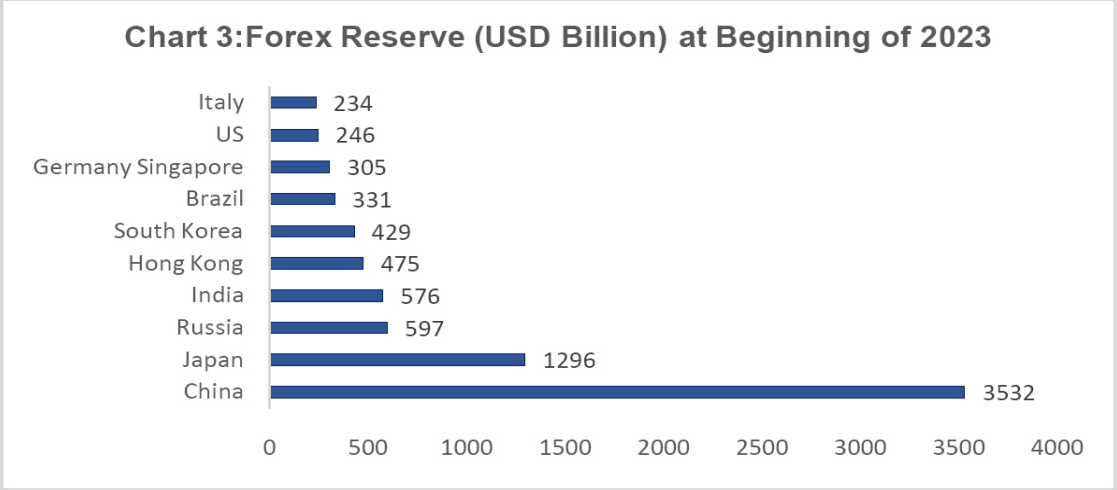


The challenges emanating from capital flows get complicated by the emergence of new monetary policy tools such as Quantitative Easing (QE) / Quantitative tightening (QT). Many Central Banks in the advanced economies implement QE and QT in accordance with prevailing economic conditions in their domestic territory.

Initially, the Central Banks in the AEs became accommodative by cutting the interest rate, but once rates went near zero it became difficult to drive the economy through interest rate reduction. Some central banks also tested negative interest rates. During 2008 GFC, for the first time, the US Fed utilized the quantitative easing (QE) by buying government securities and mortgage-backed securities. The quantitative easing led to the expansion in Central Banks' balance sheets of the AEs, in the process expanding the reserve money base in these countries. The QE was undertaken in the form of purchase of government securities and private sector securities. As a result, the size of Fed's balance sheet increased from US$ 800 billion in 2008 to more than US$ 4 trillion in 2016. The Fed again applied it with the outbreak of Covid-19. With the return of inflation, it stopped the QE in March 2022, and began QT in June 2022. When QE ends, Fed reinvests the proceeds of maturing securities and keeps the size of its balance sheet intact. But in QT, it stops reinvestment, allowing its assets to shrink. The Fed had earlier tried QT during 2017 to 2019. There is no clear cut answer to the efficacy of the QE or revival of the economy by QE. That is why Ben Bernanke quipped that 'The problem with QE is it works in practice, but it does not work in theory'. The US Fed generally unwinds QE before raising interest rates as its return on its assets are fixed while the payment on its liabilities increases with the rise in rates, putting itself into risk of losses with payment going beyond earnings. The signaling effect of QE is strong in case of crises, as it assuages the sentiment of the financial markets. The surprise of signaling is generally avoided in case of QT, keeping the effect of taper tantrum in mind. It is also highlighted that liquidity effect of QT is much stronger than that of QE. As Fed allows the mature securities to run off, the reserve on its liability side also gets reduced. The liquidity generally remains at a higher level when QT starts, but with the decline in liquidity the progress of QT effect on interest rate becomes higher. When the size of balance sheet is small, this risk of loss is small. But once balance sheet becomes large, the risk of loss also increases. The reduction of reserves in the balance sheet reduces the probability of getting into loss-making. Another rationale for undertaking reduction of balance sheet is to get the composition of balance sheet right. Many times, the US Fed has desired to hold treasuries primarily, while reducing the mortgage backed securities (MBS) from its balance sheet. If Fed balance sheet continues to increase, then at certain point treasuries will be in short-supply. Further, QT gives leeway for conducting future QE if need arises. Hence, it is advocated to follow counter-cyclical policy by providing support in difficult times, and unwind once the situation comes back to normalcy. However, the behavior of central banks in AEs, with implementation of policies such as QE and QT, generates challenges for the central banks in EMEs to manage their monetary policy.

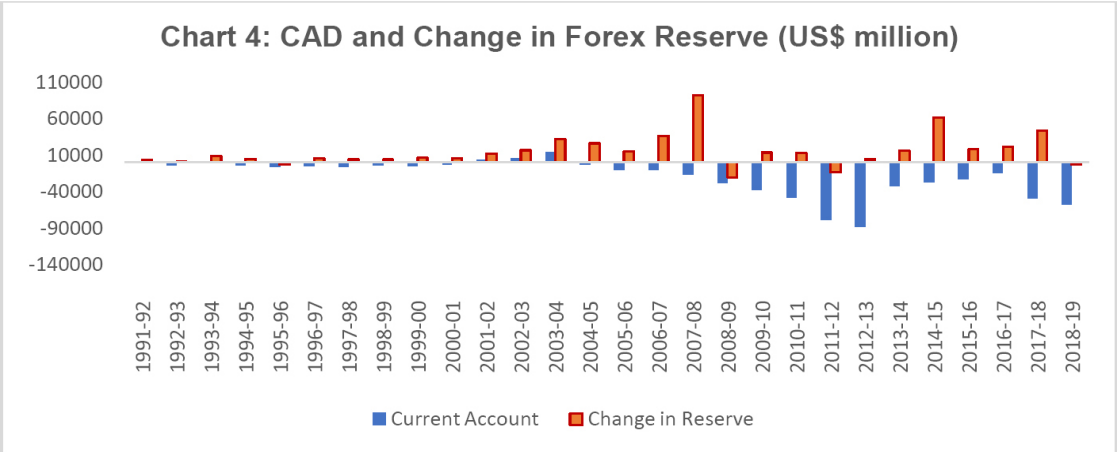
As the Indian economy opened up, the economy got buffeted by the ebb and flow of global capital. However, the sporadic spells of inflows/outflows in external capital induced exchange rate volatility, and necessitated forex intervention from the Reserve Bank. The Reserve Bank does not have any level as its exchange rate target, it only tries to reduce

the undue volatility (Jaitley, 2014). This intervention policy affects the existing level of domestic rupee liquidity in the market. It also leads to build up of forex reserve. India is having the fourth largest forex reserve in the world (Chart 3).

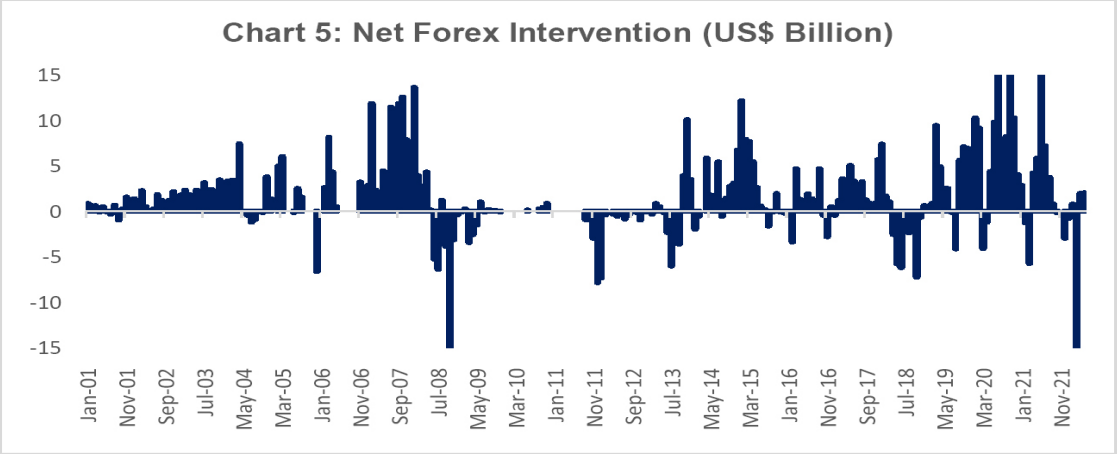


Source: Stata World.

On the positive side, capital flows helped meet the deficit in the current account front arising from the burgeoning demand of a high populace. But the current account turned surplus for a brief period in the early 2000s and again in 2020 on the back of a falling global crude oil prices (Chart 4). The rise in forex inflow created challenges for the macro management on the policy front. The forex intervention and the resultant rupee liquidity threw up multiple challenges. While the forex sale operations suck out domestic rupee liquidity, the forex purchase operations inject rupee liquidity into the system. The forex purchase intervention increased the forex reserve, it also changed the composition of RBI's balance sheet (Chart 5 and Table 1). *The rise in integration of the Indian economy has necessitated the RBI to intervene in the market, and this most of the time is in the form of purchase intervention. This has led to the rise in the share of the foreign assets in the balance sheet of the RBI.*



Source: RBI.



Source: RBI.

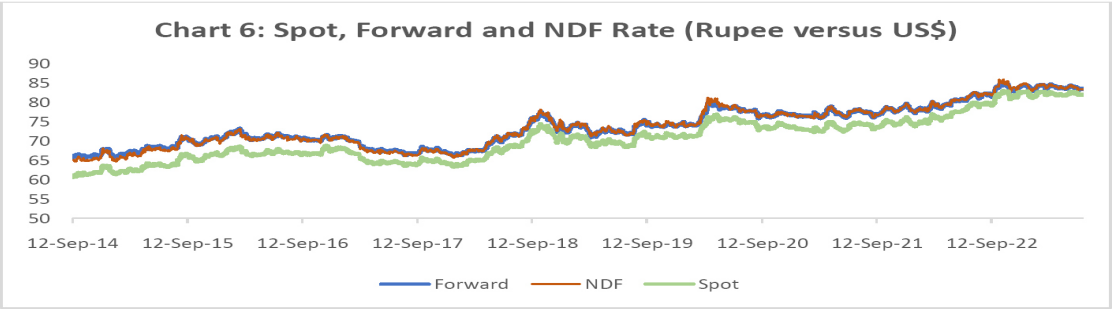
Table 1. Composition of India's Balance Sheet (Rs Crore)

End-December	Net Domestic Assets	Net Foreign Assets
Dec-01	179182	232111
Dec-02	127071	337633
Dec-03	63172	458605
Dec-04	33944	565418
Dec-05	45926	614254
Dec-06	38533	781543
Dec-07	-106542	1085265
Dec-08	-9685	1216622
Dec-09	117125	1295424
Dec-10	283029	1301870
Dec-11	472278	1544457
Dec-12	593579	1592982
Dec-13	693615	1801541
Dec-14	618430	2008882
Dec-15	600844	2317779
Dec-16	-64029	2450141
Dec-17	478178	2618553
Dec-18	921402	2749018
Dec-19	776169	3252164
Apr-20	814436	3661602

Source: RBI.

The rupee liquidity generated from the forex intervention is often not in sync with the desired increase in the reserve money. The generated excess liquidity is mopped up to permit monetary policy to achieve its desired objectives. In the absence of sterilisation of excess liquidity, the operating target crashes below the policy repo rate, putting the Central Bank in a situation of loss of control on monetary policy. This type of situation has been prominent in 2007, when a cap on the reverse repo amount in the period of high portfolio inflows, dragged down the money market rates to near zero level. The rise in excess rupee liquidity also generates challenges in the fight against inflation, thereby forcing the authorities to hike the interest rate. Many times, in its fight against inflation, the central bank mops up the liquidity floating in the system through various instruments at its disposal. The auction of these instruments affects the prevailing interest rate in the system. The interest rates get upward push with the increase in the auction of the sovereign securities by the Central Bank, widening the interest rate differential with the advanced economies, and creating another channel for attracting further capital inflows. In this way, the whole sterilisation process worsens the original problem of high level of capital inflows. When things reach a disproportionate level, the Central Bank looks for other measures to put a check on the capital inflows.

Various measures taken by India have integrated its markets with the outside world. But the issue that comes to researchers' mind is whether the monetary policy independence or control over domestic interest rate is being maintained in the face of high capital inflows/reserve build-up. A glimpse into this issue can be had by looking into whether there is presence of uncovered interest parity (UIP) in case of India. It says that the change in expected exchange rate should be equal to the differential in the interest rates of the two economies. The price transmission from one market to another happens due to arbitrage and hedging by market participants, and the process makes the capital controls appear ineffective, leading to the presence of the UIP. The co-movement of spot foreign exchange rate, forward, and Non-deliverable forwards (NDF) sends a likely message in this direction (Chart 6). But, for confirmation, the presence of the uncovered interest parity (UIP) needs to be statistically tested.



Source: Bloomberg.

The presence of the UIP is tested through the mechanism of Cheung *et al* (2003) and Kohli (2011). When capital flows take away arbitrage opportunity, any deviation from the mean would be transitory, while obstacles to free capital would make the deviation permanent. If the interest rate differential reaches any equilibrium, then it should be stationary. The stationarity test of various interest differential measures would help in throwing light in this regard. The interest rate differential between India and US is non-stationary, particularly measures such as Call-Fed Fund Rate, Mibor-Libor difference, and Treasury bill rate of India and US (Table 2). Since these measures are not stationary, it indicates inflow/outflow of capital across the border does not generate parity conditions or bring in convergence. This result is corroborated by the significance of AR terms, that indicate persistent deviations. It highlights that various regulations/ limits on capital inflows have given some leeway in monetary management.

Table 2. Uncovered Interest Rate Parity

	Call Rate - Fed Fund Rate	Mibor- US Libor (One-month)	TB-91day (India-US)
Stationarity Test	Non-Stationary	Non-Stationary	Non-Stationary
Persistence			
Ar(1)	0.51(0.0)	0.51(0.00)	0.45(0.00)
Ar(2)	0.02(0.87)	0.01(0.89)	0.05(0.54)
Ar(3)	0.17(0.05)	0.18(0.06)	0.14(0.12)
Ar(4)	-0.11(0.16)	-0.11(0.23)	-0.10(0.22)
Ar(5)	0.26(0.00)	0.27(0.00)	0.26(0.00)

Notes: Mibor-Mumbai Inter-Bank Offer Rate; Libor-London Inter-Bank Offer Rate; TB-Treasury Bill Rate.

The uncovered interest parity (UIP) was examined from the figure arrived after subtracting the change in exchange rate from the interest rate differential. The figures in parentheses are p-values.

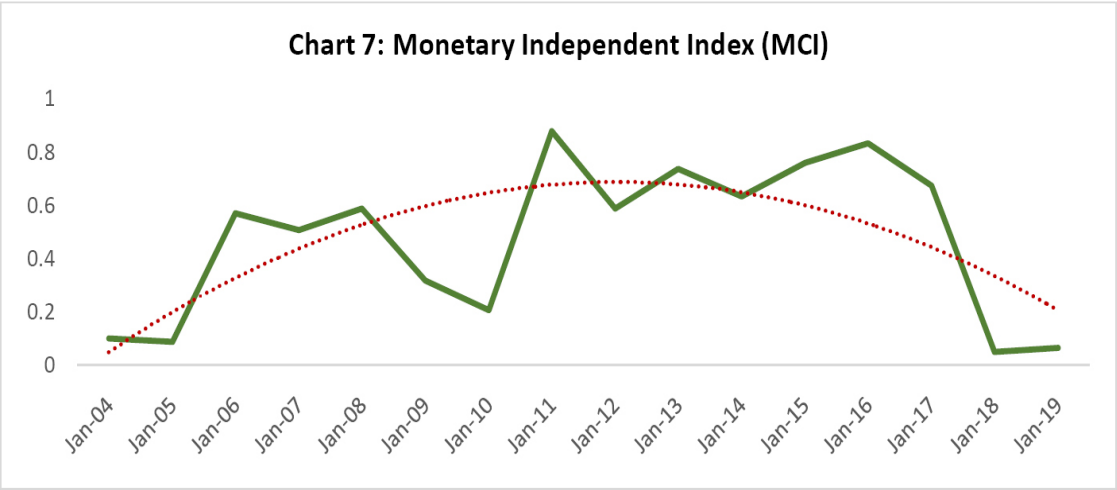
INDICATORS OF TRILEMMA

While trying to maintain monetary policy independence, the Reserve Bank tries to walk the middle path. Trilemma or Impossible trinity is examined by looking into the movement of three aspects, *i.e.*, monetary policy independence, stability in the exchange rate, and openness of capital account. It would be interesting to see how the three aspects moved in the case of India.

Monetary conditions index (MCI) indicates to what extent the domestic interest rate moves in accordance with the foreign interest rate. The calculation of it is carried out with different types of interest rate variables. Hutichson *et al.* (2012) calculated it with the use of the yield of 91-day government securities of India and the US, while Aizenman *et al.* (2013) calculated it from the money market interest rates. Here, India is the base country, and the US is taken as the foreign country. The formula for its calculation is as follows:

MCI= 1- [{Correlation (India Interest Rate, US Interest Rate) +1}/2]

In the present study, the index is measured from the annual correlation of the Indian money market interest rate and the US federal fund rate. The index witnessed much fluctuation which may be attributed to various domestic and global factors (Chart 7).

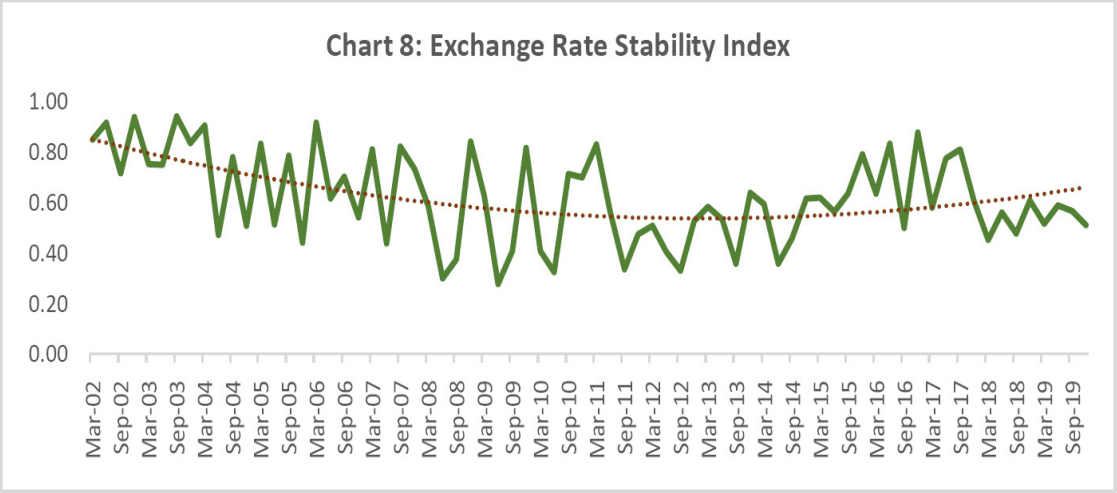


Source: Bloomberg and Author's estimates.

In some studies, the exchange rate stability index has been constructed by using exchange rate against a single currency, in other studies it is done with the use of exchange rates against a basket of currencies (Ito, and Kawai (2012)). Here, in this study, it is carried out from the exchange rate of the Indian Rupee against the US dollar. The formula for it is as follows:

$$ERS = \frac{0.01}{0.01 + stdev(\Delta(\log(exch_rate))}$$

It shows that the exchange rate has remained largely range-bound over the last twenty years, though it has witnessed sporadic spells of fluctuation (Chart 8).

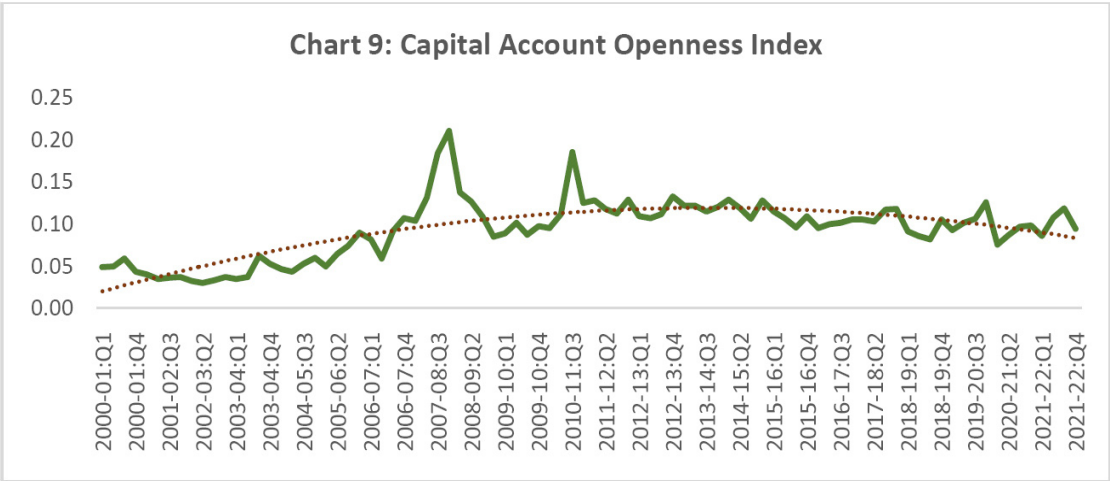


Source: Bloomberg and Author's Estimates.

The capital account openness index shows the extent to which the domestic market is integrated with the outside world. It is calculated as follows:

KO= (Capital Inflow+ Capital Outflow)/GDP

It shows that openness has increased over a period of time, mostly remaining range-bound. Overall, India has followed a gradual and cautious approach to capital account openness (Chart 9).



Source: Bloomberg and Author's Estimates.

The Reserve Bank undertakes forex intervention to control undue volatility in the forex market. The resultant increase in domestic liquidity is sucked through the sale of securities that reduces the net domestic assets (NDA) in its balance sheet. The effectiveness of the sterilisation operations is examined through the sign and magnitude of sterilisation and offset coefficients. The sterilisation coefficient indicates the change in the net domestic assets (NDA) in correspondence with change in the net foreign assets (NFA). The offset coefficient indicates the change in NFA, as a result of change in the NDA, induced by rise in yields generated from the open market sale operations of the securities. These coefficients range from 0 to -1. The sterilisation coefficient of -1 highlights the condition of total sterilisation of the rupee liquidity created by the forex intervention undertaken to contain exchange rate volatility, leaving the reserve money level unchanged. A value 0 means no sterilisation of the generated rupee liquidity. The offset coefficient of -1 indicates full capital inflows in response to decline in domestic assets, a situation of total capital mobility.

The monetary reaction function (guided by (Cumby and Obstfeld, 1982), and (Kohli,2015)) is as follows:

Change in NDA= λ * Change in NFA + $^{\varepsilon}$. Here λ is the sterilisation coefficient.

The Capital flow equation (guided by Kouri and Porter, 1974) is as follows:

Change in NFA=β* Change in NDA+$^{\varepsilon}$. Here β is the offset coefficient.

Both the equations are made robust by using additional control variables. The equations are estimated by application of two stage least squares (2 sls) methodology.

In this study, an attempt is being made to estimate sterilisation and offset coefficients in the period after the Reserve Bank of India adopted flexible inflation targeting (FIT) framework, beginning from June 2016. It uses monthly data from July 2016 to December 2019, and the sterilisation and offset coefficients are calculated with model specification followed by Raj *et al* (2018), and Sengupta &Sengupta (2013).

In the regression for monetary reaction function, a change in NDA is the dependent variable while change in NFA is taken as independent variable. Some more control variables such as index of industrial production (IIP), change in treasury-bill yield, money multiplier are used in the equation to make the finding robust. The IIP is taken, as NDA is likely to increase with increase in growth, as per money demand function. Money multiplier changes with change in reserve ratio, that comes from change in reserve money in the liabilities, requiring a simultaneous change in NDA in assets side. The change in T-bill yield is used as it highlights the interest rate in the domestic territory. Similar estimation is carried out for the capital flow equation, with the change in NFA as the dependent variable while taking change in NDA as independent one. Here, other variables such as IIP, Indian money multiplier, and differential between the US federal fund rate and the Indian call money rate are used in this regression, as additional controls. IIP is taken as its growth can attract higher foreign capital. The interest rate differential between Indian call money rate and the federal funds rate is taken as foreign capital flows seeking higher return.

The estimated results show that the sterilisation coefficient is -0.58, and the offset coefficient is insignificant (Table 3). The coefficients are signed correctly negative. While the magnitude of the offset coefficient is more than -1, it remains insignificant in the FIT phase. The sterilisation coefficient is significant highlighting the effectiveness of sterilisation measures undertaken by the RBI in controlling liquidity.

Table 3. Sterilisation and Offset Coefficients

Sterilisation Coefficient (Dependent Variable: **NDA**)			***Offset Coefficient*** (Dependent Variable: **NFA**)		
	July 2016-Dec 2019			July 2016-Dec 2019	
Variables	Coefficient	p-value	Variables	Coefficient	p-value
NFA	-0.58	0.04	NDA	**-1.27**	**0.35**
IIP growth (-1)	192	0.08	IIP growth(-1)	200	0.13
Multiplier	-1771	0.03	Multiplier	-3379	0.45
Change in T-Bill Yield	587	0.48	IF	-2387	0.09
Constant	1409	0.44	Constant	12082	0.04
AR(1)	0.91	0.00	AR(1)	0.80	0.00
IV	IF & REER		IV	DS	GS
Adjusted R^2	0.94		Adjusted R^2	0.76	
DW statistic	1.75		DW statistic	1.70	
J-Statistic	4.42	0.11	J-Statistic	5.87	0.05

***Notes**: (i)Two-stage least square has been used. (ii) Variables are found stationary.*

CONCLUSION

In a highly integrated world, the EMEs face the prospect of hot capital flows from across the border. The hot capital flows to emerging economies have always attracted the attention of the policymakers. In 2007, facing the onslaught of capital inflows, the RBI governor even talked of the Tobin Tax on the flows of capital. Many EMEs adopted capital controls to avoid hot capital inflows. On many occasions, capital outflows have also created problems for the policymakers in these economies. This situation occurred in the 1997 East Asian crisis, the 2008 Global Financial Crisis (GFC), 2013 taper tantrum. These situations brought lessons to the EMEs and forced them to explore various policy options to save themselves from the onslaught of foreign capital. The capital inflows witnessed an uneven pattern. During 2007, the rise in capital flows forced India to use the market stabilisation scheme (MSS) to mop up excess rupee liquidity. In the case of India, various monetary instruments were used to keep the monetary policy insulated from hot capital inflows. On other occasions, instruments were changed to manage capital outflows.

In this context, the present study looks into how capital flows and intervention evolved over several years in the case of India. Also, this study shows how the trilemma of capital flows, monetary policy independence, and stability of exchange rates have moved over time. It also looks into monetary independence by examining the presence of uncovered interest parity in the Indian case. It is seen that various restrictions/limits have been effective in the retention of control over the implementation of monetary policy.

The study deals with various episodes of capital flows, and how these created problems for policymakers. The Reserve Bank, along with the Government of India, has explored various tools to deal with the capital inflows/outflows and liquidity created from forex intervention. These are designed to safeguard domestic economic compulsions and to preserve monetary policy independence.

The study found that the sterilisation coefficient is significant while the offset coefficient turns out insignificant in the post-FIT period. It highlights that the independence of monetary policy is maintained even after the implementation of FIT. Many countries have applied capital controls. However, in India's case, the application of various policy options has allowed its authorities to keep the monetary policy independence intact, even after the implementation of the FIT in India.

However, liquidity management measures such as the standing deposit facility (SDF) have been operational since 2020. This measure is designed to absorb a huge amount of liquidity without the requirement of any collateral. Hence, this study can be relooked later, with data covering the period after the implementation of the SDF.

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ANNEX

Annex Table 1. Chronology of Actions by Federal Reserve of US

Sl No.	Date	Chronology of Announcements by US Fed
1	November 25, 2008	QE1 announced by Fed. It declared to purchase GSEs and MBS backed securities.
2	December 16	The Fed stood ready to expand its purchase mortgage backed securities and agency debt.
3	January 28, 2009	FOMC decided to purchase long duration securities if necessary.
4	March 16	QE1 expanded, with 300 billion USD as long-term securities.
5	March 31	QE1 was terminated.
6	Aug 10	The rollover of maturing securities was announced.
7	Aug 27	QE2 was hinted, by announcing the expansion of long-term securities.
8	Nov 3, 2010	QE2 was announced.
9	Sept 21, 2011	Fed announced Operation Twist.
10	June 20, 2012	Operation Twist was extended.
11	June 29, 2012	QE2 Cessation.
12	Dec 31, 2012	Operation Twist was terminated.
13	Sept 13, 2012	QE3 was announced.
14	Dec 12, 2012	QE3 was expanded.
15	Jan 2, 2013	Fed started bond buying programme
16	May 1, 2013	QE3 modified.
17	June 19, 2013	Tapering of bond purchases discussed.
18	Dec 18, 2013	Tapering of bond purchases started.
19	Sept 16, 2014	Fed issued Normalisation plan.
20	Oct 29, 2014	Fed terminates QE3.
21	June 14, 2017	Fed signalled normalisation of its Balance sheet.
22	Dec 19, 2018	Fed said Balance sheet normalisation on auto pilot.
23	Jan 4, 2019	Fed indicated flexible approach to Balance sheet normalisation.
24	March 8, 2019	Fed indicated Balance sheet endpoint to be higher that before the crisis.
25	July 31, 2019	Fed announced the preponement of balance sheet winddown.
26	March 15, 2020	QE started to fight the adverse effect of Covid-19
27	March 23, 2020	Fed announced to keep the policy of purchases of securities open for transmission of monetary policy
28	December 2020	Fed indicated to reduce the purchases of securities with the recovery of the economy progressing.
29	November 2021	Tapering of the bond purchases began.
30	December 2021	Tapering made double of its size.

Annex Table 2. Financial Indicators and Their Sources

Name of Indicator	Description	**Sources**	**Form of the Data Used**
NDA	Net Domestic Assets	Handbook of Statistics on Indian Economy, RBI	First difference (12- month variation)
NFA	Net Foreign Assets	Handbook of Statistics on Indian Economy, RBI	First difference (12- month variation)
IIP	Index of Industrial Production	NSO	Growth (12- month variation) Taken with a lag
MM	Money Multiplier	Handbook of Statistics on Indian Economy, RBI	First difference (12- month variation)

T-Bill	Yield of 91day Treasury Bill	Bloomberg	First difference (12- month variation)
IF	Interest rate differential	Differences between 91day T-Bill Yield in India and the US	First difference (12- month variation)
REER	Real Effective Exchange rate	Handbook of Statistics on Indian Economy, RBI	First difference (12- month variation)
GS	Government Securities Turnover	Handbook of Statistics on Indian Economy, RBI	First difference (12- month variation)
DS	Difference between Policy rates and Call Rate	Handbook of Statistics on Indian Economy, RBI	First difference (12 -month variation)

Annex Table 3. Liquidity Measures undertaken by RBI

Year	LAF					SLF	MSS	OMO		Long-Term Repo Operation	TLTRO	SLF for MF	SLF for NBFC	Special LT Repo for Small Finance Bank	Special Reverse Repo	SDF	Net Injection (+) /Absorption (-)
	Repo	Reverse Repo	Term Repo	Term Reverse Repo	MSF			Sale	Purchase								
2012	108808	339	-	-	1700	276	-		9764								109722
2013	67592	1945	34575	-	28807	91	-	2532	7861								80763
2014	18706	5559	27101	13100	3204	-178	-	777	1589								22067
2015	11553	7083	18014	17298	1304	-39	-	459	1267								5784
2016	9064	9405	20976	32744	1097	-4	57162	10	6370								-4451
2017	7094	16623	4534	56207	1544	5	49091	8184	20								-58220
2018	5541	23270	18518	19523	1335	-1	-		7515								-18408
2019	5964	22083	12417	113446	2455	-2	-	835	3830								-91913
2020	2827	348781	9272	199549	1292	94	-	8858	6568	155	8395	1215					-370991
2021	-	275917	125	225110	562	-30	-	2553	6792		661			278	4236		-303176
2022	-	1200120	60005	167536	2928	-18	-	593	125							104983	

SLF = Standing Liquidity Facility

MSS = Market Stabilisation Scheme

OMO = Open Market Operation

TLTRO = Targeted Long-Term Repo Operations

SDF = Standing Deposit Facility.

Source: RBI.

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