



भारतीय स्टेट बैंक
STATE BANK OF INDIA

Foreign Exchange Market Intervention & Liquidity Management in India: Some Empirical Investigations

Soumya Kanti Ghosh & Tapas Kumar Parida

28 February 2019

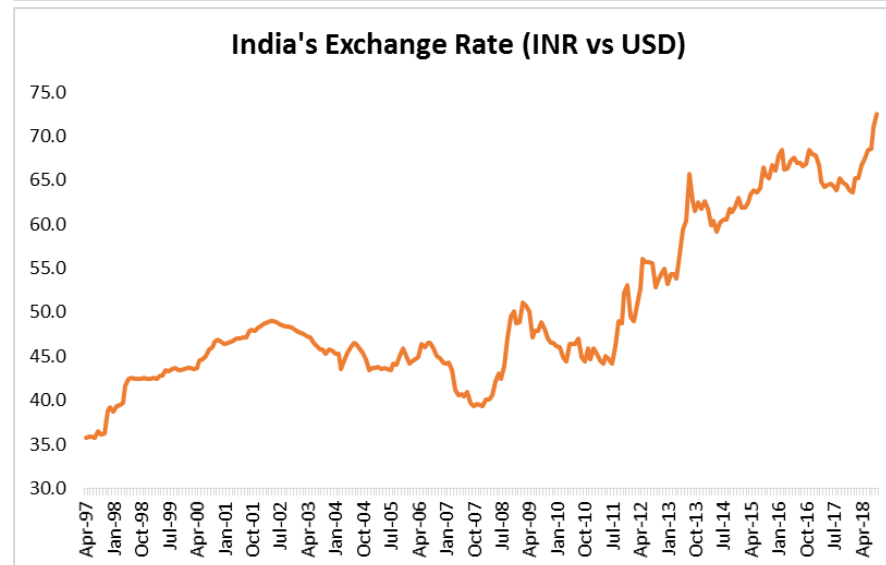
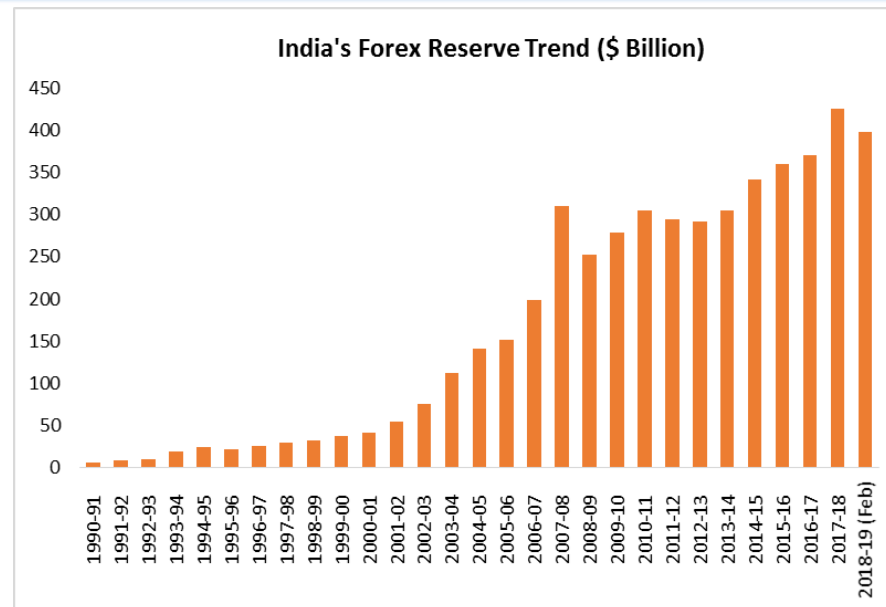
The presentation is organized as follows:

1. Setting the Context
2. Review of Literature
3. Objectives, Data, Methodology and Statement of the Model
4. Empirical Results
5. Conclusion & Scope for Future Research

SETTING THE CONTEXT

- Policy makers in an open economy choose between three policy targets simultaneously: **i) an autonomous monetary policy; ii) a fixed exchange rate; and iii) capital mobility**
- Mundell-Fleming model shows that with free capital mobility monetary policy is inefficient under fixed rates, while it is fully effective under flexible rates (Mundell, 1963)
- As per historical evidence, the financial globalization during 1990s-2000s has significantly reduced the monetary autonomy of central banks. Due to global integration, a significant costs associated with these crises have added **financial stability**, as another policy objective to the trilemma
- To substantiate this, we carried out an empirical exercise (the methodology given by Aizenman *et al*; 2012) to check whether India is indeed moving from 'policy trilemma' to 'policy quadrilemma'. The results indicate that RBI is facing policy trilemma

- In 2018, forex markets around the world was thrown into turmoil due to a number of factors: stronger dollar, recovery in US economy, rising oil prices etc.
- Currencies of emerging market economies depreciated
- The Indian Currency (INR) has depreciated by 9.2% against the dollar in 2018 and still remain volatile
- Forex reserves declined from the peak of \$426 billion in April 2018 to \$398 billion in February 2019 (declined by \$27 bn in 10 months)
- A significant part of such a decline can be attributed to the RBI intervention in the forex market. **The question arises that: is it worth doing?**

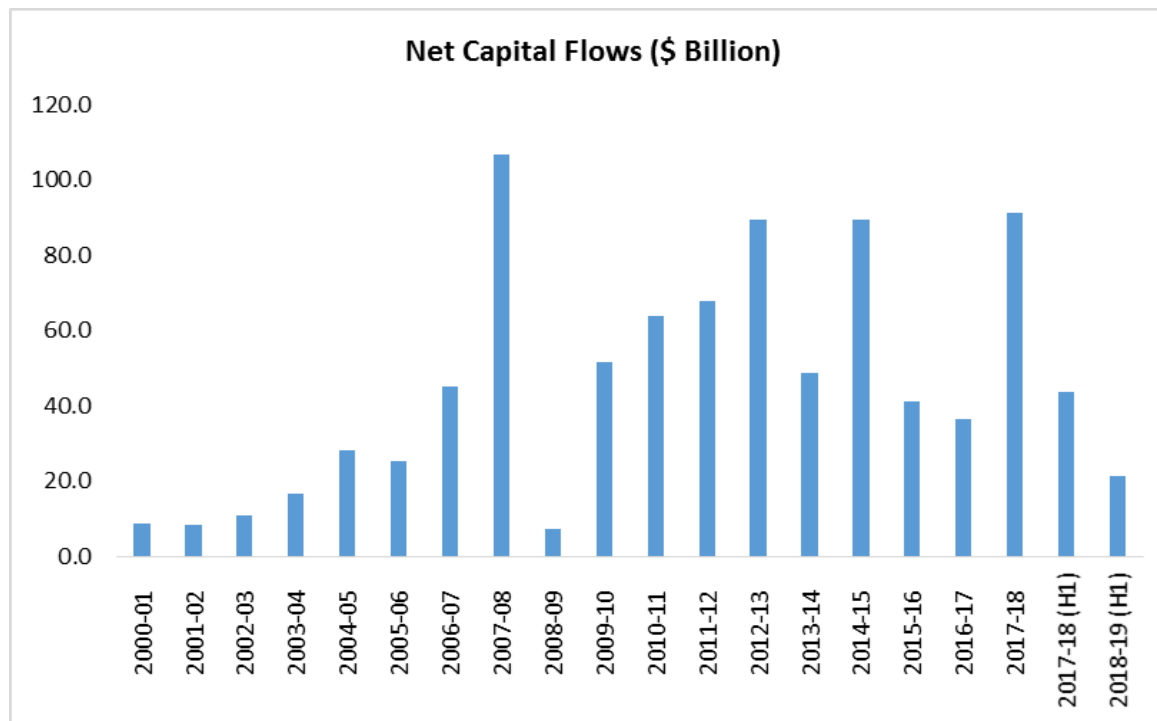


- In the merchant market (in both spot and forward segment) there was an excess demand in the range of \$9-14 billion since Feb'18, however in the interbank market the trend is quite opposite and there has been excess supply
- Specifically, in the month of August the excess demand in Merchant segment was far outstripped by the oversupply in Interbank Segment. This indicates that speculation also triggered a currency fall

| Turnover in the foreign exchange market (\$ mn) | | | | | | | |
|-------------------------------------------------|-----------------------|--------------------|---------------------|-----------------------|--------------------|---------------------|-------------|
| Month | Merchant | | | Interbank | | | Grand Total |
| | Forward Excess Demand | Spot Excess Demand | Total Excess Demand | Forward Excess Demand | Spot Excess Demand | Total Excess Demand | |
| Aug-18 | 7,835 | 3,315 | 11,150 | 149 | -14,676 | -14,527 | -3,377 |
| Jul-18 | 7,383 | 2,347 | 9,730 | 2,145 | -8,458 | -6,313 | 3,417 |
| Jun-18 | 9,127 | 5,315 | 14,441 | 124 | -12,247 | -12,123 | 2,318 |
| May-18 | 5,832 | 7,260 | 13,092 | -864 | -13,900 | -14,764 | -1,672 |
| Apr-18 | -298 | 9,775 | 9,477 | 545 | -10,291 | -9,745 | -269 |
| Mar-18 | 7,749 | 4,014 | 11,763 | 1,374 | -8,094 | -6,720 | 5,044 |
| Feb-18 | 8,919 | -126 | 8,793 | 991 | -6,078 | -5,087 | 3,706 |
| Jan-18 | 3,899 | -2,299 | 1,600 | 2,203 | -2,453 | -250 | 1,350 |

Source: RBI

- Net capital flows into the country increased from USD 7.1 billion in 1990-91 to USD 51.6 billion in 2009-10, and further to USD 91.4 billion during 2017-18
- India was the recipient of highest net capital flows among the emerging market economies (EMEs) of Asia
- Such sustained capital flows helped India in financing the current account deficit and also resulting in reserve accretion of USD 110.5 billion during 2017-18



REVIEW OF LITERATURE

Country-wise Estimation of Sterilisation & Offset Coefficient

| Author | Method | Country | Period | Sterilisation coefficient | Offset coefficient |
|-------------------------|----------|----------------|-----------|---------------------------|--------------------|
| Ljubaj et al. (2010) | 2SLS | Croatia | 2000-2009 | -0.81 | -0.48 |
| Brissimis et al. (2002) | 3SLS | Germany | 1980–1992 | -0.96 | -0.40 |
| Ouyang et al. (2007) | 2SLS | China | 1999–2005 | -0.92 to -0.97 | -0.63 to -0.70 |
| Christensen (2004) | VAR | Czech Republic | 1993–1996 | -0.11 | -0.15 |
| Siklos (2001) | OLS | Hungary | 1992–1997 | -1.002 | - |
| Palić (2005) | 2SLS | Serbia | 2001–2005 | -0.81 | -0.61 |
| Emir et al. (2000) | 2SLS | Turkey | 1995–1999 | -0.88 | -0.78 |
| Waheed (2007) | VAR | Pakistan | 2001–2006 | -0.5 | -0.16 |
| Cavoli and Rajan (2005) | VAR, OLS | Korea | 1990–1997 | -1.11 | - |
| | | Indonesia | | -0.76 | - |
| | | Thailand | | -0.91 | - |
| | | Malaysia | | -0.94 | - |

Source: Igor Ljubaj, Ana Martinis, Marko Mrkalj (April, 2010)

India: Estimation of Sterilisation Coefficient

| Author | Method | Period | Sterilisation Coefficient |
|-------------------------------|--------|-----------------------------|---------------------------|
| Patnaik (2004) | ECM | April 1993-December 2003 | -0.82 |
| RBI (2004) | VAR | April 1994-September 2003 | -0.92 |
| | | October 1995-September 2003 | -0.65 |
| Soumya Kanti Ghosh (2004) | - | FY1994-2004 | -0.73 |
| Ouyang and Rajan (2008) | 2SLS | 1990:Q1 – 2004:Q4 | -1.1 |
| Sen Gupta and Sengupta (2013) | OLS | January 1990 - August 2010 | (-0.21) to (-0.61) |
| RBI (2018) | 2SLS | July 1997 to October 2017 | -1.03 |
| Kohil (2001) | 2SLS | 1993-2000 | -1.09 |
| SBI (2018) | - | FY2013-2018 | -0.93 |

OBJECTIVES, DATA, METHODOLOGY & STATEMENT OF THE MODEL

1. RBI's intervention in the forex market: Evidence and effectiveness
2. Implications of attendant liquidity management because of such foreign exchange market intervention
3. Whether markets and RBI are in sync with such liquidity management and shifts in RBI intervention patterns in foreign exchange market

- The monetary policy reaction function may be written as follows:

$$\Delta NDA = \alpha_1 (C+K) + \beta_i X_i$$

Where, ΔNDA is the change in the central bank's net domestic assets, α_1 is the degree of sterilisation, C is the current account balance, K is the capital account balance and X is the vector of other variables that could also affect monetary policy actions.

As per BoPs, the sum of current and capital account balances ($C + K$) is equal to the change in the central bank's net foreign assets ΔNFA (which is approximated by the change in international reserves)

$$\Delta NDA = \alpha_1 \Delta NFA + \beta_i X_i, \quad \text{Where, } \alpha_1 \text{ value ranges from minus one to zero}$$

- If, $\alpha_1 = -1$ sterilisation is complete, means that by reducing NDA the central bank completely neutralises the increase in M_0 caused by the growth in NFA
- If the value of α_1 is closer to zero, that is the degree of sterilisation is lower ($(\Delta M_0 \neq 0; \Delta NDA < \Delta NFA)$)
- If, $\alpha_1 = 0$; if sterilisation is not carried out at all

- To calculate the sterilisation and offset coefficients, this study used the monthly data for the period from April 1996 to September 2018, a total of 258 months

| Variables | Description |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Δ NFA | Change in NFA of the RBI, scaled by reserve money from the previous period |
| Δ NDA | Change in NDA of the RBI, scaled by reserve money from the previous period |
| GDPGR | Nominal GDP (quarterly data interpolated to monthly), because as per the standard money demand specification, NDA may increase with higher nominal GDP. We have taken the YoY growth on a monthly basis. |
| IRS | Spread between the policy rate (Repo) and the weighted average call money rate (WACLR), because liquidity management aims at keeping the latter close to the policy rate |
| MM | Money multiplier, because multiplier may change due to change in CRR or currency/deposit ratio, both of which could alter reserve money from the liability (or components) side, requiring offsetting changes on the assets (sources side) |
| DIR | Interest differentials measured as the spread of the call rate over the effective federal funds rate, because foreign capital in search of higher yields is generally sensitive to interest rate differentials |
| USDINR | India's Exchange Rate with USD |
| GSEC | Quantum of secondary market operations in Government securities |

In order to estimate sterilisation and offset coefficients, we built an econometric model:

➤ The *Monetary Policy Reaction Function* is:

$$\Delta \text{NDA}_t = \alpha_0 + \alpha_1 \Delta \text{NFA}_t + \alpha_2 \text{GDPGR}_t + \alpha_3 \text{MM}_t + \alpha_4 \text{IRSt} + \mu_t \quad (1)$$

Where, α_1 is the sterilisation coefficient

➤ The *capital flow equation* is:

$$\Delta \text{NFA}_t = \beta_0 + \beta_1 \Delta \text{NDA}_t + \beta_2 \text{GDPGR}_t + \beta_3 \text{MM}_t + \beta_4 \text{USDINR}_t + \beta_5 \text{DIR}_t + \delta_t \quad (2)$$

Where, β_1 is the offset coefficient

EMPIRICAL RESULTS

- The Hausman endogeneity test has been carried out in order to check the endogeneity of the NFA variable in eq. 1 and of the NDA variable in eq. 2.
- Although the results of the *Hausman test* do not indicate that any of the two tested variables has an endogeneity problem, due to theoretical implications the two-stage least squares (2SLS) method applied for the estimation of both equations
- Some papers estimated the equations by using VAR models (e.g. Waheed, 2007; Cavoli and Rajan, 2005; Moreno, 1996 and Christensen, 2004). However, a disadvantage of VAR is that it only estimates the impact of the change in regressors on the dependent variable with a time lag, while the 2SLS method also enables the estimation of the current impact of the regressor on the dependent variable (i.e., within the same month if one is speaking about monthly time series).
- The estimated equations have been tested for the presence of heteroscedasticity, using the *White test*, and for autocorrelation, using the Lagrange multiplier test (LM test)
- The results of these tests indicate the presence of heteroscedasticity and serial correlation of residuals in the capital-flow equation so variances have been corrected with *Newey-West correction* method

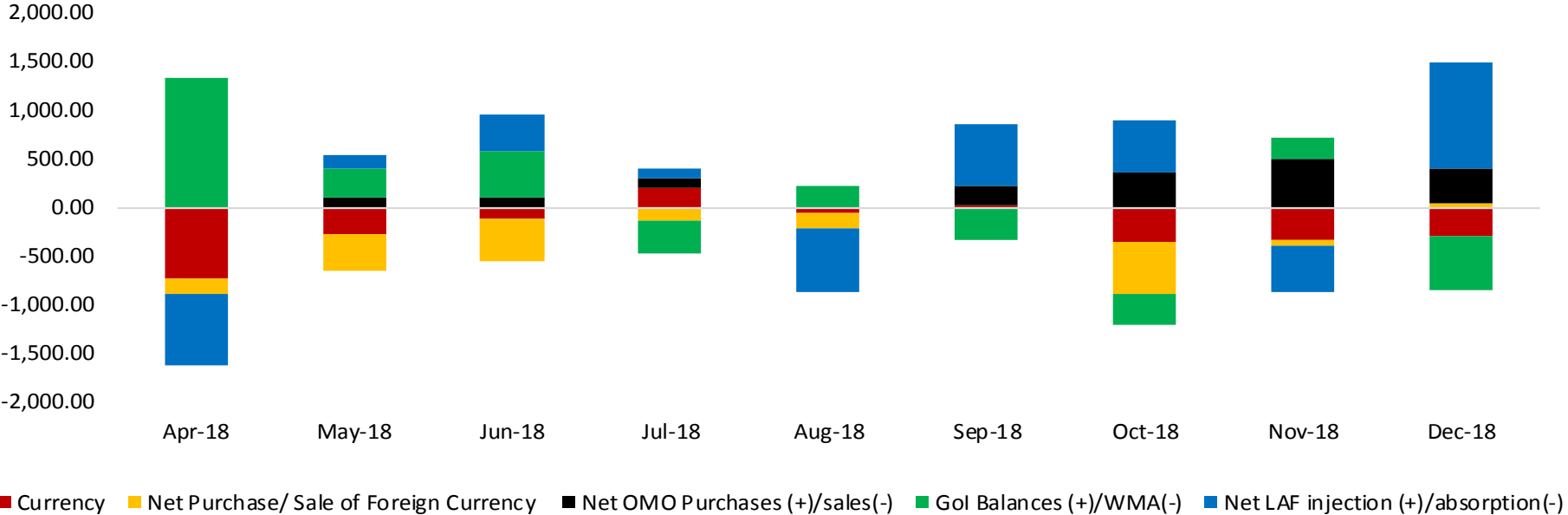
Test of Stationarity of the Variables

| Variable | Model | ADF Test Statistic | | Phillips Perron Test Statistic | |
|----------|------------------------|--------------------|----------|--------------------------------|----------|
| | | Value | P-values | Value | P-values |
| NDA | No Intercept, No Trend | -14.73 | 0.0000 | -14.69 | 0.0000 |
| NFA | No Intercept, No Trend | -11.05 | 0.0000 | -12.08 | 0.0000 |
| IRS | Intercept | -7.79 | 0.0000 | -10.87 | 0.0000 |
| GDPGR | Intercept | -4.83 | 0.0001 | -9.80 | 0.0000 |
| DIR | Intercept | -4.88 | 0.0001 | -6.99 | 0.0000 |
| USDINR | Intercept | -14.71 | 0.0000 | -14.74 | 0.0000 |
| GSEC | Intercept | -17.29 | 0.0000 | -29.51 | 0.0000 |
| MM | Intercept | -13.46 | 0.0000 | -15.79 | 0.0000 |

| Estimation of Sterilisation and Offset Coefficients | | | | | |
|-----------------------------------------------------|--------------|---------|-------------------------|--------------|---------|
| Dependent Variable: NDA | | | Dependent Variable: NFA | | |
| Monetary Policy Reaction Function | | | Capital Flows Function | | |
| | Coefficient | P-Value | | Coefficient | P-Value |
| Constant | 0.01 | 0.00 | Constant | 0.00 | 0.84 |
| NFA | -0.76 | 0.00 | NDA | -0.84 | 0.00 |
| GDPGR | -0.66 | 0.00 | GDPGR | 0.01 | 0.09 |
| MM | -0.14 | 0.00 | MM | -0.12 | 0.00 |
| IRS | 0.00 | 0.02 | USDINR | 0.00 | 0.01 |
| AR(1) | -0.20 | 0.00 | DIR | 0.00 | 0.07 |
| AR(3) | -0.11 | 0.10 | AR(1) | -0.04 | 0.02 |
| | | | AR(3) | -0.16 | 0.01 |
| Instrument Variables | DIR | USDINR | Instrument Variables | IRS | GSEC |
| Adjusted R ² | 0.73 | | Adjusted R ² | 0.72 | |
| DW Statistic | 1.97 | | DW Statistic | 1.98 | |
| Prob. | 0.023 | | Prob. | 0.003 | |

- Both the estimated models are statistically significant, which is indicated by the overall 'P' value. The **calculated sterilisation coefficient stands at -0.76**, which is similar to the other studies conducted for India. The sterilisation coefficient indicate that around 76% of the liquidity injected through dollar purchases during the period April 1997 to September 2018 has been neutralised by the RBI through attendant liquidity management. Thus, sterilisation has been largely successful in Indian context
- The **estimated offset coefficient is -0.84** that indicate that the sterilisation process attracts capital leading to higher NFA, which leads to expansion reserve money in the economy. Alternatively, these results clearly show the **challenges in liquidity management of the RBI in the face of increased capital inflows**. From the policy stand point of view, the higher offset coefficient than the sterilised coefficient signifies the rising ineffectiveness of sterilisation with growing openness of the capital account

- The systemic liquidity underwent significant shifts in the first three quarters of FY19. While the liquidity conditions generally remained in deficit during Q1 FY19, it was in surplus mode in Q2 and Q3
- The RBI's forex operations and currency expansion has turned out to be the prime drivers of durable liquidity in the banking system in 2018-19 whereas the ebb and flow of Government spending was the key trigger for transient liquidity movements



- The larger question is even as RBI has pointed out the contours of liquidity management, the markets may have failed to notice it
 - In recent times, RBI communication has shifted from speeches to more rigorous research articles that underlines subtle policy changes. The market could take a cue from such publications and thereby tactically be in sync with RBI policy shifts. This could in effect reduce volatility in financial markets
- We expect a better synchronisation of markets and RBI and more frequent communication from RBI regarding liquidity management

CONCLUSION
&
SCOPE FOR FUTURE RESEARCH

- The increasing value of the offset coefficient (along with quasi fiscal costs) is unavoidable given the integration of global financial markets with India and thus making sterilisation progressively less effective. This would clearly imply the limits to RBI intervention in forex market and hence greater exchange rate flexibility. RBI communication in fact suggests that a relatively hands off exchange rate approach is the new RBI response in current times!
- The RBI has also been relatively successful in addressing the attendant liquidity implications. Movements in durable and transient liquidity has been effectively addressed and the system has moved from a liquidity deficit in Q1FY19 to a largely balanced liquidity regime by Q3FY19.

- One indicator of effective liquidity management is that the weighted average call rate (WACR) has been largely aligned with the policy rate. However, on examination we find that movements in WACR could be liquidity-agnostic as it has hardly moved even when deficit has been as large as INR 2.6 trillion (Typically, market microstructure)
- Thus, Liquidity management per se still has some operational challenges like improving the market microstructure, addressing sectoral liquidity mismatches and a balance between effective mix of durable and transient liquidity injection. A discussion of such could be the scope for future research in the Indian context

| Average Net LAF & WACR | | |
|---------------------------|------------------------------------------|-----------------------|
| Month | Average net LAF deficit (-) /surplus (+) | Monthly Average WACR |
| | Rs Billion | % |
| Apr-18 | 496 | 5.90 |
| May-18 | 142 | 5.91 |
| Jun-18 | 140 | 6.10 |
| Jul-18 | -107 | 6.16 |
| Aug-18 | 30 | 6.36 |
| Sep-18 | -406 | 6.46 |
| Oct-18 | -560 | 6.45 |
| Nov-18 | -806 | 6.40 |
| Dec-18 | -996 | 6.47 |
| Jan-19 | -335 | 6.39 |
| <i>Memo:</i> | | |
| 16-Mar-16 | -2665 | 7.02 (Repo: 6.75%) |
| Source: RBI; SBI Research | | |

Thank
you