WP-2017-017

Monetary transmission in India: Working of price and quantum channels

Ashima Goyal and Deepak Kumar Agarwal

Indira Gandhi Institute of Development Research, Mumbai
September 2017

Monetary transmission in India: Working of price and quantum channels

Ashima Goyal and Deepak Kumar Agarwal

Email(corresponding author): ashima@igidr.ac.in

Abstract

We examine the strength and efficacy of transmission from the policy rate and liquidity provision to market rates in India, using event window regression analysis. We find the interest rate transmission channel is dominant, but the quantity channel has an indirect impact in increasing the size of interest rate pass through. The speed of response is faster where there is more market depth. Short term liquidity matters for short term rates, especially where markets are thin and long-term liquidity for longer term government securities. Asymmetry, or more transmission during tightening, finds little support, but pass through is faster during tightening. Market rates respond similarly to policy rate changing direction. The quantum channel directly contributes more when in sync with the interest rate channel only occasionally, but contributes indirectly by increasing the size of coefficients. Implications for policy are drawn out.

Keywords: Monetary transmission; Repo Rate; market rates; short and long-term liquidity

JEL Code: E51; E58; E42

Acknowledgements:

We thank Dr. Kanagasabapathy for valuable comments and Reshma Aguiar for secretarial assistance.

Monetary transmission in India: Working of price and quantum channels

1. Introduction

Post 2002, with the introduction of the Liquidity Adjustment Facility (LAF), the Reserve Bank of India (RBI) moved towards using the Repo Rate, instead of monetary aggregates, as the instrument of monetary policy. Collateralized overnight liquidity injection at the Repo and absorption at the Reverse Repo Rate, defined a LAF band, within which the Call Money Rate (CMR), the overnight interbank borrowing rate, which was the intermediate target for policy, was to stay.

There was considerable development of the money market to support the LAF. Active money markets fulfil short term borrowing needs and also help maintain liquidity, so that RBI intervention should be required only at the margin. New instruments such as Certificates of Deposits (CD), Commercial Papers (CP), Collateralized Borrowing and Lending Obligations (CBLO), contributed to the demand and supply equilibrium making funds available for those willing to borrow from those willing to lend. For most instruments, however, rates of growth were higher in the first half of the period, reflecting either a lower base or higher economic activity in that period.

Government securities markets also showed significant growth (Table 1). The LAF provides short-term liquidity, but Open Market Operations (OMO) and Market Stabilisation Scheme (MSS) involving purchase and sale of government securities (G-Secs), foreign exchange (forex) market intervention, and Cash Reserve Requirement (CRR: The percentage of their deposits commercial banks have to keep as cash reserves with the RBI), affect long-term liquidity or money supply growth. The latter accommodates changes in money demand in line with nominal income growth.

Table 1: Growth in Money & Government Securities Market – Start, Middle and End of the Study Period

		Volume (Rs. Crores)			Percentages		
S. No.	**Nomenclature**	**2002-03 (X)**	**2009-10 (Y)**	**2016-17 (Z)**	**Compound Annual Growth (X to Y)**	**Compound Annual Growth (Y to Z)**	**Compound Annual Growth (X to Z)**
1	Call/Notice/Term Money (*)	4517510.04	2530236.4	4240856	-7.95	7.66	-0.45
2	CDs	18023.35	3034759	2277896.32	107.9894	-4.02	41.29
3	CPs	199200	1977473	9225737	38.8	24.61	31.52
4	CBLO	976789 (#)	14859364.1	22586062	72.36	6.16	29.92
5	Market Repo	1560510 (#)	6072828.37	11470261.8	31.23	9.51	18.08
6	Central Government Securities	1293383.43	2558041.09	15178392.2	10.23	28.97	19.23
7	Treasury Bills	75515.36	387101.11	1090386.01	26.3	15.94	21.01
8	Total Government Securities (6+7)	1368898.79	2945142.2	16268778.2	11.57	27.65	19.34

 # Figures for 2004-05; * Lending volume total turnover
Source: Computed using data from DBIE and EPWRFITS

These changes raise questions about the nature of transmission from the Repo to market rates, and how it is affected by short- and long-term liquidity. The Indian case is particularly interesting as markets had to shift from quantity to rate signals, especially after 2011, when following the recommendations of RBI (2011) it was decided to keep liquidity in deficit. This meant the LAF would be in injection mode even during periods of monetary loosening. RBI's belief was that transmission works better with liquidity in deficit mode. But was this borne out?

The objective of this paper is to examine the working of the LAF, in particular the Repo Rate and RBI liquidity operations in influencing the market rates of interest. It explores the extent and strength of pass through to the market when the policy rate changes level and direction, and the impact of not only short but also long term liquidity. Specific questions addressed are:

a) Does a change in the Repo Rate lead to a significant change in market interest rates?
b) Is the transmission asymmetric for a rise and a fall in the Repo Rate?
c) Is there any significant asymmetry in transmission when short run liquidity is in injection mode (deficit) and when it is in absorption mode (surplus)?
d) Is there any significant asymmetry in transmission when total liquidity is in absorption mode and when it is in injection mode?
e) Do the quantity variables work better when they are in sync with the Repo Rate change?
f) Is there any asymmetry when injection or absorption is through short term or through long term liquidity?

The rest of the paper is divided into five sections: Section 2 gives a brief literature review and section 3 the data and methodology. This includes stylized facts and graphs showing composition and trends of short term and long term liquidity corresponding to phases of policy and, movements of market rates corresponding to policy rates. Section 4 uses regression analysis to examine transmission. Section 5 concludes the paper, also providing implications for policy.

2. Literature review

Work on Indian monetary transmission, focuses largely on transmission to the real sector. There are a large number of studies using a Structural VAR framework. For example, Khundrakpam and Jain (2012) find monetary policy impacts output with a lag of 2-3 quarters and inflation with a lag of 3-4 quarters, the impact persisting for 8-10 quarters. The CMR interest rate channel is found to be the strongest. It accounts for about half of the total impact of monetary shocks on output growth and about one-third of the total impact on inflation. But effect of CMR on output is 2-3 times greater than its effect on inflation.

While the first leg of transmission to financial market rates does occur, since post LAF financial rates move with policy rates (Goyal, 2017), it has rarely been studied rigorously. Kanagasabapathy et.al. (2014) do study the interplay and complementarity between the rate and quantum channels in India, by estimating Granger causality between various sets of variables in Vector Auto Regressive (VAR) models. They find the Repo Rate has a stronger effect on liquidity than the reverse, but long-run liquidity moves sufficiently independently to partly nullify the effect of the Repo Rate on non-food credit. Their study period, the post LAF period up to May 2012, when liquidity was largely in surplus due to large inflows, may be influencing these results. They also find the Repo Rate is more effective in adjusting short run market rates, such as call money market rate and one year G-Secs, as compared to long run market rates like 10 year G-Secs, which depend on various other factors like output gap, future economic activity etc.

In the initial stages of LAF, policy aimed to change both price and quantity variables in the same direction. The volatility of call money rates, although reduced, was still appreciable since they could jump from one edge of the band to the other. RBI (2011) concluded from international experience that transmission is better when liquidity is in deficit mode. Money market instruments respond faster to policy rate shocks in such settings. The report also pointed out, due to large exogenous liquidity shocks from foreign inflows and variations in government cash balances, it is difficult for the market to predict liquidity with complete accuracy on a daily basis.

The RBI decided to operate the modified LAF in a deficit mode. Accommodation of liquidity through repo was constrained by an indicative restriction of 1 per cent of net demand and time liabilities (NDTL) of commercial banks, supplemented with a marginal standing facility (MSF) fixed at 100 basis points above the Repo Rate. The MSF would make additional liquidity available up to one per cent of the SLR. Steps were also taken to improve liquidity forecasting and reduce transaction costs in accessing liquidity from the RBI, so as to allow finer tuning of liquidity requirements and smoother adjustment of market rates. Such fine tuning became all the more imperative with the decision to keep liquidity at the injection mode.

Following (RBI, 2014) RBI moved to shift markets to variable rate term repo by restricting borrowing in the fixed rate LAF repo to 0.25 per cent of NDTL, with 0.75 made available through term repos. An active term repo market was expected to improve market resilience to liquidity shocks reducing dependence on the RBI, as well as provide benchmarks for financing a wider range of market products[1]. After a transitional period, the operating target was to shift to the 14-day term repo; the reverse repo was to approach the repo, with the floor of the LAF corridor now provided by a non-collateralized remunerated standing deposit facility. But banks were reluctant to depend too much on each other since in the absence of a benchmark rate bilateral rates could rise too much.

When the RBI moved to an easing phase in 2015, tight liquidity caused severe problems in transmission, and there were numerous complaints from markets. As a result, on April 5, 2016 it was announced market developments were now sufficient to narrow the LAF corridor from 100 to 50 basis points without the CMR overshooting the bounds, and to move towards surplus long-term liquidity. Even if the CMR fell towards the Reverse Repo, it would not be a large change. The ex-ante liquidity deficit would be reduced over time from 1 per cent of NDTL towards neutrality (RBI 2016).

This period of experimentation with LAF offers rich data points to test hypotheses about the interaction of interest rates with short and long-term liquidity. Results could be useful inputs in policy design.

China is another country with monetary systems in transition. Qiao and Liu (2017) in a detailed event-window regression analysis of the interaction between the Central Bank target rate and its Open Market Operations found the effectiveness of the target rate change is conditional on a change in liquidity in the same direction, especially in a loosening cycle. They surmise this may be because of the clear and strong signal market operators then receive. We do a similar analysis of the Indian economy, while making the additional distinction between short- and long-term liquidity.

3. Data and Methodology

Our data covers the active LAF period from April 2002 onwards to March 2017, and is sourced from Database on Indian Economy (DBIE) and Weekly Statistical Supplement (WSS) of the RBI, RBI (2017), EPWRFITS of the EPW Research Foundation, and CMIE. All the rates are in per cent per annum and the liquidity figures are in Rupees crores. The variables are explained in the table below.

[1] Apart from market development, this was conditional on better government cash management, and better liquidity assessment, with daily reporting, by banks.

VARIABLE NAME	DESCRIPTION
Repo Rate	Repo Rate is the policy interest rate which was introduced in 2002. It refers to the rate at which RBI lends to other banks for short-term credit requirements to manage mismatches between the demand and supply of funds.
Call Money Market Rate	Call Money Market refers to the market where surplus funds are traded at interbank rates with the purpose of managing temporary mismatches in funds and or to meet CRR and SLR requirements mandated by RBI.
Collateralized Borrowing and Lending Obligations	CBLO is a money market instrument that facilitates borrowing and lending of funds in a collateralized environment with various maturity tenors.
Treasury Bills and G-Secs	Treasury Bills are instruments used to fulfil short term money borrowing needs of the Government. They are very secure and are highly marketable and tradable. T-Bills in secondary market are traded for various maturities. G-Secs are longer maturity borrowings.
Liquidity Adjustment Facility injection and absorption	LAF uses repurchase agreements to inject and absorb liquidity in the money markets.
Cash Reserve Ratio	CRR is a method of monetary control whereby banks are required to set aside a portion of their total deposits as reserves with the RBI, thus reducing their ability to lend.
Open Market Operations	OMOs imply buying and selling of Government Securities to manage liquidity. Buying securities injects long term liquidity and selling securities results in absorption of the same.
Foreign Exchange Market Intervention	Buying and selling of foreign assets affect foreign reserves. These operations result in liquidity injection when foreign currency is purchased and absorption when foreign currency is sold. It is a kind of OMO in foreign currency market.
Market Stabilisation Scheme	MSS was introduced in 2004 as an instrument to absorb excess liquidity generated when RBI purchased foreign currency following excess foreign capital inflow after 2002. RBI sells Government bonds and deposits the proceeds in a separate MSS account to be used during buy backs/redemption of securities issued under MSS.

For LAF, purchase and sale data for Repo, Reverse Repo, Term Repo and Term Reverse Repo was taken and Net Injection (+)/Absorption (-) was calculated as a difference between Repo and Reverse Repo for both Spot and Term LAF. Change in Bankers' Deposits with RBI proxy for liquidity injection or absorption from CRR operations. There is liquidity injection when deposits in RBI decrease and vice versa. Net Injection (+)/Absorption (-) from OMO is the difference between purchase and sale of government securities. Data on Forex Assets proxies for RBI Forex market intervention. Increase in Foreign Currency Assets injects liquidity and decrease absorbs liquidity. Finally, deposits in MSS account from RBI WSS proxies for liquidity injection or absorption through MSS. An increase in deposits is taken as absorption and vice versa. Total Liquidity is a sum of Net Injection (Purchases)/ Absorption (Sale) from all the above five liquidity variables. Long Term Liquidity is Total Liquidity minus LAF liquidity.

Data is collected for T and T+5 windows around periods of Repo Rate change. OLS[2] is used to estimate the impact of a change in the Repo Rate, liquidity and other variables on change in different market rates. The regressions are estimated using STATA.

3.1 Stylized Facts: Easing and Tightening Phases

The period under study can be divided into seven phases of easing and tightening corresponding to continuous fall or increase in policy Repo Rate respectively. There were four easing and three tightening phases. Phase I, an easing phase, runs from April 2002 to October 2005; the final Phase VII from February 2015 to March 2017 is also an easing phase (Table 2).

Table 2: Monthly Liquidity Operations

Phases	Easing Phase (Apr 02 to Oct 05)	Tightening Phase (Nov 05 to Oct 08)	Easing Phase (Nov 08 to Mar 10)	Tightening Phase (Apr 10 to Apr 12)	Easing Phase (May 12 to Sep 13)	Tightening Phase (Oct 13 to Jan 15)	Easing Phase (Feb 15 to Mar 17)
	I	II	III	IV	V	VI	VII
Time Duration (months)	43	36	17	25	17	26	26
Change in Repo	8.00 to 6.00	6.00 to 9.00	9.00 to 4.75	4.75 to 8.5	8.5 to 7.25	7.25 to 8.00	8.00 to 6.25
No. of Times Changed	4	10	6	13	4	3	6
Basis Points	-200	300	-425	325	-125	75	-175
LAF (Net Injection (+)/Absorption (-))	6103872	-2317386	-23132185	26767905.5	25205282	6975521	-7439967
OMO (Net Purchase of Securities (+)/Sale (-))	-94498	19018	150800	210796	177757.13	-34775	160453
Net RBI Intervention in Forex Market (Net Purchase of Foreign Assets (+)/Sales (-))	368228	671788	-128912	170138	246590	262350	405430
CRR Amount (Net Injection (+)/Absorption (-))	-33138.00	-144369.00	-33378.00	-17327.00	-62695.00	11134.00	-180207.00
MSS (Net Injection (+)/Absorption (-))	-69255	-100250	166760	2737	0	0	0
Long Term Liquidity	171337.00	446187.00	155270.00	366344.00	361652.13	238709.00	385676.00
Total Liquidity	6275209	-1871199	-22976915	27134249.5	25566934.13	7214230	-7054291

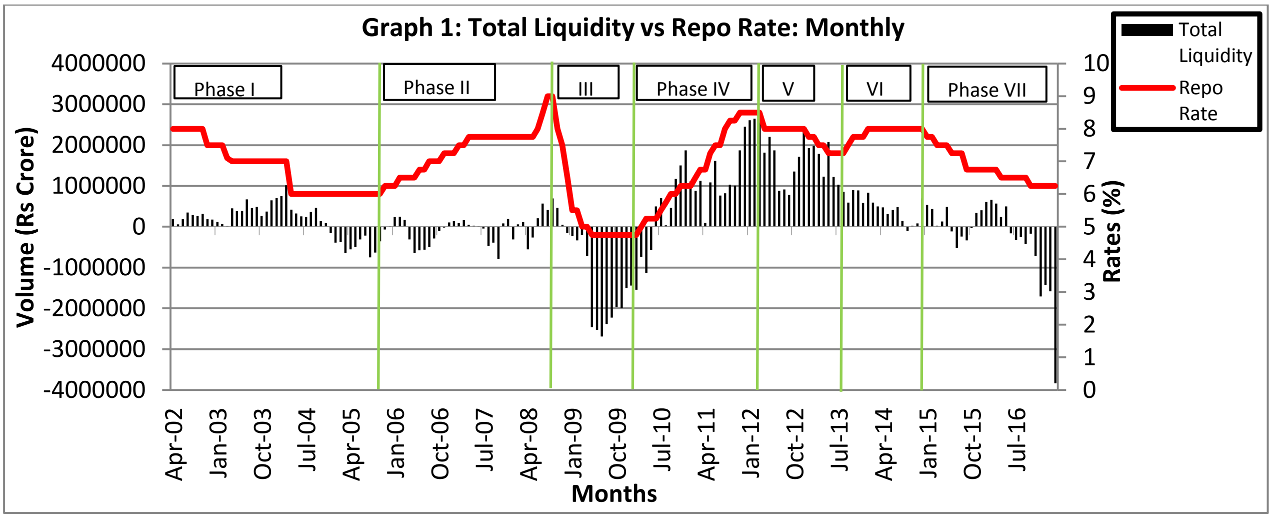
Source : Self Computed using data sourced from EPWRFITS and DBIE

The duration of the cycles range from 25 months to as long as 43 months. The shortest phases were III and V. Phase III was the post Global Financial Crisis (GFC) stimulus. The GDP growth hit a decade low of 5 per cent in 2012-2013 (Phase V). RBI, therefore, followed an accommodating monetary stance, which was reversed by the move towards inflation targeting.

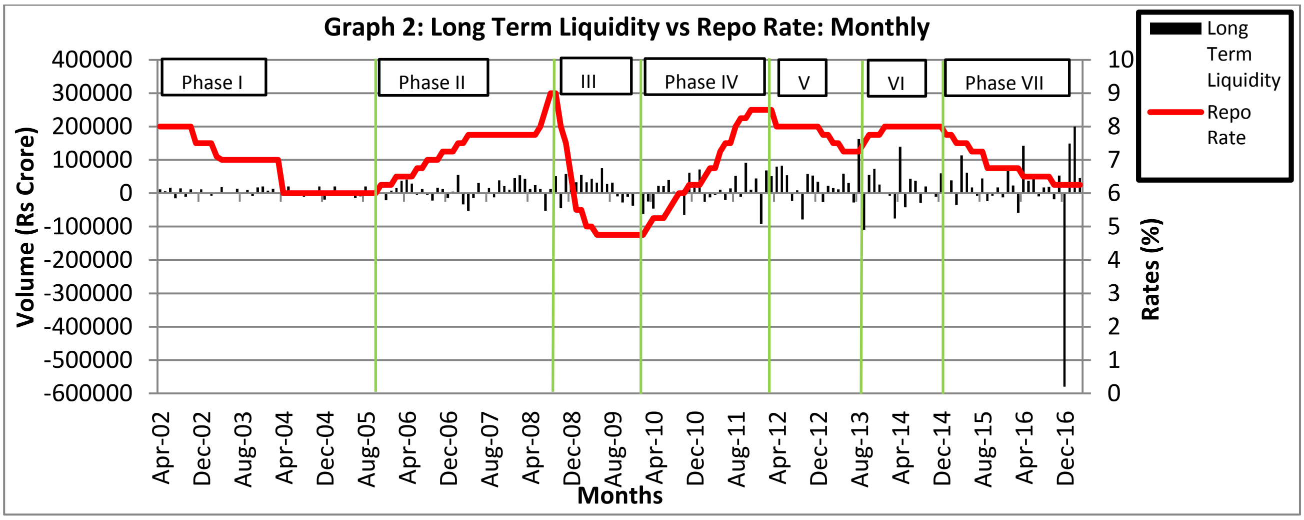
Total Liquidity has been derived as a summation of Net Injections (+)/Absorptions (-) through LAF, OMO, CRR, MSS and Forex market intervention. Long Term Liquidity is obtained by subtracting LAF from Total Liquidity. Long Term Liquidity has remained in the net injection mode throughout the period while Total Liquidity has both injection and absorption phases.

[2] Dicky-Fuller unit root tests, of all the non-dummy variables used in the regressions, rejected the null hypotheses of non-stationarity, validating the use of OLS.

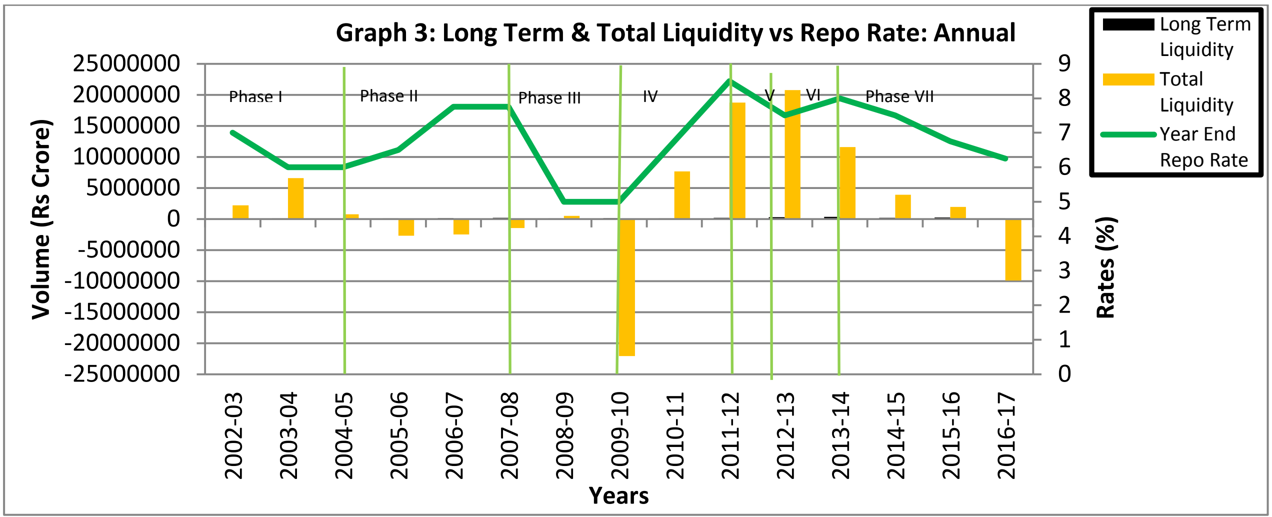
Therefore LAF had a major impact on liquidity conditions in the economy. The policy rate and different types of liquidity were not necessarily complementary to each other.



Liquidity and the Repo have often not worked in the same direction. Liquidity has not always been surplus during easing phases, since the RBI was most often in the injection mode, denoting a liquidity deficit, even during easing phases. Over 2010-15, this was a conscious decision. Between 2003 and 2009 large capital flows and the post GFC stimulus kept liquidity in surplus requiring absorption regardless of the monetary cycle (Graph 1).



Irrespective of the phases, Long Term Liquidity saw net injections for most of the period, albeit at low levels, to meet the needs of a growing economy (Graphs 2 and 3). The size of intervention increased over the years with the size of the economy. It is interesting to observe the huge liquidity absorption through Long Term Liquidity channels, in December 2016 following demonetisation, after which liquidity was injected till March, 2017. This may have been due to the high cost of sterilisation for the RBI using LAF and the decision to shift some of this burden to the banking system, rather than due to changes in the demand for Long Term Liquidity. Total Liquidity, however, was in absorption mode for the entire period after demonetisation.



Graph 3 shows Long Term and Total Liquidity for annual data. As with the high frequency data, Long Term Liquidity is positive for the entire period while Total Liquidity switches from injection to absorption with much higher amounts in the post GFC period. But injections shrink over 2013-16. The absolute value of the ratio of Long Term Liquidity to Total Liquidity is very low implying that LAF was the dominant source of short-term liquidity (Table 3).

Table 3: Annual Liquidity Operations

Phases	Easing Phase (2002-05)	Tightening Phase (2005-08)	Easing Phase (2008-10)	Tightening Phase (2010-12)	Easing Phase (2012-13)	Tightening Phase (2013-14)	Easing Phase (2014-17)
	I	II	III	IV	V	VI	VII
LAF (Net Injection (+)/Absorption (-)	9364782	-7023996	-21779135	26160475.5	20469885	11250543	-4567497
OMO (Net Purchase of Securities (+)/Sale (-))	-97898.77	-3115.26	170016.245	201310.33	154547	52290	122374.233
Net RBI Intervention in Forex Market (Net Purchase (+)/Sales (-)	344003	602902	-46373	180861	82119	248280	584030
CRR Amount (Net Injection (+)/Absorption (-)	-22887.94	-92930.3898	-93979.4002	-132234.64	67217.967	35620.2212	-181154.8182
MSS (Net Injection (+)/Absorption (-)	-64211	-104181	165655	2737	0	0	0
Long Term Liquidity	159005.29	402675.3502	195318.8448	252673.69	303883.967	336190.2212	525249.4148
Total Liquidity	9523787.29	-6621320.65	-21583816.16	26413149.19	20773768.97	11586733.22	-4042247.585

Source : Self Computed using data sourced from DBIE and EPWRFITS

3.2 Stylized facts: Repo Rate and Market Interest Rates

Larger alteration in Repo Rate causes most of the rates to move in the same direction (Table 4). In Phases V and VI, which had the lowest adjustment compared to other phases, with the LAF in deficit despite an easing cycle, the market rates did not adjust in the same direction as the Repo Rate. Over the years, elasticity of adjustment of 91-Day T-Bills and to some extent 1-Year G-Sec increased in absolute terms but 10-Year G-Sec did not follow the same pattern. This suggests long-term market rates may be influenced by other factors like present and future economic activities, output gap, fiscal policy and the global environment (Kanagasabapathy et. al. 2016). Among other rates, CD Rate (low), CP and Call Money Rate show good adjustment to changes in the policy rate.

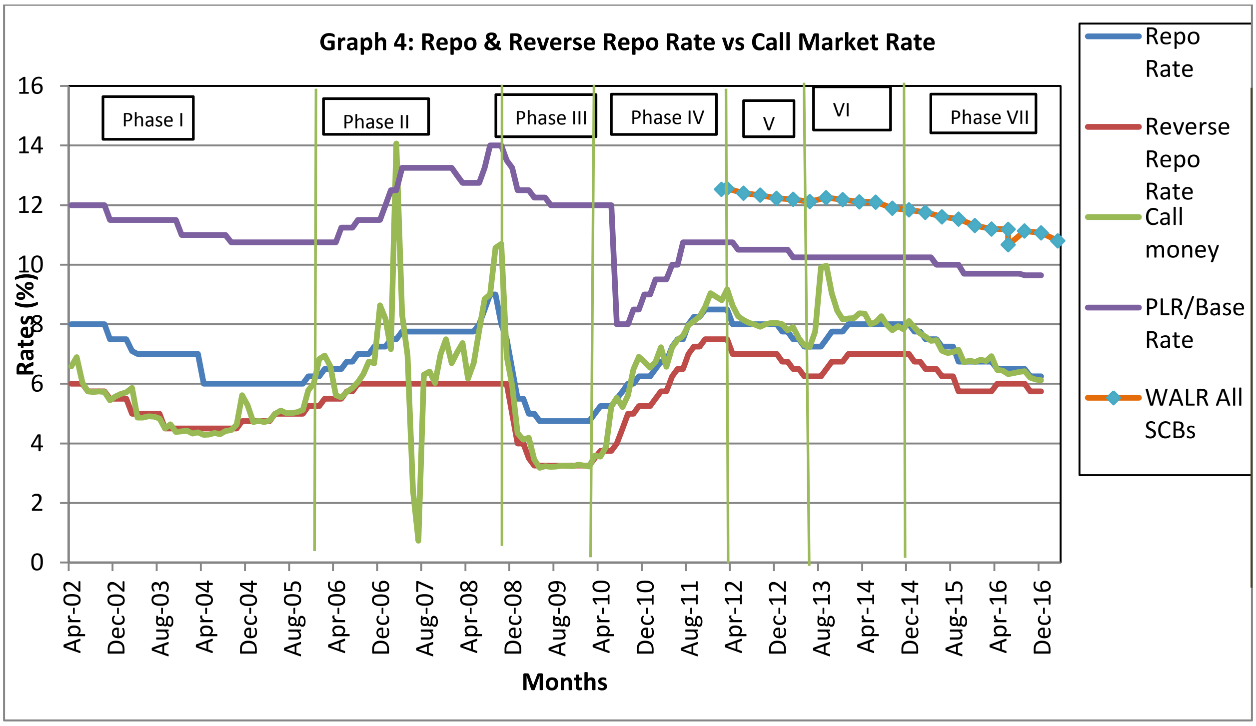
Table 4: Repo Rate and Market Interest Rates – Basis Points changes in the phases

Phases	**Easing Phase (Apr 02 to Oct 05)**	**BPS**	**Tight. Phase (Nov 05 to Oct 08)**	**BPS**	**Easing Phase (Nov 08 to March 10)**	**BPS**	**Tight. Phase (Apr 10 to Apr 12)**	**BPS**	**Easing Phase (May 12 to Sep 13)**	**BPS**	**Tight. Phase (Oct 13 to Jan 15)**	**BPS**	**Easing Phase (Feb 15 to Mar 17)**	**BPS**
	I		II		III		IV		V		VI		VII	
Time Duration (months)	43		36		17		25		17		26		26	
Change in Repo	8.00-6.00	-200	6.00-9.00	300	9.00-4.75	-425	4.75-8.5	325	8.5-7.25	-125	7.25-8.00	75	8.00-6.25	-175
Change in Call Money Market Rate	6.51-5.12	-139	5.29-4.16	-113	6.78-3.34	-344	3.47-8.82	535	8.81-10.26	145	9.08-8.11	-97	7.88-6.04	-184
Change in CD Rate														
Low	5-4.66	-34	5.25-8.92	367	8.8-4	-480	4.52-9.34	482	9-9.37	37	9.16-8.3	-86	8.06-6.21	-185
High	10.88-7.75	-313	7.75-21	-754	12.9-7.36	-554	7.12-12	488	10.6-11.95	135	11.95-8.67	-328	8.65- 6.7	-195
Change in CP Rate														
Low	7.6-5.69	-191	5.63-11.9	627	11.55-4	-755	5.3-8.51	321	8.02-8.17	15	9.5-7.98	-152	8.06-5.99	-207
High	11.1-7.5	-360	7.5-17.75	1025	16.9-8.9	-800	9-14.5	550	14.25-13.8	-45	13.57-12.61	-96	11.73-13.33	160
Change in CBLO	3.55-5.09 (From Jan'04)	154	5.05-4.08	-97	5.32-3.27	-205	3.05-8.5	545	8.39-10.22	183	7.76-8.32	56	8.02-5.5	-252
Change in 91 Day TB	5.85-5.47	-38	5.41-7.43	202	7.05-4.3	-275	4.25-8.59	434	8.37-9.9	153	9.84-8.15	-169	7.92-6.06 (till Feb '17)	-186
Change in 1 Year G-Sec	5.68-5.78	10	5.8-7.8	200	7.47-5.38	-209	5.25-8.12	-287	7.97-9.58	161	12.29- 8.01	-428	7.77-6.36 (till Feb '17)	-141
Change in 10 Year G-Sec	7.23-7.14	-9	7.14-7.73	59	7.85-7.88	3	7.87-8.50	-63	8.45-8.18	-27	8.35-7.98	-37	7.88-7.43 (till Feb '17)	-45
Change in Bank PLR /Base Rate														
Low	11-10.25	-75	10.25-13.75	350	13-11	-200	11-10	-100	10-9.8	-20	10-10	0	10-9.25	-75
High	12-10.75	-125	10.75-14	325	13.5-12	-150	12-10.75	-125	10.5-10.25	-25	10.25-10.25	0	10.25-9.6	-65

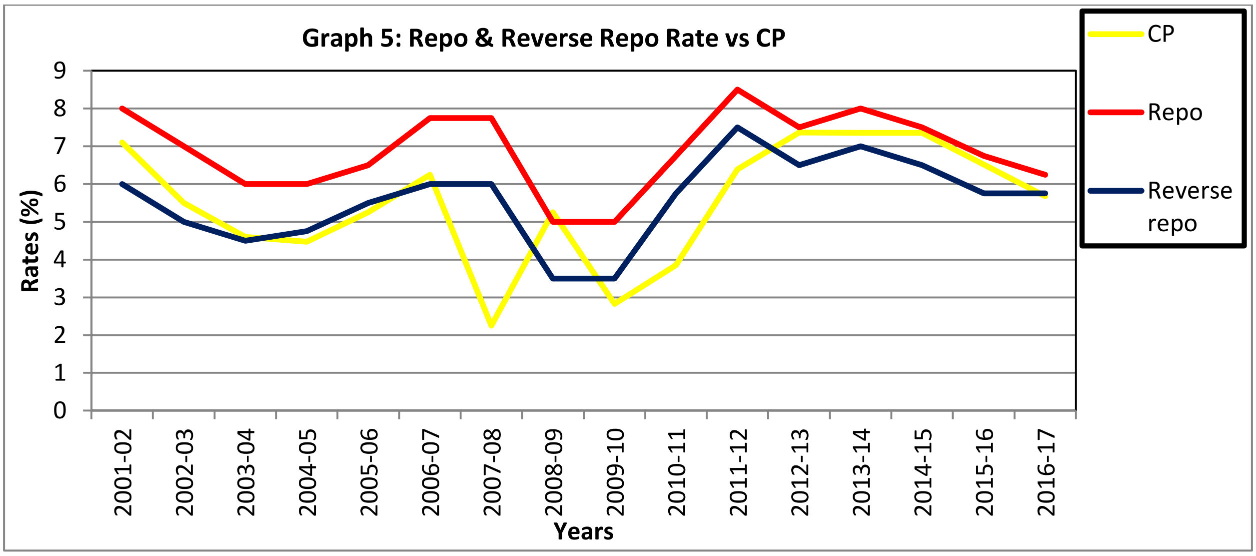
Source: Self Computed using data from EPWRFITS and DBIE

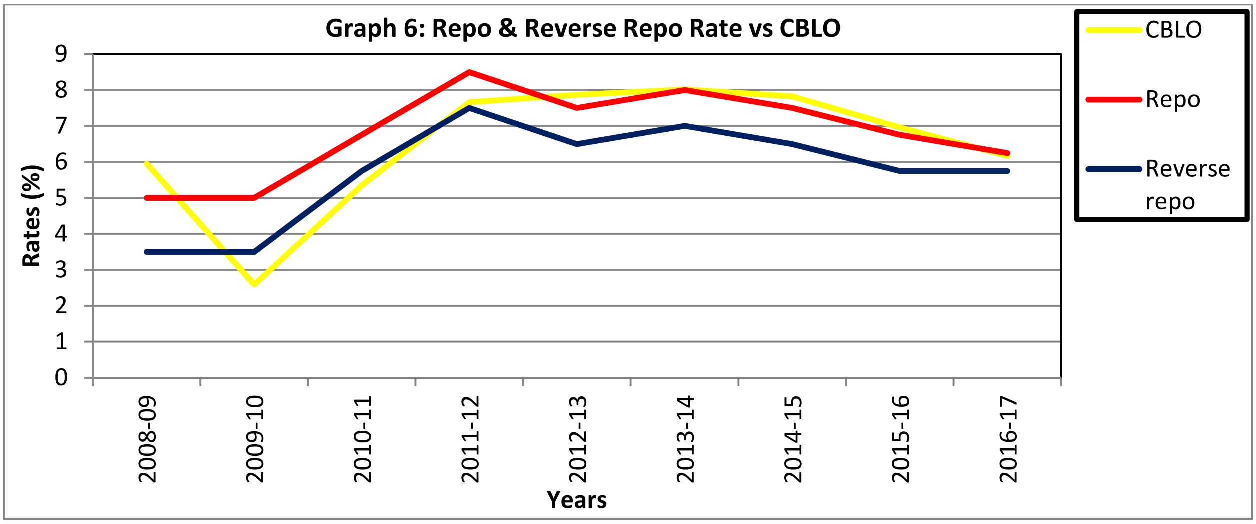
Surplus liquidity meant the overnight call money market rate stayed closer to the reverse Repo Rate until 2010, after which the deficit mode kept it closer to the Repo Rate. Large exogenous shocks that could not be smoothed meant it overshot the LAF bounds, although this became rarer over the years. Indicative bank lending rates are also shown in Graph 4. The Prime Lending Rate (PLR), which is closer to an upper bound is graphed until July 2010 and the Base Rate, closer to a minimum rate after. That is why the gap between the Repo Rate and the bank lending rate shrinks. Bank lending rates also follow the Repo Rate, but less than market rates do and generally more during tightening compared to loosening episodes (Table 4). The weighted average lending rate (WALR) for all commercial banks, shown for the period after February 2012 lies above the Base

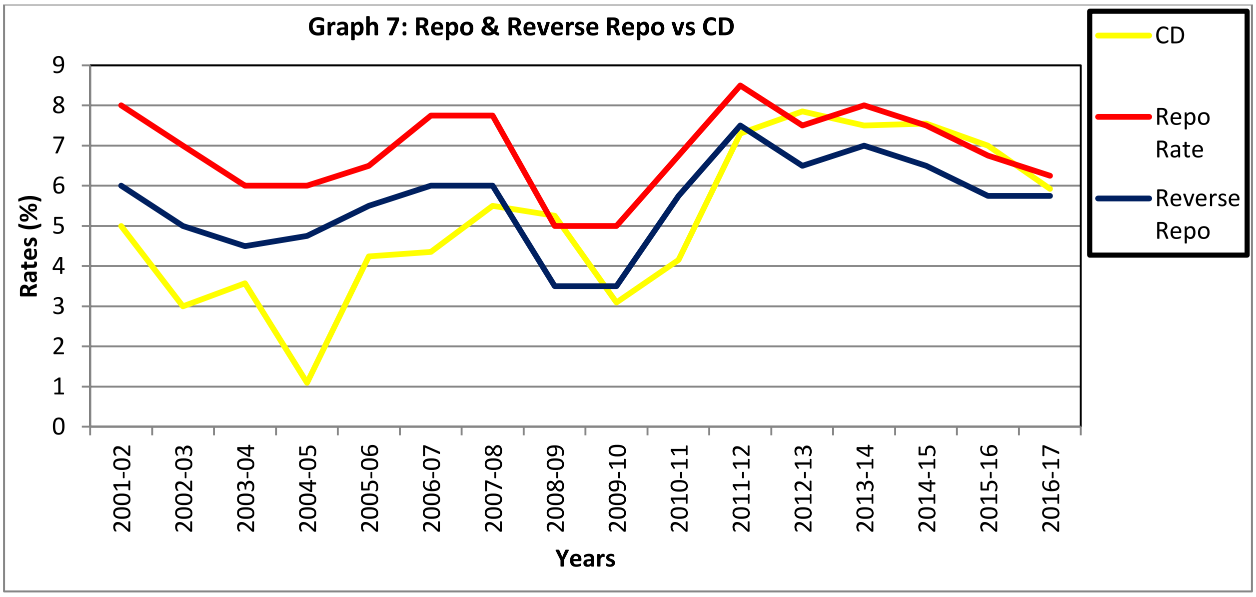
Rate. While the Base Rate did not rise with the Repo Rate in the tightening phase VI, the WALR continued to fall. It has been falling since 2013, perhaps reflecting poor demand for loans. It is not true that the current monetary loosening has not transmitted to banks, although the gap between the Base Rate, the WALR and the Repo increased in 2016 that between the Base Rate and the WALR fell.



Other rates show a similar picture with some variations. CP rates adjusted closely within the repo and reverse repo band over the years. It failed to stay in the window from 2006-2012 possibly because of surplus liquidity and then reduced demand. But it reached the top of the LAF band by 2014 (Graph 5). The CBLO rates reached and sometimes exceeded the top of the LAF band in the liquidity deficit period of 2012 (Graph 6).


Graph 5: Repo & Reverse Repo Rate vs CP
CP
Repo
Reverse repo
Rates (%)
Years
0
1
2
3
4
5
6
7
8
9
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17


Graph 6: Repo & Reverse Repo Rate vs CBLO
CBLO
Repo
Reverse repo
Rates (%)
Years
0
1
2
3
4
5
6
7
8
9
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17


Graph 7: Repo & Reverse Repo vs CD
CD
Repo Rate
Reverse Repo
Rates (%)
Years
0
1
2
3
4
5
6
7
8
9
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17

Before 2010, CD rates were erratic, and did not respond much to the policy rate changes (Graph 7). After 2010, it rose along with the policy rate and is in tune with the Repo Rate in the recent years.

4. Analysis

We next turn to regression analysis of T and T±5 event windows of Repo Rate change. In our baseline model, we take change in the Repo Rate as our primary independent variable and see if its coefficient is significant on regressing with change in other market rates. Then we check if there exists any asymmetry in pass through between increase and decrease in Repo Rate. Next we try to analyse the efficacy of pass through when LAF is in injection mode and when Total Liquidity is in absorption mode, denoting liquidity deficit[3]. We also assess the relative effectiveness of short versus long run liquidity and how a Total Liquidity relative to LAF variable performs. Last, we see if transmission is better when quantity variables are in sync with the Repo Rate.

The Repo Rate has changed 56 times in the period under consideration. So T period regressions have few data points. T±5 event window has more than 500 observations and also allows us to investigate slightly longer-run market reactions. Table 5 gives the summary statistics. CMR, CBLO are change in Call Money Market Rate and CBLO respectively; _91D is the change in 91-Day T-Bills rate; _1Y, _10Y are the changes in yield of G-Secs of maturities 1-Year and 10-Years; DRepo is the Repo Rate change around announcement dates, LRL is Long Run Liquidity, and TL is Total Liquidity.

On an average, Repo Rate changed by -3.30 bps. Table 6 shows pairwise correlation between the variables used in the analysis. All the market rates are positively correlated with DRepo. Similarly, we observe positive correlation between the rates and quantity variables except for Long Run Liquidity with 10-Year G-Secs. The correlation between yield curves and call money rates, however, is negative. Our regression analysis will investigate the significance of these correlations.

Our baseline model (Model 1) is –

$$\Delta MarketRate = \propto \ + \beta \ DRepo + u$$

[3] Liquidity is injected in the LAF during deficit periods. So although the transaction itself reduces liquidity it is used in the regressions to capture periods of short-term liquidity deficit. The absorption mode or OMO sale of G-Secs is used to indicate liquidity tightening since it directly reduces money supply.

Table 7 shows the results of the baseline regression. We observe that all rates except 91-day T-Bills and CMR reacts significantly to a change in Repo Rate for the T period regression. However, 91-day T-Bills alone react significantly for the longer window. The strongest and most immediate impact is on CLBO rates. The significance and the magnitude of Repo influence increases with maturity, for T-Bills and G-Secs. One bps increase in DRepo increases _10Y and _1Y G-Sec yields by 1.018 bps and 0.903 bps respectively in T, while 91-day T-Bills rate rises 0.186 bps only in T±5.

We use dummies to distinguish between periods of DRepo increase or decrease. Policy Rate dummy R_D is set to be 1 if DRepo increases and 0 otherwise. Table 8 gives results on direction of Repo Rate changes using the dummy variable. We observe that R_D is quite significant for both the event windows, but it is significant for more rates in the T window with relatively higher coefficients. The conclusion follows that transmission is faster during tightening. Now, we introduce slope and intercept dummies in our baseline model to further test for asymmetry between policy rate increase and decrease, while controlling for the change in the Repo itself. So we will estimate the following Model 2 for each market rate studied[4]:

Model 2

$$\Delta MarketRate = \alpha_1 + \alpha_2\, R\_D + \beta_1\, DRepo + \beta_2\, DRepo * R\_D + u$$

Second, we try to assess the additional impact of quantum channels on transmission. For this we take LAF_V_D as 1 if LAF is in injection mode and 0 otherwise in Model 3. TL_V_D is 1 if Total Liquidity (TL) is in absorption mode and it is 0 otherwise in Model 4.

Model 3

$$\Delta MarketRate = \alpha_1 + \alpha_2\, LAF\_V\_D + \beta_1\, DRepo + \beta_2\, DRepo * LAF\_V\_D + u$$

Model 4

$$\Delta MarketRate = \alpha_1 + \alpha_2\, TL\_V\_D + \beta_1\, DRepo + \beta_2\, DRepo * TL\_V\_D + u$$

Table 9 for **CMR** reveals no significant difference from the baseline model for all the three models. None of the coefficients are significant. The graphs showed us that the CMR was aligned with the Repo Rate only under LAF deficit, but the LAF_V_D is not significant. These results do not support the RBI (2011) view, that pass through is most rapid for the CMR since it reflects demand by liquidity constrained banks.

[4] As a robustness exercise, the models below were regressed through the origin and the results obtained were similar to OLS regressions.

Table 10 shows the results for **CBLO** market. Only T window coefficients are significant, again supporting immediate impact of DRepo on CBLO rates. The DRepo coefficients continue to be strongly significant, while the R_D is not. The interaction of the Repo Dummy is insignificant revealing that CBLO rates respond to Repo Rate increase or decrease in a similar manner, when DRepo is included. However, the interaction with LAF Dummy and TL Dummy is significant. CBLO falls when LAF liquidity is being injected but rises when Total Liquidity is being drained in absorption mode. Thus changes in liquidity matter or the quantum channel adds to the rate channel. Repo Rate changes dominates the direction effect of Repo Rate increase.

Table 11 displays the results for **91-day Treasury Bills** market. The interaction dummies are significant as is the Repo dummy in the T event window. The market reacts to Repo Rate increasing operations and liquidity injecting operations (considering both LAF and TL) to a larger extent. But DRepo has a stronger impact compared to quantity change dummies. The significant coefficient for R_D in T±5 is negative, moreover, suggesting that the rate falls during tightening when the Repo Rate is rising.

Table 12 shows that the interactions are not significant for either event windows for **1-Year G-Secs**. Only the DRepo coefficient is significant. There is no asymmetry and the quantum channel does not add to transmission. The T period DRepo coefficients are larger suggesting immediate impact of a policy rate change.

Table 13 for **10-Year G-Secs** shows significant coefficients for DRepo in T. This responds fast perhaps since it is the deepest G-sec market. Of the dummy variables only TL dummy is significant in T, suggesting that long-run liquidity matters for a rate that gives the markets view of longer-term prospects.

Although the volume and volume interaction dummies are rarely significant in models 3 and 4, the controls for the quantum channels increase the size of the DRepo coefficients, compared to the baseline model, suggesting the quantum channel increases the impact of a change in the Repo Rate. Next we investigate results for settings when liquidity and repo changes work in sync with each other, that is, when liquidity changes are in the same direction as Repo Rate changes. For example, for periods when the Repo Rate is rising so R_D equals one, we take the periods when the LAF was in injection mode and the TL in absorption mode as indicated by the dummy variables. The relevant coefficients under four different combinations of Repo, LAF and TL change are listed in Table 14(A) and (B). The models used are –

Model 5

$$\Delta MarketRate = \alpha + \beta_1\, R\_D \; + \beta_2\, LAF\_V\_D + \; \beta_3\, R\_D * LAF\_V\_D$$

Model 6

$$\Delta MarketRate = \alpha + \beta_1\, R\_D \; + \beta_2\, TL\_V\_D + \; \beta_3\, R\_D * TL\_V\_D$$

For the first time, the R_D coefficient is significant for CMR in T (Model 5, Table 15), pointing to the impact of a LAF channel in sync for transmission from CMR. Only for 1-Year G-Secs is an interaction dummy significant and positive, suggesting that transmission is better in T±5 under tightening when the LAF is in injection mode (Table 18). While R_D coefficients are often significant, the only other quantity dummy significant is a negative impact of total liquidity reduction on CLBO rates in T (Table 16), but a positive impact on 10-Year G-Secs rates in T±5. The significant constant term for CBLO suggests it responds to monetary loosening also.

Lastly, all the markets respond more to monetary tightening (and loosening for CLBO and 10 Year G-Secs, where the coefficient is significant) when quantity controls are included. This again suggests that quantity variables intensify the pass through of Repo Rate changes.

To assess the relative effect of short-versus long-run liquidity, we will now insert the ratios LAF/TL and LAF/LRL one by one to the baseline model where LRL stands for Long Run Liquidity. We define LR1 = LAF/TL and LR2 = LAF/LRL as the two Liquidity Ratios. The new models are –

Model 7

$$\Delta MarketRate = \propto \; + \beta \; DRepo + \gamma \; LR1 + u$$

Model 8

$$\Delta MarketRate = \propto \; + \beta \; DRepo + \delta \; LR2 + u$$

Tables 20-21 show results for those of the above models, where liquidity ratios are significant. These are only the negative impact of LR1 on CMR in T (Table 20)[5] and its positive impact on 10-Year G-Secs in T±5. When LR1 increases, CMR decreases by 2.31 units and 10-Year G-Sec yield increases by 0.004 units. It is interesting that this is only the second significant coefficient obtained for CMR, and like Model 5 (Table 15), suggests that it is affected by relative short-run

[5] When regressed through origin (RTO), LR1 was no longer significant for CMR; all the other results remained the same.

liquidity, falling when LAF injections are relatively high. The positive LR1 coefficient for 10-Year G-Sec supports the result frequently obtained that LR liquidity is important for 10-Year G-Secs so that a relative rise in short-run liquidity raises yields. DRepo is significant for some rates, which further supports the dominant role of the interest rate channel.

Finally, we draw out implications of the results, for the questions we posed. The speed of transmission is fastest for CBLO and 10-Year G-Secs markets that have more depth, while it is slowest in the 91-day T-Bills market. Table 1 shows the turnover is more for CBLO than for Call Money Market, and more for G-Secs compared to T-bills. Thin markets are more dependent on RBI liquidity provision. CMR shows least transmission although RBI (2011) wanted it to be the instrument variable. Our results suggest CLBO would now be a better rate to target.

Analysis with dummies reveals that only 10-Year G-Secs yield is affected by absorption through Total Liquidity channel, and only 91-day T-Bills yield is affected by Repo Rate changing direction, responding more to rate increases. Its relative market depth makes the 10-Year G-Secs yield respond fast to short-term policy rate changes, but the impact of the long-run factors Kanagasabapathy et. al. (2014) found more important comes in through the impact of long-run liquidity.

5. Conclusion

This paper uses simple OLS regressions of event windows around change in Repo Rates to explore the relative performance and interaction of rate and quantity channels in Indian monetary transmission. The results find the interest rate channel, with Repo Rate as the policy rate, as the most effective medium to influence market rates. Over the years, RBI has been quite successful in controlling the market rates through adjustments in Repo and Reverse Repo Rates. After 2012, the market rates have operated within the corridor defined by the Repo and Reverse Repo rates.

The interest rate transmission channel is dominant, but controlling for the liquidity channel increases the impact of the Repo Rate, especially for the rates where markets are thin. So the quantity channel has an indirect impact. The speed of response is faster where there is more market depth. Short term liquidity matters for short term rates, especially where markets are thin and long-term liquidity for longer term government securities. Asymmetry, or better transmission during tightening, finds little support, except for faster pass through during tightening. Market rates respond similarly to policy rate changing direction. The quantum channel directly contributes more when it works in sync with the interest rate channel only for 1-year G-Secs and the CMR, but contributes indirectly by increasing the size of rate change coefficients.

What are the implications for current policy positions and research conclusions? Our results do not support the current RBI practice of keeping the CMR as the intermediate target. This is especially so if quantity and rate variables are not in sync. The CLBO Rate responds most and fastest to a change in the Repo Rate, because of the largest turnover in this market (Table 1). Similarly the 10-Year G-Sec responds fastest because of greater market depth but the long run variables that the literature finds affect this variable come in through the impact on it of long-run liquidity. Our results also do not support the recommendation of RBI (2011) that transmission is fastest when liquidity is in deficit, since the size of pass through rises if rate and quantity variables are in sync. Table 4 also shows that during the easing phase V (May 2012 to Sept. 2013) when liquidity was in deficit market rates did not follow the Repo Rate down. Liquidity provision matters more in thin markets. Therefore the current move away from maintaining liquidity in deficit, even while narrowing the LAF corridor, is in the right direction.

Possible extensions include examining the role of the term Repo markets and outcome in windows longer than T and T±5. Transmission to bank lending rates is of major interest, and needs rigorous analysis. It requires alternative approaches, however, since it cannot be captured in five and twenty day windows. Since the two are linked (Graph 4), and policy seeks to further increase their sensitivity to market rates, improving transmission to market rates will also improve that to bank lending rates.

References

Goyal, A. 2017. 'Monetary Policy Transmission in India,' Chapter 3 in S. Mahendra Dev (ed.), *India Development Report 2017*, pp. 35-48, New Delhi: IGIDR and Oxford University Press.

Kanagasabapathy, K., R. A. Bhangaonkar, and S. R. Pandey. 2014. 'Monetary Policy Transmission in India: Interplay of Rate and Quantum Channels,' chapter 6 in Goyal, A. (ed.) *A Concise Handbook of the Indian Economy in the 21st Century*. OUP Catalogue.

Khundrakpam, J. K. and R. Jain. 2012. 'Monetary Policy Transmission in India: A Peep Inside the Black Box,' *RBI working paper series no. 11*. Available at https://www.rbi.org.in/scripts/PublicationsView.aspx?id=14326.

Qiao, Z. and Y. Liu. 2017. 'Open Market Operation Effectiveness in China,' *Emerging Markets Finance and Trade*, 53(8), pp. 1706-1719.

RBI (Reserve Bank of India). 2011. 'Report of the Working Group on Operating Procedures of Monetary Policy,' 15th March: Website: https://www.rbi.org.in/scripts/PublicationReportDetails.aspx?ID=631

RBI. 2014. 'Report of the Expert Committee to Revise and Strengthen the Monetary Policy Framework,' January. Website: https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/ECOMRF210114_F.pdf

RBI. 2016. 'Reserve Bank of India Annual report 2015-16'. Website: https://www.rbi.org.in/Scripts/AnnualReportPublications.aspx?year=2016

RBI. 2017. Handbook of Statistics on Indian Economy: Website: http://www.rbi.org.in

Appendix

Table 5: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
CMR	0.0464151	0.7261015	-1.18	4.7
CBLO	0.065283	0.9288715	-2.95	2.35
_91D	0.197883	1.283596	-1.8548	7.0458
_1Y	-0.0356038	1.003339	-3.532	4.842
_10Y	-0.012434	0.6808206	-1.474	2.38
DRepo	-0.0330189	0.4788752	-1	1.75
LAF	20692	49678.65	-96615	145365
LRL	1323.811	5760.611	-10326	30398
TL	22015.81	51162.56	-96615	145365
Total Observations = 53				

Table 6: Pairwise Correlation

	CMR	CBLO	_91D	_1Y	_10Y	DRepo	LAF	LRL	TL
CMR	1								
CBLO	0.1311	1							
_91D	0.1572	0.0364	1						
_1Y	-0.0582	0.3608	0.1666	1					
_10Y	-0.0179	0.5268	0.1612	0.3362	1				
DRepo	0.1907	0.5983	0.2604	0.4312	0.7161	1			
LAF	0.0034	0.1867	0.0354	0.1723	0.0876	0.2968	1		
LRL	0.4001	0.0784	0.0797	0.1654	-0.1497	0.0712	0.2035	1	
TL	0.0483	0.1901	0.0433	0.186	0.0682	0.2962	0.9939	0.3102	1

Table 7: Baseline Model

		T		T±5		
		N=53		N=507		
		DRepo	_cons	DRepo	_cons	R-sq
(1)	CMR	0.289	0.0560	0.325	0.0232	0.0003
		(0.171)	(0.575)	(0.683)	(0.821)	
(2)	CBLO	1.161***	0.104	-0.0202	-0.0221	0
		(0.000)	(0.321)	(0.959)	(0.665)	
(3)	_91D	0.698	0.221	0.186***	-0.000569	0.0237
		(0.060)	(0.206)	(0.001)	(0.934)	
(4)	_1Y	0.903**	-0.00577	0.126	-0.000590	0.0074
		(0.001)	(0.964)	(0.053)	(0.944)	
(5)	_10Y	1.018***	0.0212	0.0436	0.00366	0.0018
		(0.000)	(0.750)	(0.337)	(0.530)	

p-values in parentheses *p<0.05 **p<0.01 ***p<0.001

Table 8: Model with only Repo Dummy

		T		T±5		
		N=53		N=507		
		R_D	_cons	R_D	_cons	R-sq
(1)	CMR	0.385	-0.150	0.234	0.0100	0.0005
		(0.053)	(0.285)	(0.614)	(0.924)	
(2)	CBLO	0.968***	-0.428**	-0.146	-0.0145	0.0008
		(0.000)	(0.009)	(0.527)	(0.781)	
(3)	_91D	0.722*	-0.170	0.0743*	-0.00502	0.0111
		(0.039)	(0.488)	(0.018)	(0.477)	
(4)	_1Y	0.566*	-0.324	0.113**	-0.00681	0.0174
		(0.039)	(0.095)	(0.003)	(0.426)	
(5)	_10Y	0.711***	-0.375**	0.0156	0.00271	0.0007
		(0.000)	(0.002)	(0.555)	(0.650)	

p-values in parentheses *p<0.05 **p<0.01 ***p<0.001

Table 9: CMR: Models 2, 3 and 4						
	T			T±5		
	(2)	(3)	(4)	(2)	(3)	(4)
Variables	CMR	CMR	CMR	CMR	CMR	CMR
DRepo	-0.160	0.719	0.335	0.128	0.292	0.578
	(0.761)	(0.059)	(0.220)	(0.893)	(0.798)	(0.604)
R_D	0.475			-0.0318		
	(0.167)			(0.983)		
DRepo	0.0940			0.785		
	(0.895)			(0.878)		
LAF_V_D		-0.398			0.144	
		(0.079)			(0.491)	
DRepo _LAFVD		-0.499			-0.00108	
		(0.278)			(0.999)	
TL_V_D			-0.123			-0.0880
			(0.606)			(0.732)
DRepo _TLVD			-0.233			-0.584
			(0.631)			(0.717)
_cons	-0.217	0.354	0.0784	0.0125	-0.0363	0.0383
	(0.412)	(0.063)	(0.528)	(0.907)	(0.787)	(0.739)
N	53	53	53	507	507	507
R-sq	0.074	0.103	0.044	0.001	0.001	0.001

p-value in parenthesis * p<0.05 ** p<0.01 *** p<0.001

Table 10: CBLO: Models 2, 3 and 4						
	T			T±5		
	(2)	(3)	(4)	(2)	(3)	(4)
Variables	CBLO	CBLO	CBLO	CBLO	CBLO	CBLO
DRepo	1.153*	1.819***	0.746**	0.141	0.0226	-0.0894
	(0.043)	(0.000)	(0.007)	(0.768)	(0.968)	(0.872)
R_D	0.203			-0.317		
	(0.574)			(0.676)		
DRepo _R_D	-0.344			0.442		
	(0.649)			(0.862)		
LAF_V_D		0.0991			0.0784	
		(0.662)			(0.451)	
DRepo _LAFVD		-1.084*			-0.121	
		(0.023)			(0.880)	
TL_V_D			-0.138			-0.104
			(0.560)			(0.417)
DRepo _TLVD			1.032*			0.0687
			(0.034)			(0.932)
_cons	0.0599	0.106	0.217	0.0118	-0.0540	0.000610
	(0.830)	(0.578)	(0.081)	(0.824)	(0.420)	(0.992)
N	53	53	53	507	507	507
R-sq	0.366	0.435	0.433	0.001	0.001	0.001

p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001"

Table 11: 91-day T-Bills: Models 2, 3 and 4						
	T			T±5		
	(2)	(3)	(4)	(2)	(3)	(4)
Variables	_91D	_91D	_91D	_91D	_91D	_91D
DRepo	-0.888	-0.300	1.351**	0.130*	0.0128	0.363***
	(0.325)	(0.641)	(0.004)	(0.041)	(0.865)	(0.000)
R_D	0.694			-0.255*		
	(0.237)			(0.012)		
DRepo _R_D	2.068			1.002**		
	(0.094)			(0.003)		
LAF_V_D		-0.114			-0.0148	
		(0.767)			(0.282)	
DRepo _LAFVD		1.625*			0.349**	
		(0.043)			(0.001)	
TL_V_D			-0.0388			0.0253
			(0.922)			(0.134)
DRepo _TLVD			-1.845*			-0.346**
			(0.024)			(0.001)
_cons	-0.546	0.194	0.107	-0.00252	0.00408	-0.00737
	(0.230)	(0.547)	(0.602)	(0.721)	(0.645)	(0.331)
N	53	53	53	507	507	507
R-sq	0.135	0.156	0.167	0.041	0.047	0.050
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001"						

Table 12: 1-Year G-Secs: Models 2, 3 and 4						
	T			T±5		
	(2)	(3)	(4)	(2)	(3)	(4)
Variables	_1Y	_1Y	_1Y	_1Y	_1Y	_1Y
DRepo	1.186	1.033*	0.732*	0.0391	0.0187	0.228*
	(0.084)	(0.039)	(0.036)	(0.616)	(0.841)	(0.013)
R_D	-0.357			0.151		
	(0.417)			(0.223)		
DRepo_R_D	0.0432			-0.174		
	(0.962)			(0.676)		
LAF_V_D		0.200			0.00197	
		(0.493)			(0.908)	
DRepo_LAFVD		-0.295			0.211	
		(0.622)			(0.107)	
TL_V_D			-0.181			0.000705
			(0.551)			(0.973)
DRepo_TLVD			0.321			-0.209
			(0.600)			(0.111)
_cons	0.178	-0.121	0.0722	-0.00606	-0.00230	-0.00144
	(0.601)	(0.620)	(0.645)	(0.486)	(0.834)	(0.878)
N	53	53	53	507	507	507
R-sq	0.197	0.202	0.201	0.018	0.013	0.012
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001						

Table 13: 10-Year G-Secs: Models 2, 3 and 4						
	T			T±5		
	(2)	(3)	(4)	(2)	(3)	(4)
Variables	_10Y	_10Y	_10Y	_10Y	_10Y	_10Y
DRepo	1.030**	1.128***	1.033***	0.0308	0.0207	0.0704
	(0.005)	(0.000)	(0.000)	(0.572)	(0.750)	(0.266)
R_D	-0.175			-0.0766		
	(0.445)			(0.376)		
DRepo _R_D	0.286			0.287		
	(0.551)			(0.324)		
LAF_V_D		-0.211			-0.0114	
		(0.168)			(0.336)	
DRepo _LAFVD		-0.0789			0.0506	
		(0.799)			(0.578)	
TL_V_D			0.317*			0.0269
			(0.043)			(0.065)
DRepo _TLVD			0.232			-0.0361
			(0.456)			(0.693)
_cons	0.0610	0.167	-0.0613	0.00331	0.00817	-0.00199
	(0.731)	(0.191)	(0.442)	(0.587)	(0.285)	(0.761)
N	53	53	53	507	507	507
R-sq	0.524	0.532	0.552	0.004	0.004	0.009

p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001

Table 14(A): Possible combinations of LAF and Repo Rate changes				
	DRepo>0		DRepo<0	
	Coefficients	Interpretation	Coefficients	Interpretations
LAF>0	Constant + R_D + LAF_V_D + (R_D*LAF_V_D)	Increase in Repo Rate during LAF injection	Constant + LAF_V_D	Decrease in Repo Rate during LAF injection
LAF<0	Constant + R_D	Increase in Repo Rate during LAF absorption	Constant	Decrease in Repo Rate during LAF absorption

Table 14(B): Possible combinations of Total Liquidity and Repo Rate changes				
	DRepo>0		DRepo<0	
	Coefficients	Interpretation	Coefficients	Interpretations
TL<0	Constant + R_D + TL_V_D + (R_D*TL_V_D)	Increase in Repo Rate during TL absorption	Constant + TL_V_D	Decrease in Repo Rate during TL absorption
TL>0	Constant + R_D	Increase in Repo Rate during TL injection	Constant	Decrease in Repo Rate during TL injection

Table 15: CMR: Models 5 and 6				
	T		T±5	
	(5)	(6)	(5)	(6)
	CMR	CMR	CMR	CMR
R_D	0.851*	0.447	0.772	0.276
	(0.014)	(0.071)	(0.382)	(0.603)
LAF_V_D	-0.0230		0.170	
	(0.933)		(0.428)	
R_D_LAF_V_D	-0.624		-0.814	
	(0.133)		(0.435)	
TL_V_D		0.0230		-0.0824
		(0.936)		(0.753)
R_D _TL_V_D		-0.261		-0.170
		(0.553)		(0.878)
_cons	-0.136	-0.159	-0.0573	0.0268
	(0.515)	(0.394)	(0.672)	(0.820)
N	53	53	507	507
R-sq	0.151	0.081	0.003	0.001
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001				

Table 16: CBLO: Models 5 and 6				
	T		T±5	
	(5)	(6)	(5)	(6)
	CBLO	CBLO	CBLO	CBLO
R_D	1.398***	0.674*	0.0467	-0.216
	(0.000)	(0.013)	(0.915)	(0.413)
LAF_V_D	0.717*		0.103	
	(0.023)		(0.336)	
R_D_LAF_V_D	-0.738		-0.311	
	(0.113)		(0.549)	
TL_V_D		-0.717*		-0.119
		(0.023)		(0.359)
R_D _TL_V_D		0.676		0.315
		(0.157)		(0.567)
_cons	-0.842***	-0.125	-0.0553	0.00977
	(0.001)	(0.534)	(0.412)	(0.868)
N	53	53	507	507
R-sq	0.350	0.350	0.003	0.003
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001"				

Table 17: 91-day T-Bills: Models 5 and 6				
	T		T±5	
	(5)	(6)	(5)	(6)
	_91D	_91D	_91D	_91D
R_D	0.411	0.976*	0.0374	0.0924**
	(0.501)	(0.026)	(0.528)	(0.009)
LAF_V_D	-0.469		-0.0205	
	(0.351)		(0.156)	
R_D_LAF_V_D	0.524		0.0599	
	(0.485)		(0.392)	
TL_V_D		0.469		0.0274
		(0.350)		(0.118)
R_D _TL_V_D		-0.718		-0.0819
		(0.352)		(0.269)
_cons	0.101	-0.369	0.00307	-0.0106
	(0.792)	(0.260)	(0.735)	(0.180)
N	53	53	507	507
R-sq	0.097	0.100	0.016	0.017
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001"				

Table 18: 1-Year G-Secs: Regression results for Models 5 and 6				
	T		T±5	
	(5)	(6)	(5)	(6)
	_1Y	_1Y	_1Y	_1Y
R_D	0.575	0.452	-0.0150	0.153***
	(0.228)	(0.176)	(0.834)	(0.000)
LAF_V_D	0.434		-0.0118	
	(0.267)		(0.497)	
R_D_LAF_V_D	-0.107		0.180*	
	(0.853)		(0.033)	
TL_V_D		-0.434		0.00663
		(0.267)		(0.754)
R_D _TL_V_D		0.122		-0.173
		(0.838)		(0.054)
_cons	-0.574	-0.141	-0.00213	-0.00816
	(0.056)	(0.579)	(0.846)	(0.394)
N	53	53	507	507
R-sq	0.114	0.113	0.026	0.025
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001"				

Table 19: 10-Year G-Secs: Models 5 and 6				
	T±5		T	
	(5)	(6)	(5)	(6)
	_10Y	_10Y	_10Y	_10Y
R_D	-0.0190	0.0312	0.872**	0.600**
	(0.705)	(0.300)	(0.004)	(0.004)
LAF_V_D	-0.0144		0.0830	
	(0.239)		(0.726)	
R_D_LAF_V_D	0.0539		-0.236	
	(0.363)		(0.506)	
TL_V_D		0.0294*		-0.0830
		(0.048)		(0.723)
R_D _TL_V_D		-0.0709		0.425
		(0.258)		(0.240)
_cons	0.00841	-0.00327	-0.422*	-0.339*
	(0.275)	(0.625)	(0.022)	(0.029)
N	507	507	53	53
R-sq	0.004	0.009	0.285	0.302
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001"				

Table 20: CMR: Models 7 and 8				
	T		T±5	
	(7)	(8)	(7)	(8)
	CMR	CMR	CMR	CMR
DRepo	0.234	0.846	0.331	1.633
	(0.162)	(0.814)	(0.737)	(0.832)
LR1	-2.309***		0.00551	
	(0.000)		(0.849)	
LR2		-0.435		0.00434
		(0.333)		(0.880)
_cons	2.234***	1.611	0.0439	0.301
	(0.000)	(0.311)	(0.789)	(0.609)
N	53	6	318	81
R-sq	0.412	0.339	0.000	0.001
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001				

Table 21: 10-Year G-Secs: Models 7 and 8				
	T		T±5	
	(7)	(8)	(7)	(8)
	_10Y	_10Y	_10Y	_10Y
DRepo	1.018***	0.985	0.0441	0.0129
	(0.000)	(0.540)	(0.438)	(0.973)
LR1	0.0102		0.00409*	
	(0.977)		(0.015)	
LR2		-0.0104		0.000476
		(0.953)		(0.739)
_cons	0.0115	0.0779	0.00120	0.0247
	(0.973)	(0.901)	(0.899)	(0.397)
N	53	6	318	81
R-sq	0.513	0.145	0.021	0.001
p-values in parentheses * p<0.05 ** p<0.01 *** p<0.001				

Tables

Table 1: Growth in Money and Government Securities Market – Start, Middle and End of the Period under study

Table 2: Monthly Liquidity Operations

Table 3: Annual Liquidity Operations

Table 4: Repo Rate and Market Interest Rates – Basis Points changes in the phases

Table 5: Summary Statistics

Table 6: Pairwise Correlation

Table 7: Baseline Model Regression results

Table 8: Regression results for Model with only Repo Dummy

Table 9: CMR: Regression results for models 2, 3 and 4

Table 10: CBLO: Regression results for models 2, 3 and 4

Table 11: 91-day T-Bills: Regression results for models 2, 3 and 4

Table 12: 1-Year G-Secs: Regression results for models 2, 3 and 4

Table 13: 10-Year G-Secs: Regression results for models 2, 3 and 4

Table 14(A): Possible combinations of LAF and Repo Rate changes

Table 14(B): Possible combinations of Total Liquidity and Repo Rate changes

Table 15: CMR: Regression results for models 5 and 6

Table 16: CBLO: Regression results for models 5 and 6

Table 17: 91-day T-Bills: Regression results for models 5 and 6

Table 18: 1-Year G-Secs: Regression results for models 5 and 6

Table 19: 10-Year G-Secs: Regression results for models 5 and 6

Table 20: CMR: Regression results for models 7 and 8

Table 21: 10-Year G-Secs: Regression results for models 7 and 8

Graphs

Graph 1: Total Liquidity vs Repo Rate: Monthly

Graph 2: Long Term Liquidity vs Repo Rate: Monthly

Graph 3: Long Term & Total Liquidity vs Repo Rate: Annual

Graph 4: Repo & Reverse Repo Rate vs Call Money Market Rate

Graph 5: Repo & Reverse Repo Rate vs CP

Graph 6: Repo & Reverse Repo Rate vs CBLO

Graph 7: Repo & Reverse Repo Rate vs CD