Financial Benchmarks India Private limited

A Theme Paper on Money Market Rates

Series 1/2023

This research paper is prepared by FBIL Research team with the help of Dr. Ashok Nag. The views expressed here may not necessarily represent the views of the FBIL management.

An Empirical Analysis of Three Money Market Rates- MIBOR, MROR and WACR

- **Introduction:**

Money market, the most liquid segment of any financial market, deals with instruments having maturities ranging from one day to one year. This market for short-term funds is important for management of liquidity in the economy as a whole and acts as a primary conduit of a Central Bank's policy intervention for management of overall liquidity and its cost. The RBI, in its Annual Report for FY22, has identified 3 instruments as money market instruments of significance. These are: Call money, Triparty Repo and Market Repo. FBIL, as a benchmark administrator publishes the following money market rates for various tenors.

Table1: Money Market Benchmark Rates, for different Tenors, published by FBIL.

Name of the benchmark	Tenors	Start Date of FBIL published rate
Overnight MIBOR	O/N and 3-Days	July 24, 2015
Market Repo	1-Day and 3-Days	December 12, 2017
Term MIBOR	14-Day, 1-Month, and 3-Months	September 23, 2015
T-Bill	7-Day, 14-Day, 1 Month to 12 Months	August 23, 2017
CD Curve	14-Day, 1-Month, 2-Months, 3-Months, 6-Months, 9-Months, and 12-Months	August 23, 2017

Amongst the portfolio of five Money Market Benchmarks published by FBIL, Overnight MIBOR (MIBOR) and Overnight Market Repo (MROR) are expected to move in sync with Call Money rate (WACR), which is the declared operating target rate of the RBI since May 2011. This theme paper is an empirical analysis of the above-mentioned three money market rates – during the period, January 2016 to August 2022, thus covering both pre- and post- COVID period. It is important to note the uniqueness of this study-period of 6 and a half-year in its coverage of four policy-regimes – Accommodative – Tightening - Accommodative and again Tightening.

Before we present the main findings of our empirical study of the above money market rates, we provide an overview of the Indian Money Market based on four major instruments, namely, Call Money, Market Repo, Collateralized Borrowing and Lending Obligation (CBLO) and Tri-Party Repo (TREP)[1]. CBLO was discontinued and replaced with Triparty Repo with effect from November 05, 2018. Since these two instruments are close substitutes and non-overlapping of each other, we have made one single series out of them. We have used daily traded volume and weighted average rates (WAR) data published by CCIL for the purpose of the study. The period covered by CCIL data is January 2015 to November 2022.

The remaining part of this paper is divided into 5 sections. **Section I** presents a summary of CCIL's volume and weighted average rate data for the three instruments referred to above and their extent of alignment with the RBI's policy rate. A measure of dispersion amongst the weighted average of these 3 rates is also computed to see how these instruments are aligned amongst themselves. **Section II** presents a summary of two Money Market rates, published by FBIL, namely, Overnight Mumbai Inter-Bank Outright Rate (MIBOR) and Market Repo Overnight Rate (MROR). We bring in Weighted Average Call Rate (WACR) in this analysis as we need to analyze the extent of alignment of these two FBIL benchmarks with WACR. **Section III** presents an analysis of the spread between the three instruments, amongst each other, and their spread over the policy Repo rate. **Section IV** gives a summary of the time-series analysis undertaken for this study. **Section V** summarizes the findings.

- **Section I: CCIL's Volume and Weighted Average Rate Data**

In volume terms, the Call Money market has seen a secular decline in its share between 2015 and 2022 from 11% to just 2%. The market share of collateralized short-term borrowings (CBLO/TREP) has increased during the same period from 61% to 74%. During this period, the average daily total volume of the Money Market instruments registered its highest growth of 44% in the year 2021. The two pre-pandemic years, i.e., 2018 and 2019, witnessed two lowest growth rates of 13.4% and 12.4% respectively.

[1] While discussing development in Money Market in its annual report, the RBI uses these four instruments

Table 1.1: Instrument wise share in Money Market

Year	Call Money	Repo	CBLO/TREP	Average of daily Volume (in ₹ crore)	Growth rate in average of daily Total Volume
2015	11.1%	27.8%	61.0%	1,23,613	
2016	11.8%	31.6%	56.6%	1,44,034	16.5%
2017	8.1%	29.1%	63.0%	1,77,647	23.3%
2018	8.7%	27.9%	63.4%	2,01,533	13.4%
2019	8.2%	24.0%	67.8%	2,26,446	12.4%
2020	3.8%	28.9%	67.3%	2,97,102	31.2%
2021	2.1%	23.6%	74.3%	4,28,641	44.3%
2022	2.0%	24.1%	73.8%	5,28,005	23.2%

Data Period: January 2015 to November 2022. The volumes traded on Saturdays and Sundays are not included. Shares are based on the average daily volume for the year.

The monthly average of daily market shares of these 3 instruments is given in Chart 1.1 below. The monthly average total volume of this period is given in Chart 1.2. The secular trend observed in yearly data on the shares of each instrument is clearly visible in the monthly averages also. The volume data shows a faster growth after January 2020.

Chart 1.1: Monthly Average of Daily Shares of 3 Money Market Instruments

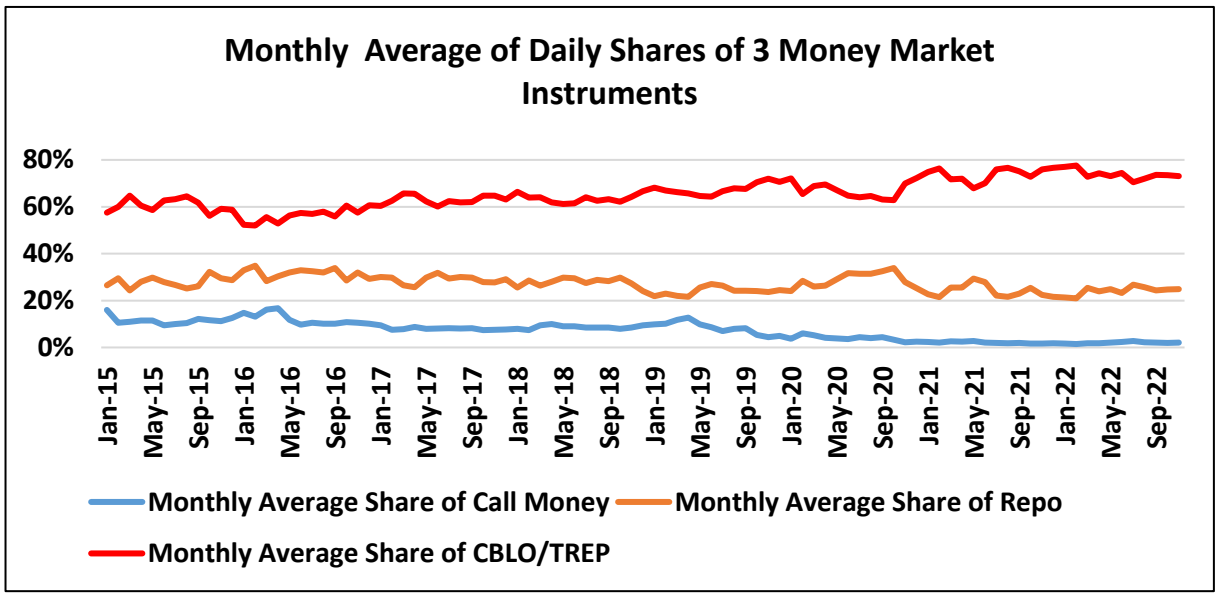
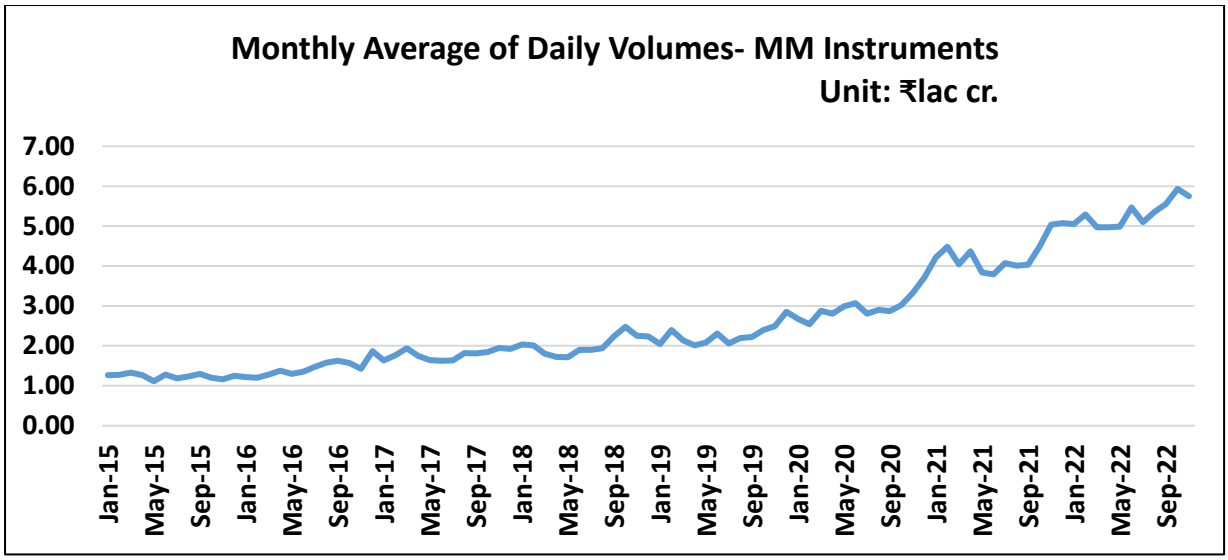


Chart 1.2: **Monthly Average of Combined Daily Volumes of 3 Money Market Instruments**



As regards alignment of the three money market instruments with policy rates, the following 3 tables and the Chart 1.3 show that rates of these money market instruments are closely aligned with the policy Repo rates, albeit with a small discount vis-à-vis the latter. However, during the period of COVID-19, these rates plunged to a level much lower than the prevailing policy rate. Between March 2020 to March 2022, out of 25 months, the spread of monthly volume-weighted average yield (WAY) of both Market Repo and CBLO/TREP remained negative by more than 50 basis points. For Call money, the corresponding spread was 21 basis points. This was mainly due to the slowing down of commercial bank credit which declined perceptibly between the periods, March 2018 – March 2019, and June 2019- March 2022 – from 11.9% to 7.5%.

(Source: Quarterly Statistics on Deposits and Credit of Scheduled Commercial Banks DBIE RBI)

Table 1.2: Frequency Distribution of Daily Spread of Money Market WAY over Policy Rates

	Frequency Distribution of Daily WAY of Money Market Rates Minus Policy Repo Rate		
Class Interval in bps	**WAY of Call Money**	**WAY of Market Repo**	**WAY of CBLO/TREP**
Less than or equal to (-100)	0	107	126
(-)100 to (-)50	422	420	445

(-)50 to (-)25	203	210	221
(-)25 to 0	1,043	864	804
Between 0 and 25	189	255	254
25 to 50	18	18	27
50 to 100	0	3	1
Above 100	4	2	1
Total (number of days)	1,879	1,879	1,879

Data: January 2015 to November 2022; Source: CCIL.

WAY=Volume Weighted Average Yield

Table 1.3: Frequency Distribution of Spread of Monthly Average Money Market Rates Over Policy Rates

	Frequency Distribution of Monthly Average difference of Money Market instruments and Policy Repo Rate		
Class Interval in bps	**WAY of Call Money**	**WAY of Market Repo**	**WAY of CBLO/TREP**
Less than or equal to (-)100	0	6	5
(-100) to (-)50	22	22	20
(-)50 to (-)25	7	7	13
(-)25 to 0	54	45	50
Between 0 and 25	12	15	7
25 to 50	0	0	0
50 to 100	0	0	0
Above 100	0	0	0
Total No of Months	95	95	95

Data: January 2015 to November 2022; Source: CCIL.

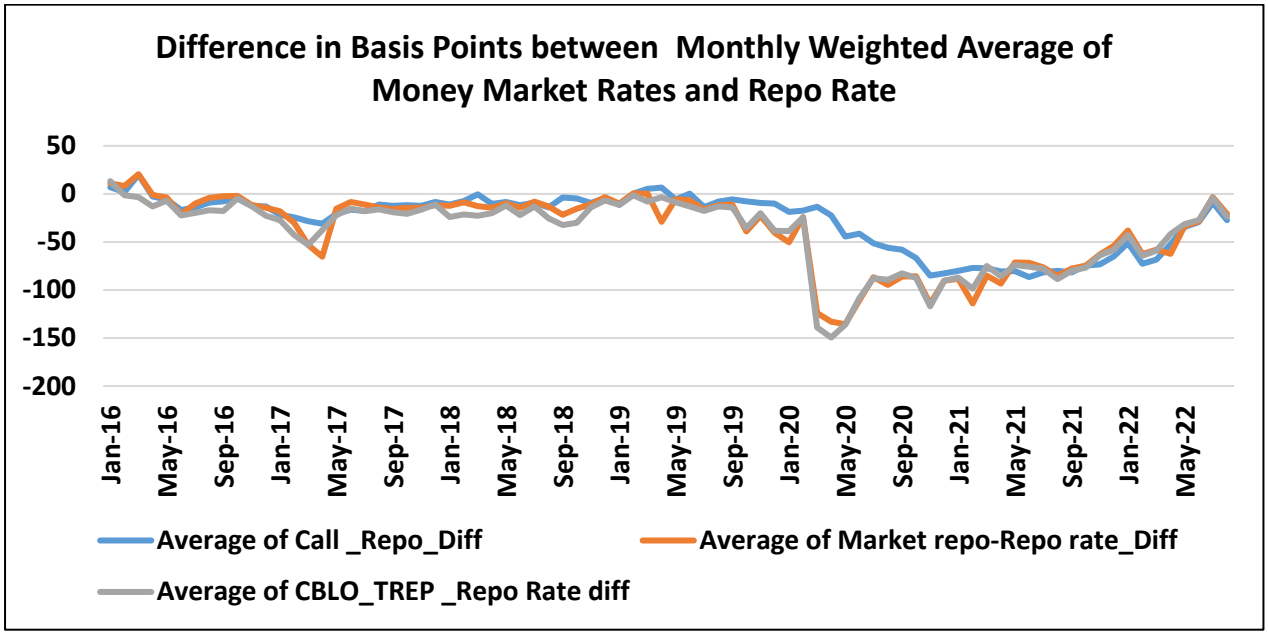
WAY=Volume-Weighted Average Yield

Table 1.4: Yearly Average of Daily spread between Money Market Instruments and Policy Repo Rate (in bps)

Year	Average of spread between Call money WAY and Repo rate	Average of Market repo and Repo Rate Diff	Average of CBLO/TREP and Repo Rate diff
2015	-7	1	-4
2016	-6	-3	-11
2017	-18	-23	-25
2018	-9	-12	-21
2019	-6	-16	-16
2020	-47	-94	-95
2021	-79	-80	-79
2022	-33	-30	-28

Source and Data Period: As in table 1.2

Chart 1.3: Difference between Money Market Rates and Policy Repo Rate



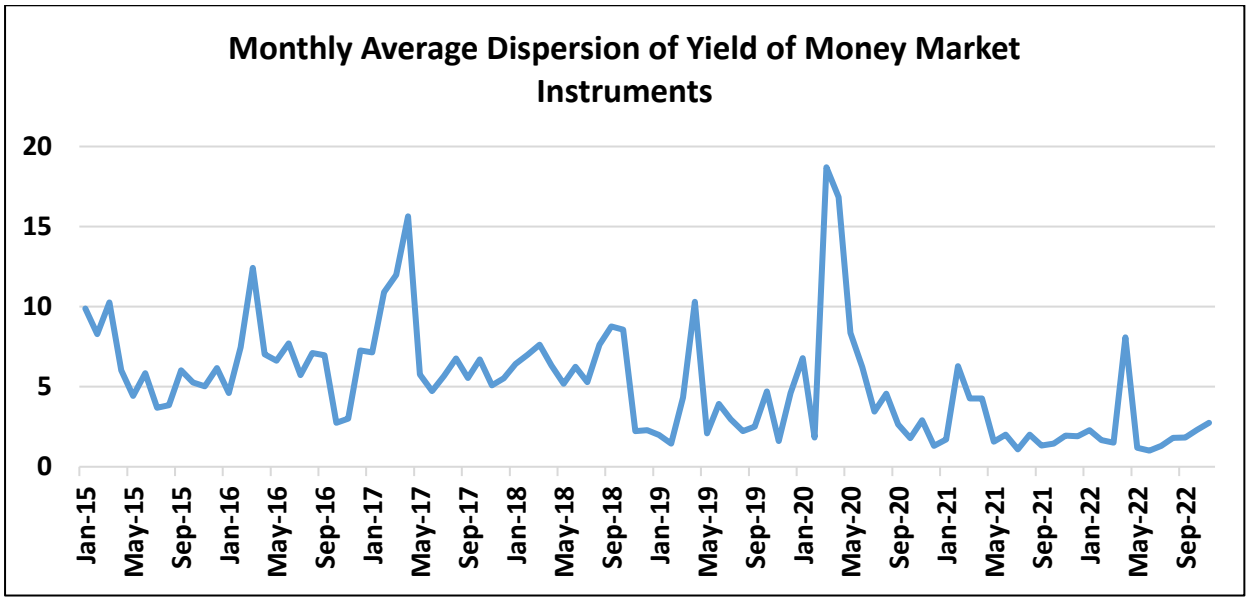
The closeness of daily WAY of the above 3 instruments is an important indicator of how efficiently and smoothly the impact of policy changes pass-through the short-end maturity spectrum. For a given trading day, volume-weighted average absolute mean deviation, also

known as Dispersion Measure, has been used in the literature to normalize this dispersion. This measure D_t is computed as follows:

$$D_t = \sum_i w_{it} |y_{it} - \overline{y_t}|$$

where w_{it} is the volume-based weight of the i^{th} instrument at time t, y_{it} is the WAY of the i^{th} instrument at time t, and $\overline{y_t}$ is the weighted average yield of all the instruments as at the time t.

Chart 1.4: Monthly Average Dispersion of Yields of Money Market Instruments



The inter-instruments divergence in WAY is quite moderate. It is worthwhile to emphasize that only in 8 months out of 95 months of data, the divergence index exceeded 10 basis point.

The analysis of market data of three money market instruments, presented above, brings out three main features of this market during one of the most dynamic monetary policy environments – from demonetization on November 8, 2016, to a highly aggressive accommodative stance till June 5, 2018, followed by a tightening stance[2]. These are:

1. WACR, being the operating target of monetary policy in India, has remained within a 100-basis point corridor around Repo Rate, i.e., RBI's policy rate. This is corroborated both by daily WAY of Call Money and its monthly average. The other two rates have

[2] The details are given Table 3.2

been largely within 100 basis points around Repo rate but for a period that largely overlaps with the pandemic period. In other words, the short-term money market responded well to the monetary policy actions during this period.

2. The share of Call Money in overall Money Market turnover has seen a sharp decline during the period covered in this section with a concomitant increase in the share of collateralized borrowing/lending. Since Call Money market is largely an interbank market, this could be due to lack of demand from perennially deficit banks in terms of liquidity. This is also reflected in significant increase in growth of banking sector's deposit with the RBI, FY wise, as can be seen from the table below:

   Table 1.5: Growth of Banking Sector's deposit with RBI

2021-22	2020-21	2019-20	2018-19	2017-18
25.4%	28.5%	-9.6%	6.4%	3.9%

3. The transmission process of monetary policy action worked reasonably well, at least in the lower end of the maturity spectrum of the financial market.

- **Section II: Profiles of the 3 instruments - Overnight MIBOR, MROR and WACR**

The Overnight Mumbai Interbank Outright Rate (MIBOR) is based on the transactions in the NDS Call. It is the rate at which unsecured borrowing-lending, for one-day, takes place in the interbank market. This study is based on the MIBOR data from January 2016 till October 2022 published by FBIL.

The Market Repo Overnight Rates (FBIL- MROR) is another Money Market benchmark published by FBIL and is based on the Basket Repo trades executed on CROMS platform of CCIL. [3]

[3] The Annex 3 briefly describes the methodology followed by FBIL to work out the published rates of these two instruments.

Year-wise Analysis:

The tables 2.1, 2.2, and 2.3 below give a broad year-wise summary of the MIBOR, MROR, and WACR for the period January 2016 to August 2022. The main take-aways from these 3 tables are as follows:

1. In step with policy rate changes, MIBOR also declined sharply between 2018 and 2021. As policy rate was moved up in 2021, average of MIBOR also followed suit. It is also seen that volatilities of the rate in year 2020 and 2021 were way above the average volatilities of all other years.
2. Yearly averages of MIBOR and its volatility are closely aligned with the WACR, the operating target of RBI.
3. Yearly averages of MROR were always below corresponding averages of MIBOR for 5 years for which FBIL-MROR data is available. The difference went up sharply in 2020, by 69 basis points. For the other 4 years, these differences ranged between 9 and 17 basis points.

Table 2.1: MIBOR- Yearly Average and Other Statistics

Year	Yearly Average (%)	Maximum of the year (%)	Minimum of the year (%)	Median (%)	1st Quartile (%)	3rd Quartile (%)	Standard Deviation	Coefficient of Variation
2016	6.59	9.00	6.08	6.54	6.40	6.76	0.32	5%
2017	6.13	7.37	5.90	6.15	6.00	6.25	0.14	2%
2018	6.28	9.39	5.95	6.25	6.00	6.50	0.32	5%
2019	5.83	8.80	5.14	5.85	5.40	6.25	0.50	9%
2020	4.16	5.48	3.35	3.89	3.68	4.63	0.65	16%
2021	3.43	4.05	3.34	3.42	3.39	3.46	0.07	2%
2022	4.20	5.36	3.39	4.28	3.50	4.85	0.68	16%

Coefficient of variation =Std.Dev/Mean

Table 2.2: WACR- Yearly Average and Other Statistics

Year	Yearly Average	Maximum of the year	Minimum of the year	Median	1st Quartile	3rd Quartile	Standard Deviation	Coefficient of Variation
2016	6.45	9.36	5.90	6.40	6.27	6.56	0.32	5%
2017	5.97	6.19	5.76	5.98	5.88	6.05	0.09	2%
2018	6.16	7.57	5.81	6.14	5.91	6.41	0.26	4%
2019	5.70	8.49	4.95	5.69	5.26	6.15	0.51	9%
2020	3.86	5.35	3.02	3.51	3.41	4.27	0.69	18%
2021	3.22	3.66	3.09	3.21	3.17	3.25	0.08	2%
2022	4.00	5.21	3.21	4.00	3.30	4.67	0.68	17%

Table 2.3: MROR- Yearly Average and Other Statistics

Year	Yearly Average	Maximum of the year	Minimum of the year	Median	1st Quartile	3rd Quartile	Standard Deviation	Coefficient of Variation
2018	6.17	6.76	5.76	6.19	5.94	6.40	0.25	4%
2019	5.66	7.45	4.59	5.69	5.26	6.19	0.56	10%
2020	3.47	5.03	0.99	3.21	3.05	3.53	0.84	24%
2021	3.26	3.99	2.28	3.28	3.22	3.33	0.16	5%
2022	4.11	5.34	3.24	4.09	3.51	4.71	0.65	16%

Statistics of Average Daily Changes in the 3 rates, actual and absolute, are given in Table 2.4 below. It may be seen that averages are quite modest. But for the financial year-end effect, these averages would be still lower, signifying the robustness of Indian Money Market.

Table 2.4: Average of Adjusted Daily Changes – Nominal and Absolute (Unit: Basis point)

Year	Average of Adjusted Daily Change in MIBOR	Average of Adjusted Daily Change in MROR	Average of Adjusted Daily Change in WACR	Average of Absolute Adjusted Daily Change in MIBOR	Average of Absolute Adjusted Daily Change in MROR	Average of Absolute Adjusted Daily Change in WACR
2016	0.15		0.12	5		7
2017	0.20		0.13	3		3
2018	1.27	0.58	0.88	4	4	3
2019	0.10	-0.26	0.21	3	4	4
2020	-0.35	-1.73	-0.31	3	10	4
2021	0.23	-0.03	0.31	2	4	3
2022	1.80	1.97	1.71	5	7	5

Adjusted Change is actual difference in published rates for two consecutive trading days divided by the period covered in these two dates.

Table 2.5: Standard Deviation of Adjusted Daily Absolute Changes (Unit: Basis point)

Year	Std Dev of Absolute Daily Adjusted Change in MIBOR	Std Dev of Absolute Daily Adjusted Change in MROR	Std Dev of Absolute Daily Adjusted Change in WACR
2016	12		18
2017	9		3
2018	22	6	10
2019	17	9	15
2020	3	19	5
2021	5	7	3
2022	8	10	7

The standard deviations given in table 2.5 would be much lower if the financial year-end effect are taken into account. The table 2.6 below gives all data points for which absolute adjusted daily differences are more than 50 basis points. Total number of days for which adjusted daily changes are more than 10 basis points are given in table 2.7.

Table 2.6: Dates for which Adjusted Daily Differences are beyond 50 basis points

Date	MIBOR Adjusted Daily Change	Date	MROR Adjusted Daily Change	Date	WACR Adjusted Daily Change
31-03-2016	162	28-03-2018	84	31-03-2016	260
04-04-2016	-55	29-03-2019	121	04-04-2016	-64
31-03-2017	127	03-01-2020	-91	28-03-2018	157
28-03-2018	334	07-01-2020	73	29-03-2019	225.4
03-04-2018	-57	24-03-2020	-125	02-04-2019	-57.5
29-03-2019	252	26-03-2020	-124.5	27-03-2020	-67.1
02-04-2019	-64	07-04-2020	62.5		
		08-04-2020	-100		
		21-04-2020	53		
		29-04-2020	51		
		13-05-2020	-92		
		15-05-2020	84		
		22-05-2020	-64		
		25-06-2020	-78		
		08-06-2022	65		

Table 2.7: No of days with Absolute Value of Adjusted Daily Changes are more than 10 basis points

Year	MIBOR	MROR	WACR	No of trading days in the year
2016	24	NA	44	240
2017	5	NA	6	241
2018	8	17	6	240
2019	9	23	16	242
2020	12	51	14	245
2021	8	26	8	241
2022	19	36	16	160

Spreads of Money Market instruments over policy rate and over the instrument of operating target are useful indicators of efficacy of the monetary policy transmission process as well as the liquidity of the market. The data given in tables 2.8 suggests that in terms of yearly average of daily spread over the prevailing policy Repo rate, MIBOR was having less spread as compared to even the operating target rate WACR during all years except in 2016 and 2019.

Table 2.8: Year-wise Average of Spread of Different Rates over WACR and Repo Rate (in basis point)

Year	Average of Spread of MIBOR over WACR	Average of Spread of MROR over WACR	Average of Spread of MIBOR over Repo	Average of Spread of MROR over REPO	Average of Spread of WACR over REPO
2016	14	NA	9	NA	-5
2017	16	NA	-2	NA	-18
2018	12	1	4	-7	-8
2019	13	-4	7	-9	-5

2020	30	-39	-17	-86	-47
2021	21	5	-57	-74	-78
2022	20	11	-23	-31	-43

Data for MROR is available from December 2017 and average for this year is omitted

Month-wise Analysis

The Charts 2.1 to 2.2 below trace monthly averages of MIBOR and WACR from January 2016 to August 2022. For MROR, Chart 2.3 traces data from December 2017 to August 2022. All the charts show the effect of policy rate cuts that started from February 2019 and continued till end of May 2020.

Chart 2.1: Monthly Average of Daily Published Rates of MIBOR

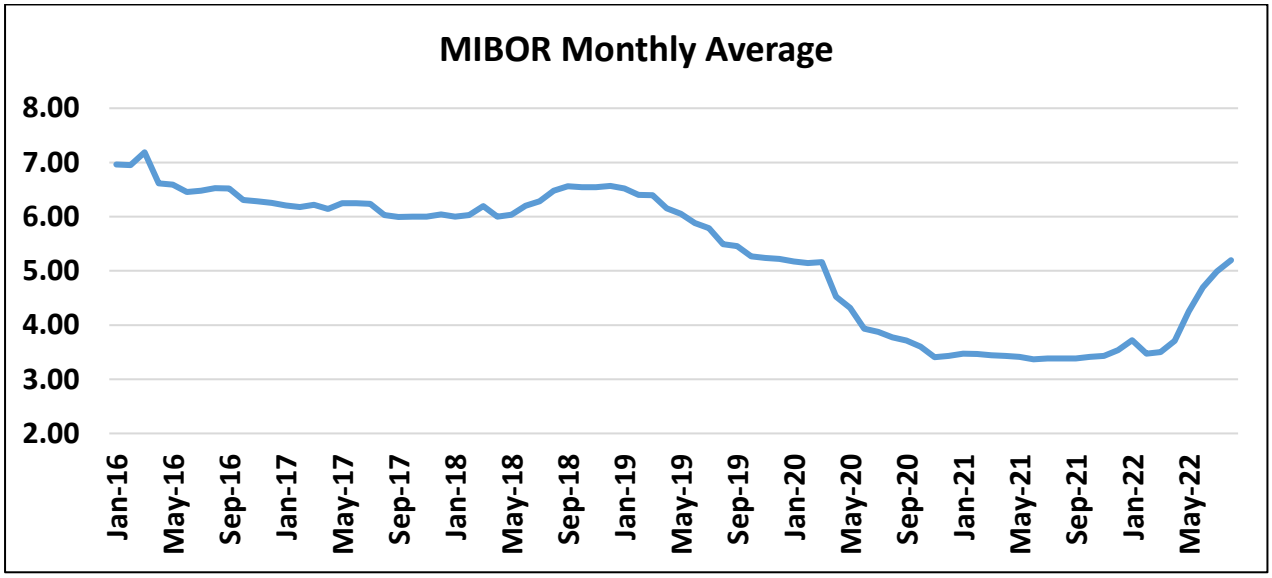


Chart 2.2: Monthly Average of Daily Published Rates of WACR

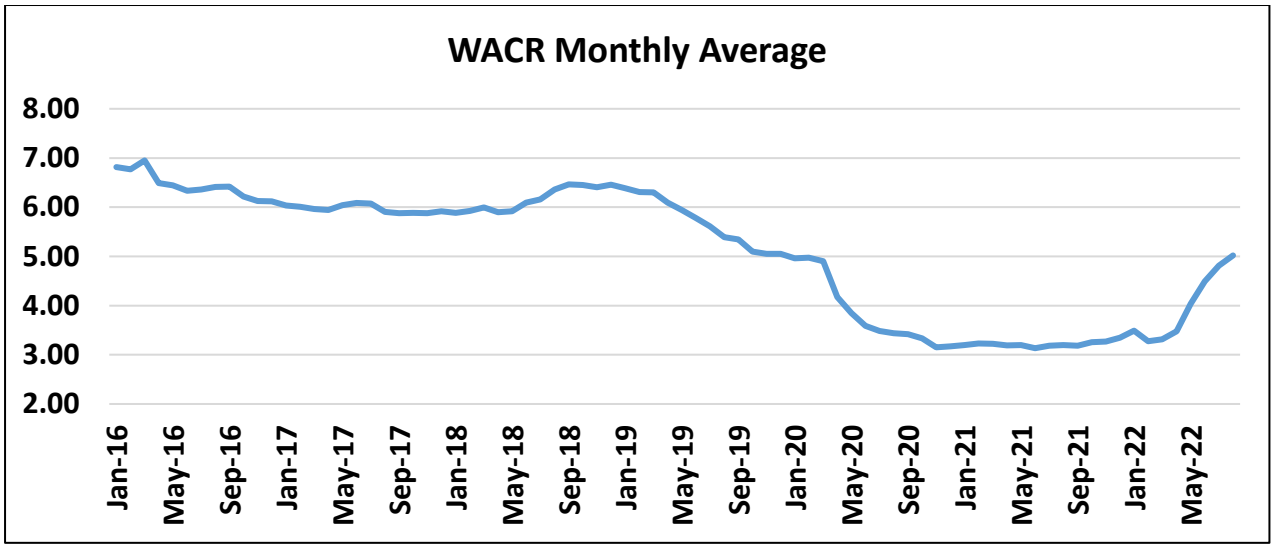


Chart 2.3: Monthly Average of Daily Published Rates of MROR

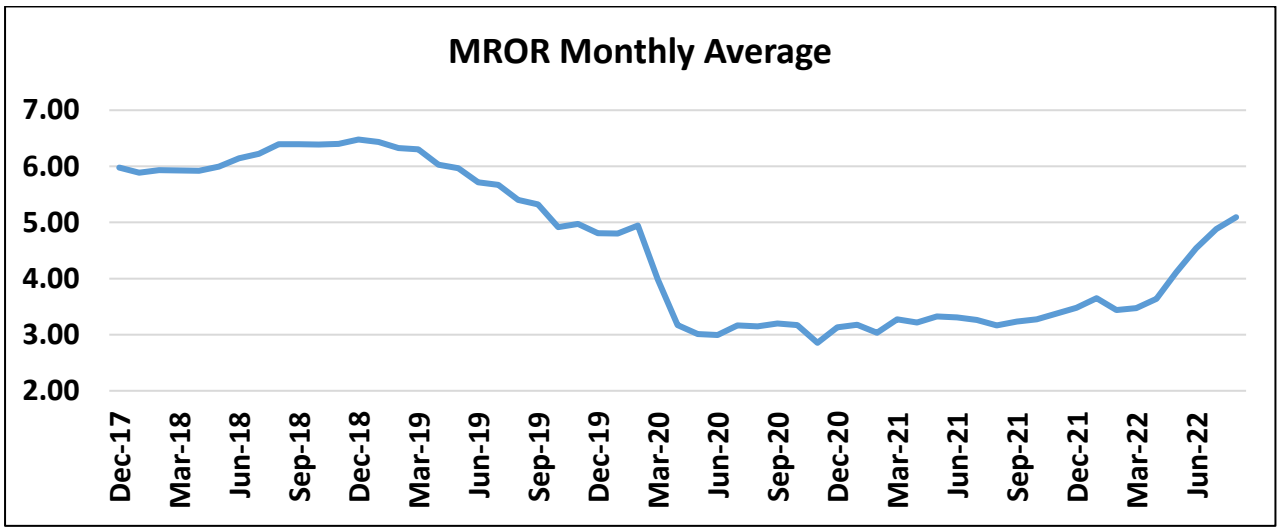


Chart 2.4 to Chart 2.6 are exhibits of Monthly Standard Deviation of these 3 rates.

Chart 2.4: Month-wise Standard Deviation of MIBOR

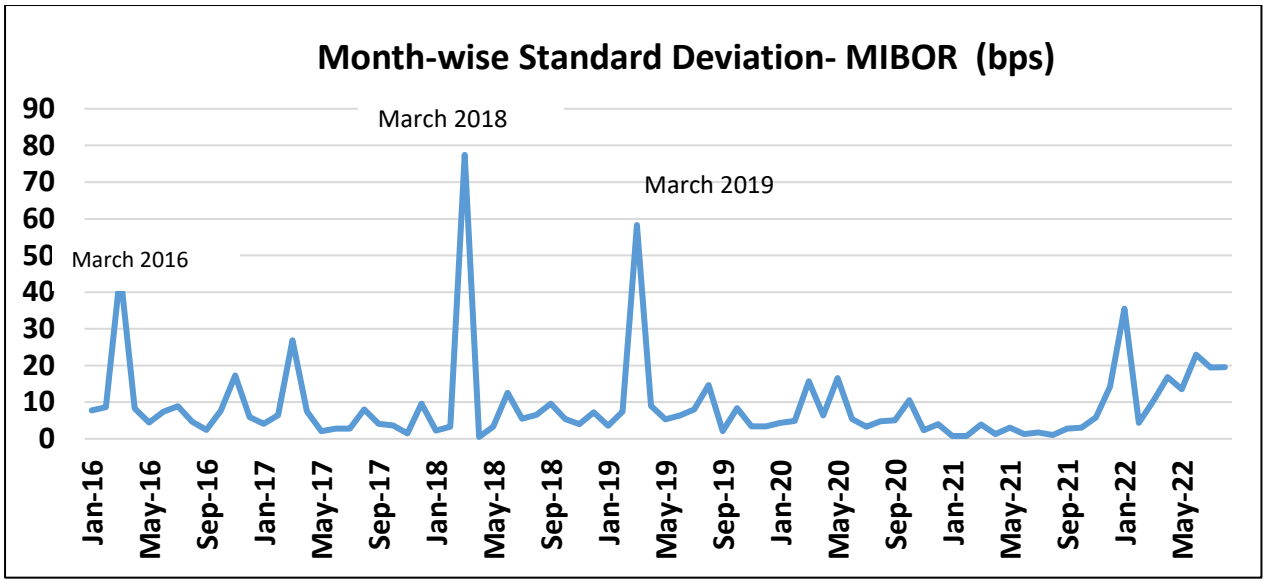


Chart 2.5: Month-wise Standard Deviation of WACR

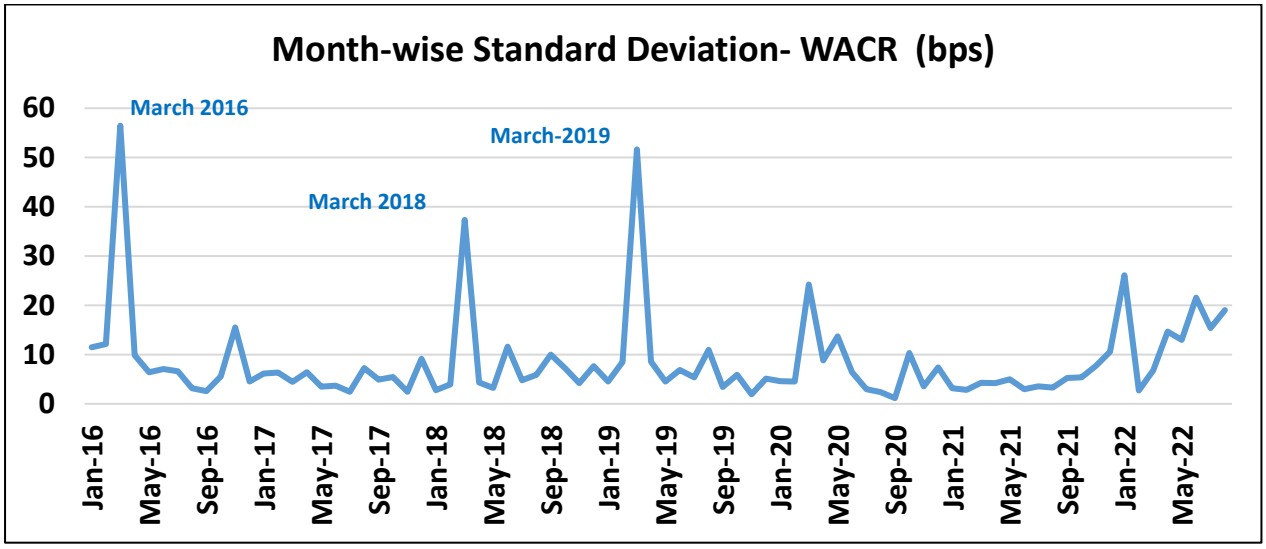
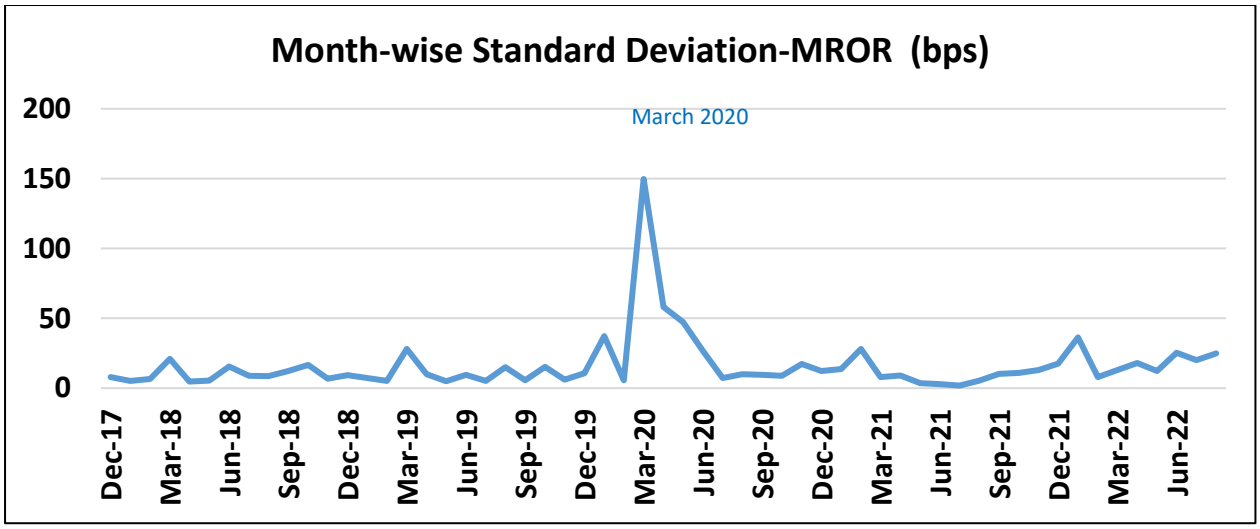


Chart 2.6: Month-wise Standard Deviation of MROR



The Chart 2.7 to 2.9 give the monthly coefficient of variation of these 3 rates.

Chart 2.7: Month-wise Coefficient of Variation-MIBOR

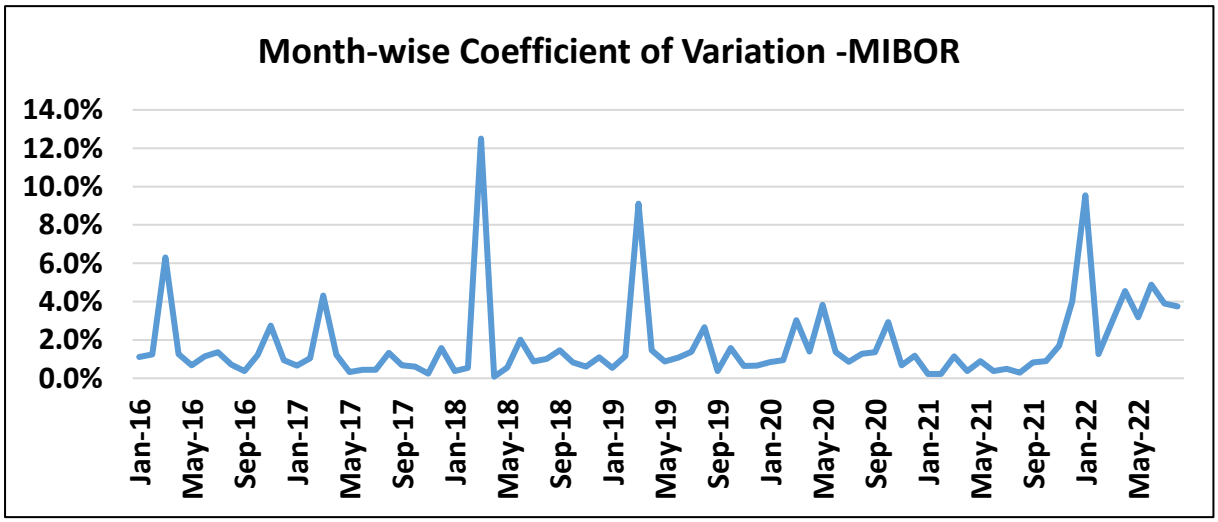


Chart 2.8: Month-wise Coefficient of Variation-WACR

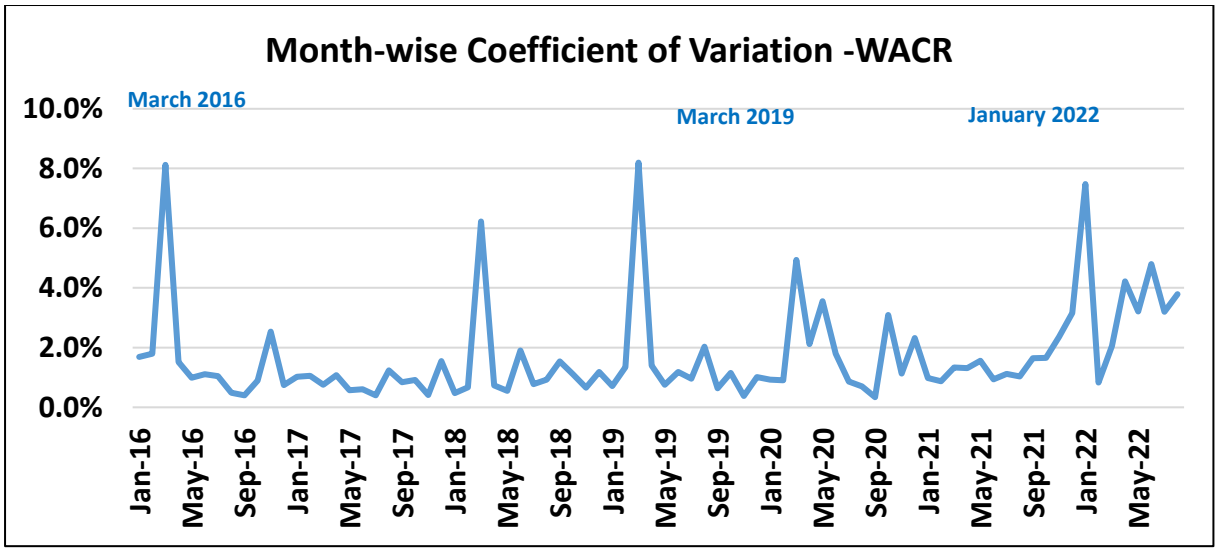
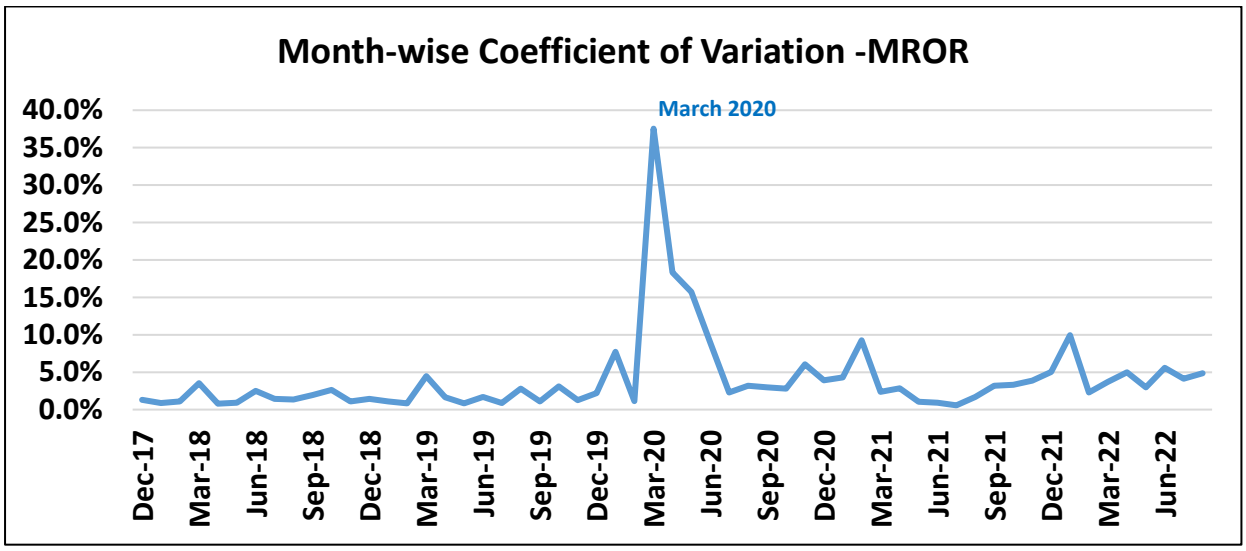


Chart 2.9: Month-wise Coefficient of Variation-MROR



All the 6 charts above show that peaks in the series of both month-wise standard deviation and coefficient of variation generally occur in the month of March, reflecting the year-end balance-sheet management effect.

Alignment with Operating Target-WACR

WACR being the operating target of monetary policy, the success of monetary policy transmission, at step 1, should be evaluated by examining the degree of alignment of other Money Market instruments with WACR and then alignment of WACR itself with the policy rate. To examine the level of alignment, we have analyzed two distance measures viz.

nominal distance and absolute distance. Apart from giving a statistical summary of these measures and their visual trajectory during the period under study, we have also examined the co-movement of the rates by time-series analysis.

A simple graphical analysis of the 3 rates along with the policy rate, *prima facie*, shows that monthly average of these rates remained closely aligned till May 2021. But from June 2020 till June 2022, all the three rates were below the Repo rate. Two large policy rate cuts preceded this period; on March 27, 2020, the policy rate was cut by 75 basis point and on May 22, 2020 it was further cut by 40 basis point.

Chart 2.10 A: Monthly Average Rates of MIBOR, MROR and WACR

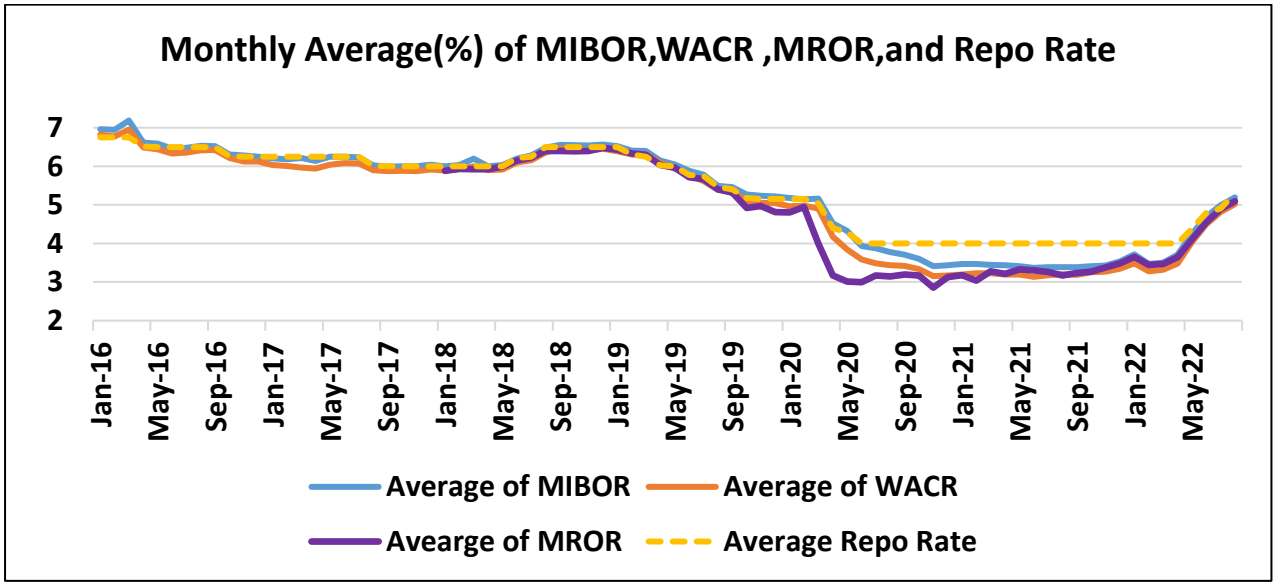
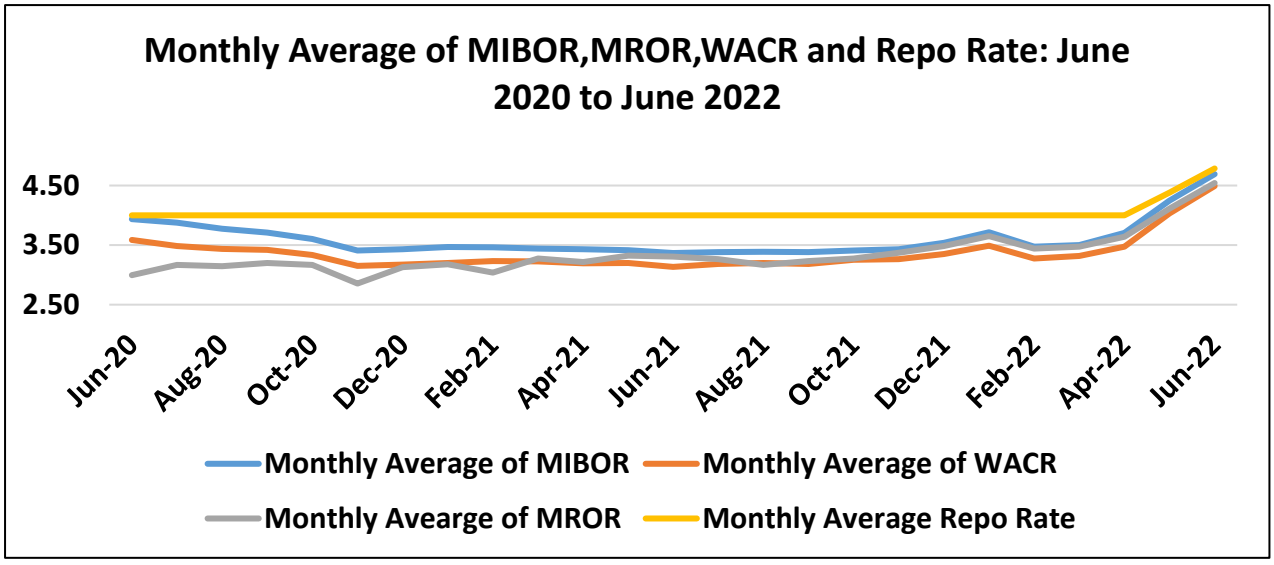


Chart 2.10 B: Monthly Average Rates of MIBOR, MROR and WACR



- **Section III: Analysis of Spreads**

This section summarizes the spread between the three instruments amongst each other and, over the prevailing Repo rate of the day. It may be seen from Table 3.1 below that while the spread of MIBOR over WACR and MROR had been largely positive, that of MROR over WACR is evenly distributed between positive and negative values. In respect of spread over policy Repo rate, in 47% of trading days, MIBOR had negative spread while positive spread has been observed in 34% of days. The corresponding numbers for MROR were 89% and 9% respectively. These results are due to the fact that WACR has been overwhelmingly below the policy rate (92% of trading days covered in this analysis). The average of negative spreads of WACR was 2.5 times that of positive spreads. It is also to be noted that during the period of our study, on 1,365 days out of a total of 1,610 trading days there was accommodative monetary policy stance. But for 8 months of tightening between June, 2018 and January, 2019, and then between May, 2022 and August, 2022, all trading days were under accommodative policy stance. This is the period when the pandemic was at its peak and the banking system was flushed with liquidity.

Table 3.1: Summary of Daily Spread (in basis points) of MIBOR, MROR over WACR and over Policy Repo Rate

Spread	Spread of MIBOR over WACR	Spread of MIBOR over MROR	Spread of MROR over WACR	Spread of MIBOR over Repo	Spread of MROR over Repo	Spread of WACR over Repo
No. of days with Positive Spread	1,596	1,086	600	550	108	131
No. of days with Negative Spread	14	39	541	754	1,011	1,479
Zero Spread	0	16	0	306	22	0

Positive Average	18	27	9	12	9	13
Negative Average	-5	-6	-23	-32	-48	-32

Charts 3.1 to 3.6 present various spreads computed based on monthly average WAY of the three money market instruments and the policy Repo rate. These charts clearly show that since the onset of the pandemic, the money market rates went perceptibility below the policy rate. During the same period, MIBOR was above WACR by around 25 basis points, peaking at 47 bps in the month of May 2020. This spread came down sharply thereafter, touching a low of 16 bps in the month of October 2021.

The spread of MIBOR over MROR reached a peak of 135 bps in the month of April 2020 and then witnessed a gradual decline to 6 bps in the month of June 2021.

It is also observed that the spread of WACR over Repo rate, which was largely negative, witnessed a steep negative spread of around 80 bps during the period November 2020 to September 2021.

Chart 3.1: Spread (in basis points) of Monthly Average rates of MIBOR over the corresponding WACR

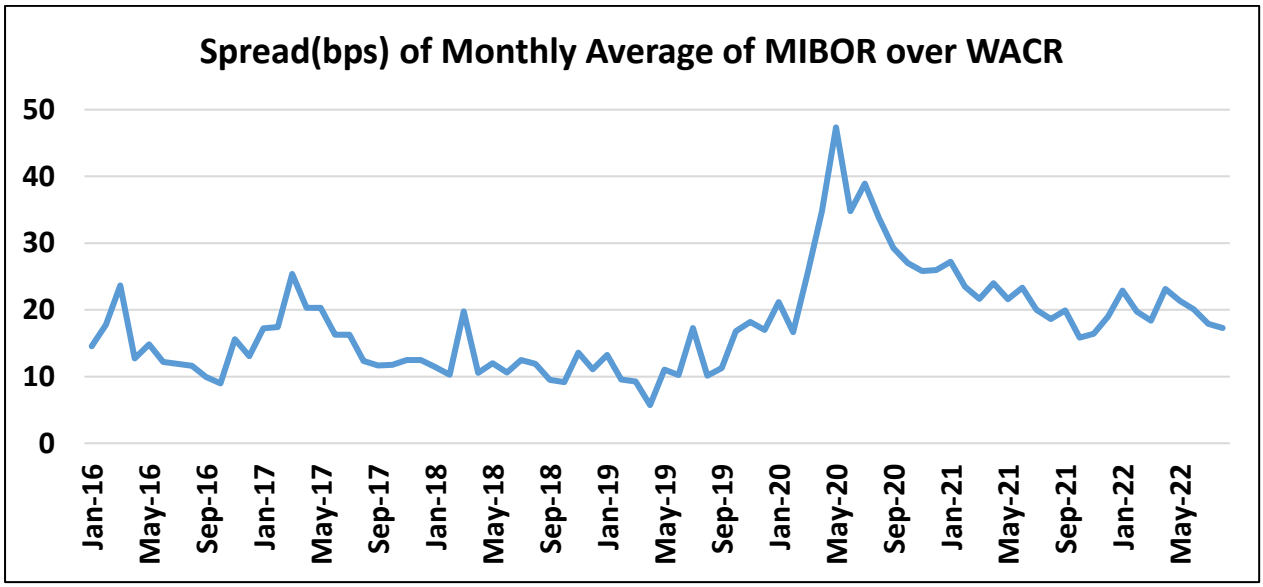


Chart 3.2: Spread (in basis points) of Monthly Average rates of MIBOR over MROR

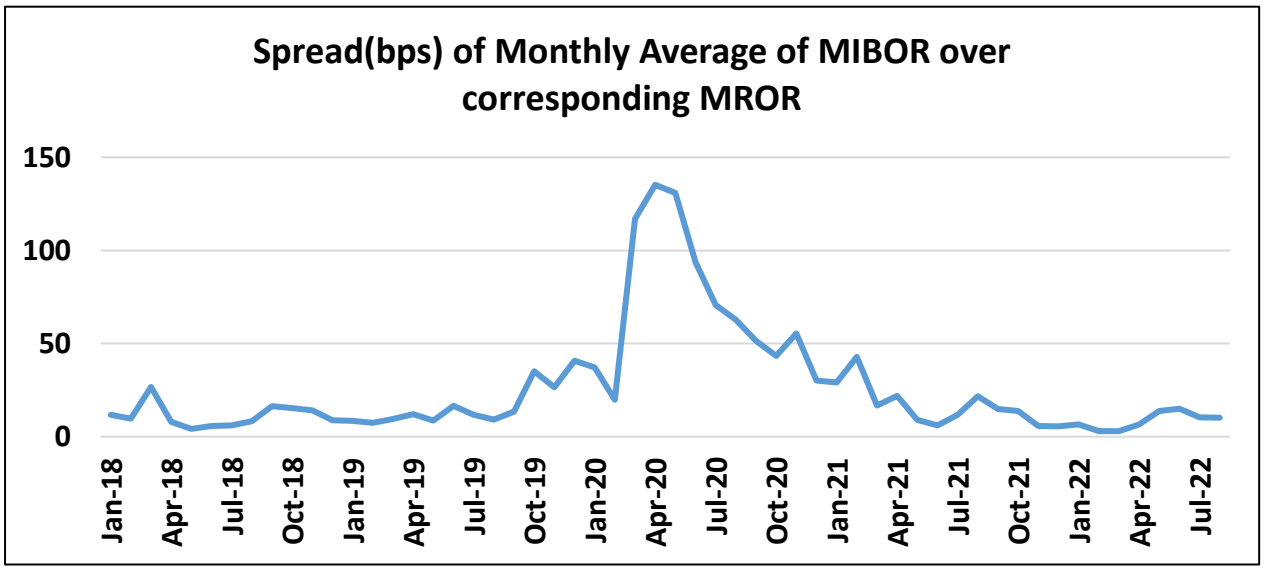


Chart 3.3: Spread (in basis points) of Monthly Average rates of MIBOR over Repo Rate

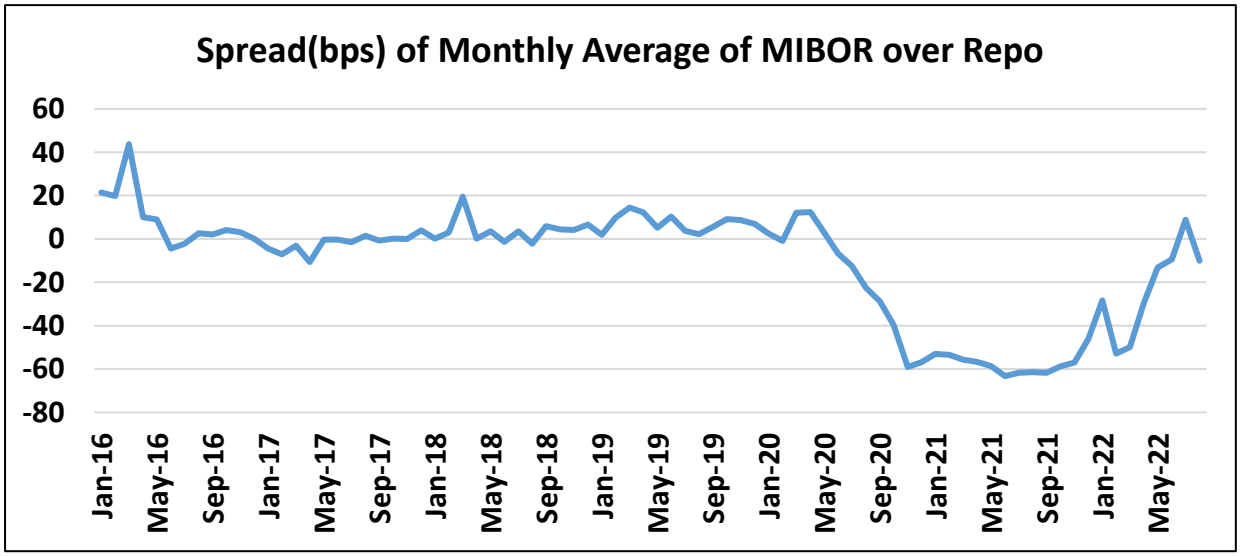


Chart 3.4: Spread of Monthly Average rates of WACR over Repo Rate

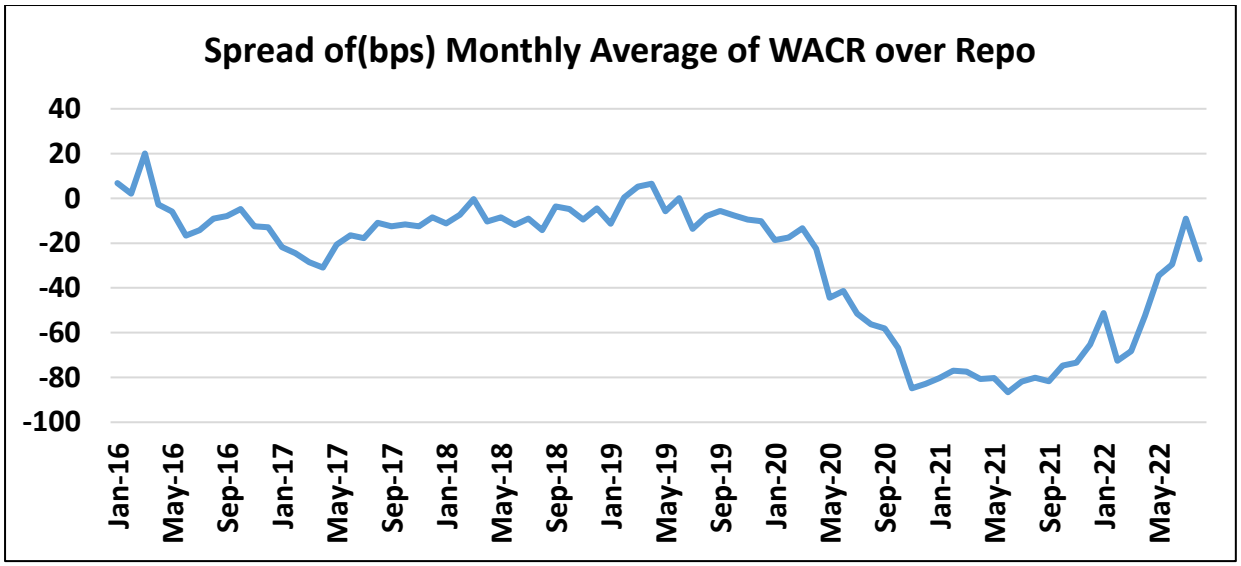


Chart 3.5: Spread of Monthly Average rates of MROR over WACR

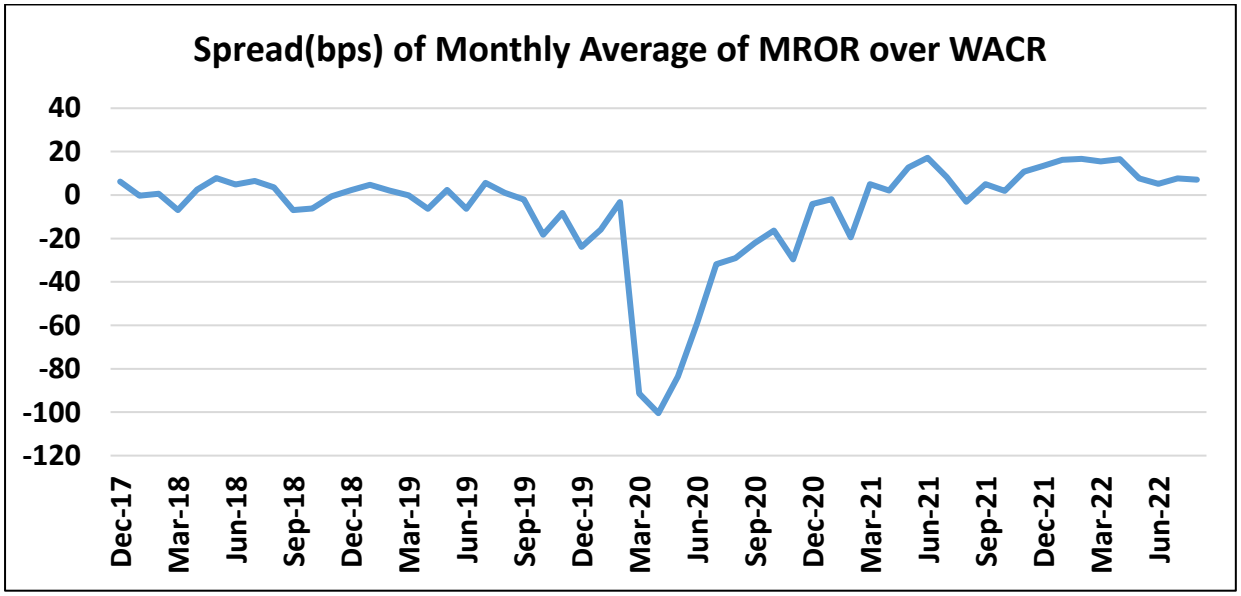
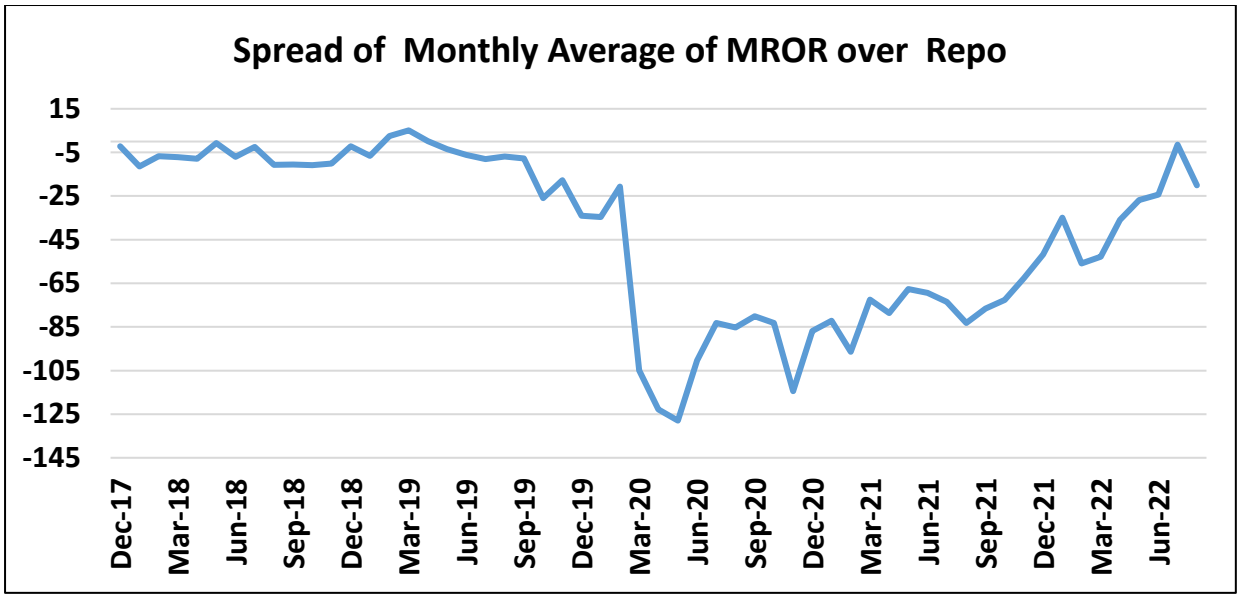


Chart 3.6: Spread of Monthly Average rates of MROR over Repo Rate



The tables below give the spread data for different policy regime periods. Each regime starts with a change in the policy rate. When the policy rate is brought down, we consider it as a period of accommodative policy stance (value given 1), otherwise it is considered as a period of tightening (value given 0). The two tables below give the average spread, actual and absolute value of MIBOR and MROR, over WACR.

These two tables show that the spread of MROR over WACR and Repo rate reached a very high level during the most aggressive period of cut in policy rate.

Table 3.2: Policy Regime-wise Average of Daily Spread of MIBOR and MROR over WACR

Regime	Average of Spread MIBOR over WACR	Average of Spread MROR Over WACR	Count of Trading Days	Change in Repo	Accommodative flag	Start Date	End date
1	18		61		1	01-01-2016	04-04-2016
2	12		121	-25	1	05-04-2016	03-10-2016
3	17		200	-25	1	04-10-2016	01-08-2017

4	12	1	203	-25	1	02-08-2017	05-06-2018
5	12	6	40	25	0	06-06-2018	31-07-2018
6	11	0	124	25	0	01-08-2018	06-02-2019
7	9	1	36	-25	1	07-02-2019	03-04-2019
8	9	-1	40	-25	1	04-04-2019	04-06-2019
9	14	1	44	-25	1	06-06-2019	06-08-2019
10	11	-1	37	-35	1	07-08-2019	03-10-2019
11	18	-20	116	-25	1	04-10-2019	10-01-2020
12	42	-115	33	-75	1	27-03-2020	21-05-2020
13	24	-4	474	-40	1	22-05-2020	02-05-2022
14	21	5	24	40	0	04-05-2022	07-06-2022
15	19	6	42	50	0	08-06-2022	04-08-2022
16	17	10	15	50	0	05-08-2022	30-08-2022

Table 3.3: Policy Regime-wise Average of Absolute Daily Spread of MIBOR and MROR over WACR

Regime	Average of Absolute Spread MIBOR over Repo	Average of Absolute Spread MROR over Repo	Average of Absolute Spread WACR Over Repo	Accommodative flag	Start Date	End date
1	27.9		14.8	1	01-01-2016	04-04-2016
2	6.2		10.4	1	05-04-2016	03-10-2016
3	5.7		19.5	1	04-10-2016	01-08-2017
4	4.2	8.7	11.2	1	02-08-2017	05-06-2018
5	5.6	8.2	10.6	0	06-06-2018	31-07-2018
6	5.3	10.1	9.7	0	01-08-2018	06-02-2019
7	13.2	8.2	12.7	1	07-02-2019	03-04-2019

8	8.4	5.9	7.9	1	04-04-2019	04-06-2019
9	8.2	8.0	10.7	1	06-06-2019	06-08-2019
10	5.5	8.9	6.9	1	07-08-2019	03-10-2019
11	6.1	32.8	13.6	1	04-10-2019	10-01-2020
12	14.1	145.5	32.1	1	27-03-2020	21-05-2020
13	46.4	74.8	70.0	1	22-05-2020	02-05-2022
14	12.4	27.8	33.2	0	04-05-2022	07-06-2022
15	11.5	20.6	23.0	0	08-06-2022	04-08-2022
16	11.1	18.5	28.2	0	05-08-2022	30-08-2022

- **Section IV: Time series Analysis**

Data series used in this paper are all having time as a dimension. Statistical analysis of any relationship amongst them must factor in their time-series properties. Since Money Market instruments are expected to be aligned with the operating target of the monetary policy, WACR in our case, analysis of that alignment needs to factor in the time-series properties of individual instruments. For this, we need to focus on two properties, namely, stationarity and constancy of volatility of each series.

Stationarity examines whether the fluctuation of a time-series is around a constant mean or around a fixed temporal trajectory of the underlying time variable. Since it is a known fact that mean value of any money market rate necessarily changes as the policy rates change, so mean stationarity cannot be a property of the money market rates. Similarly, since changes in the policy rate are carried out only intermittently, it is also very unlikely that money market rates covered in this study will be fluctuating around a purely time-dependent curve. Hence. the time-series analysis of MIBOR, MROR, and WACR is focused to seek answers to the following four questions:

1. Whether daily changes (adjusted for period differences) in each series are stationary?
2. Whether spreads described in Section II are stationary?
3. Whether MIBOR and MROR move in step with WACR? In terms of time-series jargon, are these two instruments co-integrated with WACR?
4. Whether the volatilities in adjusted changes of the three instruments vary over time?

We carried out Augmented Dickey Fuller (ADF) test for assessing the stationarity of the variables mentioned above. The result is given in Table 4.1 below.

Table 4.1: Stationarity test of 6 derived measures

Measure	Conclusion of stationarity test
Adjusted Daily Change-MIBOR	Stationary
Adjusted Daily Change MROR	Stationary
Adjusted Daily Change WACR	Stationary
Spread of MIBOR over MROR	Stationary
Spread of MIBOR over WACR	Stationary
Spread of MROR over WACR	Stationary

Table 4.2: Test for Volatility Clustering

Measure	Conclusion of ARCH effect test
Adjusted Daily Change-MIBOR	No ARCH effect
Adjusted Daily Change MROR	ARCH effect is present
Adjusted Daily Change WACR	ARCCH effect present
Spread of MIBOR over MROR	ARCH effect is present
Spread of MIBOR over WACR	ARCH effect is present
Spread of MROR over WACR	ARCH effect is present

ARCH stands for Auto Regressive Conditional Heteroscedasticity

The presence of observed ARCH effect in 5 out of 6 measures is largely due to high volatility during the months of March/April for many of the years.

It needs to be clarified here that the stationarity of a long time-series does not imply that there would be no short-term movement in one or another direction, as we have seen in the last section. However, the presence of stationarity implies that eventually the series would reverse its direction towards its long-term average value.

As regards co-movement of MIBOR and MROR with WACR, we find that both the overnight rates were co-integrated with WACR.

Section V: Concluding observations.

1. The short-term Money Market instruments have remained sufficiently responsive to the monetary policy actions of the RBI.
2. The turnover of Call Money market in comparison to the two collateralized Money Market instruments, namely, Market Repo and CBLO/TREP, has seen a steep decline during the period covered in this study. Notwithstanding this, the transmission process of monetary policy action worked reasonably well, at least in the lower end of the maturity spectrum. In other words, monetary policy actions impacted the Money Market, as desired.
3. FBIL publishes two overnight rates viz. MIBOR and MROR. These rates along with WACR have been analyzed in more detail in this study. The study finds that these two published rates are reasonably aligned with WACR.
4. The spread of these two instruments over WACR was largely within 25 basis points, but for the initial period of the pandemic. The average spread of MROR went to as low as (-)115 basis points during March-May 2020. The year-end effect on these two rates has been significant, leading to clustering of high volatility in these two rates during these months.
5. The fluctuations in day-to-day changes in these two rates are bounded without exhibiting any trend over time.
6. The spread of these two rates over the policy rate became negative during the start of the pandemic period and the magnitude of monthly average spread for MROR went below minus 100 basis point for the initial months of the pandemic. In other words, the market was ahead of policy changes during that period.

References:

Bhattacharyya Indranil et. Al. published online 03 Apr 2009. "*Money market microstructure and monetary policy: the Indian experience"* in Macroeconomics and Finance in Emerging Market Economies

Cook Timothy and Thomas Hahn, 1988, July," The *Effect of Changes in the Federal Funds Rate Target on market Interest Rates in the 1970s*" Working Paper 88-4 Federal Reserve Bank of Richmond

Das, Rituparna 2009. "Indian G-Sec Market: "*How the Term Structure Reacts to Monetary Policy,*" MPRA Paper 16436, University Library of Munich, Germany. 9also available as a SSRN paper)

Dilip, Archana 2021 November, "*Changing Tides in the Indian Money Market* "RBI Bulletin

Ghosh Saurabh and Indranil Bhattacharyya, 2009 " *Spread, Volatility and Monetary Policy: Empirical Evidences from the Indian Overnight Money Market*" in Macroeconomics and Finance in Emerging Market Economies Volume 2, Issue 2:

Kavediya Rajesh and Sitikantha Pattanaik 2016 "Operating *Target Volatility: Its Implications for Monetary Policy Transmission*" in Reserve Bank of India Occasional Papers" Vol 37 No 1&2

Annex 1

Table A1.1: Month-wise Statistics for MIBOR-WACR spread(bps)

Year	Month	Average Spread	Std. Deviation Spread	Max Spread	Min Spread	Median Spread	Spread 25 percentile	Spread 75 percentile
2016	January	15	12	42	-6	14	7	23
2016	February	18	13	39	-8	17	8	29
2016	March	24	22	62	-36	27	13	38
2016	April	13	9	30	1	13	6	17
2016	May	15	7	26	1	14	10	20
2016	June	12	6	25	-3	12	9	15
2016	July	12	5	21	0	12	11	15
2016	August	12	3	20	5	12	9	13
2016	September	10	3	13	3	11	9	12
2016	October	9	6	23	2	7	7	10
2016	November	16	9	31	4	15	8	23
2016	December	13	4	20	6	14	11	15
2017	January	17	5	24	4	17	15	21
2017	February	17	5	26	9	18	14	20
2017	March	25	25	133	8	22	16	24
2017	April	20	4	29	13	20	17	23

2017	May	20	4	27	9	20	18	23
2017	June	16	4	21	8	17	15	19
2017	July	16	3	22	8	17	15	18
2017	August	12	5	20	1	14	12	15
2017	September	12	5	17	-6	14	10	15
2017	October	12	4	17	0	12	11	15
2017	November	12	3	16	6	13	11	14
2017	December	12	5	23	3	14	9	17
2018	January	11	3	16	3	12	9	13
2018	February	10	4	16	0	11	9	12
2018	March	20	39	182	2	12	10	13
2018	April	11	5	20	-2	11	9	13
2018	May	12	4	19	6	11	9	15
2018	June	11	4	18	3	11	8	13
2018	July	12	5	19	1	13	9	16
2018	August	12	5	20	2	12	9	16
2018	September	10	5	21	0	9	7	13
2018	October	9	5	17	2	8	6	13
2018	November	14	5	21	5	14	11	17
2018	December	11	5	20	4	10	7	15
2019	January	13	4	19	3	13	12	16
2019	February	10	6	21	0	9	5	15
2019	March	9	6	31	3	10	5	11
2019	April	6	3	12	-1	6	5	7
2019	May	11	3	15	6	11	9	13
2019	June	10	4	17	-3	11	9	12
2019	July	17	6	32	0	17	14	22
2019	August	10	5	25	2	9	7	13
2019	September	11	3	21	8	11	9	13
2019	October	17	4	26	9	16	14	19
2019	November	18	3	22	12	18	18	20

2019	December	17	3	21	12	17	15	19
2020	January	21	5	30	8	21	19	24
2020	February	17	4	22	8	17	14	19
2020	March	25	15	68	13	19	17	24
2020	April	35	6	45	22	35	31	38
2020	May	47	8	60	32	46	43	54
2020	June	35	7	51	20	35	30	39
2020	July	39	4	46	31	38	37	42
2020	August	34	5	47	25	34	31	36
2020	September	29	5	40	18	29	25	34
2020	October	27	4	34	21	27	25	30
2020	November	26	3	32	20	27	24	28
2020	December	26	6	35	18	26	21	31
2021	January	27	3	32	21	27	25	29
2021	February	23	3	28	14	24	22	25
2021	March	22	3	28	17	22	20	24
2021	April	24	5	34	19	22	21	28
2021	May	22	4	28	11	23	21	24
2021	June	23	3	29	18	24	21	25
2021	July	20	2	24	14	20	19	22
2021	August	19	3	26	12	18	17	20
2021	September	20	3	24	12	21	18	22
2021	October	16	4	22	10	16	12	19
2021	November	16	6	29	1	17	15	19
2021	December	19	7	39	3	18	16	22
2022	January	23	11	47	7	20	17	30
2022	February	20	4	30	15	19	18	21
2022	March	18	4	34	12	17	16	20
2022	April	23	5	31	14	24	19	27
2022	May	21	3	28	16	21	20	23
2022	June	20	3	25	14	20	18	21

2022	July	18	4	28	10	17	15	20
2022	August	17	3	22	10	18	16	19

Table A1.2: Month-wise Statistics for MROR-WACR spread(bps)

Year	Month	Average Spread	Std. Deviation Spread	Max Spread	Min Spread	Median Spread	Spread 25 percentile	Spread 75 percentile
2017	December	2	5	9	-7	0	2	5
2018	January	0	4	9	-6	-4	-2	1
2018	February	1	5	12	-9	-3	1	4
2018	March	-7	18	6	-81	-6	-3	-1
2018	April	3	6	15	-9	-2	3	7
2018	May	8	6	18	-5	4	8	12
2018	June	5	6	12	-8	3	6	10
2018	July	6	6	16	-5	1	8	11
2018	August	4	6	14	-2	-1	2	6
2018	September	-7	8	5	-25	-11	-8	-1
2018	October	-6	12	6	-38	-5	-2	0
2018	November	-1	5	7	-10	-4	-1	2
2018	December	2	5	13	-6	-2	2	6
2019	January	5	5	14	-4	0	5	9
2019	February	2	6	12	-9	-2	1	7
2019	March	0	26	12	-104	3	6	8
2019	April	-6	5	3	-15	-10	-8	-1
2019	May	2	6	11	-7	-2	2	8
2019	June	-6	9	8	-19	-14	-6	2
2019	July	6	7	16	-12	2	8	10
2019	August	1	7	15	-10	-6	2	7

2019	September	-2	4	5	-9	-5	-3	2
2019	October	-18	11	0	-39	-24	-18	-12
2019	November	-8	7	3	-22	-13	-9	-3
2019	December	-24	11	-10	-52	-28	-23	-16
2020	January	-16	36	7	-131	-7	-1	1
2020	February	-3	6	8	-18	-4	-3	0
2020	March	-91	138	-4	-415	-73	-20	-9
2020	April	-100	58	-11	-266	-130	-82	-65
2020	May	-84	46	-44	-202	-98	-65	-53
2020	June	-59	26	-32	-152	-62	-56	-44
2020	July	-32	9	-21	-59	-33	-30	-27
2020	August	-29	10	-17	-48	-38	-26	-22
2020	September	-22	10	-11	-42	-23	-17	-16
2020	October	-16	6	-4	-28	-18	-16	-13
2020	November	-30	17	-10	-72	-41	-23	-17
2020	December	-4	10	6	-32	-8	-1	4
2021	January	-2	14	13	-40	-7	3	7
2021	February	-19	28	4	-93	-35	-7	1
2021	March	5	6	14	-14	3	5	7
2021	April	2	7	10	-15	1	3	7
2021	May	13	7	24	1	8	12	18
2021	June	17	3	21	9	16	18	19
2021	July	8	5	19	-1	5	7	11
2021	August	-3	7	9	-13	-6	-4	-1
2021	September	5	9	18	-12	-5	8	11
2021	October	2	8	13	-19	-1	2	8
2021	November	11	11	46	-4	5	10	12
2021	December	13	10	36	-1	7	10	16
2022	January	16	12	36	2	7	13	26
2022	February	17	7	29	0	13	16	22
2022	March	15	9	29	2	10	15	23

2022	April	17	10	46	2	11	17	19
2022	May	8	4	16	1	5	8	9
2022	June	5	9	37	-9	-1	4	9
2022	July	8	7	21	-7	3	10	13
2022	August	7	6	17	-7	4	7	12

Table A1.3: Month-wise Statistics for MIBOR-MROR spread(bps)

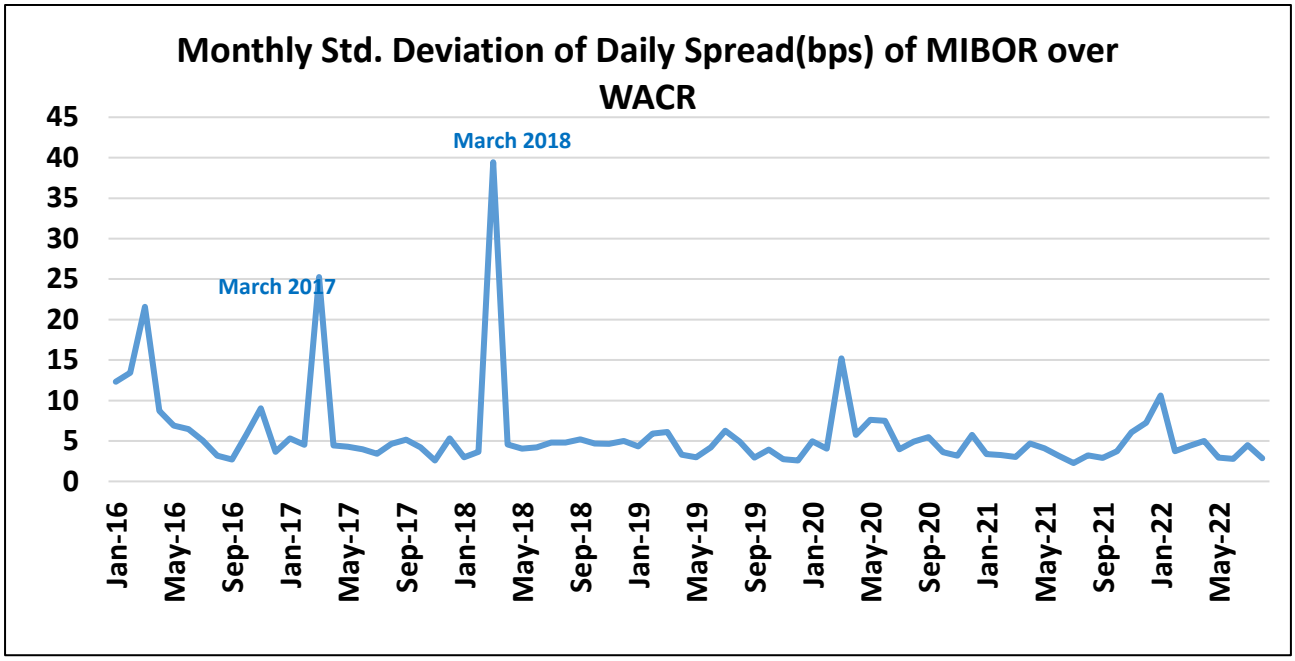
Year	Month	Average Spread	Std. Deviation Spread	Max Spread	Min Spread	Median Spread	Spread 25 percentile	Spread 75 percentile
2017	December	10	6	23	5	7	9	13
2018	January	12	4	18	3	9.25	12	14.75
2018	February	10	4	17	4	6	9	11
2018	March	27	57	263	2	12.5	13	17.5
2018	April	8	5	18	1	6	7	9.5
2018	May	4	4	13	-6	0.5	5	6.75
2018	June	6	4	16	0	2	6	7
2018	July	6	6	23	0	2.25	4	6.75
2018	August	8	4	14	-2	6	9	11.25
2018	September	16	8	34	3	13	15	18
2018	October	15	13	47	1	8	10	14
2018	November	14	5	24	2	11	14	18
2018	December	9	5	21	1	6	8	11.25
2019	January	8	6	20	-3	4.5	9	12
2019	February	7	5	18	-3	5	8	10.5
2019	March	9	31	135	-2	0.5	2	4.5
2019	April	12	5	19	4	7.5	13	15.5
2019	May	9	5	18	0	5.25	8.5	13
2019	June	16	10	35	6	8.5	14	23.5
2019	July	12	9	35	3	6	11	13.5

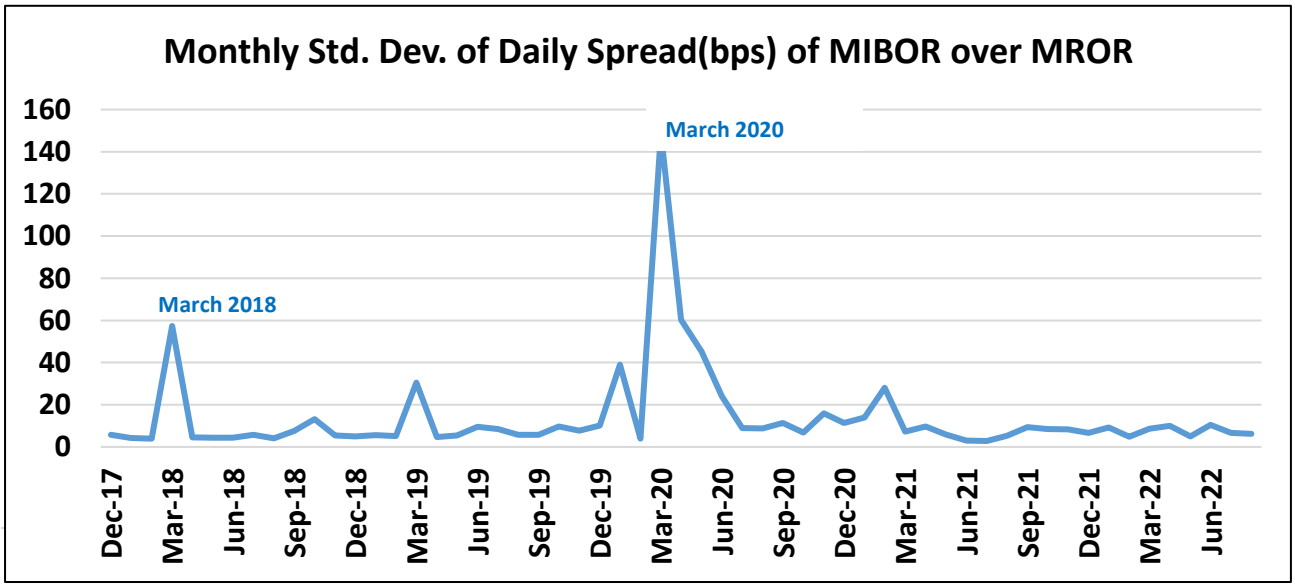
2019	August	9	6	19	-1	5	8	13.25
2019	September	13	6	22	3	8.5	16	17.5
2019	October	35	10	56	19	30	35	39.5
2019	November	27	8	40	10	21.75	27	31
2019	December	41	10	66	29	33	37	47
2020	January	37	39	159	14	17	23	27
2020	February	20	4	26	12	17.25	20.5	21.75
2020	March	117	149	428	24	31	41.5	92.75
2020	April	135	60	302	41	101	121	167
2020	May	131	45	245	91	100.25	114.5	140.5
2020	June	94	24	179	76	81	85.5	96
2020	July	71	9	97	59	64	70	73
2020	August	63	9	79	46	57	61	66
2020	September	51	11	75	38	42.25	47	58
2020	October	43	7	58	35	39.5	41	45.5
2020	November	55	16	92	37	43	49	68
2020	December	30	11	55	14	24	30.5	35
2021	January	29	14	67	16	21	23	35
2021	February	43	28	118	20	23.5	26	60
2021	March	17	7	39	7	12	15	19
2021	April	22	10	44	11	15	20	23
2021	May	9	6	20	2	4	6	13.5
2021	June	6	3	13	2	4	5.5	7
2021	July	12	3	15	5	10	12	14
2021	August	22	5	31	12	19	22	23.25
2021	September	15	9	30	4	7	13	24
2021	October	14	8	31	3	8.5	11	20.5
2021	November	6	8	14	-17	5	7	10
2021	December	6	7	14	-14	2.5	8	9.5
2022	January	7	9	20	-9	-0.25	6.5	15.25
2022	February	3	5	15	-7	0.5	2	6

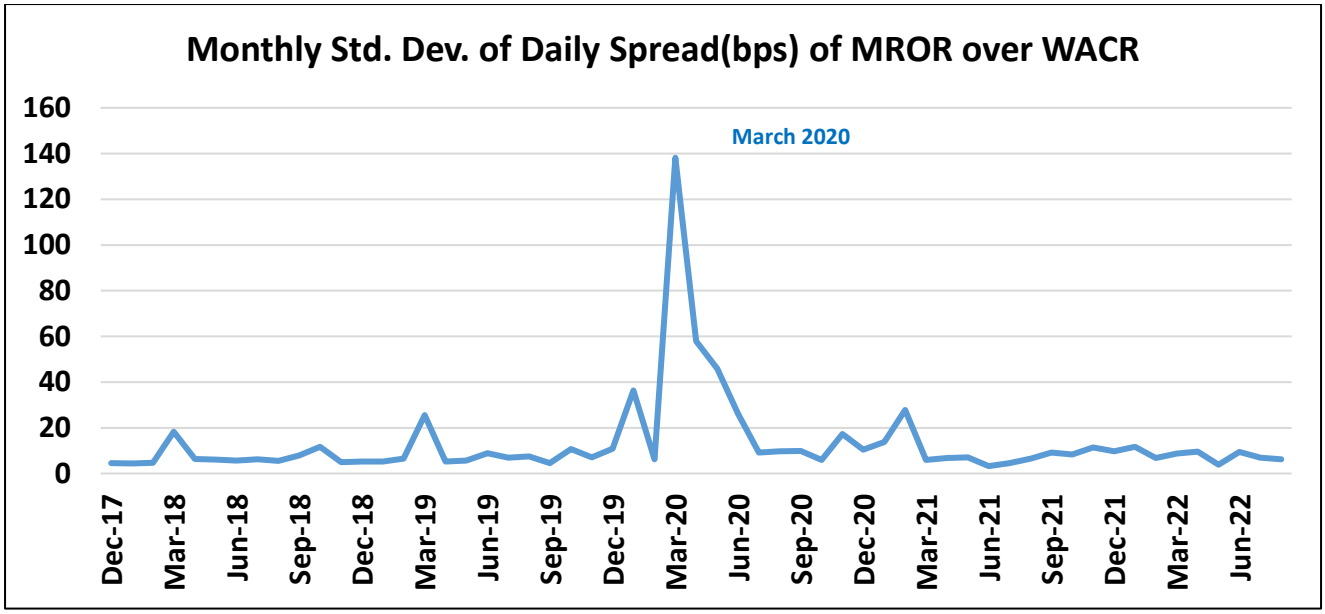
2022	March	3	9	19	-13	-3	4	9
2022	April	7	10	22	-18	1.25	6.5	13.5
2022	May	14	5	24	5	10.75	13.5	17
2022	June	15	11	29	-23	10	17.5	21.75
2022	July	10	7	22	-3	6	12	16
2022	August	10	6	25	2	6	8	13

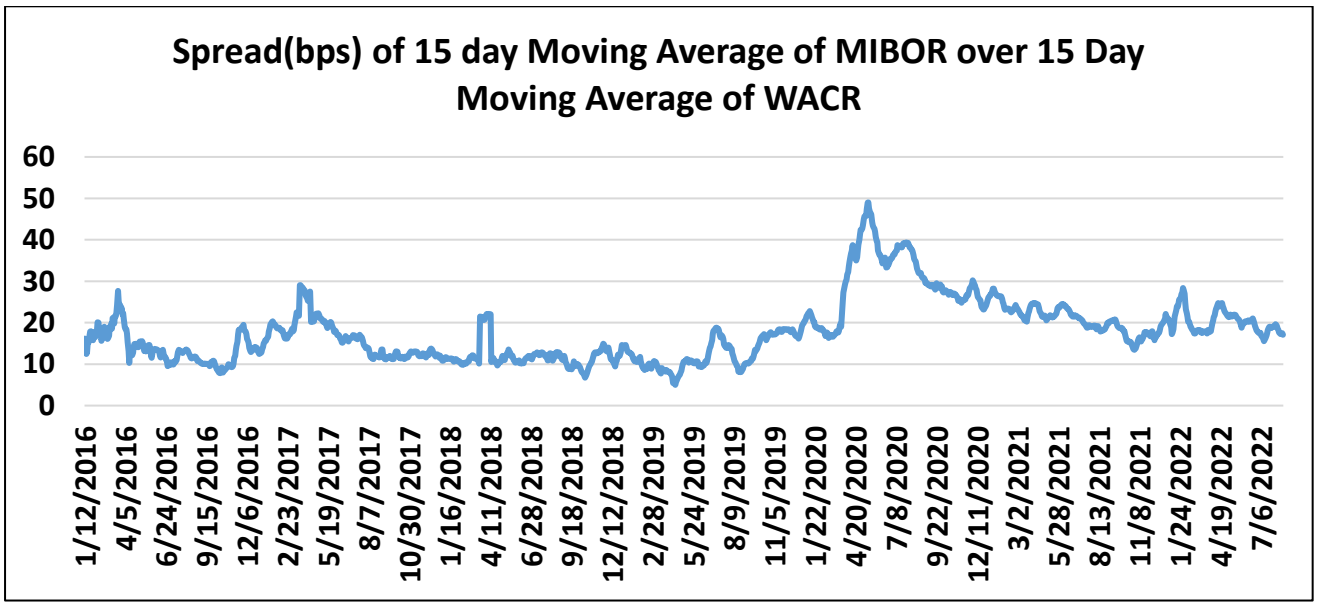
Annex 2

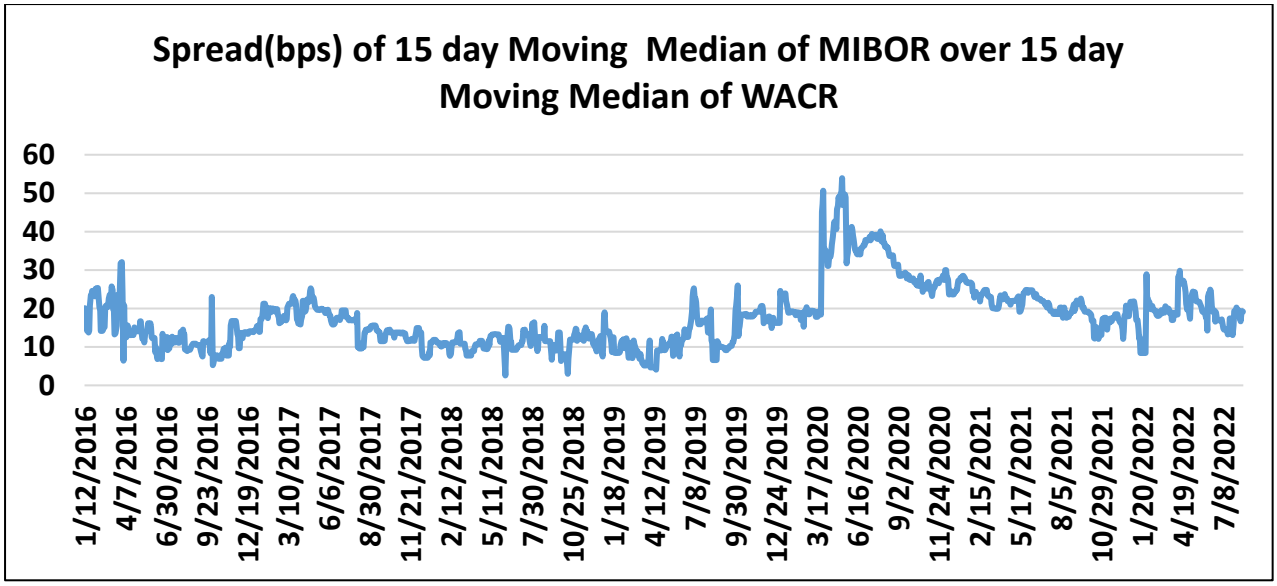
Graphs

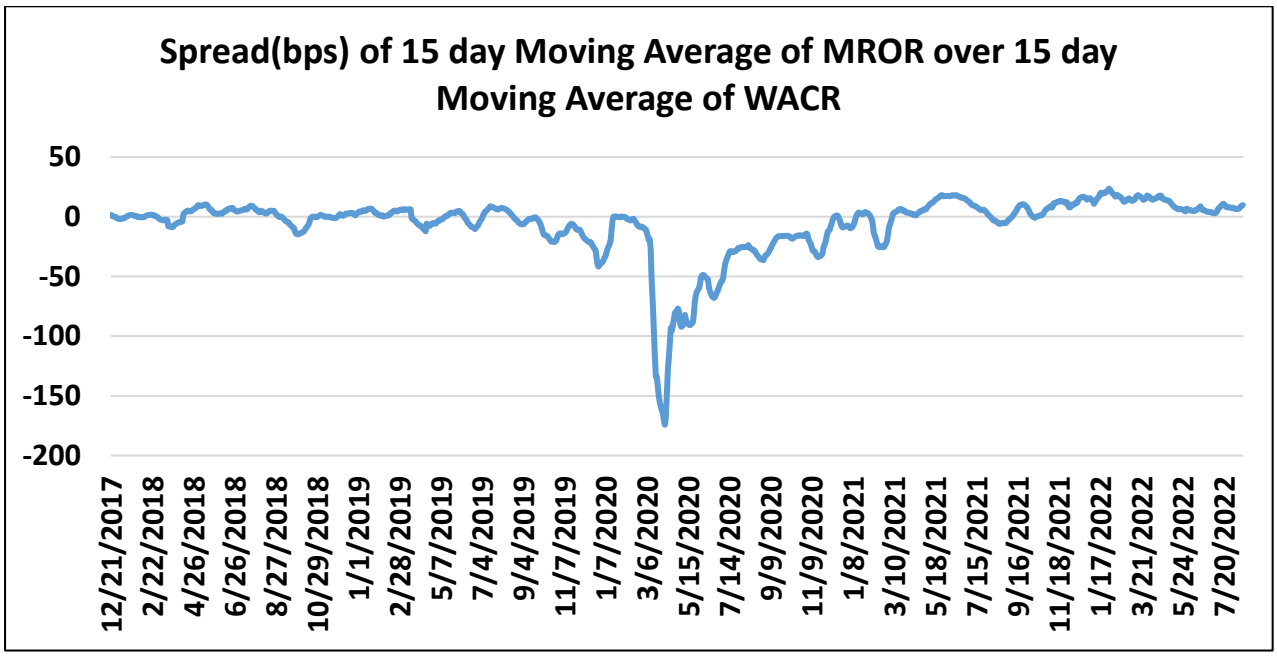





Monthly Std. Dev. of Daily Spread(bps) of MROR over WACR
March 2020
160
140
120
100
80
60
40
20
0
Dec-17
Mar-18
Jun-18
Sep-18
Dec-18
Mar-19
Jun-19
Sep-19
Dec-19
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Mar-22
Jun-22


Spread(bps) of 15 day Moving Average of MIBOR over 15 Day Moving Average of WACR
60
50
40
30
20
10
0
1/12/2016
4/5/2016
6/24/2016
9/15/2016
12/6/2016
2/23/2017
5/19/2017
8/7/2017
10/30/2017
1/16/2018
4/11/2018
6/28/2018
9/18/2018
12/12/2018
2/28/2019
5/24/2019
8/9/2019
11/5/2019
1/22/2020
4/20/2020
7/8/2020
9/22/2020
12/11/2020
3/2/2021
5/28/2021
8/13/2021
11/8/2021
1/24/2022
4/19/2022
7/6/2022


Spread(bps) of 15 day Moving Median of MIBOR over 15 day Moving Median of WACR
60
50
40
30
20
10
0
1/12/2016
4/7/2016
6/30/2016
9/23/2016
12/19/2016
3/10/2017
6/6/2017
8/30/2017
11/21/2017
2/12/2018
5/11/2018
7/30/2018
10/25/2018
1/18/2019
4/12/2019
7/8/2019
9/30/2019
12/24/2019
3/17/2020
6/16/2020
9/2/2020
11/24/2020
2/15/2021
5/17/2021
8/5/2021
10/29/2021
1/20/2022
4/19/2022
7/8/2022


Spread(bps) of 15 day Moving Average of MROR over 15 day Moving Average of WACR
50
0
-50
-100
-150
-200
12/21/2017
2/22/2018
4/26/2018
6/26/2018
8/27/2018
10/29/2018
1/1/2019
2/28/2019
5/7/2019
7/4/2019
9/4/2019
11/7/2019
1/7/2020
3/6/2020
5/15/2020
7/14/2020
9/9/2020
11/9/2020
1/8/2021
3/10/2021
5/18/2021
7/15/2021
9/16/2021
11/18/2021
1/17/2022
3/21/2022
5/24/2022
7/20/2022

Annex 3

Computation methodology of published MIBOR and MROR by FBIL

MIBOR:

Data coverage: All trades executed on NDS-Call system excluding reciprocal and reported deals within the first hour of trading (currently from 9.00 A.M. to 10.00 A.M.) are considered for computation purpose. The settlement date must be the reporting date. The maturity date should be next Mumbai working day, excluding Saturdays. If the next working day is 4 days ahead of the trading day, then trades with 4 days of maturity will be considered.

Requirement of number and value of trades: A minimum of 10 trades with each having a traded value of 5 crore and an aggregated value of 500 crore is required for further computation. If the condition is not met, the time period coverage is extended by 30 minutes first and if required by another 30 minutes. If two such extensions fail to reach the target numbers, a fallback mechanism kicks in.

Outlier detection: Any trade with rate beyond ± 3 sigma band around volume weighted average rate will be considered as outlier and will be discarded. The weighted average rate of the remaining trade will be the published rate.

Fallback mechanism: If the threshold criteria for preparation of dataset for computation of the day's MIBOR are not satisfied, the first fallback mechanism is invoked to augment the dataset with deals not traded but reported on NDS-Call platform in the first 1 hour of trading. Such augmentation will be considered only when at least 3 dealt trades are available in the computational dataset to begin with. Inclusion of reported deals are also subjected to a number of stringent selection criteria, including outlier detection etc. After inclusion of reported deals, final computation of published rate is carried out provided the initial condition of number and volume of trades are met by this dataset.

MROR

Data coverage: This benchmark is based on basket repo trades executed on the Basket Repo segment of CROMS dealing system platform of CCIL. Deals made in the first 1 hour of the trading time are considered for creating the computational dataset.

Requirement of number and value of trades: A minimum of 10 trades of Rs. 5 crore each and with aggregate traded value of Rs. 1000 crore are required for the computational dataset. If these threshold criteria are not met, time for consideration of eligible trades is extended by 30 minutes twice i.e., 10.00 AM to 10.30 AM and 10.30 AM to 11.00 AM.

Outlier detection: The process is the same as in the case of MIBOR.

Fallback Mechanism: Previous day's benchmark is reported.