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Repo Market and Market Repo Rate as a Collateralized Benchmark Rate

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ABSTRACT

The FBIL MROR Rate, which is released by the benchmark administrator, Financial Benchmarks India Limited (FBIL) since December 2017 is calculated using the Basket Repo trades dealt on the Clearcorp Repo Order Matching System (CROMS) upto 10.00 am. CROMS is an anonymous electronic trading platform for market repo transactions. It facilitates two types of repos – Basket Repo, where collateral selection is based on a basket of securities and Special Repo, where the borrower identifies the collateral to be used. According to the paper, the call money rates, which is an uncollateralized market has a strong correlation with Basket Repo transactions, compared to the OTC Repo and Special Repo trades. According to the study, this is because Basket Repo is a lending and borrowing activity for funds, unlike Special Repo, which is primarily used for borrowing of securities. Further, T-test results of the Basket Repo and Call market rates show that there is no significant difference in the structure of these two markets. On the other hand, the tests indicate larger spreads and unequal means between Basket Repo and Special Repo trades. Hence the study suggests that Basket Repo trades could be used efficiently as a benchmark as a proxy for the call market, with a small spread. The paper further constructs a “Liquidity Moderation Index Rate” using the weighted average cut-offs of all LAF operations in order to analyze the fund requirement of banks. It finds that in instances of both excess and deficit liquidity, the Repo rate in the first hour of trading has a higher correlation (around 94%) with this Rate, compared to the Repo rate of the entire day. The study concludes by suggesting the use of the first hour of Basket Repo trades with adequate threshold criteria and fallback mechanism to calculate the collateralized benchmark rate.

JEL Classification: G23, E44

Keywords: Market Repo, Liquidity, T-Test, Spreads, Call Money Market, Anonymous Trading, Lending, Borrowing

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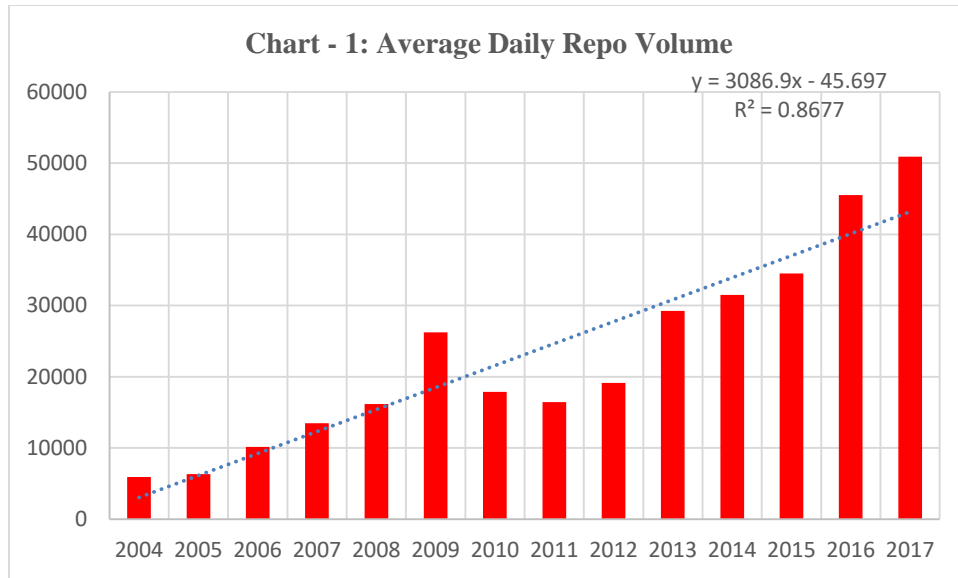
1. INTRODUCTION

Collateralized markets have grown significantly over the years and surpassed the uncollateralized call market. In 2004, Call market contributed 50% of the short-term money market volume and the same has come down to 9% in 2017 (till Feb'17). Repo Market daily volume has increased from `5917crores in 2004 to `50939crores in 2017 (data till Feb'17). CBLO market has grown extensively during the period as markets preferred collateralized deals vis-à-vis uncollateralized transactions. Table -1 gives the data of the Market structure of the Repo market.

2. REPO MARKET STRUCTURE

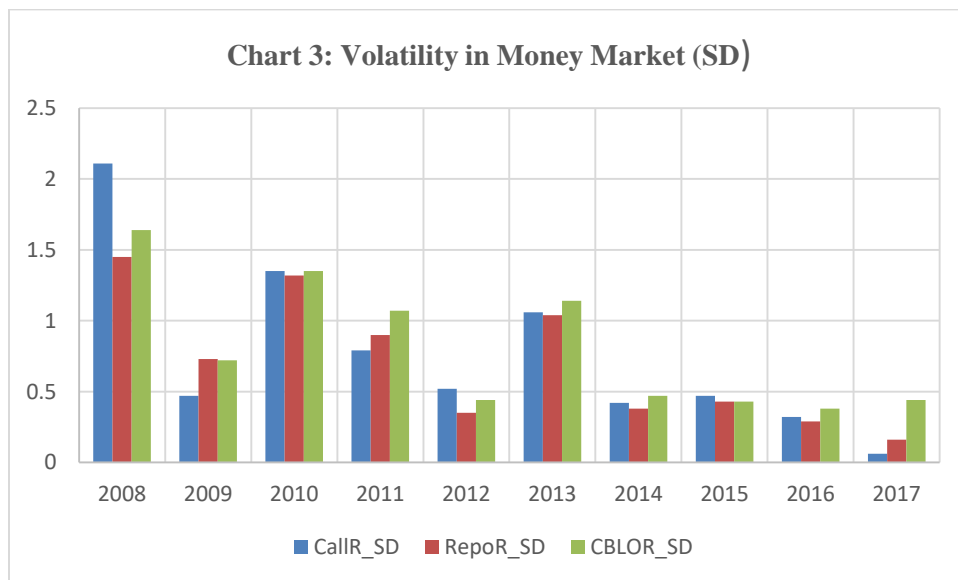
Repo trading happens using Clearcorp Repo Order Matching systems (CROMS) as well as through OTC mechanism (also reported to CROMS platform after executing the transaction). CROMS is an automated anonymous order matching systems and allows members to trade without knowing the counter-party name as CCIL provides the guarantee of settlement for all deals in Repo market. CROMS account for about 94% of the total Repo transactions. CROMS is again divided into two parts – a General collateral repo called Basket Repo and Special Repo. As the name suggests, the borrower has to identify a particular security while borrowing in CROMS. Table -2 gives the structure of Repo market volumes in recent years. The CROMS market has grown significantly over the years while OTC market is slowly falling.

In the short-term Money market, Repo market has maintained its market share and has been a steady product though CBLO has gained significantly as the Call market volumes dipped. There has been significant volume growth over the years in Repo market. Chart-1 gives the year-wise trend of the volumes in Repo market.



Short-term markets have wide fluctuation depending on the liquidity availability in the system. All short term rates (CBLO, call and Repo) move in tandem and their volatilities vary widely at times. However, the volatility in Rates has come down in recent years. However, during liquidity crunch, Call rates flares up relatively more than CBLO and Repo (Table -3).

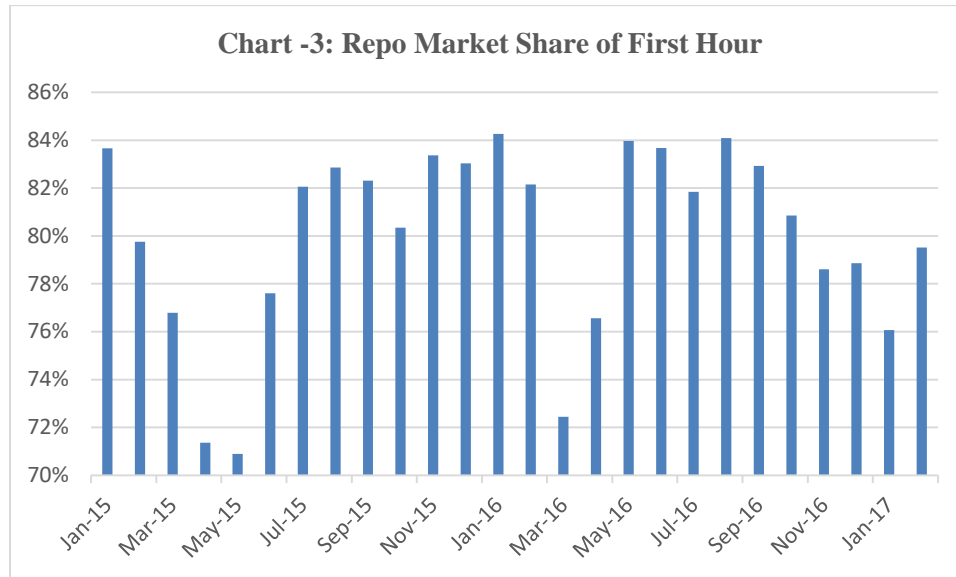
Since 2014, volatility in overnight money market has been stable as depicted in Chart -3. During Financial crisis period (2007 and 2008), volatility of the overnight market was very high.



Basket Repo accounts for the large market share vis-à-vis Special Repo as given in Table – 4 though in recent months, Special is showing an increasing trend. In recent months, Special

Repo has increased possibly due to increase in short selling by the market participants. In early March'17, Repo Rate in Special Repo segment as gone down to 0.10% for a particular security, which was in high demand.

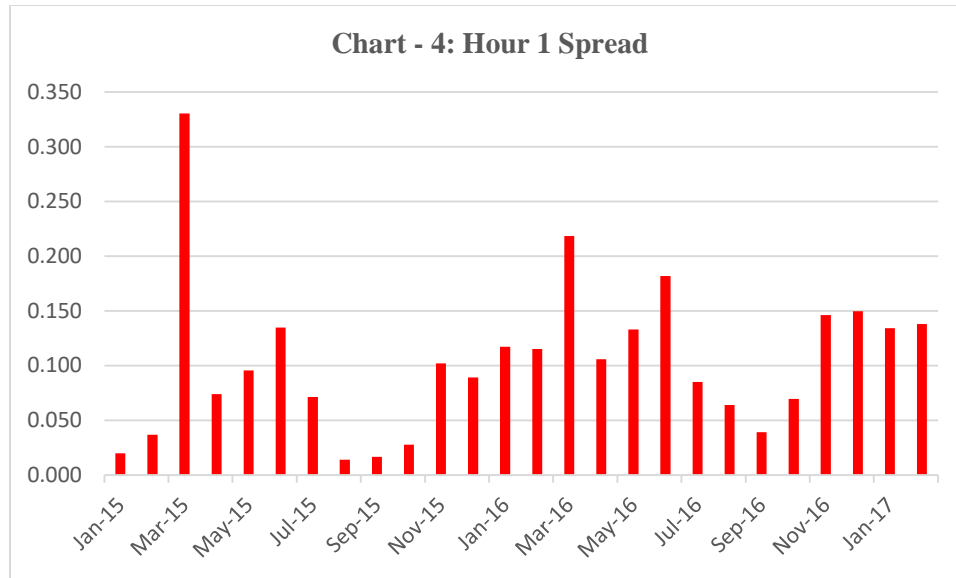
In terms of activity, Repo market is very active in first hour of the day as about 80% of the transactions take place between 9.00AM and 10.00AM. Table - 5 gives the descriptive statistics of the Market share of the First Hour of trading in Repo Market (Jan'15 to Feb'17) (Chart - 3).



3. CALL MARKET AND REPO MARKET

The Repo market has a very close relationship with the overnight Call Market. The Correlation is more than 91% as given in the Table -6A for CROMS dealt all Repo trades (Special and Basket). If we consider only Basket Repo, the correlation improves to 99% (Table -6B).

The traded spread is calculated as the difference in the Call Rate (Dealt) and Repo Rate (both Basket and Special put together) in the First hour of trading given in Table - 7 using the monthly average spread from Jan'15 to Feb'17. A single outlier in the data as on 31-Mar-2015 has affected the data and increased its variance as well as the mean.



The T-Test results clearly show the difference in data structure and high variance of the spread. The spread is about 11bps as Call is uncollateralized (Table – 8).

The above T-Test Result show that the Hour 1 Rates of Dealt deals in NDS Call and Repo deals in CROMS (Special and Basket together) have unequal variance and unequal mean and they are structurally different. Further investigating the data, we found a large outlier is distorting the results. The above descriptive statistics for spread includes March 31, 2015 data point where the spread was hugely an outlier. If we remove the same, the descriptive statistics changes significantly as given in Table – 9a.

If we remove the outlier, the data sets have Equal variance but their Means were different as expected (Table – 9b).

4. BASKET VS. SPECIAL REPO

Since Special Repo Rate depends on the availability of the particular security and any short supply can push down the rates of borrowing to lower levels. Hence Basket repo provides more representative money market rate than Special Repo. Basket typically trades above Special and historically they have an average spread of 12bps (Table – 10). The data very clearly shows that the Rates have equal Variances but significantly Unequal Mean.

However, during First Hour of trading in CROMS, the difference between Special and Basket Repo rate is higher at about 14bps as given in Table - 11.

The T-test Results (Table – 12) also shows that the Rates have equal Variances but significantly Unequal Mean.

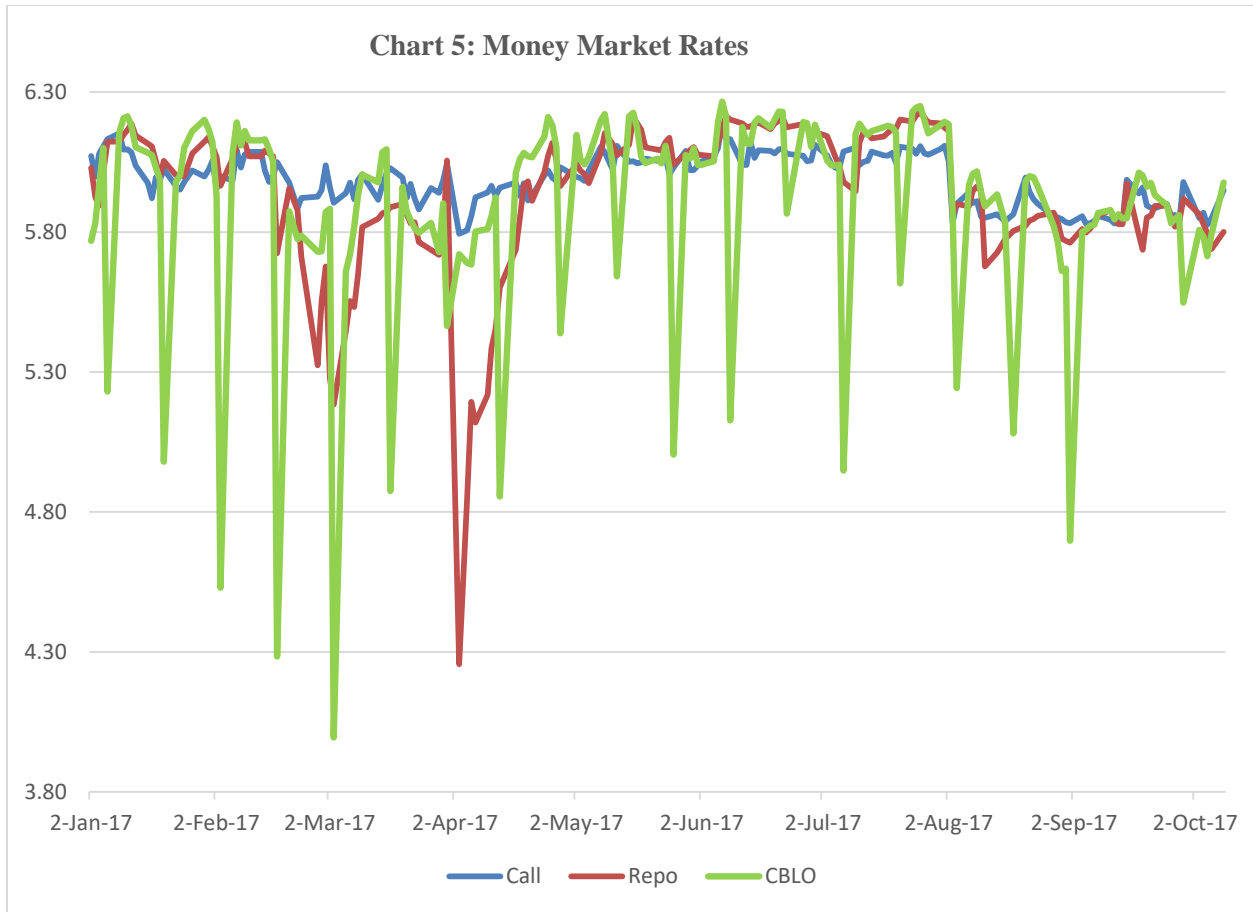
5. CALL RATE AND BASKET REPO RATE

Basket Repo is a lending and borrowing activity for the funds unlike Special Repo which is used for borrowing of Securities and the result rate in Special Repo vary depending on the demand and supply of a particular security in the market. In order to understand the true relationship of the repo Market with Call market, we looked the behavior of the Dealt trades in NDS-Call and Basket Repo in CROMS during Hour 1 when major part of the trading happens in the respective markets. The data clearly shows that there is not any significant difference in the structures of these markets (Table - 13).

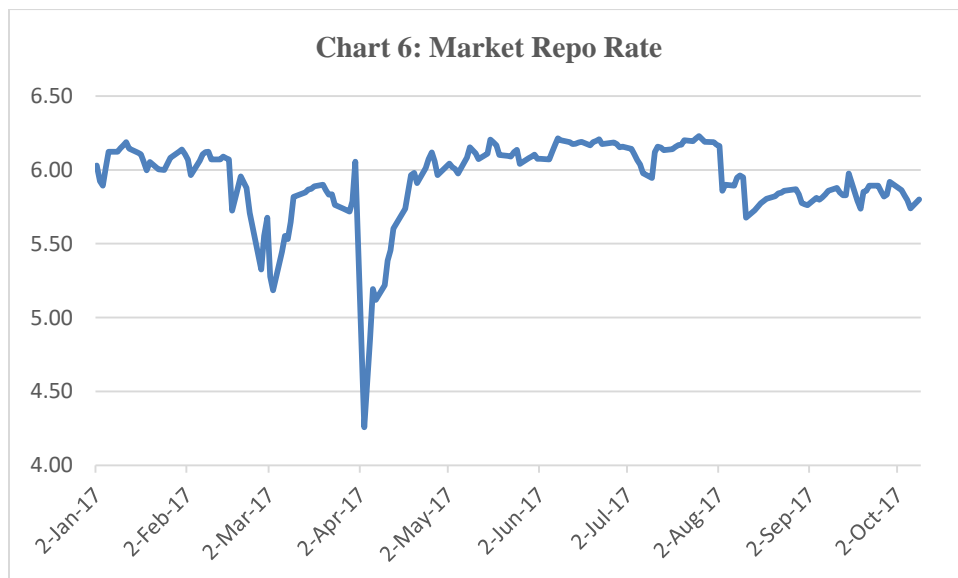
Accordingly, if we use only Basket Repo as a Benchmark, the efficiency of Rate improves as given in T-Test results (Table - 13). Basket Repo can be efficiently used as a proxy for call market with a small spread.

6. IMPACT OF REPORTING FRIDAYS ON REPO RATE

Reporting Fridays create different kind of activities in the money market. Typically, on non-Reporting days, the market participants prefer to trade in CBLO and on Reporting Fridays, market participants shift their positions to Market Repo. CBLO as a product does not give them benefit of CRR/SLR while Market Repo being a Buy and Sell-back arrangement between lender and borrower is exempted from SLR/CRR computation. Hence we see CBLO rate dipping to lower levels on Reporting Fridays as liquidity moves out to Market Repo and the market shifts their position on Monday to CBLO market. The switch of liquidity to Market Repo from CBLO affects the CBLO rates on reporting Fridays (data for 2017) (Chart-5).



CBLO Rates revert to their usual levels soon after Reporting Fridays. We do not observe any such pattern in Market Repo rate (Chart – 6).



However, there may be possibility of Market Repo Rate diverting from the usual trajectory on Reporting Fridays because of excess liquidity shift to the segment from CBLO. We

conducted a statistical test to see if the Market Repo rates on Reporting Fridays for the period Jan'11 to Sep'17 are statistically different than non-reporting days by testing their structure of the Means and Variances. The result is given in Table – 14.

We also conducted a statistical test to see if the Market Repo rates on Reporting Fridays for the recent period Jan'14 to Sep'17 (to exclude 2013) are statistically different than non-reporting days by testing their structure of the Means and Variances. The result is given in Table – 15.

We also run the test only for the year 2017 which shows that the Rates on Reporting and non-Reporting days have very little difference in mean and but their variances are statistically the same (Table -16).

Structurally, the market Repo does not represent different versions on Reporting and non-Reporting days and their Minimum and Maximum values remain synchronized as given in Table -16. Coefficient of variation has been same for both the group of days since 2014.

7. TRANSMISSION MECHANISM AND LAF REPO RATE

RBI introduced variable rate mechanism in daily Repo and Reverse repo auctions from Oct'13 and currently shortage of 0.25% of NDTL of the Banks can be routed through fixed rate overnight Repo while the remaining part has to be borrowed using variable repo rates of various tenors. RBI publishes daily variable rates after the auction. RBI also conducts variable reverse repo auctions to accommodate excess liquidity in the system. In order to understand the transmission of the said repo rate to the funding system, we analyzed the data from Oct'13. Since LAF activities can be undertaken during the day using both fixed and variable rate, we constructed a simple “Liquidity Moderation Index Rate” by calculating a daily volume weighted average rate of all LAF operations. We have computed the average rates for Repo market operations and the same is given in Table-17.

The above data includes all scenarios – excess and shortage scenarios of the market. The Repo Market Rate is the weighted average of all market repo transactions while Repo rate in H1 gives the weighted average rate of all repo deals of Hour 1 in Basket Repo market. It is a well-known fact that most of the repo transactions in the market are executed in Hour 1. Hence comparison has been made with market repo rate of Hour1 (Table – 18).

We also bifurcated the data into excess scenarios and shortage scenarios to understand the transmission mechanism. In Excess (RBI is absorbing liquidity – Reverse repo size is more than Repo size) scenarios, we find that the Liquidity Moderation Index Rate is higher than

the market repo rate while in Shortage scenarios, the Liquidity Moderation Index Rate is lower than the market repo rates (Table – 19).

During excess scenarios, we find that the correlation of the Liquidity Moderation Index Rate with market repo rate is lower at 91% (and 96% with Hour 1 rate) and the correlation between market repo and Repo rate in Hour 1 is 97% (Table -20).

In our analysis, we found 319 instances where, excess liquidity has been absorbed by RBI while there were 635 instances in which RBI has injected liquidity. Most of the excess scenarios are in the post-demonetization period (215 instances). There were 635 shortage scenarios during the period of analysis and we find that the liquidity absorption was done at a rate lower than the market repo rate (Table – 21).

During shortage scenarios, we find that the correlation of the Liquidity Moderation Index Rate with market repo rate is lower at 94% and the correlation between market repo and Repo rate in Hour 1 is 99%.

Looking at the above analysis, Repo Benchmark would be one of the effective variable rates for pricing liability products of the banks.

8. CONCLUSION AND SUGGESTIONS

World over, there has been a move to explore acceptable collateralized rates which can be used as benchmarks for the market to price financial products. Slowly LIBOR is losing its grip after the unearthing of the LIBOR scandals and its fallout results and regulators have decided to move towards acceptable collateralized rates as benchmarks. Basket Repo Rate of the First Hour of trading may also be used as a standalone Benchmark Rate. Since Special repo rate can fluctuate widely depending on the supply and demand for a particular security, market should use only unbiased Basket Repo Rate for the Benchmark Computation. Further, it is reasonable to use Market Repo Basket trades of First Hour with a time varying spread to construct the MIBOR curve as a waterfall mechanism in case sufficient data points are not available on a day to construct the MIBOR curve. Accordingly, the following is proposed for the Market Repo benchmark:

1. Only Basket Repo for Overnight Tenor to be considered.
2. Minimum of 10 trades and value of `100crores between 9.00AM and 10.00AM (first hour) would be the threshold criteria for computation of benchmark Market Repo Rate.
3. If the threshold criteria are not met, the computation window will be extended by 30 minutes twice i.e. 10.00AM to 10.30AM and 10.30AM to 11.00AM.

4. Mean and SD to be computed for the trades after the threshold criteria is met.
5. Rates falling in the range of +/- 3SD to be considered for computation after removal of outliers.
6. Weighted Average Rate will be the Benchmark Market Repo Rate.
7. If the day's Benchmark Market Repo Rate is not calculated because of threshold criteria is not met, previous day's Benchmark Market Repo Rate will be repeated.

| Table - 1: Repo Market Structure | | | | | | | | | |
|---|---------------------|-------------|-------------|---------------------|----------------|---------------|-----------------------------|----------------|----------------|
| Year | Market Share | | | Average Rate | | | Daily Average Volume | | |
| | Call | Repo | CBLO | Call R% | Repo R% | CBLOR% | Call DV | Repo DV | CBLO DV |
| 2004 | 50% | 34% | 16% | 4.61 | 4.23 | 4.23 | 8601 | 5917 | 2805 |
| 2005 | 45% | 24% | 31% | 5.12 | 4.95 | 4.85 | 11973 | 6316 | 8351 |
| 2006 | 32% | 24% | 44% | 6.43 | 6.11 | 6.00 | 13729 | 10130 | 18402 |
| 2007 | 25% | 25% | 50% | 6.62 | 5.67 | 5.38 | 13776 | 13487 | 26845 |
| 2008 | 23% | 24% | 53% | 7.71 | 7.20 | 6.84 | 15277 | 16179 | 35522 |
| 2009 | 12% | 27% | 61% | 3.49 | 3.09 | 2.84 | 11552 | 26244 | 59149 |
| 2010 | 13% | 22% | 65% | 4.97 | 4.76 | 4.58 | 10788 | 17898 | 52931 |
| 2011 | 18% | 21% | 61% | 7.59 | 7.37 | 7.19 | 14707 | 16459 | 48500 |
| 2012 | 23% | 23% | 54% | 8.33 | 8.20 | 8.07 | 18946 | 19123 | 45507 |
| 2013 | 16% | 25% | 58% | 8.28 | 8.26 | 8.08 | 18462 | 29272 | 67202 |
| 2014 | 14% | 28% | 58% | 8.12 | 8.24 | 8.12 | 16104 | 31511 | 65832 |
| 2015 | 11% | 28% | 61% | 7.23 | 7.31 | 7.25 | 13861 | 34494 | 75191 |
| 2016 | 12% | 32% | 57% | 6.45 | 6.47 | 6.39 | 16974 | 45511 | 81549 |
| 2017 | 9% | 30% | 61% | 6.02 | 6.03 | 5.91 | 14575 | 50939 | 102857 |

| Table - 2: Trading Analysis of Repo Market | | | | | |
|---|---------------------|--------------------|--------------|------------------|--|
| Financial Year | Special Repo | Basket Repo | CROMS | OTC Deals | |
| 2009-10 | 3107 | 14826 | 17933 | 7464 | |
| 2010-11 | 3267 | 8130 | 11398 | 5125 | |
| 2011-12 | 5535 | 5117 | 10652 | 4960 | |
| 2012-13 | 7841 | 11852 | 19692 | 2177 | |
| 2013-14 | 5211 | 21207 | 26418 | 2840 | |
| 2014-15 | 5724 | 25019 | 30743 | 2346 | |
| 2015-16 | 11869 | 21822 | 33691 | 1936 | |
| 2016-17 (Upto February 2017) | 17010 | 28502 | 45511 | 2926 | |

| Table - 3: Repo market Rate Structure | | | | | | | | | |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|--------------------|
| Year | CallR MAX | RepoR MAX | CBLOR MAX | CallR MIN | RepoR MIN | CBLOR MIN | CallR SD | RepoR SD | CBLO SD |
| 2004 | 6.30 | 6.00 | 6.05 | 4.07 | 3.17 | 2.70 | 0.48 | 0.63 | 0.65 |
| 2005 | 7.16 | 6.53 | 6.63 | 4.52 | 3.61 | 2.11 | 0.47 | 0.52 | 0.66 |
| 2006 | 16.89 | 14.88 | 12.78 | 5.47 | 4.92 | 4.81 | 1.13 | 0.89 | 0.77 |
| 2007 | 55.59 | 26.12 | 28.69 | 0.13 | 0.14 | 0.02 | 5.45 | 3.06 | 3.10 |
| 2008 | 19.74 | 12.42 | 11.97 | 5.26 | 3.02 | 2.50 | 2.11 | 1.45 | 1.64 |
| 2009 | 5.25 | 5.10 | 4.53 | 2.99 | 0.98 | 0.39 | 0.47 | 0.73 | 0.72 |
| 2010 | 8.06 | 6.87 | 7.96 | 3.12 | 2.06 | 1.19 | 1.35 | 1.32 | 1.35 |
| 2011 | 9.77 | 9.20 | 9.11 | 5.88 | 3.72 | 1.57 | 0.79 | 0.90 | 1.07 |
| 2012 | 13.14 | 10.98 | 12.04 | 7.34 | 7.24 | 6.80 | 0.52 | 0.35 | 0.44 |
| 2013 | 13.69 | 11.48 | 12.47 | 6.58 | 6.38 | 4.67 | 1.06 | 1.04 | 1.14 |
| 2014 | 11.71 | 10.50 | 11.28 | 7.23 | 7.27 | 6.93 | 0.42 | 0.38 | 0.47 |
| 2015 | 11.21 | 8.97 | 9.26 | 6.49 | 6.56 | 6.33 | 0.47 | 0.43 | 0.43 |
| 2016 | 9.36 | 7.92 | 7.38 | 5.90 | 5.92 | 4.59 | 0.32 | 0.29 | 0.38 |
| 2017 | 6.15 | 6.19 | 6.21 | 5.88 | 5.32 | 4.28 | 0.06 | 0.16 | 0.44 |

| Month | Basket | Special |
|--------------|---------------|----------------|
| Jan-15 | 80% | 20% |
| Feb-15 | 83% | 17% |
| Mar-15 | 78% | 22% |
| Apr-15 | 71% | 29% |
| May-15 | 68% | 32% |
| Jun-15 | 70% | 30% |
| Jul-15 | 69% | 31% |
| Aug-15 | 67% | 33% |
| Sep-15 | 71% | 29% |
| Oct-15 | 71% | 29% |
| Nov-15 | 67% | 33% |
| Dec-15 | 60% | 40% |
| Jan-16 | 60% | 40% |
| Feb-16 | 52% | 48% |
| Mar-16 | 46% | 54% |
| Apr-16 | 68% | 32% |
| May-16 | 66% | 34% |
| Jun-16 | 58% | 42% |
| Jul-16 | 64% | 36% |
| Aug-16 | 59% | 41% |
| Sep-16 | 71% | 29% |
| Oct-16 | 55% | 45% |
| Nov-16 | 52% | 48% |
| Dec-16 | 55% | 45% |
| Jan-17 | 50% | 50% |
| Feb-17 | 50% | 50% |

| | |
|--------------------|----------|
| Mean | 0.801261 |
| Standard Error | 0.00359 |
| Median | 0.819614 |
| Standard Deviation | 0.081541 |
| Kurtosis | 0.940504 |
| Skewness | -1.03925 |
| Range | 0.435378 |
| Minimum | 0.505297 |
| Maximum | 0.940675 |
| Days | 516 |

| Table - 6 A: Correlation between Call and Repo market rate (First Hour Call and CROMS Repo) | | |
|--|------------------|------------------|
| | <i>Repo Rate</i> | <i>Call Rate</i> |
| Repo Rate | 1 | |
| Call Rate | 0.911384 | 1 |

| Table - 6 B: Correlation between Call and Repo market rate (First Hour Call and Basket Repo) | | |
|---|------------------|------------------|
| | <i>Repo Rate</i> | <i>Call Rate</i> |
| Repo Rate | 1 | |
| Call Rate | 0.99145 | 1 |

| Table - 7: Descriptive Statistics - Average Monthly Spread | |
|---|---------------|
| Parameters | Spread |
| Mean | 0.104175 |
| Standard Error | 0.013653 |
| Median | 0.098784 |
| Standard Deviation | 0.069619 |
| Sample Variance | 0.004847 |
| Kurtosis | 3.294302 |
| Skewness | 1.362300 |
| Range | 0.316309 |
| Minimum | 0.014068 |
| Maximum | 0.330377 |
| Sum | 2.708552 |
| Count | 26 |

| Table - 8: T-TEST of the Spread | | | | | | | |
|--|---------------|-------------|----------------|----------------|----------------|----------------|--------|
| Group | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
| CallH1 | 517 | 6.9438 | 0.656 | 0.0288 | 6.0235 | 15.0164 | |
| RepoH1 | 517 | 6.8387 | 0.5814 | 0.0256 | 5.8856 | 9.0999 | |
| Diff (1-2) | | 0.105 | 0.6198 | 0.0386 | | | |
| Group | Method | Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | | |
| CallH1 | | 6.9438 | 6.8871 | 7.0004 | 0.656 | 0.6183 | 0.6986 |
| RepoH1 | | 6.8387 | 6.7885 | 6.889 | 0.5814 | 0.548 | 0.6192 |
| Diff (1-2) | Pooled | 0.105 | 0.0294 | 0.1807 | 0.6198 | 0.5942 | 0.6478 |
| Diff (1-2) | Satterthwaite | 0.105 | 0.0294 | 0.1807 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 1032 | 2.72 | 0.0065 | | | |
| Satterthwaite | Unequal | 1017.3 | 2.72 | 0.0065 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | | | |
| Folded F | 516 | 516 | 1.27 | 0.0062 | | | |

| | |
|--------------------|----------|
| Mean | 0.093432 |
| Standard Error | 0.010364 |
| Median | 0.092361 |
| Standard Deviation | 0.052848 |
| Sample Variance | 0.002793 |
| Kurtosis | -0.25851 |
| Skewness | 0.342489 |
| Range | 0.204321 |
| Minimum | 0.014068 |
| Maximum | 0.218389 |
| Sum | 2.429244 |
| Count | 26 |

| Group | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
|-----------------------|---------------|--------|-------------|---------|----------------|---------|--------|
| CallH1 | 516 | 6.9281 | 0.5517 | 0.0243 | 6.0235 | 8.9941 | |
| RepoH1 | 516 | 6.8343 | 0.5734 | 0.0252 | 5.8856 | 8.2952 | |
| Diff (1-2) | | 0.0938 | 0.5626 | 0.035 | | | |
| Group | Method | Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | | |
| CallH1 | | 6.9281 | 6.8804 | 6.9758 | 0.5517 | 0.5199 | 0.5876 |
| RepoH1 | | 6.8343 | 6.7847 | 6.8839 | 0.5734 | 0.5404 | 0.6107 |
| Diff (1-2) | Pooled | 0.0938 | 0.025 | 0.1625 | 0.5626 | 0.5393 | 0.588 |
| Diff (1-2) | Satterthwaite | 0.0938 | 0.025 | 0.1625 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 1030 | 2.68 | 0.0075 | | | |
| Satterthwaite | Unequal | 1028.5 | 2.68 | 0.0075 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | | | |
| Folded F | 515 | 515 | 1.08 | 0.3817 | | | |

| Table - 10: T-Test Result of Repo Rate in Basket and Special in CROMS (all day) | | | | | | | |
|--|---------------|--------|-------------|---------|----------------|---------|--------|
| Group | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
| Basket | 521 | 6.8687 | 0.5731 | 0.0251 | 5.6162 | 8.7758 | |
| Special | 521 | 6.75 | 0.6024 | 0.0264 | 4.9973 | 9.3177 | |
| Diff (1-2) | | 0.1187 | 0.5879 | 0.0364 | | | |
| Group | Method | Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | | |
| Basket | | 6.8687 | 6.8194 | 6.9181 | 0.5731 | 0.5403 | 0.6102 |
| Special | | 6.75 | 6.6981 | 6.8018 | 0.6024 | 0.5679 | 0.6414 |
| Diff (1-2) | Pooled | 0.1187 | 0.0473 | 0.1902 | 0.5879 | 0.5637 | 0.6143 |
| Diff (1-2) | Satterthwaite | 0.1187 | 0.0473 | 0.1902 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 1040 | 3.26 | 0.0012 | | | |
| Satterthwaite | Unequal | 1037.4 | 3.26 | 0.0012 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | | | |
| Folded F | 520 | 520 | 1.1 | 0.2554 | | | |

| Table -11: spread between Basket and Special Repo | |
|--|----------|
| Mean | 0.142916 |
| Standard Error | 0.006326 |
| Median | 0.098219 |
| Standard Deviation | 0.14439 |
| Sample Variance | 0.020848 |
| Kurtosis | 2.483888 |
| Skewness | 1.26163 |
| Range | 1.142335 |
| Minimum | -0.24831 |
| Maximum | 0.894025 |
| Days | 521 |

| Table - 12: T-Test Result of Repo Rate in Basket and Special in Hour 1 in CROMS | | | | | | | |
|--|---------------|-------------|----------------|----------------|----------------|----------------|--------|
| Group1 | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
| BasketH1 | 521 | 6.882 | 0.5794 | 0.0254 | 5.6364 | 9.0053 | |
| SpecialH1 | 521 | 6.739 | 0.6056 | 0.0265 | 4.8598 | 9.2536 | |
| Diff (1-2) | | 0.143 | 0.5927 | 0.0367 | | | |
| Group1 | Method | Mean | 95% CL Mean | | Std Dev | 95% CL Std Dev | |
| BasketH1 | | 6.882 | 6.8321 | 6.9318 | 0.5794 | 0.5462 | 0.6169 |
| SpecialH1 | | 6.7391 | 6.6869 | 6.7912 | 0.6056 | 0.5709 | 0.6448 |
| Diff (1-2) | Pooled | 0.1429 | 0.0709 | 0.215 | 0.5927 | 0.5682 | 0.6193 |
| Diff (1-2) | Satterthwaite | 0.1429 | 0.0709 | 0.215 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 1040 | 3.89 | 0.0001 | | | |
| Satterthwaite | Unequal | 1038 | 3.89 | 0.0001 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | | | |
| Folded F | 520 | 520 | 1.09 | 0.3135 | | | |

| Table 13 : T-Test results of Hour 1 basket and Hour 1 Call Dealt | | | | | | | |
|---|---------------|-------------|----------------|----------------|----------------|----------------|--------|
| Group | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
| BasketH1 | 516 | 6.8865 | 0.5661 | 0.0249 | 5.8049 | 8.3709 | |
| CallH1 | 516 | 6.9281 | 0.5517 | 0.0243 | 6.0235 | 8.9941 | |
| Diff (1-2) | | -0.0416 | 0.5589 | 0.0348 | | | |
| Group | Method | Mean | 95% CL Mean | | Std Dev | 95% CL Std Dev | |
| BasketH1 | | 6.8865 | 6.8376 | 6.9355 | 0.5661 | 0.5335 | 0.6029 |
| CallH1 | | 6.9281 | 6.8804 | 6.9758 | 0.5517 | 0.5199 | 0.5876 |
| Diff (1-2) | Pooled | -0.0416 | -0.1099 | 0.0267 | 0.5589 | 0.5358 | 0.5842 |
| Diff (1-2) | Satterthwaite | -0.0416 | -0.1099 | 0.0267 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 1030 | -1.2 | 0.2321 | | | |
| Satterthwaite | Unequal | 1029.3 | -1.2 | 0.2321 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | | | |
| Folded F | 515 | 515 | 1.05 | 0.5583 | | | |

Table 14 : T-Test results of Hour 1 Basket Repo on Reporting and non-Reporting Days in 2011-17

| Group | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
|-----------------------|----------------------|--------|-------------|---------|-------------------|----------------|--------|
| NONREPORTING | 1445 | 7.5032 | 0.9897 | 0.0260 | 4.4824 | 10.6757 | |
| Reporting days | 176 | 7.4596 | 1.0267 | 0.0774 | 3.6977 | 10.2266 | |
| Diff (1-2) | | 0.0436 | 0.9938 | 0.0793 | | | |
| Group | Method | Mean | 95% CL Mean | | Std Dev | 95% CL Std Dev | |
| NONREPORTING | | 7.5032 | 7.4521 | 7.5543 | 0.9897 | 0.9549 | 1.0272 |
| Reporting | | 7.4596 | 7.3069 | 7.6124 | 1.0267 | 0.9295 | 1.1469 |
| Diff (1-2) | Pooled | 0.0436 | -0.1120 | 0.1992 | 0.9938 | 0.9607 | 1.0293 |
| Diff (1-2) | Satterthwaite | 0.0436 | -0.1173 | 0.2046 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 1619 | 0.55 | 0.5826 | | | |
| Satterthwaite | Unequal | 216.52 | 0.53 | 0.5938 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | Coef of Variation | Reporting | 0.1319 |
| Folded F | 175 | 1444 | 1.08 | 0.4938 | | NonReporting | 0.1376 |

Table 15 : T-Test results of Hour 1 Basket Repo on Reporting and non-Reporting Days in 2014-17

| Group | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
|-----------------------|----------------------|---------|-------------|---------|-------------------|----------------|--------|
| NONREPORTING | 802 | 7.1068 | 0.8916 | 0.0315 | 5.6400 | 10.5400 | |
| Reporting days | 98 | 7.1319 | 0.8955 | 0.0905 | 5.6600 | 9.1100 | |
| Diff (1-2) | | -0.0252 | 0.8920 | 0.0954 | | | |
| Group | Method | Mean | 95% CL Mean | | Std Dev | 95% CL Std Dev | |
| NONREPORTING | | 7.1068 | 7.0450 | 7.1686 | 0.8916 | 0.8500 | 0.9375 |
| Reporting | | 7.1319 | 6.9524 | 7.3115 | 0.8955 | 0.7853 | 1.0420 |
| Diff (1-2) | Pooled | -0.0252 | -0.2125 | 0.1622 | 0.8920 | 0.8526 | 0.9352 |
| Diff (1-2) | Satterthwaite | -0.0252 | -0.2148 | 0.1644 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 898 | -0.26 | 0.7921 | | | |
| Satterthwaite | Unequal | 121.71 | -0.26 | 0.7932 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | Coef of Variation | Reporting | 0.1255 |
| Folded F | 97 | 801 | 1.01 | 0.9224 | | NonReporting | 0.1256 |

| Group | N | Mean | Std Dev | Std Err | Minimum | Maximum | |
|-----------------------|---------------|--------|-------------|---------|-------------------|--------------|--------|
| NONREPORTING | 162 | 6.0485 | 0.1494 | 0.0117 | 5.6364 | 6.2752 | |
| Reporting days | 20 | 6.0349 | 0.1482 | 0.0331 | 5.6604 | 6.2291 | |
| Diff (1-2) | | 0.0137 | 0.1493 | 0.0354 | | | |
| Group | Method | Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | | |
| NONREPORTING | | 6.0485 | 6.0254 | 6.0717 | 0.1494 | 0.1347 | 0.1677 |
| Reporting | | 6.0349 | 5.9655 | 6.1042 | 0.1482 | 0.1127 | 0.2164 |
| Diff (1-2) | Pooled | 0.0137 | -0.0561 | 0.0835 | 0.1493 | 0.1353 | 0.1665 |
| Diff (1-2) | Satterthwaite | 0.0137 | -0.0589 | 0.0862 | | | |
| Method | Variances | DF | t Value | Pr > t | | | |
| Pooled | Equal | 180 | 0.39 | 0.6996 | | | |
| Satterthwaite | Unequal | 24.022 | 0.39 | 0.7007 | | | |
| Equality of Variances | | | | | | | |
| Method | Num DF | Den DF | F Value | Pr > F | | Reporting | 0.0247 |
| Folded F | 161 | 19 | 1.02 | 1.0000 | Coef of variation | Nonreporting | 0.0246 |

| Parameters | Repo Market Rate | Liquidity Moderation Index Rate | Repo Rate in H1 |
|------------------|------------------|---------------------------------|-----------------|
| Mean | 7.14 | 7.11 | 7.19 |
| Standard Error | 0.03 | 0.03 | 0.03 |
| Median | 6.98 | 6.80 | 7.09 |
| S Deviation | 0.96 | 0.79 | 0.93 |
| Sample Variance | 0.93 | 0.62 | 0.87 |
| Kurtosis | -0.93 | -1.55 | -1.01 |
| Skewness | 0.24 | 0.17 | 0.31 |
| Range | 6.24 | 2.61 | 4.91 |
| Minimum | 4.26 | 5.95 | 5.64 |
| Maximum | 10.50 | 8.55 | 10.54 |
| Sum | 6807.17 | 6785.83 | 6858.03 |
| Co. of variation | 0.14 | 0.11 | 0.13 |
| Count | 954 | 954 | 954 |

| | <i>Repo Market Rate</i> | Liquidity Moderation Index Rate | <i>Repo Rate in H1</i> |
|---------------------------------|-------------------------|---------------------------------|------------------------|
| Repo Market | 1 | | |
| Liquidity Moderation Index Rate | 0.963791 | 1 | |
| Repo rate H1 | 0.995671 | 0.965291 | 1 |

| | <i>Repo Market Rate</i> | Liquidity Moderation Index Rate | <i>Repo Rate in H1</i> |
|--------------------|-------------------------|---------------------------------|------------------------|
| Mean | 6.23 | 6.39 | 6.30 |
| Standard Error | 0.03 | 0.02 | 0.03 |
| Median | 6.13 | 6.23 | 6.18 |
| Standard Deviation | 0.50 | 0.39 | 0.45 |
| Sample Variance | 0.25 | 0.15 | 0.20 |
| Kurtosis | 1.37 | 1.79 | 1.19 |
| Skewness | 0.67 | 1.64 | 1.35 |
| Range | 3.64 | 2.01 | 2.40 |
| Minimum | 4.26 | 5.95 | 5.64 |
| Maximum | 7.89 | 7.95 | 8.04 |
| Sum | 1988.93 | 2038.21 | 2010.90 |
| Co. of variation | 0.08 | 0.06 | 0.07 |
| Count | 319 | 319 | 319 |

| | <i>Repo Market Rate</i> | Liquidity Moderation Index Rate | <i>Repo Rate in H1</i> |
|---------------------------------|-------------------------|---------------------------------|------------------------|
| <i>Repo Market Rate</i> | 1 | | |
| Liquidity Moderation Index Rate | 0.905887 | 1 | |
| <i>Repo Rate in H1</i> | 0.966664 | 0.958784 | 1 |

| | <i>Repo Market Rate</i> | <i>Liquidity Moderation Index Rate</i> | <i>Repo Rate in H1</i> |
|--------------------|-------------------------|--|------------------------|
| Mean | 7.59 | 7.48 | 7.63 |
| Standard Error | 0.03 | 0.03 | 0.03 |
| Median | 7.73 | 7.73 | 7.76 |
| Standard Deviation | 0.81 | 0.68 | 0.79 |
| Sample Variance | 0.66 | 0.46 | 0.62 |
| Kurtosis | -0.92 | -1.39 | -0.85 |
| Skewness | 0.00 | -0.39 | 0.03 |
| Range | 4.45 | 2.42 | 4.35 |
| Minimum | 6.04 | 6.14 | 6.19 |
| Maximum | 10.50 | 8.55 | 10.54 |
| Sum | 4818.25 | 4747.62 | 4847.13 |
| Co. of variation | 0.11 | 0.09 | 0.10 |
| Count | 635 | 635 | 635 |

| | <i>Repo Market Rate</i> | <i>Liquidity Moderation Index Rate</i> | <i>Repo Rate in H1</i> |
|--|-------------------------|--|------------------------|
| <i>Repo Market Rate</i> | 1 | | |
| <i>Liquidity Moderation Index Rate</i> | 0.942188 | 1 | |
| <i>Repo Rate in H1</i> | 0.997411 | 0.935418 | 1 |