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Methodology for Computation of Benchmark Forward Premia and MIFOR Curve

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Methodology for Computation of Benchmark Forward Premia and MIFOR Curve

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Abstract

The FBIL Forward Premia Rate which is released by the benchmark administrator Financial Benchmarks India Limited (FBIL) since April 2019 is calculated from the OTC forex swap transactions for the Spot-Forward and Cash-Tom swap pairs reported to CCIL for settlement. This paper traces the development of the system design for calculation of these rates, starting from the data selection, filtration, Outlier criteria, fallback system in the absence of traded rates etc. The traded rate for each tenor is computed only when the tenor has atleast 3 trades of cumulative value USD 25 million, with each trade of value atleast USD 1 million. Due to its market acceptability, Mean was selected as the criteria for outlier detection. The volume weighted average forward premia for each tenor is computed from the spot-forward pairs for the respective month ends. In case there are no traded spot-forward pairs for a tenor, then the paper proposes the calculation of the missing tenor by interpolation from the two adjacent tenors, based on the condition of adequate traded tenors at the short and long end of the curve. The study also accounts for calculation of the rolling forward premia rate, which is interpolated from the corresponding two month end rates and the rupee forward premia from the relevant forward premia rate and the Spot rate for the day. The MIFOR is calculated from the Rolling forward premia and LIBOR rate. Based on the analysis of the pattern of the trade reporting to CCIL, the study evaluates that the forward premia computation needs to capture trades upto atleast 3 PM for an accurate reflection of the market. The paper analysed the impact of year-end volatility on the forex market by taking into account the forward rate for the period from the last day of the financial year to the first day of the next financial year. A comparative study of the polled rates which were being released prior to the release of the FBIL rates, showed no statistical differences between these rates and the traded rates. An efficiency test indicated that the traded rates were on an average symmetrical around the benchmark rate.

JEL Classification: G23, E44,

Keywords: Forward Premia, Benchmark, Fx-Swaps, Year-end Turn, Two Sample T-Test, Distribution Analysis, LIBOR

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1. OVERVIEW OF THE INDIAN FX SWAP MARKET

Foreign exchange markets play a very important role in enabling global trade, investment, financial transactions. The Indian foreign exchange market has come a long way since liberalization process initiated in the 1990s following the balance of payments crisis. A gradual transition from a fixed rate system to a market based system has been adopted. Along with current account convertibility, there has been gradual liberalization on the capital account convertibility front as well. Other measures introduced in this market include introduction of cross- currency derivatives with the rupee as one leg, Rupee-foreign exchange options and exchange traded currency futures and options, setting up of a CCP-The Clearing Corporation of India that provides guaranteed settlement for transactions in this market, among others.

Foreign exchange products like foreign currency swaps and forwards are an important part of the global financial markets as they facilitate cross border trade and investment. The level of the forward exchange rate i.e. the rate at which one currency is exchanged for another at a future date is determined by the interest rate differential between the two countries and could be at a discount or premium. A foreign currency swap is a contract under which two entities agree to exchange two currencies at a fixed rate and then to re-exchange those currencies at an agreed upon rate on some future date. The offsetting transaction pairs are for different value dates but are concluded at the same time for generally the same transaction value in both the spot and forward legs. An outright forward transaction involves exchange of two currencies at a future date at an agreed upon exchange rate. In case of a forex swap, the forex risk on the spot transaction is offset by the forward transaction and they are only exposed to interest rate risk. Therefore the forward rate arrived at by taking into consideration the differential between the spot and forward leg of a FX-SWAP pair is an indicator of the interest rate differential between the two currencies under consideration.

In the Indian forex market trading takes place either bilaterally or on electronic platforms like FX-CLEAR or the Reuters trading platform. CCIL is the central counterparty (CCP) in the Indian forex market, offering guaranteed settlement for all transactions reported to it for settlement. In addition to this, RBI has mandated since June 2014 the settlement of all forex forward transactions through CCIL and it accepts all FX-forward traded for guaranteed settlement upto 13 months maturity. Currently CCIL settles more than 95% of the inter-bank forex transactions bring undertaken in the Indian forex market. In the Indian forex market, swap deals could be in pairs like Cash-Tom, Tom-Spot, Cash-Spot, Spot-Forward pairs, with the fx-swap market predominantly dealing in Spot-Forward pairs.

The summary statistics of the growth in the OTC forward and exchange traded currency futures market is provided in *Table 1*.

Table 1: Summary Statistics of Currency Forwards and Futures			
Panel A: Forex Forwards Accepted For Settlement by CCIL			
Year	**No. of Trades**	**Value in USD Million**	**Y-o-Y Growth**
2009-10 *	6,969	41,092	
2010-11	28,868	150,505	266%
2011-12	40,760	240,384	60%
2012-13	50,146	287,697	20%
2013-14	46,640	254,982	-11%
2014-15#	101,372	914,979	259%
2015-16	94,770	964,070	5%
2016-17	108,787	1,170,618	21%
Panel B:Trading Statistics of Currency Futures			
Year	**OI**	**Value in Rs. Cr.**	**Y-o-Y Growth**
2009-10	451,841	3,723,230	
2010-11	851,187	8,226,911	121%
2011-12	2,048,982	8,488,539	3%
2012-13	2,670,785	6,971,453	-18%
2013-14	2,906,766	5,394,874	-23%
2014-15	1,033,816	4,194,471	-22%
2015-16	3,002,932	4,900,719	17%
2016-17	4,119,578	4,904,523	0%
* Commenced operation from December 1, 2009. # Mandate by RBI for CCP Clearing of Forward trades w.e.f. June , 2014			

Shift to Benchmark computation from Trade Data

The global furor generated following the revelation of manipulation of the key globally used Benchmark rate -the LIBOR (London Interbank Offered Rate), led to a re-evaluation of the fixing methodology of key financial market benchmarks all over the financial markets. Various reports following the so-called LIBOR scandal have stressed on the importance of relying on explicitly supported by transaction data to compute the Benchmarks, evolving adequate oversight and a clear governance structure in the process of computation to ensure integrity of the setting process. The fixing of LIBOR along with key Benchmarks like TIBOR in Japan, HIBOR fixing in Hong Kong, SGD SIBOR and SGD Spot FX fixing in Singapore etc. has been revamped with a Code of Conduct for the Benchmark setting process, setting up of specified Benchmark Administrators for the rate fixing, phasing out of illiquid tenors/currencies and a strong Governance Framework for Submitters and Administrators of the new regime.

Globally, in the forex market, the WM/Reuters FX Benchmark is the most important benchmark rate used in this market for portfolio valuation, index calculation, price reference in financial contracts and performance measurement. The WM/R 4pm fix rate is obtained by accumulating quote and trade data within a set time interval around the fixing

time. Following investigations by regulators which showed that traders had tried to manipulate the fixing process by sharing information about client orders, in order to align their trading strategies around the fix, the computation of these rates was revised effective February 15, 2015 to source data directly from the market, widening of the data sourcing window and the increase in the number of sources from which the trade currency data is gathered.

MIFOR Benchmark

MIFOR is the synthetic term Rupee rate derived from the USD LIBOR and USD/INR forward premium. It is used by Authorised Dealers (ADs) for pricing and settlement of IRS transactions referenced to MIFOR. The banks providing currency swaps to corporates/ financial institutions for hedging their long term foreign currency borrowings use MIFOR swaps to price the currency swaps and cover their positions. The MIFOR is also used by banks for pricing of long-term forex forwards in the absence of liquid markets in the above instruments beyond 1 year. It is currently published by Thomson Reuters at 5 PM for five tenors i.e. 1 month, 2 month, 3 month, 6 months and 1 year, based on polled quotes. It is computed by first calculating the rolling forward benchmark rates, annualizing it and using these rates along with the LIBOR to calculate the MIFOR.

The following study proposes a methodology to compute the MIFOR rate based on fx-swap trades reported to CCIL for settlement.

1.1 Data Description

To compute the overnight forward premia/discount, Cash-Tom swap pairs reported to CCIL for settlement were considered. In case of month end forward premia rates, the forward transactions reported to CCIL for settlement were segregated initially by month-end forward dates and the Spot-Forward swap pairs were obtained. Trades with a dollar amount greater than or equal to **USD 1 million** were retained. The percentage share of transactions with a dollar leg of less than USD 1 million was, on an average, less than 1% of the total traded value in case of all tenors (*Table 2*).

Table 2: Break-Up of Swap Value in USD Million (2013-2017)

Tenor	*< 1 Million*	*>= 1 Million*	*Tenor*	*< 1 Million*	*>= 1 Million*
O/N	0.00%	100.00%	**7 M**	0.12%	99.88%
1 M	0.02%	99.98%	**8 M**	0.12%	99.88%
2 M	0.09%	99.91%	**9 M**	0.08%	99.92%
3 M	0.18%	99.82%	**10 M**	0.06%	99.94%
4 M	0.17%	99.83%	**11 M**	0.05%	99.95%
5 M	0.23%	99.77%	**12 M**	0.02%	99.98%
6 M	0.18%	99.82%	**13 M**	0.04%	99.96%

The transactions considered were initiated on both the spot and forward legs by the same party and with the same dollar amount on both the sides. In addition to the above matching criteria, the transaction pairs were identified by a common indicator, the Reference number, with the flag also indicating the first leg and the second leg of that fx-swap pair.

The implied forward premia[1] for each trade was then computed during the sample period from **1st January 2013 to 31st May 2017.** A preliminary analysis of the data revealed that around 99.98% of implied forward premia/discount falls within -5% to 20% during the period of study (*Table 3*). Rates beyond this range were often found to be fat finger trades or erroneous trades which were amended or cancelled at a future date. Such trades were therefore dropped from the analysis and only the cash-tom pairs and spot-forward pairs with the forward premia within the **-5% to 20%** range were considered for computation.

Table 3: Frequency Distribution of Implied Forward Premia

Class	***Frequency***	***Frequency (%)***
Less Than-5%	0	0.00%
-5% To 0%	44	0.10%
0% To 5%	2145	4.94%
5% To 10%	40051	92.18%
10% To 20%	1198	2.76%
Greater Than 20%	10	0.02%

To analyze the liquidity across tenors, we then compared the data based on daily average number of trades and value. *Table 4* provides a tenor wise comparison of the daily average volumes (in USD Million) and the average number of Swap trades for the period of 2013 to 2017. The following points can be highlighted:

- 1 month and 12 month were found to be the most active tenors, with an average share in the total volumes of 16% and 25% respectively.
- Tenor's upto 3 months together accounted for 38% of the total trading volumes.
- The average percentage share in the total trading volumes, for the intermediate tenors (i.e. 4 months to 11 months), range from 3% to 6%.
- On an average, we observed around 60 trades in the 1 month tenor on a daily basis.
- The daily average number of trades in the tenor of 12 months was found to be well over 100, more so in recent years.

[1] The computation methodology of forward premia is discussed in Section 2

Table 4: Analysis of Trades and Volumes in the FX-Swap Market														
Tenor-wise Analysis of Daily Average Volumes in USD Million*														
Year	**O/N**	**Forward**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**
2013	4047	1310	237	166	105	82	51	79	63	36	43	54	93	301
			18%	*13%*	*8%*	*6%*	*4%*	*6%*	*5%*	*3%*	*3%*	*4%*	*7%*	*23%*
2014	5464	3462	528	324	219	161	123	182	187	137	162	189	264	986
			15%	*9%*	*6%*	*5%*	*4%*	*5%*	*5%*	*4%*	*5%*	*5%*	*8%*	*28%*
2015	5483	3810	981	420	224	188	105	185	154	86	116	144	213	994
			26%	*11%*	*6%*	*5%*	*3%*	*5%*	*4%*	*2%*	*3%*	*4%*	*6%*	*26%*
2016	7362	4556	906	547	327	246	204	290	219	162	158	152	258	1087
			20%	*12%*	*7%*	*5%*	*4%*	*6%*	*5%*	*4%*	*3%*	*3%*	*6%*	*24%*
2017	5148	4709	715	650	360	352	205	215	244	106	183	194	246	1239
			15%	14%	8%	7%	4%	5%	5%	2%	4%	4%	5%	26%
Tenor-Wise Analysis of Daily Average Number of Trades*														
2013	152	248	38	32	23	18	12	16	14	9	9	11	17	49
			15%	*13%*	*9%*	*7%*	*5%*	*6%*	*6%*	*4%*	*4%*	*4%*	*7%*	*20%*
2014	193	481	50	42	32	26	20	28	28	20	23	27	38	147
			10%	*9%*	*7%*	*5%*	*4%*	*6%*	*6%*	*4%*	*5%*	*6%*	*8%*	*31%*
2015	186	483	76	44	29	25	19	27	22	14	18	22	32	155
			16%	*9%*	*6%*	*5%*	*4%*	*6%*	*5%*	*3%*	*4%*	*5%*	*7%*	*32%*
2016	230	569	71	52	37	30	28	38	29	22	20	22	40	180
			12%	*9%*	*7%*	*5%*	*5%*	*7%*	*5%*	*4%*	*4%*	*4%*	*7%*	*32%*
2017	172	595	70	56	41	37	26	31	27	19	22	26	50	190
			12%	*9%*	*7%*	*6%*	*4%*	*5%*	*5%*	*3%*	*4%*	*4%*	*8%*	*32%*
**Trades of USD 1 million and Above have been considered.*														
Figures in the italics indicate percentage share of Total Forward trades/volumes.														

An analysis of the frequency of trading is depicted in *Table 5*. We do not compute an overnight rate in case of a U.S. holiday wherein we will not have Cash and subsequent Tom settlement. We find a marginal drop in the frequency of trades for the tenors of 8 months to 10 months. During the entire period of study (2013-2016), we found on an average of 25 days (4% of the entire sample period) during which trades were unavailable for these tenors.

Table 5: Tenor-Wise Analysis of Total Number of Day Traded*														
Year	**Criteria**	**O/N**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**
2013	Trading is Present	224	243	244	241	244	243	243	242	224	227	233	238	244
	Trading is Absent	0	1	0	3	0	1	1	2	20	17	11	6	0
2014	Trading is Present	218	235	236	236	235	235	236	231	230	229	228	234	236
	Trading is Absent	0	1	0	0	1	1	0	5	6	7	8	2	0
2015	Trading is Present	227	241	241	240	240	236	240	240	235	235	232	238	241
	Trading is Absent	0	0	0	1	1	5	1	1	6	6	9	3	0
2016	Trading is Present	224	240	241	240	240	241	241	239	230	238	233	241	241
	Trading is Absent	0	1	0	1	1	0	0	2	11	3	8	0	0
2017	Trading is Present	92	99	99	99	99	97	99	96	93	94	98	99	97
	Trading is Absent	0	0	0	0	0	2	0	3	6	5	1	0	2
**Trades of USD 1 million and Above have been considered.*														

To prevent bias in the computation process from inadequate trading on a particular day and for a particular tenor, we propose to implement a criterion of a minimum number of trades to be considered to go ahead with the computation. We looked at two alternative criteria- minimum 3 trades and minimum 5 trades in a day and for each tenor

Table 6: Tenor Wise Analysis of Number of Trading Days based on 3 or 5 Criteria																				
Year	**2013**		**2014**		**2015**		**2016**		**2017**		**2013**		**2014**		**2015**		**2016**		**2017**	
Criteria	**<3**	**=>3**	**<3**	**=>3**	**<3**	**=>3**	**<3**	**=>3**	**<3**	**=>3**	**<5**	**=>5**	**<5**	**=>5**	**<5**	**=>5**	**<5**	**=>5**	**<5**	**=>5**
O/N	0	224	0	218	0	227	0	222	0	92	0	224	0	218	0	227	0	222	0	92
1 M	1	242	3	232	0	241	0	240	0	99	2	241	5	230	0	241	0	240	0	99
2 M	0	244	0	236	0	241	0	241	0	99	1	243	1	235	0	241	0	241	0	99
3 M	1	240	0	236	1	239	1	239	0	99	6	235	0	236	2	238	3	237	0	99
4 M	5	239	4	231	3	237	3	237	1	98	11	233	5	230	11	229	7	233	1	98
5 M	8	235	3	232	4	232	0	241	2	95	32	211	14	221	9	227	5	236	2	95
6 M	3	240	3	233	2	238	3	238	0	99	18	225	8	228	5	235	5	236	1	98
7 M	11	231	8	223	6	234	3	236	1	95	34	208	10	221	12	228	10	229	8	88
8 M	29	195	8	222	22	213	5	225	5	88	67	157	19	211	50	185	20	210	14	79
9 M	45	182	13	216	12	223	15	223	5	89	80	147	23	206	33	202	29	209	14	80
10 M	31	202	14	214	16	216	14	219	5	93	62	171	30	198	32	200	34	199	10	88
11 M	9	229	6	228	10	228	7	234	0	99	26	212	10	224	23	215	22	219	0	99
12 M	0	244	0	236	0	241	0	241	0	97	1	243	0	236	0	241	0	241	0	97
**Trades of USD 1 million and above are considered.*																				

Table 6 provides a year wise comparison of days having less than 3 trades and less than 5 trades. The table suggests that the implementation of 5 trades criteria vis-à-vis the 3 trades criteria would result in a loss of significant data points, mainly in case of tenors between 5 months to 11 months. Therefore implementation of the minimum **3 trades criteria per day** would be more suitable.

1.2 Outlier Detection Criteria

The distribution of traded rates like most financial time series data was found to be skewed and hence two alternative central tendency methodologies for detection of outliers were considered.

1. Average +/-3 times the Standard Deviation
2. Median +/-3 times the Standard Deviation

We carried out an exercise of determining the outliers following the above two methods on implied forward premia from the surviving trades. We performed a T-Test on the computed Median Forward Premia as well as the Weighted Average Forward Premia (*Annexure 1*). The results suggest that the difference in the Mean of the two samples (as indicated by the Pooled T-value) is not significantly different from zero. Further, the variances of the two samples (as indicated by the Folded F Statistic) do not significantly differ from each other. We propose the use of **Mean for outlier detection**, since mean is the market accepted method to compute benchmarks.

We elaborate on the methodology and illustrate the computation of benchmark forward premia curve and the associated MIFOR curve in Section 2.

2. COMPUTATION OF BENCHMARK FORWARD PREMIA AND MIFOR CRUVE

2.1 Methodology for computation of Forward Premia and MIFOR curve

1. In case of the overnight forward premia, the USD/INR Cash and Tom transactions which form a part of swap trades have been considered.
2. In case of month-end forward premia, the USD/INR spot and their associated month-end forward transactions which form a part of a swap trade and are reported to the Clearing Corporation of India Ltd. (CCIL), have been considered.
3. Trades have categorized on the basis of expiry, ranging from overnight and 1 month upto 12 months.
4. Trades with the dollar leg of USD 1 million and above have been considered.
5. The annualized overnight forward premia is computed using *Equation (1)*

$$\textit{Annualised O/N Forward Premia} = \left[\frac{T_t - C_t}{C_t}\right] \times \left[\frac{365}{T_{Value\ Date} - C_{Value\ Date}}\right] \times 100 \quad \ldots(1)$$

where, C_t is the Cash Rate; T_t is the Tom Rate; $C_{Value\ Date}$ is the Cash Settlement Date and $T_{Value\ Date}$ is the Tom Settlement Date.

6. In case of tenors of 1 month to 12 months, the annualized forward premia for each trade is computed using *Equation (2).*

$$\textbf{\textit{Annualised Month End Forward Premia}} = \left[\frac{F_t - S_t}{S_t}\right] \times \left[\frac{365}{F_{Value\ Date} - S_{Value\ Date}}\right] \times \mathbf{100} \quad \ldots(\mathbf{2})$$

where, F_t is the Forward Rate; S_t is the Spot Rate; $F_{Value\ Date}$ is the Forward Settlement Date and $S_{Value\ Date}$ is the Spot Settlement Date.

7. Trades with a forward premia within a range of -5% and +20% have been retained.
8. For each day, a minimum number of 3 trades are required for the purpose of computation for each tenor.
9. Outliers range have been estimated using a +/- 3 standard deviation rule from the weighted average rate of the computed forward premia for that day. In case an outlier is detected, the trade is dropped from the analysis.
10. From the surviving trades, the Weighted Average (Mean) Forward Premia for that day is calculated for each respective tenor.
11. Two days prior to the last working day of the month i.e. the day after which the near month forward window closes, we rollover from the near month to the 2 month contract, 2 month to 3 month contract and so on. For example, the rollover during the month of January 2016 will take place on January 27th 2016, with January 29th 2016 being the last working day of the month as indicated in *Table 7*:

Table 7: Illustration of Rollover at Month End

Forward Premia (%) Before Rollover*

Date	**1 M**	**2 M**	**3 M**	**4 M**	**5 M**	**6 M**	**7 M**	**8 M**	**9 M**	**10 M**	**11 M**	**12 M**	**13 M**
↓Trade/Value→	*29th Jan 2016*	*29th Feb 2016*	*31st Mar 2016*	*29th Apr 2016*	*31st May 2016*	*30th Jun 2016*	*29th Jul 2016*	*31st Aug 2016*	*30th Sep 2016*	*28th Oct 2016*	*30th Nov 2016*	*30th Dec 2016*	*31st Jan 2017*
22-Jan-16	6.39	6.20	6.19	6.49	6.40	6.36	6.31	6.30	6.29	6.29	6.28	6.22	
25- Jan -16	6.17	6.17	6.15	6.49	6.38	6.34	6.29	6.30	6.27	6.26	6.27	6.23	
27- Jan -16		6.14	6.14	6.46	6.37	6.31	6.28	6.26	6.24	6.26	6.23	6.19	6.12
28- Jan -16		6.14	6.11	6.43	6.33	6.28	6.24	6.23	6.21		6.20	6.16	6.10
29- Jan -16		6.17	6.11	6.42	6.32	6.24	6.22	6.19	6.18	6.19	6.18	6.14	6.07

Forward Premia (%) After Rollover

Date	**1 M**	**2 M**	**3 M**	**4 M**	**5 M**	**6 M**	**7 M**	**8 M**	**9 M**	**10 M**	**11 M**	**12 M**	**13 M**
22- Jan -16	6.39	6.20	6.19	6.49	6.40	6.36	6.31	6.30	6.29	6.29	6.28	6.22	
25- Jan -16	6.17	6.17	6.15	6.49	6.38	6.34	6.29	6.30	6.27	6.26	6.27	6.23	
27- Jan -16	6.14	6.14	6.46	6.37	6.31	6.28	6.26	6.24	6.26	6.23	6.19	6.12	
28- Jan -16	6.14	6.11	6.43	6.33	6.28	6.24	6.23	6.21		6.20	6.16	6.10	
29- Jan -16	6.17	6.11	6.42	6.32	6.24	6.22	6.19	6.18	6.19	6.18	6.14	6.07	

**29-01-16 was a Friday and the last working day of the month.*

12. On days when the minimum number of trades criteria is not met, we compute the Mean Forward Premia by taking the previous day's rate plus the average spread of the two adjacent tenors. For the 1 month and 12 month rate we use only nearby spread to add to previous day's rate as two adjacent points will not be available. For

example if the 7 month and 9 month forward premia are available for 1st and 2nd of January 2016, the 8 month rate can be obtained as:

Date	7 month	8 Month	9 month
January 01, 2016	7.08	7.50	8.10
January 02, 2016	7.12	**7.62***	8.30
**7.50+(((7.12-7.08)+(8.30-8.10))/2)=7.62*			

13. Having obtained the weighted average forward premia for each tenor, the **Rolling Forward Premia Rate** is obtained from month-end traded rates based on the following classification (*Table 8*):

Table 8: Rolling Forward Classification

Benchmark Rate (Calendar Days)	Month-End Forward Rates	Benchmark Rate (Calendar Days)	Month-End Forward Rates
1 Month	1 Month and 2 Month	7 Month	7 Month and 8 Month
2 Month	2 Month and 3 Month	8 Month	8 Month and 9 Month
3 Month	3 Month and 4 Month	9 Month	9 Month and 10 Month
4 Month	4 Month and 5 Month	10 Month	10 Month and 11 Month
5 Month	5 Month and 6 Month	11 Month	11 Month and 12 Month
6 Month	6 Month and 7 Month	12 Month	11 Month and 12 Month

14. The rolling forward premia rate for the benchmark tenors of 30 days to 330 days is **interpolated** from the month end Mean Forward Premia rates, using *Equation (3).* As an example, the 30 days rolling forward premia is computed.

$$\mathbf{1\ Month\ Rolling\ Forward\ Premia}\ (\%) = \boldsymbol{FP_{1M}} + \frac{[(\boldsymbol{N} - \boldsymbol{Days_{1M}}) \times (\boldsymbol{FP_{2M}} - \boldsymbol{FP_{1M}})]}{\boldsymbol{Days_{2M}} - \boldsymbol{Days_{1M}}} \ldots (\mathbf{3})$$

where,

FP_{1M} is the near month/1 month weighted average forward premia rate,

FP_{2M} is the 2 month weighted average forward premia rate,

N is the number of calendar days from Spot settlement date using modified following day convention

$Days_{1M}$ is the day difference between the settlement dates of spot and the near month forward,

$Days_{2M}$ is the day difference between the settlement dates of spot and the 2 month forward.

15. On days when the difference between the settlement date of the 12 month forward rate and that of the spot rate falls below 12M, the Rolling forward premia rate of 12 Months Rolling Forward Premia is **extrapolated** using *Equation (4*)

$$\textbf{12 Month Rolling Forward Premia}\ (\%) = FP_{12M} + \frac{[(12M - Days_{12M}) \times (FP_{12M} - FP_{11M})]}{Days_{12M} - Days_{11M}} \quad \textbf{...(4)}$$

where,

FP_{12M} *is the 12 month weighted average forward premia rate,*

FP_{11M} *is the 11 months weighted average forward premia rate,*

$12M$ *is the number of calendar days from Spot settlement date using modified following day convention*

$Days_{12M}$ *is the day difference between the settlement dates of spot and the 12 month forward,*

$Days_{11M}$ *is the day difference between the settlement dates of spot and the 11 month forward.*

16. Having obtained the Rolling Forward Premia (%), the Rupee forward premia for O/N upto 360 Days can be computed using the *Equation (5).* As an example, the 30 Days Rupee forward premia is considered.

$$\textbf{Rupee Forward Premia} = FP_M \times S_t \times \left(\frac{N}{36500}\right) \quad \textbf{...(5)}$$

where,

FP_M *is the Rolling Forward Premia Rate(%) for the relevant tenor*

S_t *is the applicable Spot Rate*

N *is the number of calendar days from Spot settlement date using modified following day convention*

17. The calculated Rolling Forward Premia Rate along with the USD LIBOR can be used to compute the associated MIFOR/MITOR, for the day, using *Equation (6)*:

$$\textbf{MIFOR} = \left[\left(1 + \textbf{LIBOR} \times \frac{N}{36000}\right) \times \left(1 + \textbf{Rolling Forward Rate} \times \frac{N}{36500}\right) - 1\right] \times \frac{36500}{N} \quad \textbf{... (6)}$$

where

N *is the number of calendar days from Spot settlement date using modified following day convention In case of MITOR,* N *is the number of calendar days from Cash settlement date using modified following day convention.*

2.2 Illustration of Forward Premia and MIFOR computation

For the purpose of illustration we consider hypothetical swap transactions for 4th of January 2016 (*Table 9*). The spot and month-end forward transactions are matched on the

basis of a common reference id as depicted in *Panel A*. Data includes only transactions with the dollar leg of USD 1 million and above. The forward premia for each trade was then computed using *Equation (1).* For example, in case of the trade with the common reference XX009, the premia is calculated as:

$$Forward\ Premia_{XX009} = \left[\frac{66.4905 - 66.2300}{66.2300}\right] \times \left[\frac{365}{23}\right] \times 100 = 6.24\%$$

In all, we have 11 trades for the day (which satisfies the minimum 3 trades criteria) and the computed forward premia rates fall within the -5% and +20% rate band.

Further, for the purpose of comparison, the outlier range was estimated as the Median +/-3 Standard Deviation as well as Weighted Average+/-3 Standard Deviation. Among the computed forward premia rates we find that the rate of 8.15% exceeds the range specified using Median as well as Weighted Average Rate and is accordingly dropped from the analysis. The rest of the rates are retained for the final computation as depicted in *Panel B*. The Median Forward Premium was thus calculated to be 6.26%, whereas the Weighted Average (Mean) forward premia was calculated as 6.27%.

To illustrate the computation of the 30 Days Rolling Forward Premia in percentage and Rupee Forward Premia as on January 04, 2016, we use the following details and apply *Equation (3)* and *(5)* respectively:

Variables	Rate	Settlement Date	Day Difference
Spot	66.47	06-01-16	
1-Month Weighted Average Forward Premia Rate	6.27%	29-01-16	23
2-Month Weighted Average Forward Premia Rate	6.36%	29-02-16	54
One Month Calendar Date		08-02-16	33

$$30\ Day\ Rolling\ Forward\ Premia\ (\%) = 6.27 + \frac{[(33 - 23) \times (6.36 - 6.27)]}{54 - 23} = 6.29$$

$$30\ Day\ Rupee\ \ Forward\ Premia = 6.29\ \times\ \ 66.47\ \times \frac{33}{36500} = 0.38\ paise$$

Using the computed Rolling Forward Rate of 6.29% and the 1 month LIBOR of 0.42% (as on 04th January 2016) we can compute the 1 month MIFOR (*Equation (6)*) as:

$$MIFOR\ (\%) = \left[\left(1 + 0.42\ \times \frac{33}{36000}\right) \times \left(1 + 6.29 \times \frac{33}{36500}\right) - 1\right] \times \frac{36500}{33} = 6.72$$

Table 9: Illustration of Computation of Forward Premia – Using Mean and Median

'Panel A'

Trade Date	Value Date	Trade Type	Buy Currency	Buy Amount	Exchange Rate	Sell Currency	Sell Amount	Common Reference	Premia (a)	Trade (b)	USD Amount (c)	Weighted (d) =
04-01-16	06-01-16	SPOT	INR	662300000	66.2300	USD	10000000	XX009F				
04-01-16	29-01-16	FORWARD	USD	10000000	66.4905	INR	664905000	XX009S	6.24	1	10000000	624191
04-01-16	06-01-16	SPOT	USD	5000000	66.2100	INR	331050000	XX094F				
04-01-16	29-01-16	FORWARD	INR	332357500	66.4715	USD	5000000	XX094S	6.27	1	5000000	313388
04-01-16	06-01-16	SPOT	USD	20000000	66.1700	INR	1323400000	XX003F				
04-01-16	29-01-16	FORWARD	INR	1328630000	66.4315	USD	20000000	XX003S	6.27	1	20000000	125431
04-01-16	06-01-16	SPOT	INR	132320000	66.1600	USD	2000000	XX002F				
04-01-16	29-01-16	FORWARD	USD	2000000	66.4200	INR	132840000	XX002S	6.24	1	2000000	124730
04-01-16	06-01-16	SPOT	USD	3000000	66.2200	INR	198660000	XX025F				
04-01-16	29-01-16	FORWARD	INR	199444500	66.4815	USD	3000000	XX025S	6.27	1	3000000	188004
04-01-16	06-01-16	SPOT	USD	5000000	66.2100	INR	331050000	XX021F				
04-01-16	29-01-16	FORWARD	INR	332357500	66.4715	USD	5000000	XX021S	6.27	1	5000000	313388
04-01-16	06-01-16	SPOT	USD	5000000	66.2135	INR	331067500	XX022F				
04-01-16	29-01-16	FORWARD	INR	332400000	66.4800	USD	5000000	XX022S	6.39	1	5000000	319363
04-01-16	06-01-16	SPOT	INR	331162500	66.2325	USD	5000000	XX007F				
04-01-16	29-01-16	FORWARD	USD	5000000	66.4935	INR	332467500	XX007S	6.25	1	5000000	312683
04-01-16	06-01-16	SPOT	INR	331175000	66.2350	USD	5000000	XX008F				
04-01-16	29-01-16	FORWARD	USD	5000000	66.4960	INR	332480000	XX008S	6.25	1	5000000	312671
04-01-16	06-01-16	SPOT	INR	66210000	66.2100	USD	1000000	XX043F				
04-01-16	29-01-16	FORWARD	USD	1000000	66.5500	INR	66550000	XX043S	8.15	1	1000000	814930
04-01-16	06-01-16	SPOT	INR	661600000	66.1600	USD	10000000	XX993F				
04-01-16	29-01-16	FORWARD	USD	10000000	66.4200	INR	664200000	XX993S	6.24	1	10000000	623652
								SUM		**11**	**71000000**	**44678**

Computation of Outliers (Median v/s Mean)

	Measure	Standard Deviation	Max	Min
	(a)	*(b)*	*(a)+3x(b)*	*(a)-3x(b)*
Median	6.27	0.57	7.97	4.56
Weighted Average Rate	6.29	0.57	8.00	4.59

Table 9: Illustration of Computation of Forward Premia – Using Mean and Median (cont.)												
'Panel B'												
Trade Date	**Value Date**	**Trade Type**	**Buy Currency**	**Buy Amount**	**Exchange Rate**	**Sell Currency**	**Sell Amount**	**Common Reference**	**Premia (a)**	**Trade (b)**	**USD Amount (c)**	**Weighted Amount (d)=(a) x (c)**
04-01-16	06-01-16	SPOT	INR	662300000	66.2300	USD	10000000	XX009F				
04-01-16	29-01-16	FORWARD	USD	10000000	66.4905	INR	664905000	XX009S	6.24	1	10000000	62419172
04-01-16	06-01-16	SPOT	USD	5000000	66.2100	INR	331050000	XX094F				
04-01-16	29-01-16	FORWARD	INR	332357500	66.4715	USD	5000000	XX094S	6.27	1	5000000	31338856
04-01-16	06-01-16	SPOT	USD	20000000	66.1700	INR	1323400000	XX003F				
04-01-16	29-01-16	FORWARD	INR	1328630000	66.4315	USD	20000000	XX003S	6.27	1	20000000	125431202
04-01-16	06-01-16	SPOT	INR	132320000	66.1600	USD	2000000	XX002F				
04-01-16	29-01-16	FORWARD	USD	2000000	66.4200	INR	132840000	XX002S	6.24	1	2000000	12473056
04-01-16	06-01-16	SPOT	USD	3000000	66.2200	INR	198660000	XX025F				
04-01-16	29-01-16	FORWARD	INR	199444500	66.4815	USD	3000000	XX025S	6.27	1	3000000	18800474
04-01-16	06-01-16	SPOT	USD	5000000	66.2100	INR	331050000	XX021F				
04-01-16	29-01-16	FORWARD	INR	332357500	66.4715	USD	5000000	XX021S	6.27	1	5000000	31338856
04-01-16	06-01-16	SPOT	USD	5000000	66.2135	INR	331067500	XX022F				
04-01-16	29-01-16	FORWARD	INR	332400000	66.4800	USD	5000000	XX022S	6.39	1	5000000	31936381
04-01-16	06-01-16	SPOT	INR	331162500	66.2325	USD	5000000	XX007F				
04-Jan-16	29-01-16	FORWARD	USD	5000000	66.4935	INR	332467500	XX007S	6.25	1	5000000	31268309
04-Jan-16	06-01-16	SPOT	INR	331175000	66.2350	USD	5000000	XX008F				
04-Jan-16	29-01-16	FORWARD	USD	5000000	66.4960	INR	332480000	XX008S	6.25	1	5000000	31267129
04-Jan-16	06-01-16	SPOT	INR	661600000	66.1600	USD	10000000	XX993F				
04-Jan-16	29-01-16	FORWARD	USD	10000000	66.4200	INR	664200000	XX993S	6.24	1	10000000	62365280
								SUM		**10**	**70000000**	**438638714**
								MEDIAN FORWARD PREMIA	**6.26**			
								WEIGHTED AVERAGE FORWARD PREMIA	**6.27**			

3. ANALYSIS OF THE COMPUTED FORWARD PREMIA AND MIFOR CURVE IN CASE OF TRADES REPORTED FOR THE FULL DAY

Using the methodology stated above, the tenor wise Weighted Average Forward Premia was computed for the period of January 1, 2013 to May 31, 2017. *Table 10* provides the descriptive statistics of the tenor wise computed Weighted Average Forward Premia (in percentage) using month end traded swaps.

Table 10: Descriptive Statistics of the Tenor wise Weighted Average Forward Premia (%)

	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Mean	7.32	7.29	7.28	7.22	7.15	7.08	7.01	6.95	6.90	6.85	6.80	6.76	6.71
Standard Error	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Median	7.41	7.33	7.28	7.24	7.22	7.19	7.14	7.06	7.00	6.91	6.82	6.74	6.68
Standard Deviation	1.49	1.52	1.44	1.38	1.34	1.30	1.27	1.25	1.23	1.22	1.19	1.17	1.14
Sample Variance	2.22	2.31	2.09	1.91	1.78	1.68	1.61	1.56	1.52	1.48	1.42	1.37	1.31
Kurtosis	6.04	0.99	-0.16	-0.31	-0.43	-0.59	-0.63	-0.64	-0.65	-0.64	-0.63	-0.62	-0.62
Skewness	0.65	-0.33	-0.20	-0.29	-0.34	-0.32	-0.33	-0.34	-0.32	-0.31	-0.32	-0.32	-0.33
Range	16.94	11.98	8.78	8.07	7.40	6.80	6.45	6.09	6.07	5.78	5.27	5.31	5.02
Minimum	0.15	0.17	2.12	2.51	2.68	3.05	3.27	3.45	3.44	3.70	3.77	3.77	3.86
Maximum	17.10	12.15	10.90	10.57	10.08	9.85	9.72	9.54	9.50	9.48	9.04	9.07	8.88
Sum	7210	7732	7728	7656	7590	7509	7434	7370	7311	7262	7218	7163	7115
Count	985	1061	1061	1061	1061	1061	1061	1061	1060	1060	1061	1060	1061

Table 11 gives the year-wise breakup between the number of days the forward premia has been computed from the traded rates using the above methodology and the number of days (missing days) on which the premia had to be computed using the previous day's rate plus the adjacent tenors' spread. The tenors of 8 months, 9 months and 10 months were found to be less liquid in comparison to other tenors. Similar methodology is followed when there are no minimum forward trades for a specific tenor.

Table 11: Tenor-Wise Analysis of No. of Days Traded After Considering The Minimum 3 Trades Criteria

	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Panel A: No. of Days Forward Premia is Computed from Trades													
2013	224	242	244	240	239	235	240	231	195	182	202	229	243
2014	218	232	236	236	231	232	233	223	222	216	214	228	236
2015	227	241	241	239	237	232	238	234	213	223	216	228	241
2016	222	240	241	239	237	241	238	236	225	223	219	234	241
2017	92	99	99	99	98	95	99	95	88	89	93	99	97
2013-2017	983	1054	1061	1053	1042	1035	1048	1019	943	933	944	1018	1058

Panel B: No. of Days the Previous Days Rate Plus Adjacent tenor Spread is used													
2013	-	2	0	4	5	9	4	12	48	61	41	14	0
2014	-	4	0	0	5	4	3	13	14	20	22	8	0
2015	-	0	0	2	4	9	3	7	28	18	25	13	0
2016	-	1	0	2	4	0	3	5	16	18	22	7	0
2017	-	0	0	0	1	4	0	4	11	10	6	0	2
2013-2017	-	7	0	8	19	26	13	41	117	127	116	42	2
Note: Trades of USD 1 million and above are considered. Days with less than 3 trades are eliminated. Outliers beyond Mean +/-3 stdev were dropped.													

In *Table 12,* we re-estimate the average number of trade and volumes in each tenor after taking into consideration the criteria followed for computation of the traded forward premia.

Table 12: Tenor-Wise Analysis of Daily Average Number of Trades and Value of Swap Transactions

Year	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Panel A: Daily Average Number of Trades													
2013	150	37	32	23	18	13	16	14	10	11	12	17	49
2014	191	50	42	32	26	21	28	29	21	24	28	39	147
2015	181	74	43	29	25	19	27	22	15	18	23	34	155
2016	226	70	51	37	30	28	39	29	23	21	23	41	180
2017	170	69	55	40	37	26	31	28	20	23	27	50	189
2013-2017	185	59	43	31	26	21	28	24	18	19	22	35	138
Panel B: Daily Average Value in USD Million													
2013	4036	235	164	105	83	52	80	66	40	52	61	96	301
2014	5450	531	322	218	163	124	184	193	141	171	200	271	986
2015	5466	973	416	224	190	107	186	158	93	122	154	222	992
2016	7342	899	542	327	248	203	292	221	165	167	160	264	1084
2017	5132	910	539	359	323	198	240	217	166	170	222	364	1254
2013-2017	5529	684	377	232	185	129	190	165	118	135	153	228	876
Note: Trades of USD 1 million and above are considered. Days with less than 3 trades are eliminated. Outliers beyond Mean +/-3 stdev were dropped.													

3.1 Computation of Rolling Forward Premia (%) and Comparison with the Polled (Reuters) Rate

Using the computed Weighted Average Forward Premia from month end traded swaps, the Rolling forward premia (%) for specific tenors of 1 Month upto 12 Months was computed, using *Equation (3) and (4).* The descriptive statistics are depicted in *Table 13.* The data

depicts characteristics of an average downward sloping curve with higher volatility at the short end.

Table 13: Descriptive Statistics of the Tenor wise Rolling Forward Premia Interpolated from Traded Rates (%)

	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Mean	7.32	7.29	7.24	7.19	7.11	7.04	6.98	6.92	6.87	6.83	6.78	6.73	6.68
Standard Error	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03
Median	7.41	7.27	7.25	7.23	7.21	7.16	7.10	7.03	6.96	6.87	6.79	6.70	6.64
Standard Deviation	1.49	1.48	1.41	1.36	1.31	1.28	1.25	1.24	1.22	1.20	1.18	1.16	1.13
Sample Variance	2.22	2.19	1.98	1.84	1.72	1.64	1.57	1.53	1.50	1.45	1.39	1.34	1.28
Kurtosis	6.04	0.10	-0.26	-0.38	-0.52	-0.62	-0.65	-0.65	-0.64	-0.64	-0.62	-0.62	-0.61
Skewness	0.65	-0.22	-0.25	-0.32	-0.33	-0.33	-0.34	-0.33	-0.32	-0.32	-0.32	-0.33	-0.34
Range	16.94	9.37	8.16	7.60	6.82	6.47	6.12	6.07	5.78	5.35	5.28	5.14	4.90
Minimum	0.15	1.99	2.49	2.68	3.02	3.27	3.44	3.44	3.70	3.76	3.77	3.86	3.90
Maximum	17.10	11.36	10.65	10.28	9.84	9.74	9.56	9.51	9.48	9.11	9.05	9.00	8.80
Sum	7210	7738	7687	7624	7548	7469	7401	7335	7286	7237	7187	7137	7083
Count	985	1061	1061	1061	1061	1061	1061	1060	1060	1060	1060	1060	1060

** The 360D Rate has been extrapolated from the 11 month and 12 month weighted average traded rates.*

Table 14 provides a comparison of the tenor-wise Rolling Forward Premia computed from traded rates vis-à-vis the forward premia mid quote obtained from Thomson Reuters. In case of all tenors, the spreads between these rates have remained low and are less than 2 bps. A correlation of the traded versus polled forward premia rate (%) is also provided in *Annexure 2*. A further comparison of the mean and variance of the Rolling Forward Premia (%) computed from trades with the Reuters Polled rates using a Two Sample T-Test (*Annexure 3*), suggests that the means and the variances of both the traded and polled rates are not significantly different from one another.

Table 14: Comparison of Traded and Polled Forward Premia (%)

Year	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Panel A: Rolling Forward Premia computed From Traded Rates (%)												
2013	8.33	8.17	8.03	7.86	7.69	7.54	7.41	7.31	7.20	7.12	7.04	6.97
2014	8.42	8.41	8.37	8.32	8.27	8.22	8.19	8.15	8.12	8.06	8.00	7.93
2015	7.23	7.20	7.17	7.14	7.11	7.08	7.05	7.02	7.00	6.96	6.92	6.87
2016	6.15	6.14	6.08	6.03	5.98	5.94	5.91	5.88	5.86	5.83	5.81	5.78

2017	4.97	5.01	5.03	4.98	4.92	4.87	4.83	4.80	4.78	4.76	4.75	4.74
2013-2017	7.29	7.24	7.19	7.11	7.04	6.98	6.92	6.87	6.83	6.78	6.73	6.68
Panel B: Thomson Reuters Polled Forward Premia Mid Quote (%)												
2013	8.32	8.18	8.04	7.87	7.71	7.56	7.43	7.32	7.22	7.13	7.05	6.97
2014	8.42	8.41	8.36	8.31	8.26	8.22	8.19	8.15	8.11	8.06	8.00	7.93
2015	7.23	7.20	7.17	7.14	7.11	7.08	7.05	7.02	7.00	6.96	6.92	6.87
2016	6.16	6.13	6.08	6.02	5.98	5.94	5.91	5.88	5.86	5.83	5.80	5.78
2017	4.99	5.01	5.02	4.98	4.92	4.87	4.83	4.80	4.78	4.76	4.75	4.75
2013-2017	7.32	7.25	7.19	7.12	7.04	6.98	6.92	6.88	6.83	6.78	6.73	6.68
Panel C: Spread in Bps												
2013	0.76	-1.36	-1.62	-1.61	-1.58	-2.09	-1.40	-0.89	-1.95	-1.28	-0.64	-0.24
2014	-0.02	0.33	0.26	0.30	0.25	0.06	0.07	0.27	0.55	0.24	0.07	-0.05
2015	-0.23	-0.13	-0.02	0.03	-0.05	0.10	-0.03	-0.09	0.05	0.12	0.01	0.29
2016	-0.42	0.24	-0.02	0.37	0.30	0.28	0.10	0.12	0.09	0.00	0.20	0.11
2017	-1.65	-0.29	0.12	0.20	-0.25	0.03	-0.05	-0.26	-0.09	-0.12	-0.43	-0.77
2013-2017	-0.13	-0.24	-0.31	-0.19	-0.27	-0.38	-0.34	-0.20	-0.34	-0.26	-0.15	-0.07
*Note: Spread = (Traded Rate-Polled Rate)*100*												

We also tried to look at the data to see the possibility of estimating Rolling Forwards from the trades reported by market participants executing Rolling Forwards in their books. However, we found such data points to be insufficient and hence no representative benchmark can be estimated using such trades (*Table 15*).

Table 15: Tenor-Wise Daily Average Number of Trades in Case of Rolling Forwards

Year	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12
2013	3	1	1	0	0	2	0	0	0	0	0	2
2014	2	0	1	0	0	3	0	0	0	0	0	2
2015	1	0	0	0	0	3	0	0	0	0	0	2
2016	2	1	1	0	0	3	0	0	0	0	0	1
2017	4	2	1	0	0	3	0	0	0	0	0	2
2013-2017	2	1	1	0	0	3	0	0	0	0	0	2

3.2 Computation of Rupee Forward Premia from Alternative Spot Rates

Using the computed percentage Rolling Forward Premia Rates, the Rupee Forward Premia was computed using three alternative spot rates namely:

- CCIL Spot Rate: This is a weighted average rate, computed from USD/INR spot transactions which are settled by CCIL after eliminating less than USD 1 million trades and outliers using +/-3 stdev criteria.
- Reserve Bank of India USD/INR Spot rate.

- The USD/INR rate of the Federal Reserve Bank of New York published from data collected by the Federal Reserve from a sample of market participants.

A comparison of the Rupee Premia using the three alternative Spot rates is displayed in *Table 16.*

Table 16: Comparison of Rupee Forward Premia using Alternative USD/INR Spot Rates (values in Rs.)

Year	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
	Panel A: Rupee Forward Premia computed using CCIL USD/INR Spot Rate												
2013	0.02	0.42	0.81	1.19	1.55	1.90	2.23	2.56	2.88	3.19	3.51	3.81	4.11
2014	0.02	0.44	0.86	1.28	1.70	2.11	2.51	2.92	3.32	3.72	4.11	4.48	4.85
2015	0.02	0.39	0.78	1.15	1.54	1.91	2.28	2.65	3.01	3.38	3.74	4.08	4.42
2016	0.02	0.35	0.70	1.03	1.36	1.68	2.00	2.33	2.64	2.96	3.28	3.58	3.89
2017	0.01	0.28	0.55	0.83	1.10	1.36	1.61	1.87	2.12	2.38	2.63	2.88	3.13
2013-2017	0.02	0.39	0.77	1.13	1.50	1.85	2.20	2.54	2.88	3.22	3.56	3.88	4.20
	Panel B: Rupee Forward Premia computed using RBI USD/INR Spot Rate												
2013	0.02	0.42	0.81	1.19	1.55	1.90	2.23	2.56	2.88	3.19	3.51	3.81	4.11
2014	0.02	0.44	0.86	1.28	1.70	2.11	2.51	2.92	3.32	3.72	4.11	4.48	4.85
2015	0.02	0.39	0.78	1.15	1.54	1.91	2.28	2.65	3.01	3.38	3.74	4.08	4.42
2016	0.02	0.35	0.70	1.03	1.36	1.68	2.00	2.33	2.64	2.96	3.28	3.58	3.89
2017	0.01	0.28	0.55	0.83	1.10	1.36	1.61	1.87	2.12	2.38	2.63	2.88	3.13
2013-2017	0.02	0.39	0.77	1.13	1.50	1.85	2.20	2.54	2.88	3.22	3.56	3.88	4.20
	Panel C: Rupee Forward Premia computed from USD/INR spot rate published by Federal Reserve												
2013	0.02	0.42	0.81	1.19	1.55	1.90	2.23	2.56	2.88	3.19	3.50	3.81	4.11
2014	0.02	0.44	0.87	1.28	1.70	2.11	2.52	2.93	3.32	3.72	4.11	4.48	4.85
2015	0.02	0.39	0.78	1.15	1.54	1.91	2.28	2.65	3.01	3.38	3.74	4.08	4.42
2016	0.02	0.36	0.70	1.03	1.36	1.69	2.01	2.33	2.65	2.96	3.28	3.59	3.89
2017	0.01	0.28	0.55	0.83	1.10	1.36	1.62	1.87	2.12	2.38	2.63	2.88	3.13
2013-2017	0.02	0.39	0.77	1.13	1.50	1.85	2.20	2.55	2.88	3.22	3.56	3.88	4.21

We find a close convergence in the Rupee forward premia computed using CCIL USD/INR spot rate and the RBI rate. A T-Test was conducted to indicate if the mean and/or variance of the Rupee forward premia are significantly different from using each of the three alternative spot rates. The results are depicted in *Annexure 4 and 5*. It was found the forward premia computed from CCIL Traded Spot rate was not statistically different from that computed using either the RBI spot rate or the spot rate published by Federal Reserve. The means and variances of all the three samples seem to be equal to each other.

3.3 Computation of Tenor-Wise MIFOR rates

The computed Rolling Forward Premia (%) along with the USD LIBOR rates was then used to compute the MIFOR rate using *Equation (6).* On days the LIBOR rate has not been published, the previous day's rate has been used. The MIFOR rate was computed for the tenors of 1 day, 1 month, 2 month, 3 month and 6 month and 12 months. *Table 17* provides the descriptive statistics of the computed MIFOR rates.

Table 17: Descriptive Statistics of the Tenor-Wise MIFOR (%)

	O/N	1M	2M	3M	6M	12 M
Mean	7.58	7.62	7.64	7.66	7.65	7.69
Standard Error	0.04	0.04	0.04	0.03	0.03	0.02
Median	7.58	7.51	7.55	7.58	7.60	7.60
Standard Deviation	1.35	1.31	1.22	1.12	0.94	0.78
Sample Variance	1.81	1.71	1.48	1.25	0.88	0.61
Kurtosis	9.08	0.39	-0.06	-0.21	-0.54	-0.53
Skewness	1.09	-0.01	-0.04	-0.10	-0.10	-0.11
Range	16.85	8.94	7.64	6.91	5.21	3.86
Minimum	0.63	2.60	3.24	3.63	4.77	5.63
Maximum	17.49	11.54	10.88	10.54	9.98	9.49
Sum	7447	8077	8094	8117	8113	8155
Count	983	1060	1060	1060	1060	1060

A summary of the yearly average MIFOR rates is depicted in *Table 18.*

Table 18: Tenor-Wise Daily Average MIFOR Rates

	O/N	1M	2M	3M	6M	12 M
Year	*Panel A: Tenor-Wise Rolling Forward Premia Rate (%)*					
2013	8.38	8.33	8.17	8.03	7.54	6.97
2014	8.31	8.42	8.41	8.37	8.22	7.93
2015	7.23	7.23	7.20	7.17	7.08	6.87
2016	6.28	6.15	6.14	6.08	5.94	5.78
2017	5.14	4.97	5.01	5.03	4.87	4.74
2013-2017	7.32	7.29	7.24	7.19	6.98	6.68
	Panel B: Tenor-Wise LIBOR Rates (%)					
2013	0.13	0.19	0.23	0.27	0.41	0.68
2014	0.09	0.16	0.20	0.23	0.33	0.56
2015	0.13	0.20	0.26	0.32	0.48	0.79
2016	0.41	0.50	0.60	0.75	1.06	1.38
2017	0.81	0.90	0.96	1.11	1.39	1.75
2013-2017	0.25	0.32	0.38	0.46	0.65	0.94
	Panel C: Tenor-Wise MIFOR Rates (%)					
2013	8.51	8.53	8.41	8.31	7.97	7.71
2014	8.41	8.58	8.61	8.61	8.57	8.55

2015	7.36	7.43	7.46	7.50	7.59	7.73
2016	6.70	6.66	6.75	6.85	7.05	7.25
2017	5.97	5.88	5.99	6.17	6.32	6.60
2013-2017	7.58	7.62	7.64	7.66	7.65	7.69

In *Table 19,* we compare the MIFOR computed using traded data with that obtained from Thomson Reuters for the period from January 2013 to May 2017. The spread between the MIFOR computed from traded forward premia and the polled rates ranges between a positive 3.26 bps to -6 bps, with a higher variation being visible in the 1 month MIFOR rates. A Two Sample T-Test of the MIFOR from traded data versus Thomson Reuters Rate (*Annexure 6*) however indicates that there is no statistical difference between the mean and variances of both the samples during the period in consideration.

Table 19: Comparison of Traded MIFOR versus Thomson Reuters MIFOR

A:MIFOR FROM TRADED FORWARD PREMIA						
Year	O/N	1M	2M	3M	6M	12M
2013	8.51	8.53	8.41	8.31	7.97	7.71
2014	8.41	8.58	8.61	8.61	8.57	8.55
2015	7.36	7.43	7.46	7.50	7.59	7.73
2016	6.70	6.66	6.75	6.85	7.05	7.25
2017	5.97	5.88	5.99	6.17	6.32	6.60
2013-2017	7.58	7.62	7.64	7.66	7.65	7.69
B:MIFOR FROM THOMSON REUTERS						
Year	O/N	1M	2M	3M	6M	12M
2013	8.48	8.56	8.43	8.33	7.98	7.70
2014	8.41	8.65	8.64	8.62	8.58	8.55
2015	7.35	7.48	7.49	7.51	7.59	7.73
2016	6.63	6.71	6.76	6.85	7.04	7.25
2017	5.83	5.93	6.03	6.19	6.31	6.60
2013-2017	7.54	7.67	7.66	7.67	7.66	7.69
Spread In Bps*						
Year	O/N	1M	2M	3M	6M	12M
2013	2.58	-2.85	-2.03	-1.63	-0.89	0.48
2014	0.22	-6.38	-2.29	-1.55	-0.49	-0.16
2015	0.94	-5.06	-2.51	-1.86	-0.44	0.25
2016	7.04	-5.16	-1.36	-0.80	0.28	0.29
2017	13.87	-4.56	-3.73	-2.16	0.62	-0.29
2013-2017	3.45	-4.82	-2.20	-1.59	-0.32	0.17
*Spread = (A-B)*100						

4. ANALYSIS OF THE COMPUTED FORWARD PREMIA AND MIFOR CURVE IN CASE OF TRADES REPORTED UPTO 3 PM

4.1 Arrival of Trades

Forward Trades are generally reported throughout the day to CCIL, and a study of the data at various time buckets shows that around 40% of the deals are generally reported by 3 PM and around 50% of the transactions are reported by 4 PM (*Table 20*). Hence, computing the forwards and MIFOR using trade information before 4.00PM may not result in robust benchmark rates.

Table 20: Time Bucket Analysis of Tenor wise Swap Trades (% share of Total Value)

	2013					
Tenor	**Upto 12 PM**	**Upto 1 PM**	**Upto 2 PM**	**Upto 3 PM**	**Upto 4 PM**	**Entire Day**
1 M	2.99	8.05	11.83	17.36	26.96	100.00
2 M	2.80	7.36	11.11	17.22	26.53	100.00
3 M	4.77	10.51	14.53	19.36	29.13	100.00
4 M	5.18	10.31	14.23	20.70	30.46	100.00
5 M	5.34	13.07	19.00	22.84	33.96	100.00
6 M	4.38	10.90	15.17	20.36	29.42	100.00
7 M	6.05	11.81	16.24	23.93	34.88	100.00
8 M	4.89	11.84	16.69	21.49	31.27	100.00
9 M	7.10	16.14	20.70	25.57	34.23	100.00
10 M	7.18	14.03	20.26	26.02	33.52	100.00
11 M	9.14	19.27	24.51	28.70	37.62	100.00
12 M	12.31	22.56	27.88	34.54	44.58	100.00
	2014					
	Upto 12 PM	**Upto 1 PM**	**Upto 2 PM**	**Upto 3 PM**	**Upto 4 PM**	**Entire Day**
1 M	5.08	11.67	15.40	22.14	32.63	100.00
2 M	5.72	13.44	18.42	25.71	36.13	100.00
3 M	5.68	14.92	20.63	27.71	37.08	100.00
4 M	7.04	15.47	21.11	26.91	38.26	100.00
5 M	8.37	16.14	22.53	28.57	39.47	100.00
6 M	9.33	19.07	24.51	30.99	39.37	100.00
7 M	9.49	19.51	25.34	32.67	43.08	100.00
8 M	10.93	20.83	28.05	33.69	44.67	100.00
9 M	11.30	21.35	27.43	35.58	45.54	100.00
10 M	12.59	23.08	28.25	34.67	46.45	100.00
11 M	12.88	21.61	28.91	37.46	48.68	100.00
12 M	18.89	30.56	37.07	43.67	52.70	100.00
	2015					
	Upto 12 PM	**Upto 1 PM**	**Upto 2 PM**	**Upto 3 PM**	**Upto 4 PM**	**Entire Day**
1 M	7.95	16.82	23.56	33.44	47.07	100.00

2 M	8.60	18.26	26.26	34.26	46.23	100.00
3 M	7.65	18.05	24.64	33.13	44.97	100.00
4 M	7.00	18.32	24.96	32.56	43.29	100.00
5 M	8.90	17.38	23.88	30.30	41.57	100.00
6 M	8.83	18.45	24.64	31.98	41.56	100.00
7 M	10.38	20.00	28.30	34.90	46.94	100.00
8 M	11.92	21.73	28.83	37.04	47.57	100.00
9 M	12.62	22.87	29.84	38.39	50.85	100.00
10 M	13.79	22.94	29.97	37.17	47.28	100.00
11 M	16.19	27.31	33.06	38.66	49.45	100.00
12 M	25.21	36.25	43.18	50.41	59.63	100.00
	2016					
	Upto 12 PM	**Upto 1 PM**	**Upto 2 PM**	**Upto 3 PM**	**Upto 4 PM**	**Entire Day**
1 M	10.23	20.02	27.44	35.85	48.56	100.00
2 M	12.47	21.85	29.68	37.16	49.59	100.00
3 M	8.48	18.77	26.67	33.84	45.93	100.00
4 M	9.45	18.46	26.94	33.83	45.13	100.00
5 M	14.24	22.67	29.13	37.71	49.88	100.00
6 M	11.72	22.32	29.74	38.28	50.09	100.00
7 M	12.52	23.84	31.28	39.07	51.28	100.00
8 M	13.94	24.25	31.38	38.63	50.57	100.00
9 M	14.34	24.68	30.68	37.24	49.68	100.00
10 M	13.22	23.22	31.23	38.42	52.21	100.00
11 M	12.83	22.07	29.14	36.02	47.34	100.00
12 M	24.11	33.99	39.90	46.73	57.25	100.00
	2017 (Upto May)					
	Upto 12 PM	**Upto 1 PM**	**Upto 2 PM**	**Upto 3 PM**	**Upto 4 PM**	**Entire Day**
1 M	11.54	22.79	29.65	38.55	53.20	100.00
2 M	10.68	19.89	26.99	34.88	50.61	100.00
3 M	10.52	19.47	28.56	37.64	51.90	100.00
4 M	10.05	20.95	29.45	35.12	50.38	100.00
5 M	12.72	20.23	28.46	34.34	48.57	100.00
6 M	14.63	24.22	31.26	37.15	50.37	100.00
7 M	13.47	23.29	32.33	38.97	53.13	100.00
8 M	13.69	19.61	27.24	38.03	49.37	100.00
9 M	10.99	19.53	27.40	34.94	49.36	100.00
10 M	13.42	20.94	29.02	38.72	49.98	100.00
11 M	12.83	21.25	29.08	37.17	52.75	100.00
12 M	23.55	32.43	40.21	45.94	57.75	100.00

4.2 Computation of Forward Premia and MIFOR for trades reported upto 3 PM.

Based on the outcome of the interactions with market participants, the cut-off time for computation of these rates was suggested to be fixed at 3 PM. The following changes have been incorporated in the proposed methodology based on the feedback from market participants to compute the forward premia in order to make it a more representative benchmark rate.

1. Fixing will be done based on all swap pairs reported to CCIL till 3 pm on daily basis.
2. Total Traded value of USD 25 million only to be considered for computation for all 13 tenor (overnight, 1M….12M).
3. Fallback mechanism for missing tenors is as follows:
    a. Interpolation/Extrapolation will be carried out if there are at least 3 traded Tenor points, which satisfy the criteria of at least one traded tenor point of less than or equal to 3M and at least one traded tenor point of greater than 6M. We first calculate the missing rates by way of interpolation between two available tenor points (traded/calculated) starting from the lowest tenor. We then extrapolate the remaining rates, beginning from tenors with the nearest available rates (traded/calculated).
    b. In case there are 3 or more traded tenor points but the criteria of less than or equal to 3M and greater than 6M is not met for the day, then the missing tenor points will be populated using previous day's forward premia rate of that tenor and the average spread of the two available nearby tenor points (traded/calculated). We calculate the rates for the extreme tenor's first and then calculate the remaining missing tenors points moving from the shorter to longer tenors.
    c. In case there are only 2 traded tenor points, then the missing tenor points are computed using previous day's forward premia rate plus the average spread of two available nearby tenor points (traded/calculated). We calculate the rates for the extreme tenor's first and then calculate the remaining missing tenors points moving from the shorter to longer tenors.
    d. In case of only 1 traded tenor point, then the previous day's rates are repeated for the missing tenors, retaining the traded tenor point.

e. In case of no traded tenor points, the previous day's rates would be repeated.

Table 21 provides the descriptive statistics of the tenor wise computed Weighted Average Forward Premia (in percentage) using month end traded swaps reported upto 3PM.

Table 21: Descriptive Statistics of the Tenor wise Weighted Average Forward Premia (%)

	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Mean	7.32	7.29	7.28	7.21	7.15	7.09	7.02	6.96	6.93	6.90	6.82	6.76	6.71
Standard Error	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Median	7.41	7.32	7.28	7.23	7.21	7.19	7.15	7.10	7.05	7.00	6.86	6.76	6.67
Standard Deviation	1.49	1.53	1.45	1.38	1.34	1.30	1.28	1.26	1.24	1.22	1.20	1.18	1.15
Sample Variance	2.22	2.35	2.11	1.91	1.79	1.70	1.63	1.58	1.53	1.49	1.44	1.39	1.32
Kurtosis	6.06	0.79	-0.07	-0.26	-0.40	-0.56	-0.61	-0.64	-0.64	-0.62	-0.63	-0.62	-0.61
Skewness	0.65	-0.24	-0.22	-0.28	-0.31	-0.31	-0.32	-0.33	-0.32	-0.33	-0.31	-0.31	-0.33
Range	16.96	11.33	9.27	8.16	7.73	6.94	6.50	6.02	5.69	5.83	5.43	5.26	5.00
Minimum	0.15	0.76	2.08	2.51	2.38	2.90	3.24	3.55	3.71	3.55	3.75	3.77	3.89
Maximum	17.11	12.10	11.34	10.67	10.11	9.85	9.74	9.57	9.41	9.38	9.17	9.03	8.88
Sum	7198	7739	7723	7654	7588	7517	7448	7389	7351	7317	7236	7174	7114
Count	983	1061	1061	1061	1061	1061	1061	1061	1061	1061	1061	1061	1061

Table 22 gives the year-wise breakup between the number of days the forward premia has been computed from the traded rates using the above methodology and the number of days (missing days) on which the premia had to be computed using the fallback procedure defined above.

Table 22 : Number of Day Forward Premia is Computed from Traded/Interpolated Data Using 3 PM as Cut-off Time

	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
	Panel A: Computed From Traded Data Points											
2013	123	121	69	56	24	46	39	22	42	41	77	215
2014	148	162	141	108	92	139	127	115	132	126	156	229
2015	227	197	156	136	100	147	128	106	136	120	148	240
2016	220	204	170	153	146	185	156	130	149	123	143	226
2017	94	89	87	79	66	76	62	46	67	63	76	97
	Panel B: Computed Using Interpolation (Criteria: At least 1 Point <=3 and 1 Point >6)											
2013	53	59	97	121	141	122	133	143	131	132	100	9
2014	57	45	61	96	115	70	81	94	77	81	55	4
2015	11	41	82	104	139	92	110	132	102	118	91	1
2016	18	34	67	85	92	54	81	108	88	114	94	15
2017	4	9	11	20	32	22	37	52	32	36	23	2
	Panel C: Computed Using Previous Days Rate+ Adjacent Tenor Spread (Criteria in Panel B is not Met)											

2013	45	43	53	43	54	51	47	54	46	47	42	9
2014	26	23	28	26	23	21	22	21	21	23	20	1
2015	2	2	2	0	1	1	2	2	2	2	1	0
2016	3	3	4	3	3	2	4	3	4	4	4	0
2017	1	1	1	0	1	1	0	1	0	0	0	0
	Panel D: Using Previous Days Rate (Criteria in Panel B and Panel C is not Met)											
2013	23	21	25	24	25	25	25	25	25	24	25	11
2014	5	6	6	6	6	6	6	6	6	6	5	2
2015	1	1	1	1	1	1	1	1	1	1	1	0
2016	0	0	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0	0	0

In *Table 23,* we re-estimate the average number of trade and volumes in each tenor after taking into consideration the criteria followed for computation of the traded forward premia upto 3 PM.

Table 23: Tenor-Wise Analysis of Daily Average Number of Trades and Value of Swap Transactions –upto 3 PM

Year	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Panel A: Daily Average Number of Trades													
2013	146	10	9	8	7	6	7	7	6	7	6	9	16
2014	188	13	11	10	10	9	12	13	12	13	14	18	60
2015	180	20	13	10	10	9	12	11	11	11	13	19	69
2016	226	23	18	15	14	15	18	16	17	15	13	27	88
2017	170	24	19	16	15	11	13	15	12	15	14	27	91
2013-2017	183	18	14	12	11	11	13	13	13	13	13	20	62
Panel B: Daily Average Value in USD Million													
2013	3964	73	53	47	48	39	46	48	37	46	38	62	108
2014	5414	206	126	102	92	78	101	110	102	110	113	144	431
2015	5443	356	185	112	92	66	103	92	93	89	97	140	466
2016	7329	379	251	162	130	124	146	132	140	131	98	174	525
2017	5130	378	207	154	145	99	105	123	98	125	118	192	578
2013-2017	5496	295	172	122	106	92	112	109	108	108	99	146	406

4.3 Computation of Rolling Forward Premia (%) And Comparison with the Polled (Reuters) Rate

Using the computed Weighted Average Forward Premia from month end traded swaps, the Rolling forward premia (%) for specific tenors of 1 Month upto 12 Months was computed, using *Equation (3) and (4).* The descriptive statistics are depicted in *Table 24.*

Table 24: Descriptive Statistics of the Tenor wise Rolling Forward Premia Interpolated from Traded Rates (%)													
	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Mean	7.32	7.29	7.24	7.18	7.12	7.05	6.99	6.95	6.92	6.86	6.79	6.73	6.68
Standard Error	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03
Median	7.41	7.27	7.24	7.22	7.20	7.17	7.12	7.08	7.04	6.93	6.82	6.71	6.63
Standard Deviation	1.49	1.49	1.41	1.36	1.32	1.29	1.26	1.25	1.23	1.21	1.19	1.16	1.13
Sample Variance	2.22	2.22	1.99	1.84	1.73	1.66	1.59	1.55	1.52	1.46	1.41	1.35	1.29
Kurtosis	6.06	0.14	-0.21	-0.34	-0.51	-0.60	-0.64	-0.65	-0.63	-0.63	-0.62	-0.61	-0.59
Skewness	0.65	-0.20	-0.25	-0.30	-0.31	-0.32	-0.33	-0.33	-0.34	-0.32	-0.32	-0.32	-0.33
Range	16.96	9.66	8.37	7.96	7.06	6.45	6.05	5.71	5.83	5.45	5.22	5.07	5.01
Minimum	0.15	1.99	2.51	2.38	2.87	3.29	3.54	3.71	3.55	3.73	3.78	3.89	3.87
Maximum	17.11	11.65	10.88	10.34	9.93	9.74	9.59	9.42	9.38	9.18	9.00	8.96	8.88
Sum	7198	7733	7685	7621	7552	7481	7416	7362	7332	7267	7198	7138	7078
Count	983	1061	1061	1061	1061	1061	1061	1060	1060	1060	1060	1060	1060
** The 360D Rate has been extrapolated from the 11 month and 12 month weighted average traded rates.*													

Table 25 provides a comparison of the tenor-wise Rolling Forward Premia computed from traded rates vis-à-vis the forward premia mid quote obtained from Thomson Reuters

Table 25: Comparison of Traded and Polled Forward Premia (%)												
Year	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Panel A: Rolling Forward Premia computed From Traded Rates (%)												
2013	8.32	8.18	8.04	7.88	7.73	7.59	7.49	7.40	7.28	7.16	7.06	6.96
2014	8.44	8.40	8.35	8.31	8.27	8.23	8.20	8.18	8.12	8.06	8.00	7.93
2015	7.23	7.20	7.17	7.14	7.11	7.08	7.06	7.05	7.01	6.96	6.92	6.87
2016	6.13	6.13	6.08	6.03	5.98	5.94	5.92	5.92	5.88	5.83	5.80	5.77
2017	4.97	5.01	5.02	4.98	4.92	4.87	4.85	4.84	4.80	4.76	4.75	4.74
2013-2017	7.29	7.24	7.18	7.12	7.05	6.99	6.95	6.92	6.86	6.79	6.73	6.68
Panel B: Thomson Reuters Polled Forward Premia Mid Quote (%)												
2013	8.32	8.18	8.04	7.87	7.71	7.56	7.43	7.32	7.22	7.13	7.05	6.97
2014	8.42	8.41	8.36	8.31	8.26	8.22	8.19	8.15	8.11	8.06	8.00	7.93
2015	7.23	7.20	7.17	7.14	7.11	7.08	7.05	7.02	7.00	6.96	6.92	6.87
2016	6.16	6.13	6.08	6.02	5.98	5.94	5.91	5.88	5.86	5.83	5.80	5.78
2017	4.99	5.01	5.02	4.98	4.92	4.87	4.83	4.80	4.78	4.76	4.75	4.75
2013-2017	7.29	7.25	7.19	7.12	7.04	6.98	6.92	6.88	6.83	6.78	6.73	6.68
Panel C: Spread in Bps												
2013	-0.30	-0.45	-0.91	0.89	2.58	3.30	6.55	8.57	5.99	3.19	0.75	-1.21
2014	1.39	-0.54	-1.02	-0.19	0.63	0.39	0.95	2.61	1.49	0.21	-0.06	-0.37
2015	-0.42	0.12	0.04	-0.33	0.04	0.15	0.82	2.64	1.12	-0.07	-0.16	0.38
2016	-2.43	-0.67	-0.45	0.37	0.76	0.60	1.10	3.29	1.91	-0.04	-0.36	-0.59
2017	-1.79	-0.30	-0.26	0.15	-0.40	0.11	1.21	3.74	1.77	0.02	-0.61	-1.06
2013-2017	-0.57	-0.38	-0.55	0.18	0.88	1.03	2.21	4.20	2.52	0.72	-0.05	-0.53
*Note: Spread = (Traded Rate-Polled Rate)*100*												

4.4 Computation of Rupee Forward Premia from Alternative Spot Rates

A comparison of the Rupee Premia using the CCIL Traded Spot rate, RBI Reference rate and the USD/INR Spot rate obtained from Federal Reserve is displayed in *Table 26.*

Table 26: Comparison of Rupee Forward Premia using Alternative USD/INR Spot Rates (values in Rs.)

Year	O/N	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Panel A: Rupee Forward Premia computed using CCIL USD/INR Spot Rate													
2013	0.02	0.42	0.81	1.19	1.56	1.91	2.25	2.59	2.92	3.22	3.53	3.82	4.11
2014	0.02	0.44	0.86	1.28	1.7	2.11	2.52	2.93	3.33	3.72	4.11	4.48	4.84
2015	0.02	0.39	0.78	1.15	1.54	1.91	2.28	2.65	3.02	3.38	3.74	4.08	4.42
2016	0.02	0.35	0.7	1.03	1.36	1.68	2	2.33	2.66	2.97	3.28	3.58	3.89
2017	0.01	0.28	0.55	0.83	1.1	1.36	1.61	1.87	2.14	2.38	2.63	2.87	3.13
2013-2017	0.02	0.39	0.77	1.13	1.5	1.85	2.2	2.55	2.9	3.23	3.56	3.88	4.2
Panel B: Rupee Forward Premia computed using RBI USD/INR Spot Rate													
2013	0.02	0.42	0.81	1.19	1.56	1.91	2.25	2.59	2.92	3.22	3.53	3.82	4.11
2014	0.02	0.44	0.86	1.28	1.7	2.11	2.52	2.93	3.33	3.72	4.11	4.48	4.84
2015	0.02	0.39	0.78	1.15	1.54	1.91	2.28	2.65	3.02	3.38	3.74	4.08	4.42
2016	0.02	0.35	0.7	1.03	1.36	1.68	2	2.33	2.66	2.97	3.28	3.58	3.89
2017	0.01	0.28	0.55	0.83	1.1	1.36	1.61	1.87	2.14	2.38	2.63	2.87	3.13
2013-2017	0.02	0.39	0.77	1.13	1.5	1.85	2.2	2.55	2.9	3.23	3.56	3.88	4.2
Panel C: Rupee Forward Premia computed from USD/INR spot rate published by Federal Reserve													
2013	0.02	0.42	0.81	1.19	1.56	1.91	2.24	2.58	2.91	3.22	3.53	3.82	4.10
2014	0.02	0.44	0.86	1.28	1.7	2.11	2.52	2.93	3.33	3.72	4.11	4.48	4.85
2015	0.02	0.39	0.78	1.15	1.54	1.91	2.28	2.65	3.02	3.38	3.74	4.08	4.42
2016	0.02	0.35	0.7	1.03	1.36	1.69	2.01	2.34	2.66	2.97	3.28	3.58	3.89
2017	0.01	0.28	0.55	0.83	1.1	1.36	1.62	1.88	2.14	2.39	2.63	2.88	3.13
2013-2017	0.02	0.39	0.77	1.13	1.5	1.85	2.2	2.55	2.9	3.24	3.56	3.88	4.2

We find a close convergence in the Rupee forward premia computed using CCIL USD/INR spot rate and the RBI rate.

4.5 Computation of Tenor-Wise MIFOR rates

The computed Rolling Forward Premia (%) along with the USD LIBOR rates were then used to compute the MIFOR rate using *Equation (6).* On days the LIBOR rate has not been published, the previous day's rate has been used. The MIFOR rate was computed for the tenors of 1 day, 1 month, 2 month, 3 month and 6 month and 12 months. *Table 27* provides the descriptive statistics of the computed MIFOR rates.

Table 27: Descriptive Statistics of the Tenor-Wise MIFOR (%)						
	O/N	**1M**	**2M**	**3M**	**6M**	**12 M**
Mean	7.58	7.62	7.63	7.66	7.67	7.69
Standard Error	0.04	0.04	0.04	0.03	0.03	0.02
Median	7.58	7.53	7.55	7.54	7.61	7.60
Standard Deviation	1.35	1.32	1.22	1.12	0.95	0.79
Sample Variance	1.81	1.74	1.48	1.26	0.90	0.62
Kurtosis	9.09	0.47	0.02	-0.14	-0.51	-0.49
Skewness	1.10	0.01	-0.03	-0.06	-0.07	-0.10
Range	16.87	9.22	7.85	7.27	5.14	4.00
Minimum	0.63	2.60	3.25	3.33	4.87	5.60
Maximum	17.50	11.82	11.11	10.60	10.02	9.60
Sum	7447	8072	8092	8115	8128	8150
Count	983	1060	1060	1060	1060	1060

In *Table 28,* we compare the MIFOR computed using traded data with that obtained from Thomson Reuters for the period from January 2013 to May 2017.

Table 28: Comparison of Traded MIFOR versus Thomson Reuters MIFOR						
A: MIFOR FROM TRADED FORWARD PREMIA						
Year	**O/N**	**1M**	**2M**	**3M**	**6M**	**12 M**
2013	8.51	8.52	8.42	8.32	8.03	7.70
2014	8.41	8.60	8.60	8.60	8.57	8.54
2015	7.36	7.43	7.46	7.50	7.59	7.73
2016	6.70	6.64	6.74	6.84	7.05	7.25
2017	5.97	5.88	5.99	6.16	6.32	6.60
2013-2017	7.58	7.62	7.63	7.66	7.67	7.69
B: MIFOR FROM THOMSON REUTERS						
Year	**O/N**	**1M**	**2M**	**3M**	**6M**	**12 M**
2013	8.48	8.56	8.43	8.33	7.98	7.70
2014	8.41	8.65	8.64	8.62	8.58	8.55
2015	7.35	7.48	7.49	7.51	7.59	7.73
2016	6.63	6.71	6.76	6.85	7.04	7.25
2017	5.83	5.93	6.03	6.19	6.31	6.60
2013-2017	7.54	7.67	7.66	7.67	7.66	7.69
Spread In Bps*						
Year	**O/N**	**1M**	**2M**	**3M**	**6M**	**12 M**
2013	2.60	-3.93	-1.19	-0.94	4.52	-0.50
2014	0.21	-4.97	-3.16	-2.83	-0.16	-0.48
2015	0.94	-5.24	-2.25	-1.80	-0.39	0.34
2016	7.04	-7.17	-2.28	-1.24	0.61	-0.42
2017	13.87	-4.69	-3.74	-2.54	0.69	-0.58
2013-2017	3.45	-5.27	-2.36	-1.84	1.08	-0.29
*Spread = (A-B)*100						

A year-wise analysis of the variability of MIFOR rates (*Table 29)* obtained from traded data vis-à-vis that computed from Reuters is depicted by the coefficient of variation (CV) expressed as (Stdev/Average)*100.

Table 29: Tenor-Wise Daily Average MIFOR Rates						
	O/N	**1M**	**2M**	**3M**	**6M**	**12 M**
Year	*Panel A: Tenor-Wise CV of MIFOR from Traded Date (%)*					
2013	16.14	14.74	14.15	13.79	12.84	10.92
2014	6.81	6.75	6.00	5.41	5.12	5.41
2015	11.37	8.96	8.24	7.45	5.36	3.58
2016	18.35	16.76	14.35	12.60	9.36	7.52
2017	10.33	6.75	5.69	4.10	3.51	4.25
2013-2017	17.78	17.30	15.95	14.64	12.36	10.24
	Panel B: Tenor-Wise CV of MIFOR from Thomson Reuters (%)					
2013	15.97	14.40	13.88	13.41	12.99	10.73
2014	7.44	8.16	6.41	5.57	5.05	5.51
2015	11.94	10.00	8.40	7.56	5.22	3.58
2016	19.92	17.38	14.24	12.37	9.43	7.42
2017	14.12	6.58	5.61	3.04	3.48	4.25
2013-2017	18.67	17.49	15.87	14.51	12.36	10.19

5. YEAR END TURN

A 'turn", a two-three or four-day period from the last business day of the one financial year to the first day of the next financial year, is an important aspect in financial markets. As 1st April in India is a Bank holiday because of the Annual closing, the turn is at least two calendar days and can be more depending on holidays and non-working days. The "turn" has become important because of the year end funding process as at times balance sheet requirement may result in good amount of borrowing at the year end. At times, the average rate around the "turn" and the "turn" rate can be different because of the demand of balance sheets in the market at the financial year end. It was felt that the "turn" rate should also be released while releasing the forwards data to the market.

During interactions with market participants it was suggested that the forward premia computation for the month of March should take into account the year-end "turn". Market

may trade "turn" through a Forward X Forward Swap[2]. Accordingly, forward-on-forward swap pairs with the first leg on the last working day of March and the second leg on the first working day of April, reported upto 3PM, are considered for estimation. This weighted average forward premia i.e. the Year End Turn (YET) rate and rupee premia is calculated for such pairs of value at least $1 million. After elimination of outliers (+/- 3 STD from the volume weighted average rate), the final volume weighted average rupee premia is calculated, provided there are a minimum of 3 trades and total value of at least $25 million. The YET obtained above is added to the day's month-end spot-forward rupee premia (traded/calculated) for the month of March. An illustration of the computation of the forward premia rate/rupee for the First Business Day (FBD) of April using the traded YET rate/rupee is depicted below using *Equation (7) & Equation (8):*

[2] A Forward X Forward Swap is a contract in which the Spot Leg will start at a future date and the Forward Leg will end after "n" days from the spot leg date.

In Case Year End Turn (YET) is Traded												
Value Date Spot	**Value Date March**	**Value Date April**	**Value Date May**	**FBD April**	**Spot Rate**	**March Rupee / %**	**April Rupee / %**	**May Rupee / %**	**Interpolated Premia on 03-04-17**	**Traded YET**	**Traded Premia on 03-04-2017**	**Applicable Premia on 03-04-17**
$Date_{Spot}$	$Date_{March}$	$Date_{April}$	$Date_{May}$	$Date_{FBD\ Ap}$		$Premia_{March}$	$Premia_{April}$	$Premia_{May}$				$Premia_{FBD\ April}$
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	0.4545	0.7510	1.0162	-	0.081	0.5355	**0.5355**
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	4.7300%	5.0900%	4.9200%	-	14.5200 %	5.2730%	**5.2693%**

$$Premia_{FBD\ April}\ (Rupees) = \text{Premia}_{\text{March}} + \text{Traded YET} \quad \textit{... (7)}$$

$$= 0.4545 + 0.0810$$

$$= \mathbf{0.5355}$$

$$Premia_{FBD\ April}\ (\%) = \left[\left\{\left[1 + \left(\text{Premia}_{\text{March}}\% \times \frac{Date_{March} - Date_{Spot}}{365}\right)\right] \times \left[1 + \left(\text{Traded YET }\% \times \frac{\text{Date}_{\text{FBDApril}} - \text{Date}_{\text{March}}}{365}\right)\right]\right\} - 1\right] \times \left[\frac{365}{Date_{FBD\ April} - Date_{Spot}}\right] \times 100 \quad \textit{...(8)}$$

$$= \left[\left\{\left[1 + \left(4.7300\% \times \frac{31/03/17 - 07/02/17}{365}\right)\right] \times \left[1 + \left(14.5200\% \times \frac{03/04/17 - 31/03/17}{365}\right)\right]\right\} - 1\right] \times \left[\frac{365}{03/04/17 - 07/02/17}\right] \times 100$$

$$= \mathbf{5.2693}\%$$

However, an analysis of the data upto 3:00 PM for the period between June'16 to March 2017 shows that actual trading of such pairs is quite insignificant (*Table 30*).

Table 30: Forward on Forward Swap Trades upto 3 PM (after threshold criteria)

Month	Trades	Days Traded	Amount in Mio
Jun-16	0	0	0
Jul-16	0	0	0
Aug-16	0	0	0
Sep-16	0	0	0
Oct-16	0	0	0
Nov-16	4	1	150
Dec-16	44	6	2490
Jan-17	6	1	250
Feb-17	3	1	120
Mar-17	19	3	575

Hence on days when the minimum trading criteria is not met, we can interpolate the implied YET rupee from the March, April and May month-end spot-forward rupee premia. An illustration of the computation of the forward premia rate/rupee for the First Business Day (FBD) of April using the implied YET rupee using *Equation (9) & Equation (10)* is as follows:

In Case Year End Turn (YET) is NOT Traded												
Value Date Spot	**Value Date March**	**Value Date April**	**Value Date May**	**FBD April**	**Spot Rate**	**March Rupee / %**	**April Rupee / %**	**May Rupee / %**	**Interpolated Premia on 03-04-17**	**Traded YET**	**Traded Premia on 03-04-2017**	**Applicable Premia on 03-04-17**
$Date_{Spot}$	$Date_{March}$	$Date_{April}$	$Date_{May}$	$Date_{FBD\ April}$		$Premia_{March}$	$Premia_{April}$	$Premia_{May}$				$Premia_{FBD\ April}$
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	0.4545	0.7510	1.0162	0.5501	-	-	**0.5501**
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	4.7300%	5.0900%	4.9200%	5.4193	-	-	**5.4193%**

$$Premia_{FBD\ April}\ (Rupees) = Premia_{March} + \left\{\left[Premia_{April} - Premia_{March}\right] - \left[\left(\frac{Premia_{May} - Premia_{April}}{Date_{May} - Date_{April}}\right) \times \left(Date_{Apr} - \mathrm{FBD}_{\mathrm{April}}\right)\right]\right\} \quad \textit{...(9)}$$

$$= 0.4545 + \left\{[0.7510 - 0.4545] - \left[\left(\frac{1.0162 - 0.7510}{31/05/17 - 28/04/17}\right) \times (28/04/17 - 03/04/17)\right]\right\}$$

$$= \mathbf{0.5501}$$

$$Premia_{FBD\ April}\ (\%) = \left(\frac{Premia_{FBD\ April}\ (Rupees)}{Spot\ Rate}\right) \times \left(\frac{365}{\mathrm{Date}_{\mathrm{FBD\ April}} - Date_{spot}}\right) \times 100 \quad \textit{...(10)}$$

$$= \left(\frac{0.5501}{67.3626}\right) \times \left(\frac{365}{03/04/17 - 07/02/17}\right) \times 100$$

$$= \mathbf{5.4193\%}$$

A comparison of the Implied Year end turn Rupee premia with the traded rupee premia obtained on days when computation was possible, suggests that there is no significant difference between the two samples (*Table 31*).

Table 31: Year End "Turn" Computation vs traded (for 03/Apr/2017)

Trade Date	Traded Year End Turn Rupee Premia (a)	Implied Year End Turn Rupee Premia (b)	Difference (Rs.) (a-b)
29-11-16	0.83	0.79	0.04
16-12-16	0.90	0.87	0.03
19-12-16	0.88	0.90	-0.02
22-12-16	0.83	0.84	-0.01
27-12-16	0.85	0.86	0.00
29-12-16	0.79	0.78	0.01
30-12-16	0.78	0.78	0.00
04-01-17	0.74	0.73	0.01
27-02-17	0.32	0.34	-0.02
07-03-17	0.25	0.26	-0.01
17-03-17	0.14	0.16	-0.01
22-03-17	0.12	0.13	-0.01
Mean	0.62	0.62	0.00
STD DEV	0.31	0.30	
Coeff of Variation	0.50	0.49	

6. CONCLUDING REMARKS

We have computed the annualized Forward Rates from the month end SWAP transactions undertaken by market participants which was reported and settled by CCIL from Jan 2013 to May 2017. The market uses a Rolling Forward premia of standard months (viz. 1-month, 2-month, etc.). Accordingly, we converted the data into standard month Forward Rates by interpolation of rates of relevant months. We also computed overnight forward premia using Cash and Tom swap rates. Then we computed the Rupee Forward premia using 3 alternative spot rates, viz. CCIL Benchmark Spot Rate, RBI Spot Rate and Spot rate published by US Fed. We further computed MIFOR using the LIBOR and relevant Rolling Forward Rates. The Rolling Forward rates computed from the trades were compared with Reuter's polling data and it was found to have similar characteristics.

A similar analysis was carried out for estimating the forward premia and MIFOR for all transactions reported upto 3 PM following the feedback from market participants. A fallback mechanism was also designed to compute the rates for the tenors which were not traded. The results were found to be largely consistent with the analysis for the full day. An analysis of the year end turn was also carried out, from forward on forward swap pairs with the first leg on the last working day of March and the second leg on the first working day of April. While we found few instances when it was possible to compute the year

end turn rupee premia from the traded data, on the days when such computation was not possible the year end turn rupee premia was implied from the March-end, April-end and May-end Spot-forward rupee premia.

Annexure 1- Two Sample T-Test Results for Comparison of Average versus Median as an Outlier Detection Method For the Period of 01-01-2013 to 31-12-2016

TENOR=1M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	955	7.52	1.39	0.04	0.17	12.15
Median	955	7.52	1.39	0.05	0.00	12.14
Diff (1-2)		0.00	1.39	0.06		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.52	7.43	7.61	1.39	1.33	1.45
Median		7.52	7.44	7.61	1.39	1.33	1.46
Diff (1-2)	Pooled	0.00	-0.13	0.12	1.39	1.35	1.44
Diff (1-2)	Satterthwaite	0.00	-0.13	0.12			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1908	-0.07	0.9466
Satterthwaite	Unequal	1908	-0.07	0.9466

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	954	954	1.00	0.9583

TENOR=2M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	962	7.52	1.31	0.04	2.12	10.90
Median	962	7.52	1.31	0.04	1.99	11.54
Diff (1-2)		0.00	1.31	0.06		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.52	7.43	7.60	1.31	1.25	1.37
Median		7.52	7.44	7.60	1.31	1.26	1.37
Diff (1-2)	Pooled	0.00	-0.12	0.11	1.31	1.27	1.35
Diff (1-2)	Satterthwaite	0.00	-0.12	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1922	-0.05	0.9592
Satterthwaite	Unequal	1922	-0.05	0.9592

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	961	961	1.01	0.9091

TENOR=3M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	954	7.45	1.25	0.04	2.51	10.57
Median	954	7.45	1.24	0.04	2.57	10.57
Diff (1-2)		0.00	1.25	0.06		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.45	7.37	7.53	1.25	1.19	1.30
Median		7.45	7.37	7.53	1.24	1.19	1.30
Diff (1-2)	Pooled	0.00	-0.11	0.12	1.25	1.21	1.29
Diff (1-2)	Satterthwaite	0.00	-0.11	0.12			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1906	0.06	0.9524
Satterthwaite	Unequal	1906	0.06	0.9524

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	953	953	1.00	0.9558

TENOR=4M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	944	7.37	1.20	0.04	2.68	10.08
Median	944	7.37	1.20	0.04	2.77	10.06
Diff (1-2)		0.00	1.20	0.06		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.37	7.29	7.45	1.20	1.15	1.26
Median		7.37	7.29	7.44	1.20	1.15	1.26
Diff (1-2)	Pooled	0.00	-0.11	0.11	1.20	1.17	1.24
Diff (1-2)	Satterthwaite	0.00	-0.11	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1886	0.06	0.9523
Satterthwaite	Unequal	1886	0.06	0.9523

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	943	943	1.00	0.9953

TENOR=5M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	940	7.29	1.16	0.04	3.05	9.85
Median	940	7.28	1.16	0.04	3.10	9.97
Diff (1-2)		0.00	1.16	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.29	7.21	7.36	1.16	1.11	1.21
Median		7.28	7.21	7.36	1.16	1.11	1.21
Diff (1-2)	Pooled	0.00	-0.10	0.11	1.16	1.12	1.20
Diff (1-2)	Satterthwaite	0.00	-0.10	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1878	0.03	0.9757
Satterthwaite	Unequal	1878	0.03	0.9757

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	939	939	1.00	0.9877

TENOR=6M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	949	7.22	1.12	0.04	3.27	9.72
Median	949	7.22	1.12	0.04	3.14	9.73
Diff (1-2)		0.00	1.12	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.22	7.15	7.29	1.12	1.07	1.17
Median		7.22	7.15	7.29	1.12	1.07	1.17
Diff (1-2)	Pooled	0.00	-0.10	0.10	1.12	1.09	1.16
Diff (1-2)	Satterthwaite	0.00	-0.10	0.10			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1896	0.04	0.9644
Satterthwaite	Unequal	1896	0.04	0.9644

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	948	948	1.00	0.9957

TENOR=7M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	924	7.15	1.10	0.04	3.45	9.54
Median	924	7.14	1.10	0.04	3.56	9.56
Diff (1-2)		0.00	1.10	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.15	7.07	7.22	1.10	1.05	1.16
Median		7.14	7.07	7.22	1.10	1.05	1.15
Diff (1-2)	Pooled	0.00	-0.10	0.10	1.10	1.07	1.14
Diff (1-2)	Satterthwaite	0.00	-0.10	0.10			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1846	0.02	0.9806
Satterthwaite	Unequal	1846	0.02	0.9806

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	923	923	1.00	0.9657

TENOR=8M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	855	7.10	1.09	0.04	3.44	9.50
Median	855	7.10	1.09	0.04	3.35	9.49
Diff (1-2)		0.00	1.09	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.10	7.03	7.17	1.09	1.04	1.15
Median		7.10	7.03	7.17	1.09	1.04	1.15
Diff (1-2)	Pooled	0.00	-0.10	0.10	1.09	1.06	1.13
Diff (1-2)	Satterthwaite	0.00	-0.10	0.10			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1708	0.01	0.9887
Satterthwaite	Unequal	1708	0.01	0.9887

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	854	854	1.00	0.9924

TENOR=9M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	844	7.04	1.07	0.04	3.70	9.48
Median	844	7.04	1.07	0.04	3.50	9.51
Diff (1-2)		0.00	1.07	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		7.04	6.97	7.11	1.07	1.02	1.13
Median		7.04	6.97	7.11	1.07	1.03	1.13
Diff (1-2)	Pooled	0.00	-0.10	0.10	1.07	1.04	1.11
Diff (1-2)	Satterthwaite	0.00	-0.10	0.10			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1686	0.01	0.9897
Satterthwaite	Unequal	1686	0.01	0.9897

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	843	843	1.00	0.9779

TENOR=10M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	851	6.99	1.06	0.04	3.77	9.04
Median	851	6.99	1.06	0.04	3.78	9.05
Diff (1-2)		0.00	1.06	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		6.99	6.92	7.06	1.06	1.01	1.11
Median		6.99	6.92	7.06	1.06	1.01	1.11
Diff (1-2)	Pooled	0.00	-0.10	0.10	1.06	1.02	1.09
Diff (1-2)	Satterthwaite	0.00	-0.10	0.10			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1700	0.00	0.9975
Satterthwaite	Unequal	1700	0.00	0.9975

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	850	850	1.00	0.9970

TENOR=11M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	919	6.96	1.02	0.03	3.77	9.07
Median	919	6.96	1.02	0.03	3.83	9.09
Diff (1-2)		0.00	1.02	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		6.96	6.89	7.02	1.02	0.98	1.07
Median		6.96	6.89	7.02	1.02	0.98	1.07
Diff (1-2)	Pooled	0.00	-0.09	0.09	1.02	0.99	1.06
Diff (1-2)	Satterthwaite	0.00	-0.09	0.09			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1836	0.00	0.9982
Satterthwaite	Unequal	1836	0.00	0.9982

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	918	918	1.00	0.9990

TENOR=12M

METHOD	N	Mean	Std Dev	Std Err	Min	Max
Average	962	6.91	1.00	0.03	3.86	8.88
Median	962	6.91	1.00	0.03	3.89	8.88
Diff (1-2)		0.00	1.00	0.05		

METHOD	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Average		6.91	6.85	6.97	1.00	0.96	1.05
Median		6.91	6.84	6.97	1.00	0.96	1.05
Diff (1-2)	Pooled	0.00	-0.09	0.09	1.00	0.97	1.03
Diff (1-2)	Satterthwaite	0.00	-0.09	0.09			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1922	0.01	0.992
Satterthwaite	Unequal	1922	0.01	0.992

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	961	961	1.00	0.9889

Annexure 2-Correlation Matrix of the Rolling Forward Premia computed from Trades (T) Versus Polled Forward Premia (P) for the period of 01-01-2013 to 31-05-2017.

	30 (T)	*60 (T)*	*90 (T)*	*120 (T)*	*150 (T)*	*180 (T)*	*210 (T)*	*240 (T)*	*270 (T)*	*300 (T)*	*330 (T)*	*360 (T)*	*30 (P)*	*60 (P)*	*90 (P)*	*120 (P)*	*150 (P)*	*180 (P)*	*210 (P)*	*240 (P)*	*270 (P)*	*300 (P)*	*330 (P)*	*360 (P)*
30 (T)	1.00																							
60 (T)	0.99	1.00																						
90 (T)	0.98	0.99	1.00																					
120 (T)	0.97	0.99	1.00	1.00																				
150 (T)	0.96	0.98	0.99	1.00	1.00																			
180 (T)	0.95	0.97	0.98	0.99	1.00	1.00																		
210 (T)	0.94	0.96	0.98	0.99	0.99	1.00	1.00																	
240 (T)	0.93	0.95	0.97	0.98	0.99	1.00	1.00	1.00																
270 (T)	0.91	0.94	0.96	0.97	0.99	0.99	1.00	1.00	1.00															
300 (T)	0.91	0.93	0.95	0.97	0.98	0.99	0.99	1.00	1.00	1.00														
330 (T)	0.90	0.93	0.95	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00													
360 (T)	0.89	0.92	0.94	0.96	0.97	0.98	0.99	0.99	1.00	1.00	1.00	1.00												
30 (P)	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.91	0.91	0.90	0.89	1.00											
60 (P)	0.99	1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.93	0.92	0.99	1.00										
90 (P)	0.98	0.99	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.95	0.95	0.94	0.98	0.99	1.00									
120 (P)	0.97	0.98	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.97	0.96	0.96	0.97	0.99	1.00	1.00								
150 (P)	0.96	0.98	0.99	1.00	1.00	1.00	0.99	0.99	0.98	0.98	0.98	0.97	0.96	0.98	0.99	1.00	1.00							
180 (P)	0.95	0.97	0.98	0.99	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.98	0.95	0.97	0.98	0.99	1.00	1.00						
210 (P)	0.94	0.96	0.98	0.99	0.99	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.94	0.96	0.98	0.99	1.00	1.00	1.00					
240 (P)	0.93	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.93	0.95	0.97	0.98	0.99	1.00	1.00	1.00				
270 (P)	0.92	0.94	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	0.99	0.92	0.94	0.96	0.98	0.99	0.99	1.00	1.00	1.00			
300 (P)	0.91	0.93	0.95	0.97	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	0.91	0.93	0.95	0.97	0.98	0.99	0.99	1.00	1.00	1.00		
330 (P)	0.90	0.93	0.95	0.97	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	0.90	0.93	0.95	0.97	0.98	0.99	0.99	1.00	1.00	1.00	1.00	
360 (P)	0.89	0.92	0.94	0.96	0.97	0.98	0.99	0.99	1.00	1.00	1.00	1.00	0.90	0.92	0.94	0.96	0.97	0.98	0.99	0.99	1.00	1.00	1.00	1.00

Annexure 3: Two Sample T Test for Comparison of Traded (T) Versus Thomson Reuters Polled (P) Forward Premia Rates (%) for the period of 01-01-2013 to 31-05-2017

TENOR=1 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	7.29	1.48	0.05	1.74	10.97
Traded	1061	7.29	1.48	0.05	1.99	11.36
Diff (1-2)		0.00	1.48	0.06		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		7.29	7.21	7.38	1.48	1.42	1.54
Traded		7.29	7.20	7.38	1.48	1.42	1.54
Diff (1-2)	Pooled	0.00	-0.12	0.13	1.48	1.43	1.52
Diff (1-2)	Satterthwaite	0.00	-0.12	0.13			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2120	0.02	0.984
Satterthwaite	Unequal	2120	0.02	0.984

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1060	1060	1	0.9812

TENOR=2 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	7.25	1.41	0.04	2.24	10.53
Traded	1061	7.24	1.41	0.04	2.49	10.65
Diff (1-2)		0.00	1.41	0.06		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		7.25	7.16	7.33	1.41	1.35	1.47
Traded		7.24	7.16	7.33	1.41	1.35	1.47
Diff (1-2)	Pooled	0.00	-0.12	0.12	1.41	1.37	1.45
Diff (1-2)	Satterthwaite	0.00	-0.12	0.12			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2120	0.04	0.9684
Satterthwaite	Unequal	2120	0.04	0.9684

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1060	1060	1	0.9774

TENOR=3 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	7.19	1.36	0.04	2.49	10.11
Traded	1061	7.19	1.36	0.04	2.68	10.28
Diff (1-2)		0.00	1.36	0.06		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		7.19	7.11	7.27	1.36	1.30	1.42
Traded		7.19	7.10	7.27	1.36	1.30	1.42
Diff (1-2)	Pooled	0.00	-0.11	0.12	1.36	1.32	1.40
Diff (1-2)	Satterthwaite	0.00	-0.11	0.12			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2120	0.05	0.9577
Satterthwaite	Unequal	2120	0.05	0.9577

Equality of Variances				
Method	Num DF	Den	F	Pr > F

TENOR=4 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	7.12	1.32	0.04	2.69	9.92
Traded	1061	7.11	1.31	0.04	3.02	9.84
Diff (1-2)		0.00	1.31	0.06		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		7.12	7.04	7.20	1.32	1.26	1.37
Traded		7.11	7.04	7.19	1.31	1.26	1.37
Diff (1-2)	Pooled	0.00	-0.11	0.11	1.31	1.28	1.35
Diff (1-2)	Satterthwaite	0.00	-0.11	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2120	0.03	0.9731
Satterthwaite	Unequal	2120	0.03	0.9731

Equality of Variances				
Method	Num DF	Den DF	F	Pr > F

		DF	Value	
Folded F	1060	1060	1	0.9592

TENOR=5 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	7.04	1.28	0.04	3.06	9.82
Traded	1061	7.04	1.28	0.04	3.27	9.74
Diff (1-2)		0.00	1.28	0.06		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		7.04	6.96	7.12	1.28	1.23	1.34
Traded		7.04	6.96	7.12	1.28	1.23	1.34
Diff (1-2)	**Pooled**	0.00	-0.11	0.11	1.28	1.24	1.32
Diff (1-2)	**Satterthwaite**	0.00	-0.11	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2120	0.05	0.9608
Satterthwaite	Unequal	2120	0.05	0.9608

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1060	1.01	0.9318

TENOR=7 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	6.92	1.24	0.04	3.35	9.56
Traded	1060	6.92	1.24	0.04	3.44	9.51
Diff (1-2)		0.00	1.24	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		6.92	6.85	7.00	1.24	1.19	1.30
Traded		6.92	6.85	6.99	1.24	1.19	1.29
Diff (1-2)	**Pooled**	0.00	-0.10	0.11	1.24	1.20	1.28
Diff (1-2)	**Satterthwaite**	0.00	-0.10	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2119	0.06	0.9495
Satterthwaite	Unequal	2119	0.06	0.9495

			Value	
Folded F	1060	1060	1.01	0.9145

TENOR=6 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	6.98	1.26	0.04	3.23	9.74
Traded	1061	6.98	1.25	0.04	3.44	9.56
Diff (1-2)		0.00	1.26	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		6.98	6.90	7.06	1.26	1.21	1.32
Traded		6.98	6.90	7.05	1.25	1.20	1.31
Diff (1-2)	**Pooled**	0.00	-0.10	0.11	1.26	1.22	1.30
Diff (1-2)	**Satterthwaite**	0.00	-0.10	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2120	0.07	0.9446
Satterthwaite	Unequal	2119.9	0.07	0.9446

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1060	1.01	0.8673

TENOR=8 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	6.88	1.23	0.04	3.46	9.41
Traded	1060	6.87	1.22	0.04	3.70	9.48
Diff (1-2)		0.00	1.22	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		6.88	6.80	6.95	1.23	1.18	1.28
Traded		6.87	6.80	6.95	1.22	1.17	1.28
Diff (1-2)	**Pooled**	0.00	-0.10	0.11	1.22	1.19	1.26
Diff (1-2)	**Satterthwaite**	0.00	-0.10	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2119	0.04	0.9695
Satterthwaite	Unequal	2119	0.04	0.9695

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1059	1.01	0.9294

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1059	1	0.9622

TENOR=9 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	6.83	1.21	0.04	3.54	9.33
Traded	1060	6.83	1.20	0.04	3.76	9.11
Diff (1-2)		0.00	1.21	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		6.83	6.76	6.90	1.21	1.16	1.26
Traded		6.83	6.75	6.90	1.20	1.15	1.26
Diff (1-2)	**Pooled**	0.00	-0.10	0.11	1.21	1.17	1.24
Diff (1-2)	**Satterthwaite**	0.00	-0.10	0.11			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2119	0.06	0.9486
Satterthwaite	Unequal	2119	0.06	0.9486

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1059	1	0.9384

TENOR=10 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	6.78	1.18	0.04	3.63	9.15
Traded	1060	6.78	1.18	0.04	3.77	9.05
Diff (1-2)		0.00	1.18	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		6.78	6.71	6.85	1.18	1.14	1.24
Traded		6.78	6.71	6.85	1.18	1.13	1.23
Diff (1-2)	**Pooled**	0.00	-0.10	0.10	1.18	1.15	1.22
Diff (1-2)	**Satterthwaite**	0.00	-0.10	0.10			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2119	0.05	0.9602
Satterthwaite	Unequal	2119	0.05	0.9602

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1059	1.01	0.9322

TENOR=11 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	6.73	1.16	0.04	3.69	8.98
Traded	1060	6.73	1.16	0.04	3.86	9.00
Diff (1-2)		0.00	1.16	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		6.73	6.66	6.80	1.16	1.11	1.21
Traded		6.73	6.66	6.80	1.16	1.11	1.21
Diff (1-2)	**Pooled**	0.00	-0.10	0.10	1.16	1.12	1.19
Diff (1-2)	**Satterthwaite**	0.00	-0.10	0.10			

Method	Variances	DF	t	Pr > |t|

TENOR=12 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Polled	1061	6.68	1.13	0.03	3.74	8.79
Traded	1060	6.68	1.13	0.03	3.90	8.80
Diff (1-2)		0.00	1.13	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Polled		6.68	6.61	6.75	1.13	1.08	1.18
Traded		6.68	6.61	6.75	1.13	1.08	1.18
Diff (1-2)	**Pooled**	0.00	-0.10	0.10	1.13	1.10	1.17
Diff (1-2)	**Satterthwaite**	0.00	-0.10	0.10			

Method	Variances	DF	t Value	Pr > |t|

			Value	
Pooled	Equal	2119	0.03	0.9757
Satterthwaite	Unequal	2119	0.03	0.9757

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1059	1	0.9549

Pooled	Equal	2119	0.01	0.9881
Satterthwaite	Unequal	2119	0.01	0.9881

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1059	1	0.9795

Annexure 4: Two Sample T Test for Rupee Forward Premia computed using CCIL versus RBI Spot Rates for the period of 01-01-2013 to 31-05-2017

TENOR=O/N

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	985	0.0126	0.0024	0.0001	0.0003	0.0311
TRADED	985	0.0126	0.0024	0.0001	0.0003	0.0310
Diff (1-2)		0.0000	0.0024	0.0001		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		0.0126	0.0124	0.0127	0.0024	0.0023	0.0025
TRADED		0.0126	0.0124	0.0127	0.0024	0.0023	0.0025
Diff (1-2)	**Pooled**	0.0000	-0.0002	0.0002	0.0024	0.0023	0.0024
Diff (1-2)	**Satterthwaite**	0.0000	-0.0002	0.0002			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1968	0.0000	0.9986
Satterthwaite	Unequal	1968	0.0000	0.9986

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	984	984	1.0000	0.9898

TENOR=1 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	0.3905	0.0757	0.0023	0.1121	0.6241
TRADED	1060	0.3905	0.0757	0.0023	0.1122	0.6244
Diff (1-2)		0.0000	0.0757	0.0033		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		0.3905	0.3859	0.3950	0.0757	0.0726	0.0791
TRADED		0.3905	0.3859	0.3950	0.0757	0.0726	0.0791
Diff (1-2)	**Pooled**	0.0000	-0.0065	0.0065	0.0757	0.0735	0.0781
Diff (1-2)	**Satterthwaite**	0.0000	-0.0065	0.0065			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9988
Satterthwaite	Unequal	2118	0.0000	0.9988

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.0000	0.9958

TENOR=2 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	0.7657	0.1372	0.0042	0.2956	1.1427

TENOR=3 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	1.1322	0.1943	0.0060	0.4571	1.6734

TRADED	1060	0.7657	0.1371	0.0042	0.2960	1.1377
Diff (1-2)		0.0000	0.1372	0.0060		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		0.7657	0.7574	0.7740	0.1372	0.1316	0.1433
TRADED		0.7657	0.7574	0.7740	0.1371	0.1315	0.1432
Diff (1-2)	**Pooled**	0.0000	-0.0117	0.0117	0.1372	0.1331	0.1414
Diff (1-2)	**Satterthwaite**	0.0000	-0.0117	0.0117			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9986
Satterthwaite	Unequal	2118	0.0000	0.9986

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.0000	0.9935

TRADED	1060	1.1322	0.1943	0.0060	0.4571	1.6660
Diff (1-2)		0.0000	0.1943	0.0084		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		1.1322	1.1205	1.1439	0.1943	0.1864	0.2030
TRADED		1.1322	1.1205	1.1439	0.1943	0.1864	0.2029
Diff (1-2)	**Pooled**	0.0000	-0.0165	0.0166	0.1943	0.1886	0.2003
Diff (1-2)	**Satterthwaite**	0.0000	-0.0165	0.0166			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9985
Satterthwaite	Unequal	2118	0.0000	0.9985

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.0000	0.9925

TENOR=4 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	1.4975	0.2498	0.0077	0.6807	2.1059
TRADED	1060	1.4975	0.2498	0.0077	0.6807	2.1121
Diff (1-2)		0.0000	0.2498	0.0109		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		1.4975	1.4824	1.5125	0.2498	0.2396	0.2610
TRADED		1.4975	1.4824	1.5125	0.2498	0.2396	0.2609
Diff (1-2)	**Pooled**	0.0000	-0.0213	0.0213	0.2498	0.2425	0.2576
Diff (1-2)	**Satterthwaite**	0.0000	-0.0213	0.0213			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9985
Satterthwaite	Unequal	2118	0.0000	0.9985

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**

TENOR=5 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	1.8475	0.3041	0.0093	0.9278	2.5134
TRADED	1060	1.8475	0.3040	0.0093	0.9290	2.5022
Diff (1-2)		0.0000	0.3041	0.0132		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		1.8475	1.8292	1.8658	0.3041	0.2917	0.3177
TRADED		1.8475	1.8292	1.8658	0.3040	0.2916	0.3176
Diff (1-2)	**Pooled**	0.0000	-0.0259	0.0259	0.3041	0.2952	0.3135
Diff (1-2)	**Satterthwaite**	0.0000	-0.0259	0.0259			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9985
Satterthwaite	Unequal	2118	0.0000	0.9985

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**

Folded F	1059	1059	1.0000	0.9932	

TENOR=6 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	2.1951	0.3571	0.0110	1.1847	2.9735
TRADED	1060	2.1951	0.3570	0.0110	1.1861	2.9734
Diff (1-2)		0.0000	0.3571	0.0155		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		2.1951	2.1736	2.2167	0.3571	0.3425	0.3730
TRADED		2.1951	2.1736	2.2166	0.3570	0.3424	0.3729
Diff (1-2)	**Pooled**	0.0000	-0.0304	0.0304	0.3571	0.3466	0.3682
Diff (1-2)	**Satterthwaite**	0.0000	-0.0304	0.0304			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9985
Satterthwaite	Unequal	2118	0.0000	0.9985

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1059	1.0000	0.993

Folded F	1059	1059	1.0000	0.9929	

TENOR=7 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	2.5440	0.4119	0.0127	1.3709	3.3804
TRADED	1060	2.5440	0.4118	0.0126	1.3726	3.3910
Diff (1-2)		0.0000	0.4118	0.0179		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		2.5440	2.5192	2.5688	0.4119	0.3951	0.4302
TRADED		2.5440	2.5192	2.5688	0.4118	0.3950	0.4301
Diff (1-2)	**Pooled**	0.0000	-0.0350	0.0351	0.4118	0.3998	0.4246
Diff (1-2)	**Satterthwaite**	0.0000	-0.0350	0.0351			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9986
Satterthwaite	Unequal	2118	0.0000	0.9986

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1059	1.0000	0.9937

TENOR=8 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	2.8837	0.4653	0.0143	1.6908	3.8582
TRADED	1060	2.8837	0.4652	0.0143	1.6929	3.8704
Diff (1-2)		0.0000	0.4652	0.0202		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		2.8837	2.8557	2.9118	0.4653	0.4463	0.4860
TRADED		2.8837	2.8556	2.9117	0.4652	0.4462	0.4859
Diff (1-2)	**Pooled**	0.0000	-0.0396	0.0397	0.4652	0.4516	0.4797
Diff (1-2)	**Satterthwaite**	0.0000	-0.0396	0.0397			

Method	Variances	DF	t Value	Pr > |t|

TENOR=9 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	3.2212	0.5156	0.0158	1.9272	4.2497
TRADED	1060	3.2212	0.5155	0.0158	1.9272	4.2631
Diff (1-2)		0.0000	0.5156	0.0224		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		3.2212	3.1901	3.2523	0.5156	0.4946	0.5386
TRADED		3.2212	3.1901	3.2522	0.5155	0.4945	0.5385
Diff (1-2)	**Pooled**	0.0000	-0.0439	0.0440	0.5156	0.5005	0.5316
Diff (1-2)	**Satterthwaite**	0.0000	-0.0439	0.0440			

Method	Variances	DF	t Value	Pr >

Pooled	Equal	2118	0.0000	0.9986
Satterthwaite	Unequal	2118	0.0000	0.9986

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.0000	0.994

				|t|
Pooled	Equal	2118	0.0000	0.9986
Satterthwaite	Unequal	2118	0.0000	0.9986

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.0000	0.9943

TENOR=10 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	3.5581	0.5644	0.0173	2.1554	4.6602
TRADED	1060	3.5581	0.5642	0.0173	2.1581	4.6749
Diff (1-2)		0.0000	0.5643	0.0245		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		3.5581	3.5241	3.5922	0.5644	0.5413	0.5895
TRADED		3.5581	3.5241	3.5921	0.5642	0.5412	0.5894
Diff (1-2)	**Pooled**	0.0000	-0.0480	0.0481	0.5643	0.5478	0.5818
Diff (1-2)	**Satterthwaite**	0.0000	-0.0480	0.0481			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9986
Satterthwaite	Unequal	2118	0.0000	0.9986

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.0000	0.9944

TENOR=11 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	3.8820	0.6078	0.0187	2.4398	5.0063
TRADED	1060	3.8819	0.6077	0.0187	2.4429	5.0221
Diff (1-2)		0.0000	0.6077	0.0264		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		3.8820	3.8453	3.9186	0.6078	0.5830	0.6349
TRADED		3.8819	3.8453	3.9185	0.6077	0.5829	0.6347
Diff (1-2)	**Pooled**	0.0000	-0.0517	0.0518	0.6077	0.5900	0.6266
Diff (1-2)	**Satterthwaite**	0.0000	-0.0517	0.0518			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9985
Satterthwaite	Unequal	2118	0.0000	0.9985

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.0000	0.9939

TYPE	N	Mean	Std Dev	Std Err	Min	Max
RBI	1060	4.2039	0.6486	0.0199	2.6699	5.3740
TRADED	1060	4.2039	0.6485	0.0199	2.6700	5.3909
Diff (1-2)		0.0001	0.6486	0.0282		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
RBI		4.2039	4.1648	4.2430	0.6486	0.6222	0.6775
TRADED		4.2039	4.1648	4.2430	0.6485	0.6220	0.6773
Diff (1-2)	Pooled	0.0001	-0.0552	0.0553	0.6486	0.6296	0.6687
Diff (1-2)	Satterthwaite	0.0001	-0.0552	0.0553			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.0000	0.9985
Satterthwaite	Unequal	2118	0.0000	0.9985

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1059	1.0000	0.994

Annexure 5: Two Sample T Test for Rupee Forward Premia computed using CCIL versus FED Spot Rates for the period of 01-01-2013 to 31-05-2017

TENOR=O/N

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	981	0.0126	0.0024	0.0001	0.0003	0.0310
TRADED	985	0.0126	0.0024	0.0001	0.0003	0.0310
Diff (1-2)		0.0000	0.0024	0.0001		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		0.0126	0.0124	0.0127	0.0024	0.0023	0.0025
TRADED		0.0126	0.0124	0.0127	0.0024	0.0023	0.0025
Diff (1-2)	Pooled	0.0000	-0.0002	0.0002	0.0024	0.0023	0.0024
Diff (1-2)	Satterthwaite	0.0000	-0.0002	0.0002			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1964	-0.0100	0.9914

TENOR=1 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	0.3908	0.0753	0.0024	0.1392	0.6203
TRADED	1060	0.3905	0.0757	0.0023	0.1122	0.6244
Diff (1-2)		0.0003	0.0755	0.0033		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		0.3908	0.3861	0.3954	0.0753	0.0721	0.0787
TRADED		0.3905	0.3859	0.3950	0.0757	0.0726	0.0791
Diff (1-2)	Pooled	0.0003	-0.0062	0.0068	0.0755	0.0733	0.0779
Diff (1-2)	Satterthwaite	0.0003	-0.0062	0.0068			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0900	0.9261

Satterthwaite	Unequal	1964	-0.0100	0.9914

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	984	980	1.0000	0.9602

TENOR=2 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	0.7664	0.1361	0.0043	0.3202	1.1501
TRADED	1060	0.7657	0.1371	0.0042	0.2960	1.1377
Diff (1-2)		0.0007	0.1366	0.0060		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		0.7664	0.7581	0.7748	0.1361	0.1304	0.1422
TRADED		0.7657	0.7574	0.7740	0.1371	0.1315	0.1432
Diff (1-2)	**Pooled**	0.0007	-0.0110	0.0125	0.1366	0.1326	0.1409
Diff (1-2)	**Satterthwaite**	0.0007	-0.0110	0.0125			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.1200	0.9039
Satterthwaite	Unequal	2076	0.1200	0.9039

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1019	1.0200	0.8016

TENOR=4 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	1.4981	0.2481	0.0078	0.6820	2.1176

Satterthwaite	Unequal	2076	0.0900	0.9261

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1019	1.0100	0.8522

TENOR=3 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	1.1331	0.1929	0.0060	0.4579	1.6842
TRADED	1060	1.1322	0.1943	0.0060	0.4571	1.6660
Diff (1-2)		0.0008	0.1936	0.0085		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		1.1331	1.1212	1.1449	0.1929	0.1849	0.2017
TRADED		1.1322	1.1205	1.1439	0.1943	0.1864	0.2029
Diff (1-2)	**Pooled**	0.0008	-0.0158	0.0175	0.1936	0.1879	0.1997
Diff (1-2)	**Satterthwaite**	0.0008	-0.0158	0.0175			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.1000	0.9208
Satterthwaite	Unequal	2076	0.1000	0.9208

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1019	1.0100	0.818

TENOR=5 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	1.8483	0.3022	0.0095	0.9632	2.5295

TRADED	1060	1.4975	0.2498	0.0077	0.6807	2.1121
Diff (1-2)		0.0006	0.2489	0.0109		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		1.4981	1.4828	1.5133	0.2481	0.2378	0.2593
TRADED		1.4975	1.4824	1.5125	0.2498	0.2396	0.2609
Diff (1-2)	**Pooled**	0.0006	-0.0208	0.0220	0.2489	0.2416	0.2567
Diff (1-2)	**Satterthwaite**	0.0006	-0.0208	0.0220			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0600	0.9556
Satterthwaite	Unequal	2076	0.0600	0.9556

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1019	1.0100	0.8268

TRADED	1060	1.8475	0.3040	0.0093	0.9290	2.5022
Diff (1-2)		0.0008	0.3032	0.0133		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		1.8483	1.8297	1.8669	0.3022	0.2897	0.3159
TRADED		1.8475	1.8292	1.8658	0.3040	0.2916	0.3176
Diff (1-2)	**Pooled**	0.0008	-0.0253	0.0269	0.3032	0.2942	0.3127
Diff (1-2)	**Satterthwaite**	0.0008	-0.0253	0.0269			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0600	0.951
Satterthwaite	Unequal	2076	0.0600	0.951

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1019	1.0100	0.8466

TENOR=6 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	2.1962	0.3551	0.0111	1.2226	3.0013
TRADED	1060	2.1951	0.3570	0.0110	1.1861	2.9734
Diff (1-2)		0.0011	0.3561	0.0156		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		2.1962	2.1744	2.2181	0.3551	0.3403	0.3712
TRADED		2.1951	2.1736	2.2166	0.3570	0.3424	0.3729
Diff (1-2)	**Pooled**	0.0011	-0.0295	0.0317	0.3561	0.3456	0.3672
Diff (1-2)	**Satterthwaite**	0.0011	-0.0295	0.0317			

TENOR=7 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	2.5451	0.4095	0.0128	1.4919	3.4229
TRADED	1060	2.5440	0.4118	0.0126	1.3726	3.3910
Diff (1-2)		0.0011	0.4107	0.0180		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		2.5451	2.5199	2.5703	0.4095	0.3925	0.4281
TRADED		2.5440	2.5192	2.5688	0.4118	0.3950	0.4301
Diff (1-2)	**Pooled**	0.0011	-0.0342	0.0365	0.4107	0.3986	0.4236
Diff (1-2)	**Satterthwait**	0.0011	-0.0342	0.0365			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0700	0.9428
Satterthwaite	Unequal	2076	0.0700	0.9428

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1019	1.0100	0.8613

TENOR=8 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	2.8850	0.4631	0.0145	1.6966	3.9067
TRADED	1060	2.8837	0.4652	0.0143	1.6929	3.8704
Diff (1-2)		0.0013	0.4641	0.0204		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		2.8850	2.8565	2.9134	0.4631	0.4438	0.4841
TRADED		2.8837	2.8556	2.9117	0.4652	0.4462	0.4859
Diff (1-2)	Pooled	0.0013	-0.0386	0.0412	0.4641	0.4505	0.4787
Diff (1-2)	Satterthwaite	0.0013	-0.0386	0.0412			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0600	0.9488
Satterthwaite	Unequal	2076	0.0600	0.9488

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1019	1.0100	0.8824

TENOR=10 M

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0600	0.9498
Satterthwaite	Unequal	2076	0.0600	0.9498

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1019	1.0100	0.8611

TENOR=9 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	3.2227	0.5132	0.0161	1.9308	4.3031
TRADED	1060	3.2212	0.5155	0.0158	1.9272	4.2631
Diff (1-2)		0.0016	0.5144	0.0226		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		3.2227	3.1912	3.2542	0.5132	0.4919	0.5365
TRADED		3.2212	3.1901	3.2522	0.5155	0.4945	0.5385
Diff (1-2)	Pooled	0.0016	-0.0427	0.0458	0.5144	0.4992	0.5305
Diff (1-2)	Satterthwaite	0.0016	-0.0427	0.0458			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0700	0.9453
Satterthwaite	Unequal	2076	0.0700	0.9453

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1019	1.0100	0.8869

TENOR=11 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	3.5593	0.5617	0.0176	2.2506	4.7188
TRADED	1060	3.5581	0.5642	0.0173	2.1581	4.6749
Diff (1-2)		0.0012	0.5630	0.0247		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		3.5593	3.5248	3.5938	0.5617	0.5384	0.5872
TRADED		3.5581	3.5241	3.5921	0.5642	0.5412	0.5894
Diff (1-2)	Pooled	0.0012	-0.0472	0.0496	0.5630	0.5464	0.5807
Diff (1-2)	Satterthwaite	0.0012	-0.0472	0.0496			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0500	0.961
Satterthwaite	Unequal	2076	0.0500	0.961

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1019	1.0100	0.8861

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	3.8835	0.6051	0.0189	2.4674	5.0692
TRADED	1060	3.8819	0.6077	0.0187	2.4429	5.0221
Diff (1-2)		0.0016	0.6064	0.0266		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		3.8835	3.8463	3.9206	0.6051	0.5799	0.6325
TRADED		3.8819	3.8453	3.9185	0.6077	0.5829	0.6347
Diff (1-2)	Pooled	0.0016	-0.0506	0.0537	0.6064	0.5885	0.6254
Diff (1-2)	Satterthwaite	0.0016	-0.0506	0.0537			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2078	0.0600	0.9534
Satterthwaite	Unequal	2076	0.0600	0.9533

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1019	1.0100	0.8909

TENOR=12 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
FED	1020	4.2055	0.6456	0.0202	2.6749	5.4416
TRADED	1060	4.2039	0.6485	0.0199	2.6700	5.3909
Diff (1-2)		0.0017	0.6471	0.0284		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
FED		4.2055	4.1659	4.2452	0.6456	0.6187	0.6749

TRADED		4.2039	4.1648	4.2430	0.6485	0.6220	0.6773
Diff (1-2)	**Pooled**	0.0017	-0.0540	0.0573	0.6471	0.6280	0.6674
Diff (1-2)	**Satterthwaite**	0.0017	-0.0540	0.0573			

Method	**Variances**	**DF**	**t Value**	**Pr > |t|**
Pooled	Equal	2078	0.0600	0.9536
Satterthwaite	Unequal	2076	0.0600	0.9536

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1019	1.0100	0.8848

Annexure 6: Two Sample T-Test of MIFOR from Traded Rates in comparison with MIFOR from Thomson Reuters

TENOR=O/N							
TYPE	**N**	**Mean**	**Std Dev**	**Std Err**	**Min**	**Max**	
Reuters	1059	7.54	1.41	0.04	0.46	18.63	
Traded	1060	7.56	1.36	0.04	0.64	17.49	
Diff (1-2)		-0.02	1.39	0.06			

TYPE	**Method**	**Mean**	**95% CL Mean**		**Std Dev**	**95% CL Std Dev**	
Reuters		7.54	7.46	7.63	1.41	1.35	1.47
Traded		7.56	7.47	7.64	1.36	1.31	1.42
Diff (1-2)	**Pooled**	-0.02	-0.13	0.10	1.39	1.35	1.43
Diff (1-2)	**Satterthwaite**	-0.02	-0.13	0.10			

Method	**Variances**	**DF**	**t Value**	**Pr > |t|**
Pooled	Equal	2117	-0.26	0.7963
Satterthwaite	Unequal	2115	-0.26	0.7963

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1058	1059	1.07	0.3019

TENOR=1 M							
TYPE	**N**	**Mean**	**Std Dev**	**Std Err**	**Min**	**Max**	
Reuters	1060	7.67	1.34	0.04	2.73	11.78	
Traded	1060	7.61	1.31	0.04	2.60	11.54	
Diff (1-2)		0.06	1.33	0.06			

TYPE	**Method**	**Mean**	**95% CL Mean**		**Std Dev**	**95% CL Std Dev**	
Reuters		7.67	7.59	7.75	1.34	1.29	1.40
Traded		7.61	7.53	7.69	1.31	1.26	1.37
Diff (1-2)	**Pooled**	0.06	-0.05	0.17	1.33	1.29	1.37
Diff (1-2)	**Satterthwaite**	0.06	-0.05	0.17			

Method	**Variances**	**DF**	**t Value**	**Pr > |t|**
Pooled	Equal	2118	1.04	0.3003
Satterthwaite	Unequal	2117	1.04	0.3003

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.05	0.4704

TENOR=2 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Reuters	1060	7.66	1.22	0.04	3.20	10.97
Traded	1060	7.63	1.22	0.04	3.21	10.88
Diff (1-2)		0.03	1.22	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Reuters		7.66	7.58	7.73	1.22	1.17	1.27
Traded		7.63	7.55	7.70	1.22	1.17	1.27
Diff (1-2)	Pooled	0.03	-0.07	0.14	1.22	1.18	1.26
Diff (1-2)	Satterthwaite	0.03	-0.07	0.14			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.59	0.5523
Satterthwaite	Unequal	2118	0.59	0.5523

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1059	1.01	0.9157

TENOR=3 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Reuters	1061	7.67	1.11	0.03	3.67	10.64
Traded	1060	7.65	1.12	0.03	3.62	10.54
Diff (1-2)		0.02	1.12	0.05		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Reuters		7.67	7.61	7.74	1.11	1.07	1.16
Traded		7.65	7.58	7.72	1.12	1.08	1.17
Diff (1-2)	Pooled	0.02	-0.07	0.12	1.12	1.08	1.15
Diff (1-2)	Satterthwaite	0.02	-0.07	0.12			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2119	0.5	0.6143
Satterthwaite	Unequal	2118.9	0.5	0.6143

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	1059	1060	1.01	0.8254

TENOR=6 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Reuters	1061	7.66	0.95	0.03	4.76	9.95
Traded	1060	7.64	0.94	0.03	4.75	9.97
Diff (1-2)		0.01	0.95	0.04		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Reuters		7.66	7.60	7.71	0.95	0.91	0.99
Traded		7.64	7.59	7.70	0.94	0.91	0.99
Diff (1-2)	Pooled	0.01	-0.07	0.10	0.95	0.92	0.97
Diff (1-2)	Satterthwaite	0.01	-0.07	0.10			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2119	0.36	0.7201
Satterthwaite	Unequal	2119	0.36	0.7201

TENOR=12 M

TYPE	N	Mean	Std Dev	Std Err	Min	Max
Reuters	1060	7.69	0.78	0.02	5.63	9.48
Traded	1060	7.68	0.79	0.02	5.61	9.48
Diff (1-2)		0.01	0.79	0.03		

TYPE	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Reuters		7.69	7.64	7.74	0.78	0.75	0.82
Traded		7.68	7.63	7.72	0.79	0.75	0.82
Diff (1-2)	Pooled	0.01	-0.05	0.08	0.79	0.76	0.81
Diff (1-2)	Satterthwaite	0.01	-0.05	0.08			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	2118	0.42	0.6763
Satterthwaite	Unequal	2118	0.42	0.6763

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1060	1059	1	0.9421

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	1059	1059	1.01	0.9164

Annexure – 7

Sample of Forward Premia Calculations

a. Computation of Month End Forward Rates for 29-01-2018

From the trades for the day, we computed the Month End Forwards for all Tenors where minimum trade criteria were met. For the trading date 29-01-2018, the Spot settlement falls on 31-Jan-2017 (not holiday) while the forward is on month end dates subject to adjustment of holidays. We calculated the weighted average forward rates for the Tenors. The next step is to calculate the Year End Turn (YET) as the last Business day of March is on 28-Mar-2018 while the first business day of April is 02-Apr-2018 that falls between the 2M and 3M tenors. Here, we have shown the data upto 5M as the same is required for YET computation.

Table 1 – Trades executed on 29-01-2018 till 3.00PM

Pair No.	Trade Date	Spot Sett. Date	Fwd. Sett. Date	Spot Rate	Forward Rate	Amount	Premia %	Weighted Premia %	Rupee Premia	Weighted Rupee Premia	Tenor
1	29-01-18	31-01-18	28-02-18	63.5250	63.7330	30000000	4.2683	128049000	0.2080	6240000	1M
2	29-01-18	31-01-18	28-02-18	63.5250	63.7330	30000000	4.2683	128049000	0.2080	6240000	1M
3	29-01-18	31-01-18	28-02-18	63.5375	63.7450	5000000	4.2572	21286000	0.2075	1037500	1M
4	29-01-18	31-01-18	28-02-18	63.5375	63.7450	5000000	4.2572	21286000	0.2075	1037500	1M
5	29-01-18	31-01-18	28-02-18	63.5450	63.7525	5000000	4.2567	21283500	0.2075	1037500	1M
6	29-01-18	31-01-18	28-02-18	63.5450	63.7525	5000000	4.2567	21283500	0.2075	1037500	1M
7	29-01-18	31-01-18	28-02-18	63.5200	63.7290	5000000	4.2891	21445500	0.2090	1045000	1M
8	29-01-18	31-01-18	28-02-18	63.5200	63.7290	5000000	4.2891	21445500	0.2090	1045000	1M
9	29-01-18	31-01-18	28-02-18	63.5300	63.7390	2000000	4.2885	8577000	0.2090	418000	1M
10	29-01-18	31-01-18	28-02-18	63.5300	63.7390	2000000	4.2885	8577000	0.2090	418000	1M
11	29-01-18	31-01-18	28-02-18	63.5000	63.7075	15000000	4.2597	63895500	0.2075	3112500	1M
					WAR =	**109000000**		**465177500**		**22668500**	
					WAPremia%	**4.2677**			**WA Rupee**	**0.2080**	
						(465177500/109000000)				**(22668500/109000000)**	
12	29-01-18	31-01-18	28-03-18	63.5100	63.9360	15000000	4.3719	65578500	0.4260	6390000	2M
13	29-01-18	31-01-18	28-03-18	63.5100	63.9360	15000000	4.3719	65578500	0.4260	6390000	2M
14	29-01-18	31-01-18	28-03-18	63.5305	63.9565	5000000	4.3705	21852500	0.4260	2130000	2M
15	29-01-18	31-01-18	28-03-18	63.5315	63.9565	5000000	4.3602	21801000	0.4250	2125000	2M
16	29-01-18	31-01-18	28-03-18	63.5305	63.9555	5000000	4.3603	21801500	0.4250	2125000	2M

17	29-01-18	31-01-18	28-03-18	63.5295	63.9555	5000000	4.3706	21853000	0.4260	2130000	2M
18	29-01-18	31-01-18	28-03-18	63.5315	63.9575	5000000	4.3704	21852000	0.4260	2130000	2M
19	29-01-18	31-01-18	28-03-18	63.5540	63.9750	10000000	4.3176	43176000	0.4210	4210000	2M
20	29-01-18	31-01-18	28-03-18	63.5300	63.9650	1700000	4.4629	7586930	0.4350	739500	2M
						66700000		**291079930**		**28369500**	
					WAPremia%	**4.3640**			**WA Rupee**	**0.4253**	
21	29-01-18	31-01-18	27-04-18	63.5200	64.2300	25000000	4.7440	118600000	0.7100	17750000	3M
22	29-01-18	31-01-18	27-04-18	63.5200	64.2300	25000000	4.7440	118600000	0.7100	17750000	3M
23	29-01-18	31-01-18	27-04-18	63.5225	64.2255	20000000	4.6970	93940000	0.7030	14060000	3M
24	29-01-18	31-01-18	27-04-18	63.5225	64.2255	20000000	4.6970	93940000	0.7030	14060000	3M
25	29-01-18	31-01-18	27-04-18	63.5200	64.2230	15000000	4.6972	70458000	0.7030	10545000	3M
26	29-01-18	31-01-18	27-04-18	63.5200	64.2230	15000000	4.6972	70458000	0.7030	10545000	3M
27	29-01-18	31-01-18	27-04-18	63.5250	64.2375	25000000	4.7603	119007500	0.7125	17812500	3M
28	29-01-18	31-01-18	27-04-18	63.5250	64.2375	25000000	4.7603	119007500	0.7125	17812500	3M
29	29-01-18	31-01-18	27-04-18	63.5300	64.2325	5000000	4.6931	23465500	0.7025	3512500	3M
30	29-01-18	31-01-18	27-04-18	63.5300	64.2325	30000000	4.6931	140793000	0.7025	21075000	3M
31	29-01-18	31-01-18	27-04-18	63.5300	64.2325	30000000	4.6931	140793000	0.7025	21075000	3M
32	29-01-18	31-01-18	27-04-18	63.5295	64.2320	5000000	4.6932	23466000	0.7025	3512500	3M
33	29-01-18	31-01-18	27-04-18	63.5155	64.2225	5000000	4.7243	23621500	0.7070	3535000	3M
34	29-01-18	31-01-18	27-04-18	63.5155	64.2225	10000000	4.7243	47243000	0.7070	7070000	3M
						255000000		**1203393000**		**180115000**	
					W.A. Premia %	**4.7192**			**WA Rupee**	**0.7063**	
35	29-01-18	31-01-18	31-05-18	63.5100	64.4700	2000000	4.5977	9195400	0.9600	1920000	4M
36	29-01-18	31-01-18	31-05-18	63.5100	64.4700	2000000	4.5977	9195400	0.9600	1920000	4M
37	29-01-18	31-01-18	29-06-18	63.5300	64.7125	5000000	4.5596	22798000	1.1825	5912500	5M
38	29-01-18	31-01-18	29-06-18	63.5300	64.7125	25000000	4.5596	113990000	1.1825	29562500	5M
39	29-01-18	31-01-18	29-06-18	63.5500	64.7350	10000000	4.5678	45678000	1.1850	11850000	5M
40	29-01-18	31-01-18	29-06-18	63.5500	64.7350	10000000	4.5678	45678000	1.1850	11850000	5M
41	29-01-18	31-01-18	29-06-18	63.5175	64.7000	5000000	4.5605	22802500	1.1825	5912500	5M
						55000000		**250946500**		**65087500**	
					W.A. Premia %	**4.5627**			**WA Rupee**	**1.1834**	

The Annualized month end forward premia is computed using the following equation:

$$\textbf{Annualised Month End Forward Premia} = \left[\frac{F_t - S_t}{S_t}\right] \times \left[\frac{365}{F_{Value\ Date} - S_{Value\ Date}}\right] \times 100$$

where,
F_t *is the Forward Rate;*
S_t *is the Spot Rate;*
$F_{Value\ Date}$ *is the Forward Settlement Date and*
$S_{Value\ Date}$ *is the Spot Settlement Date.*

For example the month end forward premia % for the Pair No. 1 is computed as ((63.7330 (FP)-63.5250(SP))/ 63.5250(SP))*(365/(28/Feb/18-31/Jan/18)) = 4.2683. The Rupee premia for Pair No 1 is calculated as: 63.7330-63.5250 = 0.2080. The traded premia for 4M (as in the Table -1) is not computed as it fails to meet the minimum criteria of at least 3 trades and the same will be computed using Fallback mechanism.

The Weighted average premia in % and in Rupees (month end) for all the traded tenors is given below.

Trade Date	Tenor	WAR	WRUP
29-01-2018	CT	4.1905	0.0073
29-01-2018	1M	4.2677	0.208
29-01-2018	2M	4.3640	0.4253
29-01-2018	3M	4.7192	0.7063
29-01-2018	4M	FAIL	FAIL
29-01-2018	5M	4.5627	1.1834
29-01-2018	6M	4.5048	1.4193
29-01-2018	7M	FAIL	FAIL
29-01-2018	8M	FAIL	FAIL
29-01-2018	9M	FAIL	FAIL
29-01-2018	10M	FAIL	FAIL
29-01-2018	11M	4.4027	2.5599
29-01-2018	12M	4.3649	2.773
29-01-2018	FWD_FWD	FAIL	FAIL

As the criteria for interpolation is met i.e. Minimum 3 traded tenors, with 1 traded tenor upto 3M and 1 traded tenor beyond 6 M, the missing tenors are calculated using interpolation as per the following equation. Example is given for M4.

$$\textbf{Month End Forward Premia}\ (\%)FP_4 = FP_3 + \frac{[(FP_5 - FP_3)]}{Days_5 - Days_3} \times (Days_4 - Days_3)$$

Table – 2 Month End Forwards using interpolation for Missing Tenors on 29-01-2018														
	Spot Settlement Date↓	**CT**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**
Month End Settlement Dates	Forward Date=>		28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019
WAR % (T-1)	30-Jan-2018	4.3154	4.1823	4.3287	4.3983	4.7465	4.6791	4.6217	4.5583	4.4999	4.474	4.4481	4.4346	4.4207
WAR % (T)	31-Jan-2018	4.1905	4.2677	4.364	4.7192	4.6347	4.5627	4.5048	4.4841	4.4654	4.4434	4.4234	4.4027	4.3649
Spread (T)-(T-1)	31-Jan-2018		8.54	3.53	32.09	11.18	11.64	11.69	7.42	3.45	3.06	2.47	3.19	5.58
Value (USD Mn)	31-Jan-2018		109	66.7	**255**		55	160					**194**	50
WAR % After Adj.	31-Jan-2018	4.1905	**4.2677**	**4.364**	**4.7192**	**4.8910**	**4.5627**	**4.5048**	**4.4841**	**4.4654**	**4.4434**	**4.4234**	**4.4027**	**4.3649**
WRUP (Rs.) (T)	31-Jan-2018	0.0073	**0.208**	**0.4253**	**0.7063**	**1.0219**	**1.1834**	**1.4193**	**1.6551**	**1.8659**	**2.112**	**2.3336**	**2.5599**	**2.773**
TRADED/CALC.		TRADED	TRADED	TRADED	TRADED	CALC.	TRADED	TRADED	CALC.	CALC.	CALC.	CALC.	TRADED	TRADED
Weighted Average Spot Rate = 63.5503														

For example, the 4M rate is computed as 4.7192+((4.5627-4.7192)/(29/Jun/2018-27/Apr/2018)) * (31/May/2018- 27/April/2018) =4.6347. Since the spread of the Forward Premia rate computed for a tenor using interpolation varies by more than (+/-) 10 bps compared to the previous day's Month-End Forward Premia (%), for 4M, the 4M rate is recomputed by adding to the previous day's 4M forward premia, the average spread of the two most liquid traded tenors of the day (i.e. 3M and 11M). The rate is computed as 4.7465+(((4.7192-4.3983)+(4.4027-4.4346))/2) = 4.8910. The month rupee premia for 4M is computed as 4.8910*63.5503*((31/May/2018-31/Jan/2018)/36500) = 1.0219.

Computation of YET Rates for 29-01-2018:

Since the YET is relevant here as Last Business Day (LBD) of March falls on 28-Mar-2018 and First Business Day (FBD) falls on 02-Apr-2018, Forward X Forward trade for the above period is to be considered for YET computation. However, since minimum threshold criteria for trades in Forward X Forward was not observed, the YET has to be computed from March/April/May month end forwards. The applicable Forward Rate for 02-Apr-2018 would be computed after finding out the Rupee premia relevant for 02-Apr-2018 using the formula:

$$Premia_{YET} = Premia_{Mar} + \left\{ \left[Premia_{Apr} - Premia_{Mar} \right] - \left[\left(\frac{Premia_{May} - Premia_{Apr}}{Date_{May} - Date_{Apr}} \right) \times \left(Date_{Apr} - Date_{YET} \right) \right] \right\}$$

Table 3: Computation of YET Rate % and Rupee										
Spot Settlement	**Value Date March**	**Value Date April**	**Value Date May**	**Year End Turn Date**	**March Rupee**	**April Rupee**	**May Rupee**	**Interpolated Rupee Premia on FBD April**	**Traded Rupee Premia on FBD April**	**Applicable Rupee Premia on FBD April**
31-Jan-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	0.4253	0.7063	1.0219	0.4742		0.4742
Spot Settlement	Value Date March	Value Date April	Value Date May	Year End Turn Date	March %	April %	May %	Interpolated % Premia on FBD April	Traded % Premia on FBD April	Applicable % Premia on FBD April
31-Jan-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	4.3640	4.7192	4.891	4.4649		4.4649

Interpolated YET Rs.	0.0489	(0.7063-0.4253)-[{(1.0219-0.7063)/(31/May/2018-27/Apr/2018)}*(27/Apr/2018-02/Apr/2018)]
Rupee Premia on FBD April	**0.4742**	**0.4253+0.0489**
Implied Premia % on FBD April	**4.4649**	**(0.4742/63.5503)*(365/(02/04/2018-31/01/2018))*100**

This Implied Premia % as on FBD of April (02-Apr-2018) will be used for computation of all Rolling Rates during 02-Apr-2018 to 27-Apr-2018. For example, Rolling Forward for 17-Apr-2018 will be computed interpolation between 4.4649% and 4.7192%.

Computation of Rolling Forward Rates for 29-01-2018:

Rolling Forward Premia (RFP) (%) is computed using the equation:

$$\boldsymbol{RFP_{15-03-18\ on\ 15-01-18}} = \boldsymbol{FP_{28-02-18}} + \frac{[(\mathbf{15-03-18})-(\mathbf{28-02-18})\times(\boldsymbol{FP_{28-03-18}}-\boldsymbol{FP_{28-02-18}})]}{((\mathbf{28-03-18})-(\mathbf{28-02-18}))}$$

Table – 4: Computation of Rolling Forwards for trade date 29-Jan-2018

	Spot Sett. Date	CT	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M	FBD
Month End Settlement Dates			28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019	02-Apr-2018
Rolling Settlement Dates	31-Jan-2018		28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019	
Month End Forward Premia (%)	31-Jan-2018	4.1905	4.2677	4.364	4.7192	4.891	4.5627	4.5048	4.4841	4.4654	4.4434	4.4234	4.4027	4.3649	4.4649
Rolling Forward Premia (%)	31-Jan-2018	4.1905	4.2677	4.364	4.7192	4.891	4.5627	4.5048	4.4841	4.4654	4.4434	4.4234	4.4027	4.3649	
Month End Forward Premia (Rs.)	31-Jan-2018	0.0073	0.208	0.4253	0.7063	1.0219	1.1834	1.4193	1.6551	1.8659	2.112	2.3336	2.5599	2.773	0.4742
Rolling Forward Premia (Rs.)	31-Jan-2018	0.0073	0.2081	0.4255	0.7066	1.0219	1.1837	1.4196	1.6551	1.8659	2.112	2.3336	2.5603	2.7739	
Weighted Average Spot Rate: 63.5503															

For example, Rolling Forward Rate for 1M (as on trade date of 29-Jan-2018) is computed as 4.2677+((4.364-4.2677)/(28/Mar/2018 - 28/Feb/2018))*(28/Feb/2018 - 28/Feb/2018) =4.2677.

In case the Rolling date of a Tenor falls on any day between the FBD April Date and the April Month End Date, for example the Rolling Date is April 16, 2018 then the Rolling Rate would be calculated as follows:

$$\boldsymbol{RFP_{16-04-18\ on\ 15-01-18}} = \boldsymbol{FP_{02-04-2018}} + \frac{[(\mathbf{16-04-18}) - (\mathbf{02-04-18}) \times (\boldsymbol{FP_{27-04-18}} - \boldsymbol{FP_{02-04-18}})]}{((\mathbf{27-04-18}) - (\mathbf{02-04-18}))}$$

The Rolling Rupee Premia is calculated from the computed Rolling Premia % using the following equation:

$$\textbf{Rupee Forward Premia} = \textbf{FP}_{\textbf{M}} \times \textbf{S}_{\textbf{t}} \times \left(\frac{\textbf{N}}{\textbf{36500}}\right)$$

where,
FP_M is the Rolling Forward Premia Rate(%) for the relevant tenor
S_t is the applicable Spot Rate
N is the number of calendar days from Spot settlement date using modified following day convention till Forward Settlement date.

In case of 1M, the rolling rupee premia is calculated as (4.2677/100)*63.5503*((28/Feb/2018-31/Jan/2018)/365) =0.2081.

Computation of Month End Forward Rates for 12-02-2018

In section (a) of this Annexure we have shown the calculation of the Month end rates and Rolling Forward Premia in case the criteria of atleast 3 trades, with 1 trade within 3M, 1 trade beyond 6M is met for which we use interpolation to calculate the missing tenors to arrive at the Month end rates for that day. However, in case the above criteria is not met then we use Previous day plus average of nearby tenor spreads to arrive at the missing tenors. For 12-02-2018 we obtained traded Month rates for only 2 Tenors i.e. 3M and 12M, due to which the nearby tenor average spread criteria was adopted. The computation of the missing month-end rates is shown below.

Computation of Month-end Rates for 12-02-2018

The Weighted average premia in % and in Rupees (month end) for all the traded tenors is given below.

Trade Date	Tenor	WAR	WRUP
12-02-2018	CT	**4.5181**	**0.0159**
12-02-2018	1M	FAIL	FAIL
12-02-2018	2M	FAIL	FAIL
12-02-2018	3M	**5.1039**	**0.6382**
12-02-2018	4M	FAIL	FAIL
12-02-2018	5M	FAIL	FAIL
12-02-2018	6M	FAIL	FAIL
12-02-2018	7M	FAIL	FAIL
12-02-2018	8M	FAIL	FAIL
12-02-2018	9M	FAIL	FAIL
12-02-2018	10M	FAIL	FAIL
12-02-2018	11M	FAIL	FAIL
12-02-2018	12M	**4.4279**	**2.7292**
12-02-2018	FWD_FWD	FAIL	FAIL

Table – 5 Month End Forwards using interpolation for Missing Tenors on 12-02-2018

	Spot Settlement Date↓	CT	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Month End Settlement Dates	Forward Date=>	14-Feb-2018	28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019
WAR % (T-1)	14-Feb-2018	4.5226	4.6611	4.7666	5.0622	4.9274	4.8124	4.6856	4.5627	4.5347	4.5017	4.4717	4.4407	4.4096
WAR % (T)	15-Feb-2018	**4.5181**	**4.7028**	**4.8083**	**5.1039**	**4.9574**	**4.8366**	**4.7069**	**4.5825**	**4.5538**	**4.5204**	**4.4902**	**4.4591**	**4.4279**
WRUP (Rs.) (T)	15-Feb-2018	**0.0159**	**0.1077**	**0.3472**	**0.6382**	**0.9167**	**1.1414**	**1.376**	**1.5898**	**1.8044**	**2.0539**	**2.2774**	**2.5051**	**2.7292**
Weighted Average Spot Rate = 64.2797														

As the criteria for interpolation is not met and only 2 Traded Tenors are there, we calculate the missing tenors as shown in the following table.

The missing tenors are computed using the following equations:

$$\textbf{Month End Forward Premia}\ (\%)\ FP_1 = FP_{1(Prev)} + \left(FP_3 - FP_{3(Prev)}\right)$$

In case of 1M which is not traded, the Month end rate is computed as: 4.6611+(5.1039-5.0622) = 4.7028

$$\textbf{Month End Forward Premia}\ (\%)\ FP_4 = FP_{4(Prev)} + \frac{\left[\left(FP_{12} - FP_{12(Prev)}\right) + \left(FP_3 - FP_{3(Prev)}\right)\right]}{2}$$

The 4M rate is computed as 4.9274+(((4.4279-4.4096)+(5.1039-5.0622))/2) =4.9574. The month end rupee premia for 4M is computed as 4.9574*64.2797*((31/May/2018- 15/Feb/2018)/36500) = 0.9167.

Computation of YET Rates for 12-02-2018:

Since the YET is relevant here as Last Business Day (LBD) of March falls on 28-Mar-2018 and First Business Day (FBD) falls on 02-Apr-2018, Forward X Forward trade for the above period is to be considered for YET computation. However, since minimum threshold criteria for trades in Forward X Forward was not observed, the YET has to be computed from March/April/May month end forwards. The applicable Forward Rate for 02-Apr-2018 would be computed after finding out the Rupee premia relevant for 02-Apr-2018 using the formula:

$$Premia_{YET} = Premia_{Mar} + \left\{\left[Premia_{Apr} - Premia_{Mar}\right] - \left[\left(\frac{Premia_{May} - Premia_{Apr}}{Date_{May} - Date_{Apr}}\right) \times \left(Date_{Apr} - Date_{YET}\right)\right]\right\}$$

Table 6: Computation of YET Rate % and Rupee										
Spot Settlement	**Value Date March**	**Value Date April**	**Value Date May**	**Year End Turn Date**	**March Rupee**	**April Rupee**	**May Rupee**	**Interpolated Rupee Premia on FBD April**	**Traded Rupee Premia on FBD April**	**Applicable Rupee Premia on FBD April**
15-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	0.3472	0.6382	0.9167	0.4334		0.4334
Spot Settlement	**Value Date March**	**Value Date April**	**Value Date May**	**Year End Turn Date**	**March %**	**April %**	**May %**	**Interpolated % Premia on FBD April**	**Traded % Premia on FBD April**	**Applicable % Premia on FBD April**
15-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	4.8083	5.1039	4.9574	5.3500		5.3500

Interpolated YET Rs.	0.0862	(0.6382-0.3472)-[{(0.9167-0.6382)/(31/May/2018-27/Apr/2018)}* (27/Apr/2018-02/Apr/2018)]
Rupee Premia on FBD April	**0.4334**	**0.3472+0.0862**
Implied Premia % on FBD April	**5.3500**	**(0.4334/64.2797)*(365/(02/04/2018-15/02/2018))*100**

Computation of Rolling Forward Rates for 12-02-2018:

Rolling Forward Premia (RFP) (%) is computed using the equation:

$$\boldsymbol{RFP_{15-03-18\ on\ 15-01-18}} = \boldsymbol{FP_{28-02-18}} + \frac{[(\mathbf{15-03-18})-(\mathbf{28-02-18})\times(\boldsymbol{FP_{28-03-18}}-\boldsymbol{FP_{28-02-18}})]}{((\mathbf{28-03-18})-(\mathbf{28-02-18}))}$$

Table – 7: Computation of Rolling Forwards for trade date 12-Feb-2018															
	Spot Sett. Date	**CT**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**	**FBD**
Month End Settlement Dates			28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019	02-Apr-2018
Rolling Settlement Dates	15-Feb-2018		15-Mar-2018	16-Apr-2018	15-May-2018	15-Jun-2018	16-Jul-2018	16-Aug-2018	17-Sep-2018	15-Oct-2018	15-Nov-2018	17-Dec-2018	15-Jan-2019	15-Feb-2019	
Month End Forward Premia (%)	15-Feb-2018	4.5181	4.7028	4.8083	5.1039	4.9574	4.8366	4.7069	4.5825	4.5538	4.5204	4.4902	4.4591	4.4279	5.35
Rolling Forward Premia (%)	15-Feb-2018	4.5181	4.7593	5.2122	5.0263	4.8949	4.7677	4.6427	4.5651	4.5366	4.5053	4.4731	4.444	4.4128	
Month End Forward Premia (Rs.)	15-Feb-2018	0.0159	0.1077	0.3472	0.6382	0.9167	1.1414	1.376	1.5898	1.8044	2.0539	2.2774	2.5051	2.7292	0.4334
Rolling Forward Premia (Rs.)	15-Feb-2018	0.0159	0.2347	0.5507	0.7878	1.0344	1.2678	1.4881	1.7205	1.9334	2.166	2.4026	2.614	2.8365	
Weighted Average Spot Rate: 64.2797															

For example, Rolling Forward Rate for 1M (as on trade date of 12-Feb-2018) is computed as 4.7028+((4.8083-4.7028)/(28/Mar/2018-28/Feb/2018))*(15/Mar/2018-28/Feb/2018) =4.7593.

In case the Rolling date of a Tenor falls on any day between the FBD April Date and the April Month End Date, for example the Rolling Date for 2M which is April 16, 2018 then the Rolling Rate would consider the FBD rate and would be calculated as follows:

$$\boldsymbol{RFP_{16-04-18\ on\ 15-02-18}} = \boldsymbol{FP_{02-04-2018}} + \frac{[(\mathbf{16-04-18}) - (\mathbf{02-04-18}) \times (\boldsymbol{FP_{27-04-18}} - \boldsymbol{FP_{02-04-18}})]}{((\mathbf{27-04-18}) - (\mathbf{02-04-18}))}$$

i.e. Rolling rate of 2M for the day would be :- 5.35+(((5.1039-5.35)/(27/Apr/2018-02/Apr/2018))*(16/Apr/2018-02/Apr/2018)) = 5.2122

The Rolling Rupee Premia is calculated from the computed Rolling Premia % using the following equation:

$$\boldsymbol{Rupee\ Forward\ Premia = FP_M \times S_t \times \left(\frac{N}{36500}\right)}$$

where,

FP_M is the Rolling Forward Premia Rate(%) for the relevant tenor

S_t is the applicable Spot Rate

N is the number of calendar days from Spot settlement date using modified following day convention till Forward Settlement date.

In case of 2M, the rolling rupee premia is calculated as (5.2122/100)*64.2797*((16/Apr/2018-15/Feb2018)/365) = 0.5507.