Assessing the Markets' Expectations of Monetary Policy in India from Overnight Indexed Swap Rates*

This article examines the behavior of Overnight Indexed Swap (OIS) rates in India to identify market expectations of the future course of monetary policy. It computes ex post "excess return" as the difference between the OIS fixed rate and the floating overnight reference rate and studies their statistical properties. It finds that OIS rates of tenors 1, 9 and 12 months provide credible measures of market expectations of the future path of policy repo rate, particularly during normal times.

Introduction

Households, firms and the government often base their current economic decisions on expectations about the near-term trajectories of key macro-financial variables. The expectations of future interest rate is one such key variable that can influence the decision of agents on whether to borrow now or later. They may advance (or postpone) their borrowing decision if they 'expect' the interest rates to rise (or decline) in the near future.

One category of agents who monitor the economy closely and tend to be forward looking in decision making are the participants in financial markets, such as banks and non-bank financial intermediaries, including pension/mutual funds, insurance companies, and primary dealers. These market participants base their expectations of future interest rates on the information set they possess as well as on their forecasts of variables that normally condition the path of monetary policy interest rate.

Central banks make use of the markets' expectation of monetary policy in various ways. While some use the information on policy rate expectations as an input for generating projection of macroeconomic indicators, such as inflation and GDP (Joyce and Meldrum, 2008). Others use the markets' expected policy rate as an input in the formulation of the monetary policy.

While monetary policy generally intends to be predictable to be effective, at times, central banks do 'surprise' markets. When they do so, it usually leads to market volatility (Fisher, 2017). Studies in the United States showed that unexpected movements in the Fed Funds Rate significantly affected Treasury Bill yields (Kuttner, 2001) and stock prices (Bernanke and Kuttner, 2005). However, markets usually stabilise when the central bank effectively communicates the rationale for its decisions. Fisher (2017), however, argued that avoiding 'unintended surprises' is beneficial to both the parties: the financial markets alter the financial conditions smoothly when there is clarity about the central bank's reaction function, which in turn helps the central bank to meet its policy targets. Furthermore, the relationship between the central bank and the financial market remains conducive, making the central bank's job easier in pursuing its policy objectives.

The literature identifies various ways to empirically assess market's expectation of future short-term interest rates. Lloyd (2018) categorised these measures under three broad (though, mutually non-exclusive) categories: survey-based; model-based; and financial market-based. The survey-based and financial market-based measures are used most commonly.

Survey-based method, as the name suggests, involves seeking answers to questions on policy rate expectations through various economic and financial

surveys (see Zulen and Wibisono (2018) for a review). For instance, the Bank of Indonesia uses outcome of Bloomberg survey to gather expectations on policy rate. Further, Christensen and Kwan (2014) utilised results of the monthly Blue-Chip Financial Forecast survey and Survey of Primary Dealers to assess alignment of market participants' expectations with expectations of the Federal Open Market Committee (FOMC). In India, the Reserve Bank has been conducting the Survey of Professional Forecasters (SPF) since September 2007. The responses, received from a panel of analysts, are presented in terms of median values of forecasts along with quarterly paths for key variables. The policy repo rate is one of the key macroeconomic indicators for which quarterly forecasts are gathered through the survey.

The financial market-based measures assess interest rate expectations from financial market transactions data. The use of the overnight indexed swap (OIS) rate as a measure of monetary policy expectation is gaining popularity in the literature, particularly for the advanced economies. An OIS is an interest rate derivative contract in which two entities agree to swap/exchange a fixed interest rate payment (the OIS rate) *vis-à-vis* a floating interest rate payment computed over a notional principal amount during the tenor of the contract. The floating rate is usually the overnight (unsecured) interbank rate[1]. The floating leg interest payment is constructed by calculating the accrued interest payments from a strategy of investing the notional principal in an overnight reference rate and repeating this on an overnight basis for the duration of the contract, investing principal plus interest each time (Lloyd, 2018, page 4).

The survey-based method has certain advantages over the market-based method. Analysis is simpler in case of the former. One could calculate the average or median value to aggregate the policy rate expectations of all survey respondents (Christensen and Kwan,

2014; Joyce and Meldrum, 2008). A study using the latter method, for instance, used prices of three different financial market instruments for estimating the probability of Bank of Canada's policy rate changes. Furthermore, it is possible to calculate the frequency distribution of respondents' expectations in the survey-based method to arrive at the percentage of respondents who expect a cut or a hike or no change in the policy rate. This is not possible in the market-based method (Christensen and Kwan, 2014). Another potential disadvantage of using the OIS rates or any other financial market-based measure is the presence of risk premia. Lloyd (2018), however, argued that on average these premia are not a material issue at shorter horizons. They argued that an OIS contract has certain special features: the 'counterparty risk' is minimum as there is no exchange of the notional principal amount.[2] Further, the 'liquidity risk' is also low as there is no initial cash flow and only the net cash flow is exchanged between the agents during settlement.

The market-based method, however, has its own advantages. It is believed to capture the real expectation in the market. The price of the instrument (under study) is expected to move along with market expectation because the market players "risk" their money in the instrument (that is, having their "money on the line"). On the other hand, given the subjective nature of survey-based method, it's likely at times that the respondents do not respond according to their actual expectation. Further, surveys cannot cover all market participants and may also be subject to misreporting. In the market-based method, the market's expectation can be calculated on a daily

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[1] The reference rate for Indian OIS Contracts is the Mumbai Interbank Outright Rate (MIBOR) rate.

[2] We are grateful to Dr. Golaka Nath for informing us that "OIS globally is moving towards Centralised Counter-Party (CCP) settlement and hence counter-party risk is being taken out from the contract. The case in which OIS discounting was initiated *vis-a-vis* LIBOR discounting as a fallout of global financial crisis has undergone drastic changes after CCP clearing of swap contracts. In India, almost 60 per cent of the deals are counter-party risk free contracts. Hence, risk premia component gets compromised in the sense that though CCP clearing concentrates risk in a single entity, the structures for CCPs as systematically important payment systems automatically reduces the risk component. Hence OIS is not a disadvantage anymore."
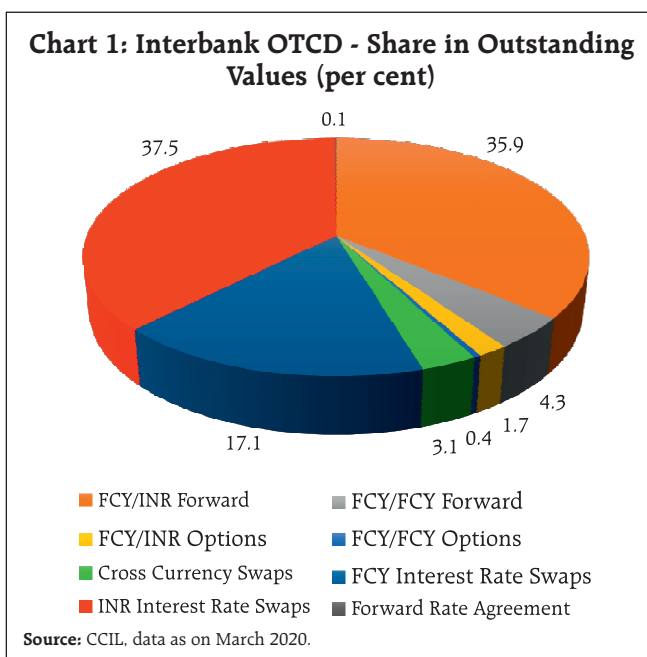
basis or even on an hour-to-hour basis, if the referred instruments are widely traded. In the survey-based method, such higher frequency (say, daily) information may not be feasible to collect and could also be costly.

In this backdrop, by adopting the methodology of Lloyd (2018), this article empirically tests whether onshore OIS trades in India of different tenors (ranging from 1 month to 10 years) are efficient measures of market's expectation of short-term interest rates. We find that the OIS rates of tenors of up to one year (specifically, tenors of 1, 9 and 12 months), on average, approximate market's expectation of future short-term interest rates. The rest of the article is divided into four sections. Section II reports some stylised facts on the OIS Market in India. Section III presents the data and methodology used. The empirical results and their discussion are set out in Section IV. Section V concludes.

II. OIS Market in India: Some Stylized Facts

Interest Rate Derivatives (IRD) were permitted in India on July 7, 1999. The IRDs are traded either on organized exchanges or on over-the-counter (OTC) markets. The Reserve Bank has, over time, issued regulations covering various IRD products such as Interest Rate Swap (IRS), Forward Rate Agreement (FRA), Interest Rate Future (IRF), Interest Rate Option (IRO) and Money Market Future (MMF). Scheduled commercial banks (excluding Regional Rural Banks), primary dealers and all-India financial institutions could undertake FRAs/IRS for their own balance sheet management and for market making purposes. A comprehensive set of guidelines on derivatives was issued in 2007 to clearly define the roles and responsibilities for users and market makers. The IRS contracts were standardised on January 28, 2013. However, except for the IRS market, the activity in other derivative markets has been rather thin and limited.

The IRS market forms the largest segment of OTC derivative (OTCD) market in India. The two main segments in IRS market relate to interbank and client

Chart 1: Interbank OTCD - Share in Outstanding Values (per cent)

- FCY/INR Forward
- FCY/INR Options
- Cross Currency Swaps
- INR Interest Rate Swaps
- FCY/FCY Forward
- FCY/FCY Options
- FCY Interest Rate Swaps
- Forward Rate Agreement

Source: CCIL, data as on March 2020.

transactions. The former is the predominant segment with a share of around 38 per cent in the outstanding values of the 'gross notional amount' (Chart 1). The interbank segment, the predominant one, witnesses major participation from foreign banks and primary dealers (PDs), followed by private sector banks. The participation of public sector banks, while increasing, is still negligible.

The IRS market in India is dominated by MIBOR - OIS with the Mumbai Interbank Outright Rate (MIBOR) as the floating interest rate, followed by the Mumbai Inter-bank Forward Outright Rate (MIFOR) and the Indian Benchmark Swaps (INBMK) (Table 1). The activity in the interbank MIBOR OIS market has increased over the recent years (Chart 2).

Table 1: Benchmark-wise Gross Notional Outstanding

(in ₹ crore)

Benchmark	Total Outstanding
MIBOR OIS	31,34,039
MIFOR	6,57,371
INBMK	2,560

Source: CCIL, data as on March 2020

Chart 2: Interbank INR IRS Outstanding Volumes

Source: CCIL.
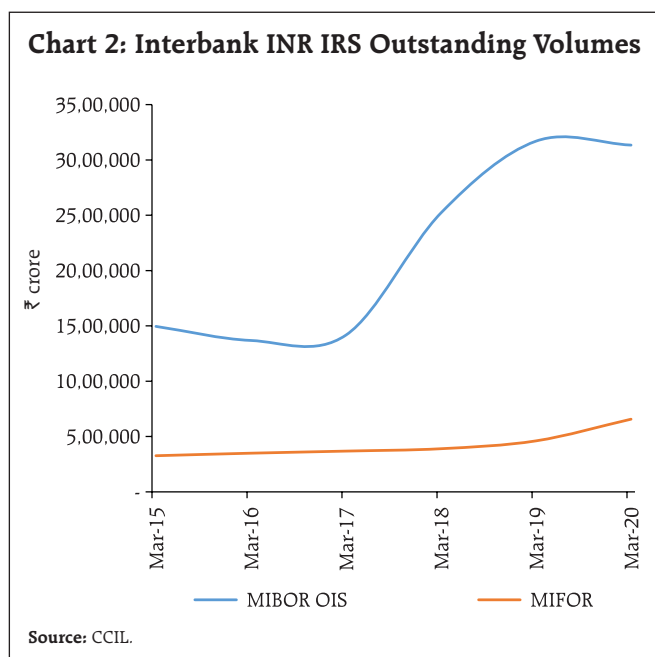
The most commonly used IRS in India, the MIBOR OIS is a product where the floating leg of the swap is linked to an overnight index, compounded every day over the payment period. As can be gauged from its basic structuring, the OIS product is traded on the basis of expectations of the trading parties about the future path of interest rate movements. Thus, any move in interest rate thereafter leads to gains or losses depending on their position in the swap. The G-Sec yields and OIS rates have shown high correlation. Thus, OIS can be used as a primary hedging tool for investors in G-Secs. Additional benefits include reduction of credit risk and creation of synthetic overnight-index-linked liability for corporates. The OIS allows financial institutions the flexibility to move to the interest rate on the basis of their choice, manage various features of their debt portfolios and the duration of investment portfolio.

III. Data and Methodology

This section tests whether the onshore MIBOR OIS trades in India of different tenors help in measuring accurately market's expectations of the future path of monetary policy, specifically the policy repo rate

under the Liquidity Adjustment Facility (LAF). We use the daily MIBOR-OIS rates for tenors ranging from 1 month to 10 years for the period from August 03, 1999 to May 31, 2019. The starting date has been decided by data availability. The data has been sourced from Bloomberg.

We adopt the method used by Lloyd (2018). First, for each of the n-month (N-days) OIS fixed rate (i_n^{fixed}) we derive the daily annualised *ex-post* realised (net) return from the floating leg of the same contract (i_n^{float}) using the expression below (FIMMDA, 2016 and Lloyd, 2018):

$$1. \quad i_n^{float} = \left[\prod_{j=1}^{d_0} \left(1 + \frac{n_j * MIBOR_j}{365} \right) - 1 \right] \times \frac{365}{d}$$

Here, d_0 is the number of business days in the relevant calculation period; n_j is the number of calendar days in the calculation period for which the rate used is $MIBOR_j$; and d is the number of calendar days in the relevant calculation period. The spot lag for Indian OIS contracts is zero days.

Thus, the unconditional *ex post* realised (annualised) 'excess return (ER)' on the n-month OIS contract is:

$$2. \quad ER_t = i_n^{fixed} - i_n^{floating}$$

Lloyd (2018, pages 5-6) indicated that *"from the perspective of an agent who swaps fixed interest payments for the floating rate over the notional principal x, (ER × x) represents the payoff of a zero-cost portfolio. So, if the expectations hypothesis holds true, the fixed leg of the OIS contract must equal the ex-ante expected value of the floating leg, i.e., $i_{n,t}^{fixed} = E_t(i_n^{float})$. Thus, if the ex post realised excess return has zero mean, the ex-ante forecasting error under the expectations hypothesis also has zero mean, and the n-month OIS contract can be said to provide an accurate measure of expected future short-term interest rates."*

Thus, to test whether the *ex post* excess returns on the OIS contracts (ER_t) has zero mean, we regress ER_t

on a constant (α_n) and test whether α_n is significantly different from zero or not.

3. $ER_t = \alpha_n + \varepsilon_n$

The standard errors and t-statistics for the above regression have been computed by the Newey West (Bartlett kernel) heteroskedasticity and autocorrelation consistent (HAC) procedure.

IV. Empirical Results and Discussion

The unconditional average *ex post* excess returns were computed for the various tenors of OIS rates, ranging from 1-month to 10 years, for the period from August 03, 1999 to May 31, 2019, and are given in Annex Table 1.

We find that the excess returns of the OIS trades of tenors of up to one year were low ranging between 2 basis points (bps) and 20 bps[3] indicating that these OIS rates were, on average, a fair indication of the direction of future course of monetary policy. Specifically, we find that the OIS rates of tenors 1, 9 and 12 months appear to more accurately measure the expectations of future short-term interest rates with the excess returns of these tenors, on average, being not significantly different from zero (Annex Chart 1).[4]

On the other hand, for the 3-Month and 6-Month OIS trades, the excess returns were low at 7.81 bps and 6.51 bps, respectively, though significantly different from zero.

One possible reason for the 9-month and 12-month OIS rates emerging as the more accurate measure of future short-term interest rates could be that the market is able to predict the direction of monetary policy but not exact timing. For instance, a market expectation of a rate hike of 25 bps in 2-month time may materialise only after 6 months. Such a scenario may lead to *ex post* excess returns for 3-month and 6-month OIS transactions turning non-zero, while that for the longer tenor OIS, viz. 9-month and 12-month, may not be affected to that extent. Thus, it could be mentioned that OIS rates are a better predictor of the direction of monetary policy rather than the actual timing of policy action. As a counterfactual, it would be expected that if a monetary policy action surprises the market, the OIS rates would immediately adjust (Table 2 presents a few examples).

Further, in order to account for the volatility in money markets during some periods, we introduce dummies, particularly for 2000 (introduction and

Table 2: Few Instances of Monetary Policy Surprises[5]

MPC Date	1 M OIS Rate (per cent)			3 M OIS Rate (per cent)			6 M OIS Rate (per cent)			9 M OIS Rates (per cent)			12 M OIS Rate (per cent)		
	Pre policy	Post policy	Change	Pre policy	Post policy	Change	Pre policy	Post policy	Change	Pre policy	Post policy	Change	Pre policy	Post policy	Change
Feb 07, 2019	6.45	6.31	-0.14	6.57	6.44	-0.13	6.51	6.38	-0.13	6.51	6.38	-0.13	6.53	6.39	-0.14
Oct 05,2018	6.86	6.57	-0.29	7.00	6.73	-0.27	7.32	7.10	-0.22	7.44	7.25	-0.19	7.56	7.39	-0.17
Feb 08, 2017	6.14	6.26	0.12	6.21	6.35	0.14	6.20	6.36	0.16	6.21	6.37	0.16	6.19	6.39	0.20
Dec 07, 2016	5.97	6.21	0.24	6.00	6.23	0.23	5.98	6.23	0.25	5.98	6.21	0.23	5.97	6.21	0.24

[3] The positive excess returns for these tenors could be on account of call rates remaining slightly below the policy repo rate which in turn could be on account of liquidity conditions.

[4] It may be mentioned here that major segments of the banks are not active participants in the OIS market. One view is that the entities involved in the OIS contracts in India may possibly look at it more from a liquidity point of view than taking a call on interest rate expectations, *per se*, and the excess returns could be a more of a premium for illiquidity. We would like to acknowledge Dr. Golaka Nath for bringing this to our notice.

[5] For the Feb 07, 2019 policy, the Monetary Policy Committee (MPC) decided to reduce the policy rate against market expectation of rate hold while for Oct 05, 2018 policy, the MPC decided to keep the policy rate unchanged against market expectation of rate hike. For the Feb 08, 2017 as well as Dec 07, 2016 policy, the MPC decisions were to keep the policy rate unchanged against market expectation of rate cut.

stabilization of the Liquidity Adjustment Facility (LAF) Scheme on May 29, 2000), 2006/7, 2008 (global financial crisis), 2013 ('the taper tantrum') and 2016 (withdrawal of specified bank notes).[6] We find that unanticipated changes in monetary policy during 2008 and 2013 in the wake of the global financial crisis and the 'taper tantrum' significantly impacted 'excess returns'.

V. Conclusion

Adapting the methodology applied by Lloyd (2018), this article finds that the OIS rates in India for tenors 1, 9 and 12 months provide accurate measures of market expectations of policy repo rate. Unanticipated changes in monetary policy during 2008 and 2013 in the wake of the global financial crisis and the 'taper tantrum' significantly impacted 'excess returns' in the OIS market, unlike normal times. OIS rates in India are found to be good predictors of the direction of monetary policy, if not the exact timing of policy changes.

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[6] Please see Annex Table 2 for details on the dummies.

Annex

Annex Table 1: Unconditional average ex-post Excess Returns on
Indian OIS Contracts at Daily Frequency *(Contd.)*

Panel A: India OIS Contracts								
Tenor	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**
$\widehat{a_n}$	**5.33**	11.43***	7.81***	12.86***	17.49***	6.51**	19.23***	11.59***	**2.08**
[t-statistics]	**[1.44]**	[3.50]	[2.62]	[3.44]	[5.38]	[2.15]	[5.42]	[3.83]	**[0.637]**
Tenor	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{a_n}$	7.92**	**5.17**	**4.40**	-26.28***	-43.34***	-71.17***	-94.33***	-182.01***	-260.49***
[t-statistics]	[2.43]	**[1.53]**	**[1.24]**	[-5.21]	[-7.78]	[-12.75]	[-17.24]	[-40.26]	[-43.18]

Panel B: India OIS Contracts with 2000 Dummy[1]								
Tenor	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**
$\widehat{a_n}$	4.92	11.75***	8.65***	-	-	7.73**	-	-	**2.29**
[t-statistics]	[1.34]	[3.62]	[2.93]	-	-	[2.54]	-	-	**[0.69]**
2000 Dummy	23.84	-15.22	-33.90	-	-	-33.04*	-	-	**-12.94**
[t-statistics]	[0.54]	[-0.44]	[-1.07]	-	-	[-1.68]	-	-	**[-0.45]**
Tenor	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{a_n}$	-	-	**3.27**	-	-	-	-	-	-
[t-statistics]	-	-	**[0.89]**	-	-	-	-	-	-
2000 Dummy	-	-	**19.61**	-	-	-	-	-	-
[t-statistics]	-	-	**[1.26]**	-	-	-	-	-	-

Panel C: India OIS Contracts with 2006 Dummy[2]								
Tenor	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**
$\widehat{a_n}$	5.63***	11.21***	7.90***	9.19***	12.94***	7.69***	-	-	**4.11**
[t-statistics]	[2.70]	[5.84]	[4.21]	[3.92]	[4.96]	[3.16]	-	-	**[1.35]**
2006 Dummy	-8.79	5.57	-2.13	111.02	142.28***	-20.49	-	-	**-27.19**
[t-statistics]	[-0.09]	[0.08]	[-0.04]	[1.49]	[2.62]	[-0.61]	-	-	**[-1.21]**
Tenor	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{a_n}$	-	-	7.39**	-15.85***	-35.02***	-72.13***	-123.18***	-205.14***	-246.51***
[t-statistics]	-	-	[2.08]	[-2.78]	[-5.28]	[-9.79]	[-16.32]	[-35.49]	[-20.51]
2006 Dummy	-	-	-34.85**	-64.52***	-35.02***	2.89	67.69***	72.71***	-25.03*
[t-statistics]	-	-	[-2.13]	[-6.44]	[-3.02]	[0.27]	[6.62]	[10.50]	[-1.93]

Panel D: India OIS Contracts with 2007 Dummy[3]								
Tenor	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**
$\widehat{a_n}$	4.54**	10.45***	7.19***	9.27***	13.04***	7.29***	11.66***	-	**3.85**
[t-statistics]	[2.09]	[5.35]	[3.78]	[3.94]	[4.98]	[3.00]	[4.04]	-	**[1.27]**
2007 Dummy	26.84	28.54	16.15	100.73	128.87**	-15.04	142.47***	-	**-25.08**
[t-statistics]	[0.26]	[0.37]	[0.26]	[1.46]	[2.51]	[-0.40]	[4.89]	-	**[-1.05]**
Tenor	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{a_n}$	-	-	6.82*	-16.31***	-36.70***	-72.22***	-118.80***	-205.78***	-247.04***
[t-statistics]	-	-	[1.93]	[-2.88]	[-5.57]	[-9.93]	[-15.35]	[-35.41]	[-20.08]
2007 Dummy	-	-	-29.98*	-63.97***	-28.66**	3.25	58.38***	73.34***	-23.65*
[t-statistics]	-	-	[-1.74]	[-6.20]	[-2.42]	[0.29]	[5.71]	[10.61]	[-1.78]

Annex Table 1: Unconditional average ex-post Excess Returns on Indian OIS Contracts at Daily Frequency (Contd.)

Panel E: India OIS Contracts with 2008 Dummy[4]								
Tenor	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**
$\widehat{\alpha_n}$	5.69	11.67***	7.14**	10.06***	13.02***	3.48	-	-	-3.19
[t-statistics]	[1.50]	[3.49]	[2.32]	[2.83]	[4.02]	[1.19]	-	-	[-1.09]
2008 Dummy	-12.97	-6.87	16.98	49.19***	80.88***	57.41***	-	-	78.86***
[t-statistics]	[-1.08]	[-0.51]	[1.46]	[4.12]	[6.25]	[2.73]	-	-	[3.18]
Tenor	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{\alpha_n}$	-	-	-3.10	-49.45***	-68.70***	-99.16***	-114.37***	-220.06***	-326.38***
[t-statistics]	-	-	[-1.01]	[-11.24]	[-12.42]	[-15.42]	[-15.32]	[-61.12]	[22.34]
2008 Dummy	-	-	92.08***	145.28***	106.72***	85.63***	46.78***	67.48***	67.66***
[t-statistics]	-	-	[3.92]	[8.65]	[7.57]	[7.65]	[4.42]	[8.83]	[4.28]
Panel F: India OIS Contracts with 2013 Dummy[5]								
Tenor	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**
$\widehat{\alpha_n}$	5.25	10.76***	7.86***	14.78***	20.74***	8.56***	28.93***	22.58***	5.86*
[t-statistics]	[1.39]	[3.22]	[2.60]	[4.35]	[6.63]	[2.82]	[9.58]	[12.31]	[1.77]
2013 Dummy	3.65	23.88**	-1.74	-28.22	-44.22**	-44.65	-70.74***	-67.59***	-58.46***
[t-statistics]	[0.44]	[2.53]	[-0.09]	[-1.46]	[-2.36]	[-2.47]	[-4.78]	[-5.06]	[-4.15]
Tenor	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{\alpha_n}$	22.94***	22.40***	9.88***	-8.86	-12.42**	-23.76***	-31.25***	-148.56***	-
[t-statistics]	[11.98]	[11.25]	[2.72]	[-1.63]	[-1.98]	[-3.72]	[-4.94]	[-50.68]	-
2013 Dummy	-77.13***	-81.82***	-73.68***	-114.63***	-134.50***	-143.61***	-147.04***	-42.16***	-
[t-statistics]	[-6.73]	[-7.68]	[-6.38]	[-12.42]	[-14.79]	[-15.97]	[-16.95]	[-6.74]	-
Panel G: India OIS Contracts with 2016 Dummy[6]								
Tenor	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**
$\widehat{\alpha_n}$	5.42	11.48***	7.85***	13.20***	17.97***	6.45**	20.47***	11.25***	1.36
[t-statistics]	[1.45]	[3.46]	[2.57]	[3.65]	[5.23]	[2.05]	[5.17]	[3.24]	[0.39]
2016 Dummy	-6.77	-3.30	-2.07	-7.20	-8.86**	1.71	-11.62***	2.68	13.95***
[t-statistics]	[-1.51]	[-0.73]	[-0.50]	[-1.64]	[-2.17]	[0.47]	[-2.66]	[0.64]	[3.07]
Tenor	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{\alpha_n}$	5.89	2.02	3.21	-31.81***	-55.79***	-83.20***	-94.24***	-164.65***	-299.36***
[t-statistics]	[1.54]	[0.50]	[0.85]	[-5.48]	[-8.64]	[-12.75]	[-14.68]	[-25.73]	[-104.56]
2016 Dummy	12.69***	17.82***	18.91***	39.99***	76.32***	61.71***	-0.41	-48.39***	64.73***
[t-statistics]	[2.73]	[3.65]	[3.88]	[6.29]	[10.92]	[6.06]	[-0.03]	[-6.43]	[6.69]

Annex Table 1: Unconditional average ex-post Excess Returns on
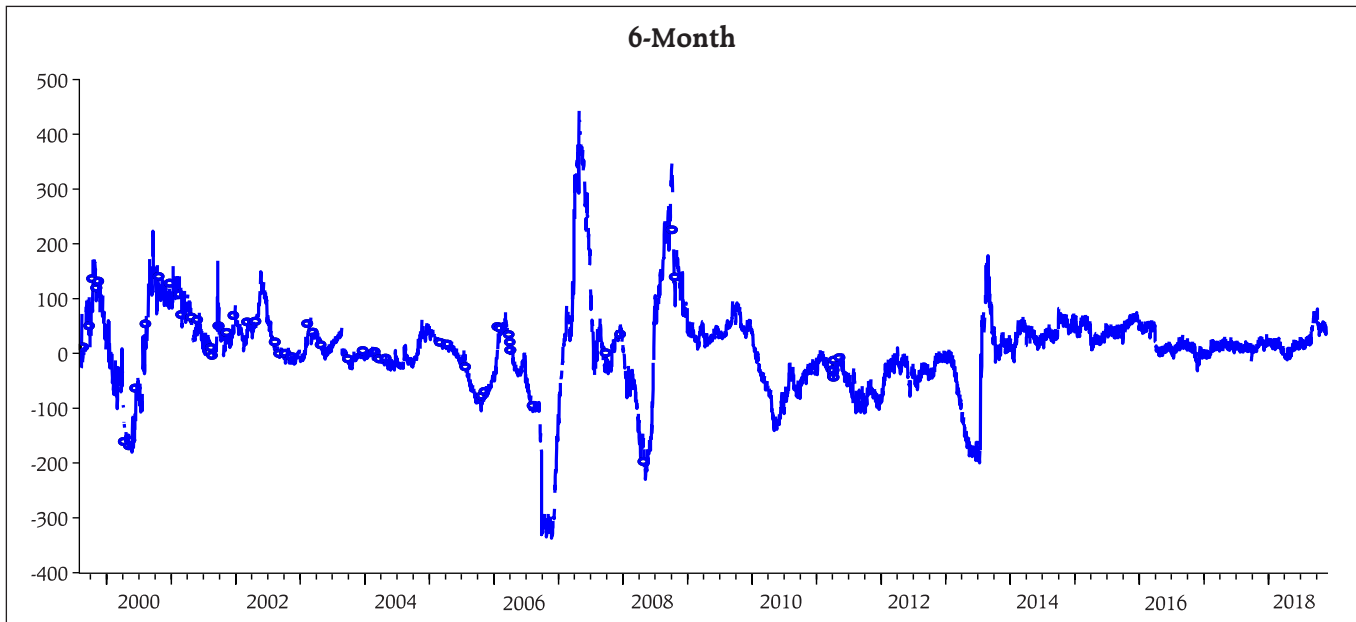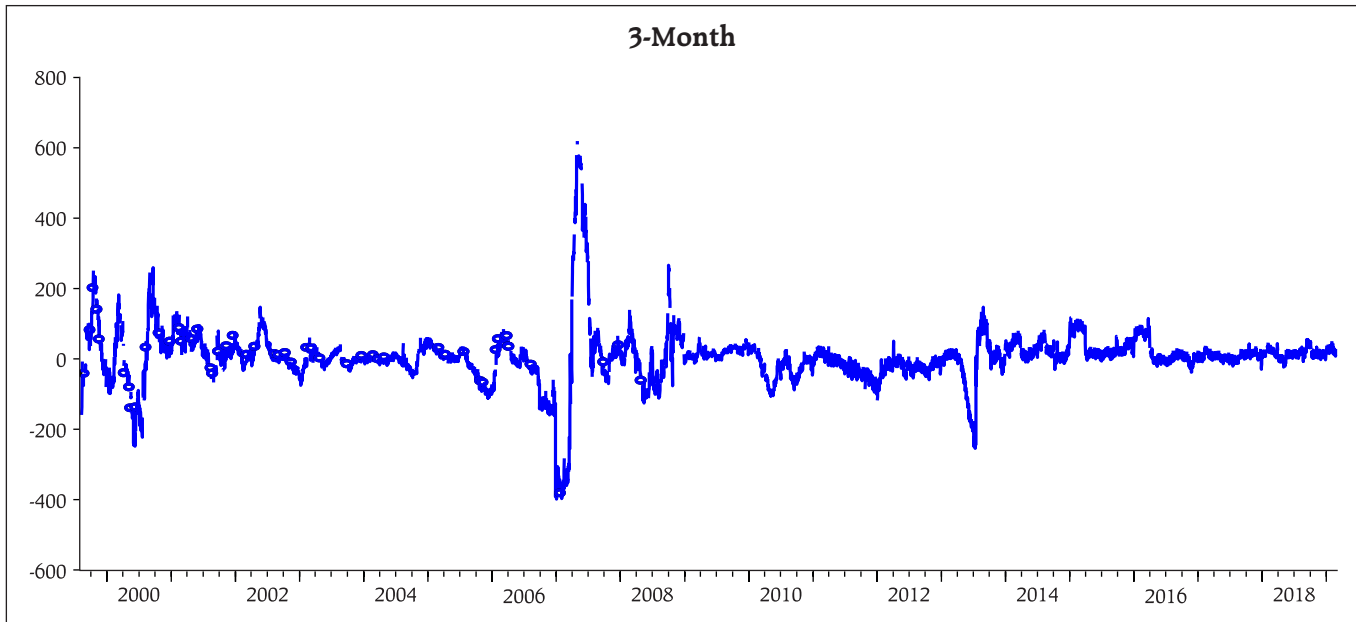## Indian OIS Contracts at Daily Frequency *(Concld.)*

Panel H: India OIS Contracts with all dummies								
Maturity	1M	2M	3M	4M	5M	6M	7M	8M	9M
$\widehat{\alpha_n}$	5.27**	10.89***	8.01***	7.83***	11.04***	8.15***	22.52***	24.17***	2.04
[t-statistics]	[2.54]	[5.25]	[4.71]	[3.83]	[4.95]	[3.99]	[11.40]	[11.47]	[0.82]
2000 Dummy	23.49	-14.35	-33.27	-	-	-36.46*	-	-	-12.68
[t-statistics]	[0.54]	[-0.42]	[-1.05]	-	-	[-1.72]	-	-	[-0.44]
2006 Dummy	-112.81**	-72.94*	-71.44**	138.54*	180.58***	-43.05***	183.08***	-	-32.41**
[t-statistics]	[-2.00]	[-19.2]	[-2.53]	[1.84]	[3.26]	[-2.75]	[5.91]	-	[-2.15]
2007 Dummy	130.47	96.29	82.65	-26.15**	-36.39***	25.32	-37.97	-	8.00
[t-statistics]	[1.39]	[1.40]	[1.54]	[-2.38]	[-3.39]	[0.80]	[-4.07]	-	[0.37]
2008 Dummy	-12.55	-6.09	16.10	51.42***	82.87***	52.74**	-	-	73.64***
[t-statistics]	[-1.09]	[-0.46]	[1.42]	[4.44]	[6.50]	[2.52]	-	-	[2.97]
2013 Dummy	3.63	23.75***	-1.89	-21.26	-34.51*	-44.25**	-64.32***	-69.18***	-54.64***
[t-statistics]	[0.48]	[2.63]	[-0.11]	[-1.11]	[-1.85]	[-2.47]	[-4.39]	[-5.16]	[-3.93]
2016 Dummy	-6.63**	-2.72	-2.23	-1.83	-1.93	0.01	-13.66***	-10.25***	13.27***
[t-statistics]	[-2.04]	[-0.75]	[-0.69]	[-0.56]	[-0.62]	[0.00]	[-5.07]	[-3.23}	[3.44]
Maturity	**10M**	**11M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**7Y**	**10Y**
$\widehat{\alpha_n}$	24.01***	23.14***	2.30	-22.64***	-31.78***	-29.03**	44.42***	-211.75***	-395.29***
[t-statistics]	[10.49]	[9.52]	[0.74]	[-3.47]	[-2.97]	[-2.29]	[3.16]	[-18.37]	[-22.53]
2000 Dummy	-	-	20.58	-	-	-	-	-	-
[t-statistics]	-	-	[1.34]	-	-	-	-	-	-
2006 Dummy	-	-	-57.18***	-19.98**	-105.43***	-31.02	71.07**	-	-
[t-statistics]	-	-	[-4.41]	[2.27]	[-10.32]	[-1.54]	[2.49	-	-
2007 Dummy	-	-	30.08*	-86.72***	9.89	-50.28***	-158.31***	-	-
[t-statistics]	-	-	[1.66]	[-8.76]	[1.06]	[-2.61]	[-5.79]	-	-
2008 Dummy	-	-	86.68***	151.66	116.86***	65.66***	-24.18**	65.16***	95.93***
[t-statistics]	-	-	[3.68]	[9.43]	[7.93]	[5.08]	[-2.10]	[5.86]	[5.54]
2013 Dummy	-78.21***	-82.56***	-66.10***	-100.85	-119.26***	-162.42***	-253.81***	-8.31	68.91***
[t-statistics]	[-6.79]	[-7.68]	[-5.79]	[-10.18]	[-10.09]	[-13.95]	[-18.59]	[-0.76]	[6.98]
2016 Dummy	-5.43	-3.30	19.81***	30.82***	61.67***	85.21***	81.55***	-	-
[t-statistics]	[-1.55]	[-0.89]	[4.51]	[4.39]	[5.58]	[7.86]	[8.46]	-	-

*, ** and *** indicate significance at 10 per cent, 5 per cent and 1 per cent, respectively.

Annex Table 2: Details on the dummies used

Dummy	Date of first policy action	Date of last policy action	Value of the dummy
D2000	22 July 2000	25 October 2000	The dummy takes value of 1 from 22 **June** 2000 to 25 Oct 2000 and zero otherwise for the 1-month OIS; from 22 **May** 2000 to 25 Oct 2000 and zero otherwise for the 2-month OIS and so on.
D2006	12 Dec 2006	16 Jul 2007	Similar strategy as above.
D2007	01 Feb 2007	31 Jul 2007	
D2008	20 Oct 2008	21 Apr 2009	
D2013	20 Sep 2013	28 Jan 2014	
D2016	08 Nov 2016	31 Dec 2016	

**Annex Chart 1: Unconditional average ex-post Excess Returns on
Indian OIS Contracts at Daily Frequency** *(Contd.)*

3-Month

6-Month

**Annex Chart 1: Unconditional average ex-post Excess Returns on
Indian OIS Contracts at Daily Frequency** *(Concld.)*