Determinants of Overnight Index Swap (OIS) Rates: Some Empirical Findings from an Emerging Market Economy, India

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This paper uses the financial sector variables over the last two years to analyse the determinants of the Overnight Index Swap (OIS) rates in India. Among the financial variables considered, in the short run, Gsec rate and call rate had positive and significant correlation with the OIS rate, while inflation rate was not contemporaneously related with the OIS rate. The other factor that significantly caused the OIS rate movement was the liquidity conditions in the Indian money market, measured by the difference between the call and repo rate. The above factors remained crucial even during and in the aftermath of the global financial crisis. The impulse response functions indicated that the market was resilient to shocks. The long run equilibrium relationship between OIS, Gsec and Call rates was confirmed by existence of at least one cointegrating vector. The coefficient of Gsec rate in the estimated cointegration was found to be positive and significant. However, the coefficient of call rate was found to be negative (and low). It could indicate that a high (low) call rate today was expected to converge to the long term market expectation as indicated by the OIS rate. The error correction term, though negative, was not found to be statistically significant at the conventional levels. This could be because of low volume in the OIS market, which is likely to pick up with further money market activities and future financial product developments.

JEL Classification : E40, G10, G31.

Keywords   : Overnight Index Swap, OIS, Money Market, Yields, Overnight Rate, Inflation.

Introduction

Interest risk management has assumed predominant importance in the management of any financial institution after the deregulation of the interest rates. In the deregulated market, every financial

organization recognizes and quantifies its risk-taking appetite. Banks and corporates face the risks on their investment portfolios, cost of raising working capital on account of the volatility in the movement of interest rates. One of the commonly used risk management practices is the use of overnight index swap (OIS). It is one type of interest rate swaps where the floating leg of the swap is linked to an overnight index, compounded every day over of the payment period. The parties agree to exchange the difference in the accrued interest arrived according to the fixed and floating interest rates at the maturity on the notional principal amount.

Use of OIS generally brings many benefits to the financial community. OIS helps in hedging the interest rate risks. Additional benefits include reduction of credit risk, creation of synthetic overnight-index-linked liability for corporates, etc.. It allows the financial institutions the flexibility to move to the interest rate basis of its choice, manage various features of their debt portfolios, the duration of its investment portfolio.

Research in money market microstructure is a relatively recent development and has mainly focused on developed markets. In contrast, research on emerging market economies (EMEs) is rather limited - perhaps because of the narrow and underdeveloped nature of the market in such economies. This paper makes an attempt to address this anomaly by analysis of relationship of the OIS rates with other financial variables. In particular, we attempt an evaluation of the determinants of Overnight Index Swap (OIS) rate and the causal relation between OIS rate and different financial variables, their short run and long run relationship. This paper is organized as follows: Section 2 concentrates on the cross country experience, Section 3 describes the data, Section 4 devotes itself to the empirical analysis and Section 5 concludes the major findings. Finally, OIS and Call rates around the recent policy dates and the market expectations (gathered from different print media) are reported in Table A1 and A2 in Annex, respectively.

Section II

Cross Country Experience

While not many academic articles on OIS were available in the public domain, reasonable literature search on the subject found the following:

In Australia the overnight index swap market started in late 1999, and has witnessed rapid growth in the subsequent years. The market is more liquid in relatively shorter end as compared with its longer counterpart. The liquidity in the OIS market makes it useful in forecasting the market expectations about the future movement of the *Cash rate*, though they are not perfect indicator of the same. In Australia, banks are the main players in the overnight interest rate swaps market. In view of its success, some Australian investment banks and fixed-income brokers introduced the OIS in the New Zealand markets (February 2002). However, there were no formal price-making arrangements in the OIS market of New Zealand. Trades between banks and their institutional clients were also low. A few Australian investment banks dominated the market, and the domestic players were insignificant. The turnover in the OIS market was only around 10 per cent of the more established FRA and bank bills futures market in New Zealand. The trades were mostly for taking a view on the direction and magnitude of changes in the *official cash rate* (OCR) so far. The OIS market remained more developed and broad-based in Australia as compared with New Zealand.

In Japan the OIS was launched in mid-1997 but it remained shallow till recently. The main reasons were the prevailing effective zero overnight interest rates and very low short-term interest rates. As the bankers did not need to hedge against short-term interest rate risks, there was no need for the financial institutions to operate in this OIS market. The OIS transactions began to grow as market participants expected the end of the Quantitative easing Policy before the crisis. Gradually, the OIS transaction volume exceeded that of all non-OIS interest rate swaps with terms of less than one year. The Japanese financial institutions benefited from utilizing the OIS by directly managing the risk of a rise in overnight rates and from the possibility of arbitrage opportunities. As the Japanese money markets become more active and interest rates become more volatile, demands for hedging

and arbitrage operations are expected to grow further; and consequently the Japanese OIS market is expected to be more broad-based and liquid.

The ushering of the global economic crisis / sub-prime crisis brought to fore a new variable as a measure of financial health. The measure is the spread between 3-month LIBOR and the 3-month Overnight Index Swap (OIS) rate. The OIS rate is a measure of market expectation of the money market rates. Expectations also play major roles on all term loans, inlcluding 3-month LIBOR. The difference between LIBOR and OIS rate thus captures factors other than interest rate expectations, such as credit and liquidity risks (Taylor 2008). An increase in the spread, holding the OIS constant, will increase the cost of such loans and have a contractionary effect on the economy. Bringing this spread down therefore became a major objective of monetary policy, as well as a measure of its success in dealing with the market turmoil.

The Interest rate swaps in India is relatively new, with the first interest rate swap being traded in July 1999. Among the Interest rate swaps, the OIS is the most popular and liquid. As the name implies the benchmark here is the overnight rate. The floating benchmark is MIBOR (Mumbai inter-bank offered rate), against which the swap is settled. The floating leg of the transaction is compounded and settled only at pre-decided frequency (generally semi-annually). Though OIS are quoted in different maturities, anecdotal evidence indicates that tenors upto five-year are liquid (according to the number of deals). In India the OIS market is generally dominated by the foreign banks and some of the segments of the OIS market remain quite illiquid.

Section III

Data and Descriptive Statistics

This study concentrates on the last two-and-half year daily data on one-year and five-year OIS rates (from August 2007 to November 2009) and attempts to identify their determinants. The major data sources for this study are the Reuters database and Weekly Statistical Supplement. The rate / financial sector variables considered for this study are as follows:

- 1-year FIMMDA generic yield (Gsec1);

- 5-year FIMMDA generic yield (Gsec5);

- Call/notice money market rate(CALL);

- Repo Rate, Reverse Repo rate & Cash reserve ratio (CRR);

- Call money spread (call_spd) is the difference between the Call rate and the repo rate (Call_spd), and the increase in the same is an indicator of the stringent liquidity conditions in the inter-bank money market.

- Weekly WPI Inflation Rate (the inflation rate is repeated for other days of the week). For October and November 2009, the inflation rate is repeated for all days in the month.

The choice of these variables was guided by opportunity cost and liquidity considerations, and supply/demand situation in the underlying and OIS market. From the cost angle 1-year and 5-year Government security yields were taken as measures of benchmark risk-free interest rates of one-year and five-year maturities. The call rate and the call spread were included as indicators of overall liquidity in the system.

Trends in One-year and five-year OIS rate

The trends in the one-year and five-year OIS rates along with Gsec rate during the period under consideration are plotted in Chart 1.

As evident from the above chart, there have been three distinct phases in the OIS market. In the first phase, i.e. from August 2007 to June 2008, the OIS rate followed an increasing trend in general, which reflected the inflationary pressures, cumulative increase in CRR and increase in the repo rate. Beginning July 2008, there was a change in the underlying trend and the OIS rate generally declined, perhaps reflecting the global financial crisis, expectations for the easing rate and liquidity conditions in the Indian money markets. Finally, from beginning of December 2008, the rate in the OIS market started increasing gradually. In the entire period under consideration the data indicated a close co-movement between OIS rates and Gsec

Chart 1:

Movement in Gsec and OIS Rates   Movement of Call and OIS Rate
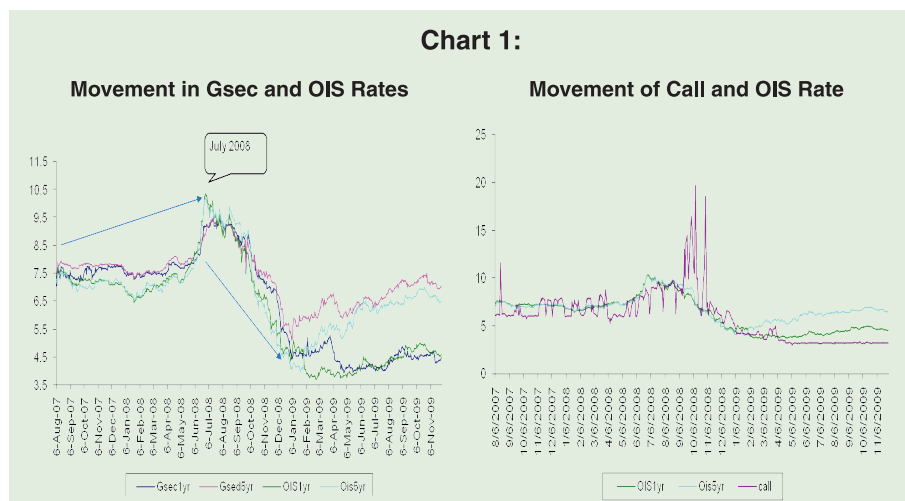
rates. The OIS rates mostly remained below the Gsec rates. It may be mentioned that the inflation measured by change in WPI index was very volatile during the period under consideration. The descriptive statistics for the level variables for the entire period (August 2007 to November 2009) are as under:

Table 1: Descriptive Statistics

	OIS1YR	OIS5YR	GSEC1YR	GSEC5YR	CALL	INF
Mean	6.19	6.81	6.44	7.36	5.87	5.11
Median	6.69	6.82	7.31	7.51	6.05	4.26
Maximum	10.35	10.20	9.46	9.50	19.70	12.91
Minimum	3.69	3.97	3.93	5.09	2.99	-1.14
Std. Dev.	1.80	1.34	1.77	0.94	2.44	4.18
Skewness	0.25	0.38	-0.06	0.07	1.19	0.43
Kurtosis	1.96	3.20	1.49	2.63	6.40	2.08

The co-movements of the rate variables with the OIS rate observed in the charts were confirmed statistically by a correlation analysis (Table 2). Generally, the factors considered have positive relationship with the OIS rates, which were found to be statistically

Table 2: Correlation Coefficient (level of variables)

	OIS1YR	OIS5YR	GSEC1YR	GSED5YR	CALL	INF
OIS1YR	1					

OIS5YR	0.85906	1				
P-value	0	-----				
GSEC1YR	0.968361	0.774268	1			
P-value	0	0	-----			
GSED5YR	0.926591	0.945672	0.884833	1		
P-value	0	0	0	-----		
CALL	0.794012	0.622974	0.847253	0.698309	1	
P-value	0	0	0	0	-----	
INF	0.810181	0.62994	0.809903	0.701048	0.775022	1
P-value	0	0	0	0	0	-----

significant at 1 per cent level (P-value). A more detail study of the correlation coefficients, causal relationship and the long term co-movement are undertaken in the following sections.

Section IV

Empirical Findings

(a) Stationarity Tests

Before proceeding to the test of overall relationship between OIS rate and other explanatory variables, it is appropriate that all the series be tested for stationarity or for the 'same statistical property'. Accordingly, in order to test for the stationarity of the series, the Phillips Peron (PP) test was conducted. The PP test showed that all the variables (i.e. OIS1, OIS5, Gsec1, Gsec5, Call and Inflation rate) were non-stationary for the period under consideration.

(b) Correlation Analysis

In view of the non-stationarity of the variables under consideration the correlations were computed using the variables in differenced

form. The correlation coefficients and their P-values are reported in Table 2(a) below:

Table 2(a): Correlation Coefficient-August 07 to Nov 09, Differenced Variable

	DOIS1	DOIS5	DGESC1	DGSEC5	DCALL	DINFLATION
DOIS1	1					Correlation
	-----					Probability
DOIS5	0.95963	1				
	0	-----				
DGESC1	0.878981	0.90181	1			
	0	0	-----			
DGSEC5	0.928576	0.953497	0.935967	1		
	0	0	0	-----		
DCALL	0.135003	0.156635	0.173708	0.159345	1	
	0.0014	0.0002	0	0.0002	-----	
DINFLATION	0.012975	-0.02169	-0.01949	-0.00917	-0.00981	1
	0.7597	0.6092	0.646	0.8288	0.8171	-----

The contemporaneous correlations indicate high degree of association of OIS rates with Gsec rates (both one and five year(s)). They also indicate moderate association of OIS rates with call rate. The correlations coefficient in the differenced form also broadly supported the direction of the association between the variables. However, unlike the correlations in the level variables, the correlation with the differenced inflation series was found to be low and not statistically significant. It may be mentioned that the *Dinflation* series has all zeros except one differenced number for each week.

Though the direct impact of the sub-prime crisis on Indian banks/financial sector was muted mainly because of limited exposure to the troubled assets, prudential policies put in place by the Reserve Bank and relatively lower presence of foreign banks in the Indian banking sector; there was a sudden change in the external environment following the Lehman Brothers' failure in mid-September, 2008. The knock-on effects of the global crisis manifested in not only as reversals in capital inflows but also adverse market expectations causing sharp correction in asset prices (on the back of sell-off in

the equity market by the foreign institutional investors (FIIs)), and pressures on the exchange rate. The cumulative effect of Reserve Bank's operations in the foreign exchange market as well as transient local factors such as build up in government balances following quarterly advance tax payments, however, adversely impacted the domestic liquidity conditions. Consequently, during July-November 2008, the LAF was in the injection mode. However, as a result of the slew of measures initiated by the Reserve Bank the money market rates declined and remained below the upper bound of the LAF corridor since November 2008. The LAF also turned into net absorption mode since December 2008 and remained in significant surplus mode in 2009-10.

The contemporary literature (Jorion, 2007) emphasizes on the changes in the correlation coefficient for financial markets variables during the crisis. To analyze the possibility of such changes in the correlation coefficient for the Indian money markets, table 2(b) reports the correlation coefficients along with their p-values in the crisis period and its aftermath (July 2008 – November 2009). A comparison of the correlation coefficients between pre and post crisis periods indicated that the contemporaneous association between OIS

Table 2(B): Correlation Coefficient-July 08-Nov 09, Differenced Variable

	DOIS1	DOIS5	DGESC1	DGSEC5	DCALL	DINFLATION
DOIS1	1					Correlation
	-----					Probability
DOIS5	0.96359	1				
	0	-----				
DGESC1	0.901547	0.918199	1			
	0	0	-----			
DGSEC5	0.94689	0.962503	0.949425	1		
	0	0	0	-----		
DCALL	0.152932	0.17446	0.185793	0.175483	1	
	0.0065	0.0019	0.0009	0.0018	-----	
DINFLATION	0.012589	-0.02705	-0.02935	-0.01484	-0.01597	1
	0.8239	0.6324	0.6038	0.793	0.7777	-----

rate and Gsec rate generally remained unchanged. However, the sensitivity to changes in OIS rate and Gsec rates has increased in the second period (July 08–November 09) as compared with the entire period. There has also been marginal increase in association between OIS rate and call rate in the second period as compared with the entire period. The relationship between differenced inflation and the other differenced variables, however, continues to remain small and insignificant.

(c) Causality Analysis

The sections above concentrated on the contemporaneous association between the variables. In an attempt to analyze the causal relationship among these variables (taking into account the lead & lagged effects) and the direction of such causality, we undertook pair-wise Granger causality test. In general, the test considers the lagged values of the dependent variable[1] and the explanatory variable and evaluates the incremental explanatory power of the second set of variable on the first. The different pair of variables considered for the causality test along with their F-Statistics and P-values are reported in the Table 3.

The F-Statistics and their P-values for the entire period under consideration indicate that the yield on Government securities (both 1 year and 5 year) were the major factors driving the OIS rate movements. But the reverse (i.e. the bi-directional) causality was not found to be statistically significant. It may be mentioned that the number of participants are much larger in the Gsec market (as compared to the OIS market), as Gsec forms a part of the statutory requirement (SLR) in India. Moreover, the Gsec is a funding based instrument while OIS is more of a (notional principal) hedging instrument which is settled by netting the difference. Therefore, the rate discovery has taken place in the Gsec market and it has percolated to the OIS market and not vice-versa. The other factor, which caused the 5-year OIS for the entire period was the call spread (difference between Call rate and repo rate), an indicator of liquidity conditions.

Table 3: Pairwise Granger Causality Tests

Null Hypothesis:	F-Statistic	Prob.	F-Statistic	Prob.
	Aug 2007-Nov 2009		July 2008-Nov 2009	
DGSEC1 does not Granger Cause DOIS1	**9.98**	**0.00**	**4.45**	**0.00**
DOIS1 does not Granger Cause DGSEC1	0.55	0.65	0.42	0.83
DGSEC5 does not Granger Cause DOIS1	**22.96**	**0.00**	**7.93**	**0.00**
DOIS1 does not Granger Cause DGSEC5	2.12	0.10	0.45	0.82
DCALL does not Granger Cause DOIS1	0.27	0.85	0.15	0.98
DOIS1 does not Granger Cause DCALL	0.09	0.97	0.17	0.97
CALL_SPD does not Granger Cause DOIS1	1.33	0.26	1.58	0.17
DOIS1 does not Granger Cause CALL_SPD	0.52	0.67	0.62	0.69
INF does not Granger Cause DOIS1	**0.48**	**0.70**	**2.03**	**0.07**
DOIS1 does not Granger Cause INF	0.09	0.97	0.06	0.99
DGSEC1 does not Granger Cause DOIS5	3.64	0.01	**2.09**	**0.07**
DOIS5 does not Granger Cause DGSEC1	0.77	0.51	0.62	0.68
DGSEC5 does not Granger Cause DOIS5	**12.18**	**0.00**	**4.67**	**0.00**
DOIS5 does not Granger Cause DGSEC5	0.46	0.71	0.10	0.99
DCALL does not Granger Cause DOIS5	0.05	0.99	0.11	0.99
DOIS5 does not Granger Cause DCALL	0.03	0.99	0.08	0.99
CALL_SPD does not Granger Cause DOIS5	**2.49**	**0.06**	**2.65**	**0.02**
DOIS5 does not Granger Cause CALL_SPD	0.18	0.91	0.24	0.94
INF does not Granger Cause DOIS5	0.44	0.72	1.52	0.18
DOIS5 does not Granger Cause INF	0.13	0.94	0.09	0.99

For the bold figures, null Hypothesis Rejected at conventional significance level.

The granger causality was also used to evaluate the plausible changes in the causal relationship over period of global crisis and its aftermath. However, the causality result for July 2008 to November 2009, generally supported the predominance of Gsec rate. The liquidity conditions factored in the model through *call spread* has statistically significant causal relationship with long term OIS rate. The inflation[2] was the additional factor that had an impact (though at

lower confidence level) on the long term OIS rate during July 2008 to November 2009. It may be mentioned that there was a large swing in the inflation rate during the period under consideration, which could explain the observed causal relationship.
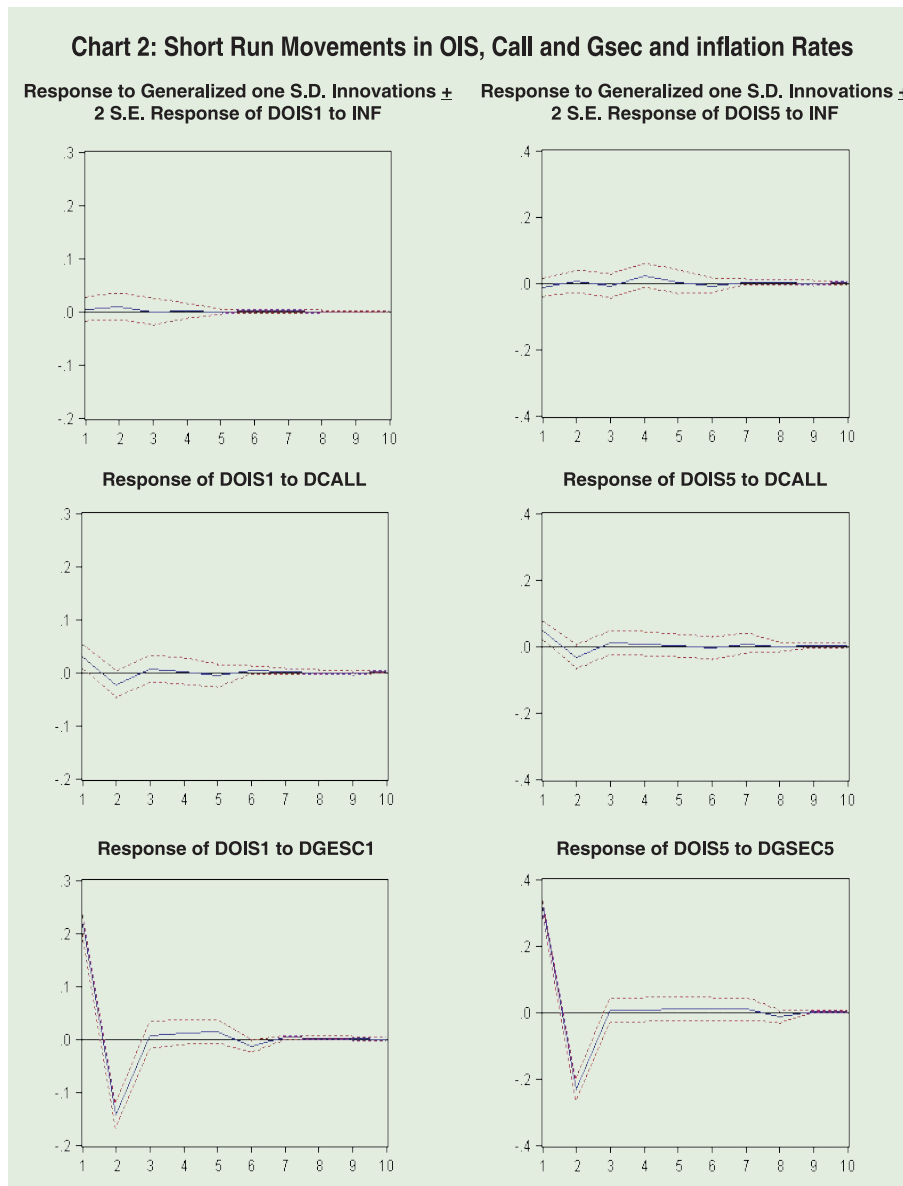
(d) Impulse Response Function

The above section indicated existence of causal relationship between changes in OIS rate to changes in Gsec rate, call rate, and inflation. In this section we investigate the direction and magnitude of such change on OIS' rate in the short run. In particular we attempt to analyze the impact of a shock / impulse in call rate and Gsec rates on the OIS rates.

For analyzing the same a three equation Vector Auto Regression (VAR) model was estimated using differenced OIS rate, call rate, Gsec yields and their lagged (with three lags) values. Inflation was used in their levels to minimize information loss. One of the major criticisms of unrestricted VAR models is that they are susceptible to ordering of variables. We tried to address this shortcoming by using *Generalized Impulse Response* function. Generalized Impulses, as described by Pesaran and Shin (1998), construct an orthogonal set of innovations that does not depend on the VAR ordering. The generalized impulse responses from an innovation to the *j*-th variable are derived by applying a variable specific Cholesky factor computed with the *j*-th variable at the top of the Cholesky ordering (Eviews User Guide).

Using the estimated set of equations, generalized impulse responses of a change in the above-mentioned three variables were plotted in Chart -3. The impulse response charts indicated the following:

● The impulse to inflation has a miniscule impact on OIS. The impact of one standard deviation shock to call had more noticeable impact on the OIS rate in the first period. The maximum impact was observed in the case of one SD generalized shock to the one-year Government Securities rate. These shocks had similar impact for one-year and five-year OIS rates.

● The effect of a shock on these financial variables (on OIS rates) died down within a short while (within ten days). This observation indicates the resilience of the market, notwithstanding the fact that is a leveraged market (i.e. positions are taken on the basis of notional principal) and participation is comparatively less.

Chart 2: Short Run Movements in OIS, Call and Gsec and inflation Rates

Response to Generalized one S.D. Innovations ± 2 S.E. Response of DOIS1 to INF

Response to Generalized one S.D. Innovations ± 2 S.E. Response of DOIS5 to INF

Response of DOIS1 to DCALL

Response of DOIS5 to DCALL

Response of DOIS1 to DGESC1

Response of DOIS5 to DGSEC5

(e) Long Run Cointegration Analysis

So far we have analysed the short run impacts of other financial market variables on the OIS rate. In this section we consider the possible long run co-movement of the rate variables. The OIS, Gsec, Call were found to be non-stationary. Therefore, the long run equilibrium relation among them is best established using cointegration approach. This involves testing for the *null hypothesis* that there are *no cointegrating vectors*. On the basis of sample data, if this *null is rejected*, then the cointegrating vector is estimated using a Vector Error Correction Model (VECM). Using the full sample period (August 2007 to November 2009) the estimated value for the test statistic leads to the rejection of the null hypothesis under different assumptions (both the trace and Max-eigenvalue test) and indicate existence of at least one cointegrating vector at 5 per cent level of significance.

After confirming the existence of contegrating vector, using the Johansen methodology (1991), the Vector error correction model was estimated. A dummy variable for the period July 2008 to November 2008 was introduced as an exogenous variable in the cointegrating VAR. The estimated long run cointegration vector is as follows (figures in the parenthesis report the t-statistic values).

OIS5= -9.06+ 2.94*Gsec5 - 0.99*Call; Error correction term = -0.002
             (7.93)   (5.96)   (-0.63)

In the estimated cointegration equation, the Gsec yield has expected (positive) sign and is significant at 1 per cent level, indicating co-movement of five year OIS and Gsec rates. A negative relationship between call and OIS rate, on the other hand, may appear counterintuitive in nature. However, it could actually indicate the long term expectations of the market participants. The call rate today could be high (low) depending on the demand and supply conditions in the market; however the five-year OIS rate adjust accordingly taking into account the long term expectation of the money market rates.

The error correction term has the right (negative) sign. As expected, the magnitude of the same is low mainly because (as the study uses daily data) it represents daily adjustment to the disequilibrium. However, the coefficient is statistically insignificant at 10 per cent level. It makes the adjustment to the equilibrium path weak. The significance could improve with the increase in depth and liquidity in the Indian OIS markets. It might be mentioned that the major market makers in the OIS market in India are the handful of foreign banks and the volume of trade are slowly picking up.

Section V

Conclusions

There haven't been many published studies on the Overnight Index Swap (OIS) for an Emerging economy. This study is an attempt in this direction, which concentrated on India. In India, the overnight market started in July 1999 and gradually developed. Anecdotal evidences suggest that the volume in the OIS market has remained low as compared with the Gsec market and the private/foreign banks have remained the major players in this market.

Among the financial variables considered in this study, the Gsec rate had high and significant positive contemporaneous correlation with the OIS rate. The call rate was also found to have positive and significant correlation with OIS rate. However, the inflation rate was not found to be contemporaneously related with the OIS rate. The above correlation didn't considerably change during the global financial crisis or in its aftermath. This could be because of the fact that the global financial crisis had a muted impact on the Indian economy.

The causality analysis generally indicated unidirectional causality from Gsec to OIS rate. The other factor that significantly caused the OIS movement was the liquidity conditions in the Indian money market, measured by the difference between the call and repo rate. While the above factors remained crucial even during and in the aftermath of the global financial crisis, inflation became a factor causing one year OIS movement in the post-crisis period. It may be mentioned in this context that inflation changed considerably during

and after the crisis period. Call rate didn't significantly cause the OIS rates or vice-versa. This could be because of the fact that the causality analysis results are indicative of a short period adjustment (as the lag length of three days is selected through HQ information criteria).

Anecdotal evidences suggested shocks to financial variables affect OIS rate movement. To evaluate the impact of such impulses, the generalized impulse response functions were considered. In this framework, the one standard deviation shocks to inflation, differenced gsec rate and differenced call rate positively impacted the OIS rate in the 1st period. However, the impact of such shocks died down over a ten working day period indicating the resilience of the OIS market.

Moving to the long-run equilibrium relationship between OIS rate, call rate and the Gsec rate, the test for cointegration indicated the presence of at least one conitegrating vector. The coefficient of Gsec rate in the estimated cointegration was found to be positive and significant. However, the coefficient of call rate was found to be negative (and low). It could indicate that a high (low) call rate today was expected to coverage to the long term market expectation as indicated by the OIS rate. The error correction term, though negative, was not found to be statistically significant at the conventional levels. This could be because of low volume in the OIS market, which is likely to pick up with further money market activities and future financial product developments.

While this is just the beginning, the road ahead for some of the empirical research in this area includes (a) the issues relating to the predictive power of the OIS rate, (b) the behavior of the MIBOR-OIS spread for India during different phases and (c) the reasons for OIS rate being lower than the risk free GoI bond rate.

Table A1: Policy Measures and Rate Movement

	Table 2: Policy Measures and Rate Movement	Call	Call	Call	OIS	OIS	OIS
Dates	Measures announced	t-1	t	t+1	t-1	t	t+1
16-Sep-08	SLAF reintroduced on daily basis from September 17,2008	10.59	13.07	9.98	9.28	9.08	8.64
	Additional liquidity support under the LAF up to 1% of NDTL						
	Interest rates raised in FCNR(B) and NR(E)RA deposits						
10-Oct-08	CRR was reduced by 150 basis points to 7.50 per cent wef October 11,2008	10.54	19.7	9.92	7.38	7.8	7.05
14-Oct-08	Introduction of a special 14 day term repo facility	9.92	9.95	10.04	7.05	7.14	6.87
15-Oct-08	Reduction of CRR to 6.5 per cent with retrospective effect from October 11,2008	9.95	10.04	6.94	7.14	6.87	6.73
20-Oct-08	Repo rate was reduced by 100 bps to 8.0 per cent with immediate effect	6.95	6.78	6.09	6.81	6.65	6.48
1-Nov-08	Reduction in the LAF repo rate to 7.5 per cent from November 3,2008	18.59	-	6.99	6.51	-	6.39

Table A1: Policy Measures and Rate Movement

15-Nov-08	Reduction in the risk-weightage to certain sectors	7.15	-	6.98	5.87	-	5.83
28-Nov-08	Continuing the special refinance facility up to June 30,2009	6.44	6.61	6.21	5.42	4.83	5.53
6-Dec-08	Reduction in the LAF rates by 100 basis points	6.10		5.26	4.97		4.97
11-Dec-08	Refinance facility to NHB and Exim Bank	5.26	5.37	5.53	4.97	4.83	4.61
2-Jan-09	Cut in repo rate,reverse repo rate and CRR rate	5.25	5.08	4.63	4.34	4.14	4.18
4-Mar-09	Cut in repo and reverse repo rate	4.07	4.07	3.64	3.79	3.94	3.83
21-Apr-09	Cut in repo and reverse repo rate	3.48	3.46	3.25	3.93	3.74	3.82
5-May-09	Withdrawal of second LAF on a daily basis	3.23	3.18	2.99	3.89	3.82	3.75
29-Sept-09	Suspension of OMO	3.35	3.38	3.24	4.69	4.70	4.79
27-Oct-09	Withdrawal of Term repo, forex swap and Special refinance facilities	3.22	3.23	3.23	4.91	4.81	4.78

Table A2: Market Expectations on OIS Rate movements during the crisis period and its aftermath (collated from different prit media)

Date		Expectations
September 8, 2008	1	Five-year OIS yield moved down more than one year OIS yield
	2	Market expected OIS yield to take direction from Gsec
September 15, 2008	1	OIS curve got inverted further on liquidity worries
	2	Market expected OIS yields to be under pressure on expected liquidity tightness.
September 22,2008	1	OIS curve come off sharply and flattened after RBI announced liquidity measures
	2	Market expected the five-year OIS to be higher on interest rate worries
October 6, 2008	1	OIS saw yields come off on positive interest rate sentiments
October 13, 2008	1	The one-over-five spread flattened by 82 bps to close at 13 bps levels.
	2	Market expected OIS yields to give back some gains.
October 20, 2008	1	OIS saw yields come off on positive interest rate sentiments.
	2	Market expected OIS yields see long unwinding after the next policy review.
October 27, 2008	1	OIS curve steepened on the back of interest rate uncertainties
	2	Market expected the curve to flatten on liquidity worries
November 3, 2008	1	OIS curve flattened owing to the spike in overnight rates.
November 10, 2008	1	OIS curve steepened on the back of easing liquidity

**Table A2: Market Expectations on OIS Rate movements
during the crisis period and its aftermath
(collated from different prit media)**

Date		Expectations
November 17, 2008	1	Market expected the OIS yields to stay bullish given rate cut expectations.
November 24, 2008	1	OIS curve fell on expectations of a cut in the reverse repo rate
	2	Market expected the OIS yields to stay bullish given rate cut expectations.
December 1, 2008	1	OIS curve moved up on profit-taking at lower levels
December 8, 2008	1	OIS curve steepened on rate-cut expectations.
	2	Market expected the curve to factor in further rate cuts and to trend down.
December 15, 2008	1	OIS curve fell on rate-cut expectations
December 22, 2008	1	OIS curve fell on rate-cut expectations, and one-over-five spread remained unchanged
December 29,2008	1	OIS curve moved up on profit-taking
	2	Market expected the curve to take its cue from government bond movements.
January 12, 2009	1	OIS curve moved up on the back of rising government bond yields, and the one-over-five spread steepened
	2	Market expected the OIS curve to take direction from the movement of government bond yields.
January 19, 2009	1	OIS curve moved down on the back of falling government bond yields.
February 2, 2009	1	Overnight index swaps (OIS) saw the curve become steeper on the back of rising government bond yields.

**Table A2: Market Expectations on OIS Rate movements
during the crisis period and its aftermath
(collated from different prit media)**

Date		Expectations
February 9, 2009	1	Overnight index swaps (OIS) saw the curve steepen.
	2	The OIS market is expected a reverse repo rate cut and betted that the higher borrowing by the government would keep yields pressured at the long end of the curve.
February 16, 2009	1	Overnight index swaps (OIS) saw the curve fall on the back of rate cut expectations.
	2	Market expected the OIS curve would flatten if there is positive news on the OMO window.
March 16, 2009	1	Overnight Index Swaps (OIS) saw the curve move higher on the back of government bond yields moving up.
	2	Market expected the OIS curve come off with a flattening bias on the back of RBI actions.
March 23, 2009	1	Overnight Index Swaps (OIS) saw the curve move down on the back of lower government bond yields.
	2	Market expected the OIS curve to take its cue from the government borrowing calendar.
March 30, 2009	1	Overnight index swaps (OIS) saw the curve steepen on the back of the rise in ten-year government bond yields.
April 5, 2009	1	Overnight index swaps (OIS) saw the curve fall on better bond market sentiments.
April 20, 2009	1	Overnight index swaps (OIS) saw the curve rise on hedging by the market.
	2	Market expected the OIS curve would take its cue from RBI policy actions.

**Table A2: Market Expectations on OIS Rate movements
during the crisis period and its aftermath
(collated from different prit media)**

Date		Expectations
April 26, 2009	1	Overnight index swaps (OIS) saw the curve come off on the back of policy rate cuts.
	2	Market expected the OIS curve would take its cue from gilt yield movements.
May 4, 2009; May 11, 2009 & May 18, 2009	1	Overnight index swaps (OIS) saw the curve move up on the back of higher government bond yields.
	2	Market expected the OIS curve would take its cue from government bond yield movements.
May 24, 2009	1	Overnight index swaps (OIS) saw the curve steepen as the five-year OIS saw good paying interest at higher levels on the back of rise in global bond yields.
June 1, 2009	1	Market expected the five-year OIS yield to be volatile on the back of uncertain interest rate environment.
June 8, 2009	1	Overnight index swaps (OIS) saw the curve flatten as the five-year OIS saw yields move down marginally while one year OIS yields moved higher.
June 22, 2009 & June 28, 2009	1	Market expected the OIS curve to trend down on the back of stable government bond yields.
July 6, 2009	1	Overnight index swaps (OIS) saw the curve almost flat week-on-week.
July 13, 2009; July 20, 2009 & July 27, 2009	1	Overnight index swaps (OIS) saw the curve trend down week-on-week on the back of fall in global bond yields.
	2	Market expected the OIS curve to trend down in the coming weeks on the back of improved interest rate sentiments.

Table A2: Market Expectations on OIS Rate movements
during the crisis period and its aftermath
(collated from different prit media)

Date		Expectations
August 3, 2009	1	Market expected the OIS curve to take its cue from government bond movements this week.
August 9, 2009	1	Market expected the OIS curve to flatten further as markets frets on liquidity.
Aug 17, 2009	1	Overnight index swaps (OIS) saw the curve almost unchanged week on week.
	2	Market expected the OIS curve take its cue from gilt yield movements.
Aug 31, 2009	1	OIS saw the curve move up week on week.
	2	Market expected the OIS curve to follow domestic bond yield movements rather than global bond yields.
September 7, 2009	1	Overnight index swaps (OIS) saw the curve flatten week-on-week.
	2	Market expected the OIS curve flatten further
Sept 20, 2009	1	Overnight index swaps (OIS) saw the curve move down week-on-week on the back of a rally in government bonds.
	2	Market expected the OIS curve to flatten further as market factors in higher rates at the short end of the curve.
Sept 27, 2009	1	Overnight index swaps (OIS) saw the curve move down week-on-week.

Notes:

[1]   We selected the lag order on the basis of Hannan Quinn (HQ) information criteria, the optimal lag length was found to be 3 (days).

[2]   Used in levels; it may be noted that the weekly WPI inflation numbers were repeated for the days of the week as the differenced inflation series actually incorporates the difference on Thursday / Friday leaving zero for all other days.

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