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Microstructure of Sub-Sovereign Bond Spreads – The case of Federal State Bonds in India

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Abstract

State development loans (SDLs) being sub-sovereign bonds offer a return higher than an equivalent maturity central government bond. The objective of this study is threefold. First, the paper revisits the existing literature that looks to identify the determinants of state specific SDL spreads using respective state-specific fiscal and market indicators. It uses a panel data framework covering 22 states over the decade from FY 2008-09 to FY 2018-19. It is observed that the state-wise fiscal prudence or lack of it does not impact the cost of borrowing. The spreads were similar irrespective of the issuer state. Second, using secondary market trade information an ex-ante measure of the SDL auction yield was estimated. It was observed that this measure has a high correlation with the ex-post SDL auction yields. The yield of SDLs was seen as a simple rudimentary process with a uniform spread over the corresponding maturity sovereign yields for all states. Third, an efficient SDL valuation measure is developed using secondary market data. Overall, the findings of this study provide valuable insights that information from the secondary market can be used for price discovery in the primary market and for valuation of non-traded SDLs.

JEL Classification: E43, H63, H74, G12

Keywords: Interest Rate, Debt management, State Borrowing, Asset pricing, Bond interest rates

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1. INTRODUCTION

The Sub-Sovereign market borrowings in India covers the State Development Loan (SDL) bonds issued by the various states to support their fiscal expenditure. Over the years, the composition of overall borrowing by the states has moved from receiving direct loans/grants from the Centre to market borrowings. As of March 31, 2019, the total outstanding size of the state borrowing, including special and UDAY bonds, was Rs. 27789.78 bn for 30 States as compared to the total outstanding of Rs. 57463.60 bn GOI securities (including Special securities and Treasury bills). The extent of SDL trade volume on the secondary market increased from Rs.360.62 bn in FY 2008-09 to Rs. 5087.75 bn in FY 2018-19, with a CAGR of 30% over the decade, while the growth in the trading of GOI securities increased from Rs.21260.73 bn in FY 2008-09 to Rs. 88322.71 bn in FY 2018-19, with a CAGR of 16%. The turnover ratio[1] for GOI securities was 1.5 for FY 2018-19, while the same was only 0.2 for SDLs mainly because of fragmentation of SDL issues.

In India, the SDLs are treated as sub-sovereign securities with an implicit Central Government guarantee. In response to the BIS report (2015) observations, the RBI indicated that extant regulations include SDLs as a part of level 1 High Quality Liquid Asset (HQLA) and thus treat them as instruments with "default free status for its market borrowings". Further under the FRBM Act (2003), the states need to follow prudence in managing their fiscal metrics and the overall budget. States unlike corporates have commitments towards social and welfare requirements. Given these conditions unlike for corporates, it does not seem necessary for States to command a differential premium based on the fiscal and market performance. In the June 2018 monetary policy, the RBI reduced the margin requirement for government securities and SDLs used as collaterals to access liquidity from the central bank. The margin for SDL was fixed between 2.5% to 6% based on maturity bucket and if rated it was to be set 1% lower. This segmentation was intended to allow for differential pricing that differentiates market risk across securities.

Most of the existing literature explains the sub-sovereign spreads over the sovereign yields using various state-specific fiscal and market indicators. The fiscal measures capture the state specific risk due to the existing liabilities that the state has to service, its income capabilities as measured by revenue deficit and fiscal deficits, the support from centre and the state's capability to generate future income. In terms of the States' market borrowings covering the SDL issuances, the primary market auction information, such as the auction frequency and size of the issuance captures the market capability to absorb additional issuance that can create potential liquidity in the secondary market. Further, the secondary market liquidity is captured through the trading information, such as number of trades and the volume.

[1] Defined as the Ratio of volume of all trades and total outstanding issuances.

The turnover ratio indicates that SDLs have a very low liquidity as compared to the government securities market. The low trading volumes which are concentrated in few high value trades also indicates lack of depth in these markets. The top 10 states account for nearly 80% of the issuances and trading activity. The SDL repo activity has taken off to a slow start but is picking up. Most of the trading has been concentrated in the new SDL issuances. The interest in trading seems to reduce after around 3 months and nearly disappears after a year of issuance. The SDL market size has increased manifold and so has the interest of market participants in this market. It is still highly illiquid and any market development measure would require a deeper understanding of the factors that explain the pricing and valuation of these securities.

The objective of the study is threefold. First, the paper revisits the existing literature to determine possible drivers of SDL spreads over corresponding underlying GSEC security using these state-specific fiscal and market indicators in a panel data framework covering 22 states over the decade from FY 2008-09 to FY 2018-19. Secondly, this study attempts to define an ex-ante measure of "spread" that could explain the variation in ex-post actual observed SDL yields over a period of time. This study covers the period from FY 2012-13 to FY 2018-19. Finally, it aims to provide an efficient valuation benchmark for non-traded SDLs such that it is both, closer to the actual market valuation of similar instruments and stable over time.

The paper is organized in the following sections: section (2) provides the literature on the theoretical and empirical work; section (3) gives the history of development of the sub-sovereign bond market in India; Section (4) gives the details on data, section (5) explains the econometric framework and discusses the results, section (6) defines an ex-ante measure for primary market SDL auction yield , section (7) provides an model for efficient valuation of SDL securities and finally section (8) concludes.

2. LITERATURE SURVEY

There is a large body of literature on the evolution of government bond yields and determinants of corporate bond yield spreads. However, very few studies have looked into pricing of sub-sovereign debt and the determinants of sub-sovereign bond spreads, which are also based on the extent of credit risk and liquidity risk over and above the underlying government securities. Most of the studies on sub-sovereign bond spreads conclude that debt, fiscal fundamentals and market indicators do influence pricing of sub-sovereign debt.

Sola and Palomba (2015) examine the determinants of sub-national governments risk premia in a cross-country framework for US, Canada, Australia and Germany. The study finds that for central governments, fiscal fundamentals matter in the pricing of risk premia, while sub-national governments with higher public debt and larger deficits pay higher premia. The study highlights that in pricing risk premia of sub-national governments, markets are less responsive to fiscal fundamentals when sub-national

governments depend on high transfers from the central government. The presence of explicit or implicit guarantees from the central government makes market pricing less effective and weakens market discipline.

Beck et al. (2016) exploit the variation of spreads across and within federations of sub-sovereign governments that includes Australian states, Canadian provinces, Swiss cantons, German Länder, US states, Spanish communities and Indian states. The study, covers the period from 1999 to 2012, establishes that sub-sovereign bond yield spreads tend to reflect fiscal and macroeconomic fundamentals regardless of the prevailing institutional arrangement at the federal level. Further, the positive link between debt and risk premia tends to break down when sub-sovereign government debt rises above certain set thresholds. The extent to which fiscal fundamentals are reflected in bond spreads depends on both the expectation of a federal bailout and the capacity of the Centre, or federation as a whole, to provide assistance. The study finds that India's evolving fiscal framework leaves little room for sub-sovereign autonomy.

Bellot et al. (2017) study the factors that affect the primary and secondary market spreads of fixed and variable rate bonds issued by sub-sovereign European governments. They observe that spreads behaved almost identically in the two markets. An important factor determining the spread of sub-sovereign bonds was the spread of the sovereign bonds in relation to the swap curve. The regional and national debt in each country thus bring closely related.

The study of provincial bonds in Canada and the factors determining the provincial-Canada yield differentials by the Institute of Fiscal Studies and Democracy (IFSD) (2018) finds that fiscal soundness at the provincial level consistently compresses yield spreads. The bigger provinces with deeper and larger markets for their bonds benefit from a liquidity discount. Global risk aversion as imbedded in corporate bond spreads remains a major factor influencing provincial-Canada bond spreads. Higher federal transfers tend to compress long-term yields, while trade openness and employment-to-population ratio, proxies for a province's capacity to attract capital and collect taxes, respectively, dampen yield spreads.

In the Indian sovereign bond market, the entire market borrowings by states are managed by the central bank (RBI). Rangarajan and Prasad (2013) assess that market and external borrowings by states in India are perceived as implicitly guaranteed by the center, as the center permits states to borrow from the market externally, and sets ceilings for states' loans and contingent liabilities. The SDL's (state securities) issued are eligible for meeting the statutory liquidity requirements of banks' and are thus backed by automatic intercepts from the state treasury account (automatic debit). Investors thus perceive an implicit sovereign guarantee attached to the SDL's as there has been no defaults associated with these state securities. This undermines market discipline as lenders have little incentive to distinguish among stronger and weaker states under a central guarantee.

Bose et al. (2011) study the determinants of Indian state-bond yields during 2006–07 to 2010–11. They find that the key deficit indicators have not been significant in determining yield spreads across States. However, states with larger dependence on central transfers appear to have benefited in terms of lower spreads. In contrast to fiscal indicators, market related variables like number of trades, size of issuances, frequency of accessing the market and interest rate environment are found to be better in explaining the yield spreads between the Central and State government securities. This study uses 5 years of data and defines yield spreads as the difference in the state government yield and the GoI dated security yield of 10 years maturity, considering State-wise annual weighted average yields and spreads thereof.

Saggar et al. (2017) study the spreads of Sub-sovereign Bonds of all Indian states' relative to the central government securities in auctions conducted during 2015-16 and 2016-17. The study establishes the disconnect between the spread and the states' fiscal indicators, suggesting investors' indifference to the credit quality of the states. This provides little market incentives for state governments to improve their fiscal and debt positions. In contrast to fiscal health of the states, other determinants such as the aggregate trading volume of state securities, weighted average call money rate, revenue transfers by Centre, the gap in the timing of bonds issued by the states and presence of large institutions in auctions were found to be negatively associated with spreads. The negative correlation between spreads and revenue transfers by Centre is indicative of some kind of guarantee factored in by the investors. The regular and frequent presence of states in SDL primary market leads to better price discovery and lower spread. The high demand for SDLs by large institutions which are generally buy and hold investors can cause the spreads to narrow. Yield differentials across states are marginal, despite material differences in deficit.

Ghosh (2017) study the differential yields of state governments attributing the spreads to be a by-product of market idiosyncrasies like trading mechanism, price formation, depth and liquidity. The study covers 15 states over the period from 2012-2017. It uses panel data with spreads being explained by various fiscal and market measures. It finds that fiscal factors do not matter and market factors have some impact with average size of bond issuance (negative), market share and number of bids in a year (positive).

Sabnavis (2018) suggest that given that SDL's are considered as sovereign debt in India, they qualify for SLR securities and that states need to adhere to FRBM, there is no need to bring in the concept of differential pricing. It would become important only if there is no sovereign backing.

Kanungo (2018) has provided a detailed insight into the state borrowings and their features. He notes that while FRBM act requirements were largely fulfilled by the states, the incidences of slippages are on a rise. While there is an increase in the amount of state market borrowing, they are still plagued with issues of low liquidity and shallow investor base which need to be addressed. An important aspect of market price of

borrowings is addressed in his statement "Following the recommendations of FC-XII[2], Government of India, disintermediated from the borrowings of State Government from FY 2006 onwards. It was expected that a rise in the volume of market borrowings would enhance the scrutiny of the states' fiscal health, and superior fiscal management would be incentivized through lower borrowing costs. However, the cut-off yields of SDLs issued by states in any given auction remain narrowly clustered, despite large variations in the state governments' fiscal performance. States with better fiscal parameters have expressed view that the market is not providing any incentive for better performance on fiscal front. A flat relationship was observed between the spread and the indebtedness of states therefore states are neither rewarded nor penalized for their debt performance."

Mukherjee (2019) provides detailed insights on the fiscal management of states and how the adoption of Fiscal Responsibility Budget Management (FRBM) Act has helped states in prudential fiscal management. The period of 2005-06 was marked by initial years of adoption of FRBM Act at state level which disciplined fiscal management practices. There was an increase in fiscal deficit in 2008-09 and 2009-10, and thereafter a falling trend was observed till 2011-12. Post the global financial crisis, union government increased market borrowing limit of states to create additional fiscal space as a part of fiscal stimulus measure, which resulted in sudden jump in market loans for majority of Indian states. This resulted in immediate fiscal stress to states and has left a long run impact in terms of burden of interest payment on market borrowings and redemption pressure on the maturity of the bonds.

3. SUB SOVEREIGN BOND MARKET IN INDIA – STATE DEVELOPMENT LOANS

Market borrowings have emerged as a vital source of financing the resource gaps of state governments. The borrowing channels for State Government's include loans from the center, open market borrowings, special securities issued to National Small Savings Fund (NSSF), loans from banks and financial institutions, state provident funds, deposits and advances, and own reserves. Historically, loans from Centre were a predominant source of finance for states. However, with various financial market developments and states' ability to borrow on their own behalf, the channel lost its significance and was discontinued in May 2005. Since then states have increasingly moved towards market-based financing through issuance of state government securities or state development loans (SDLs).

State market borrowings are finalized based on consultations between the Centre and the State governments, and managed by the Reserve Bank of India (RBI). During the 1990s, state borrowings were raised by using the traditional tranche method where the RBI held the combined borrowing program of all the States generally in two or more

[2] 12th Finance Commission

tranches through issue of bonds with a pre-determined coupon and pre-notified amounts for each state. In 1997, states' had the option of borrowing through tap or auction method by entering the market individually. The spreads were fixed at '25 basis points' over and above the central government securities of corresponding maturity in the tap tranches and were subsequently raised to '50 basis points' in 2001-02 with the introduction of umbrella tap tranche for a total targeted amount at a predetermined coupon. Gradually, there was a shift from the uniform coupon based system to the auction method so that states could borrow at competitive rates. The 12th Finance Commission (FC-XII) (2005-10) recommended a change in the role of the centre in the borrowings of state governments, by disintermediation of loans from the Centre to states. Loans were not extended to states under state plans from 2007-08 onwards, following which the state governments migrated to a full-fledged system of auction of state government securities (Annexure -1).

State development loans (SDL's) being sub-sovereign bonds have to offer a higher return than an equivalent central government bond. In a sub-sovereign market, when there is no support or assistance from the Sovereign or Central Government to the states for their borrowing/debt, the premium is attributed to the capability of the individual states to service the debt (i.e. their credit risk) and the liquidity of the issue. The move of FC-XII recommendation for doing away with central assistance to state plans in the form of loans was to encourage states to rely more on markets for meeting their borrowing needs, thereby subjecting them to market discipline. It was expected that states would mobilize funds from the market and the borrowing costs of the state would be linked to its fiscal position. The better the fiscal prudence of a particular state, lower would be its cost of borrowings as compared to other states.

In the BIS report (2015), the BIS assessment team had initially concluded that SDLs cannot be considered as sovereign debt securities in the context of the Basel standard and should not be made eligible for inclusion in the level 1 high quality liquid asset (HQLA) category. In its reply to this observation, RBI had stated that, "*SDLs in India are fiscal sovereigns as they can raise resources through taxation. Further, they state that, SDLs are issued and traded in the markets very similar to that of central government securities. SDLs are eligible as collateral for borrowing through repo and borrowing from the RBIs liquidity adjustment facility Since there is more than adequate stock of central government securities, the impact analysis should be looking only at the availability of what the Assessment Team considers eligible and liquid, without making any pro rata deductions of SDLs on a hypothetical basis*".

The RBI provides liquidity to market participants through the repo and marginal standing facility window against eligible collaterals, which include central government securities, treasury bills and SDL's. The margin requirements in respect of central government dated securities and treasury bills (including oil bonds) and SDLs stood at 4% and 6%, respectively. However, in its, Statement on Developmental and Regulatory Policies, dated June 06, 2018, the RBI proposed revised margin requirements for the

short-duration loans by assigning margin requirement on the basis of residual maturity of the collateral. Accordingly, the margin requirement for SDL was fixed between 2.5% to 6% based on the maturity buckets. In order to incentivize state governments to get SDL's a public rating, it was proposed that the margin requirement for rated SDL's be set at 1% lower than that of other SDL's which do not have a rating (Table 1). This proposal to introduce segmentation intends to shift the preference towards market based pricing for SDLs that differentiate SDL market risk across issuers and securities.

Table 1: Revised Margin Requirements for Collaterals

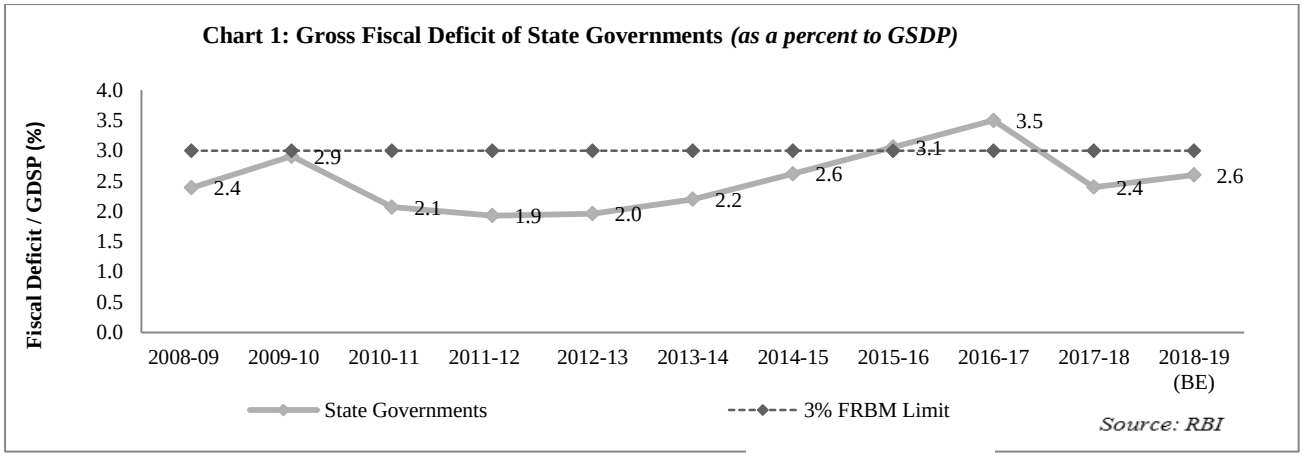
Collateral	Residual Maturity of Collateral				
	0-1 year	1-5 years	5-10 years	10-15 years	> 15 years
Treasury Bills and Central Government Dated Securities (including Oil Bonds)	0.50%	1%	2%	3%	4%
SDL's (Unrated)	2.50%	3%	4%	5%	6%
SDL's (Rated)	1.50%	2%	3%	4%	5%
Units : in percent					
Source: RBI					

In the rest of this section, a detailed description of the states' fiscal position, states' market borrowings through SDLs and the secondary market for SDLs is summarized for the period from April 2008 to March 2019. The data on SDL issuances by states is taken from the press releases of auction announcements and the auction results published by the RBI. The trading data of SDLs has been taken from NDS-OM.

3.1 State Fiscal Deficit

The Fiscal Responsibility and Budget Management (FRBM) Act, 2003, which limits fiscal deficit to 3% of GDSP, binds each state. As per the RBI Report on State Government Finances (2019), the consolidated fiscal deficit across all state governments in FY 2018-19 was 2.6% (Budgeted estimate). The long-term trends of states shows that the combined deficit of states which was close to or less than the FRBM threshold of 3% of GSDP till FY 2014-15, has since then turned less prudent.

In FY 2015-16, the deficit widened further to 3.06% as state governments took over the debt of power distribution companies under the UDAY (Ujwal DISCOM Assurance Yojana) scheme. In the years 2016-17 to 2017-18, the state government finances were under stress because of pay revisions, interest payments and farm loan waivers. As of FY 2017-18, the mounting fiscal pressure of states was clearly visible with the combined fiscal deficit of states at 3.1% of GSDP (Chart1). The actual estimate of fiscal deficit for FY 2017-18 was above the 3% norm for 19 states with fiscal deficit worsening for special category states compared to non-special category states. Further, the states with highest fiscal slippages for FY 2017-18 in the special category were: Assam-12.7%, Tripura-7.7%, Nagaland-6.6%, and in the non-special category were: Bihar-7.2%, Goa-4.6%, Punjab-4.5%, Rajasthan-3.5% and Odisha-3.5%.

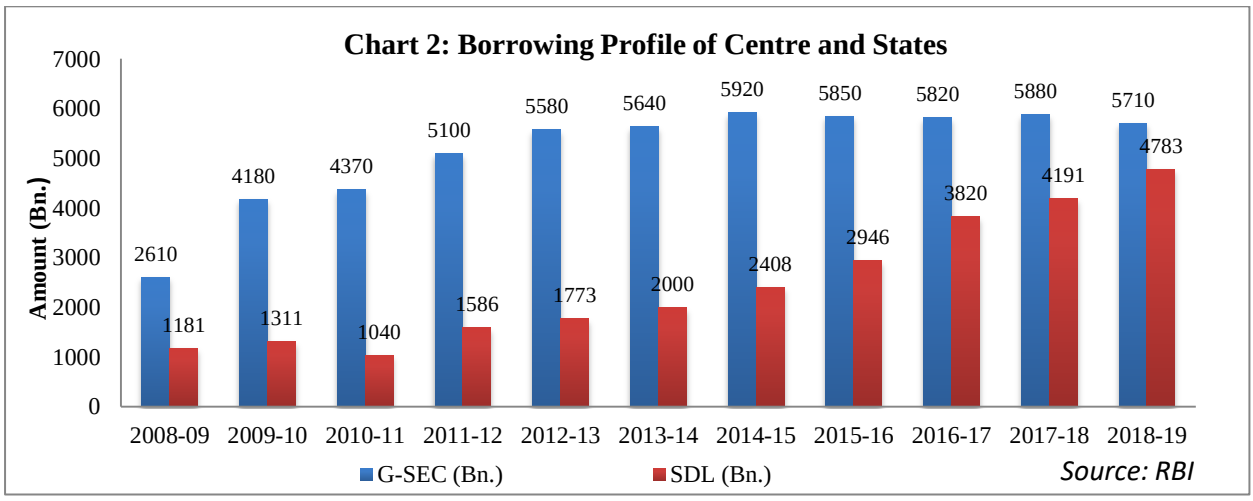


3.2 Extent of Market Borrowing versus Other Sources of Financing

The debt composition to meet state deficit has been through an increase in market borrowing. Of the total State governments' outstanding debt, market borrowings constituted 58.2% at end-March 2019[3]. Loans from banks and financial institutions have stagnated at around 4%, while the share of the high cost National Small Savings Fund (NSSF) declined from 19.8% to 9.8% for the period from FY 2013-4 to FY 2018-19. For the same period, loans and advances from the Centre and public accounts items are also declining from 5.9 % in FY 2013-14 to 4 % in FY 2018-19.

3.3 Size of State Market Borrowing

Borrowing from markets by the Government of India has remained stable over the recent years, while the borrowing by the states has been increasing (Chart 2). The gross market borrowings of states has increased from Rs.1182 billion in FY 2008-09 to Rs.4191 billion in FY 2017-18, at a CAGR of 15% as compared to the borrowings of the Centre which has increased from Rs.2610 billion in FY 2008-09 to Rs.5880 billion in FY 2017-18, a CAGR of 9%. In FY 2018-19, the borrowings of the states stood at Rs.4783 billion, while that of the Centre moderated to Rs.5710 billion.



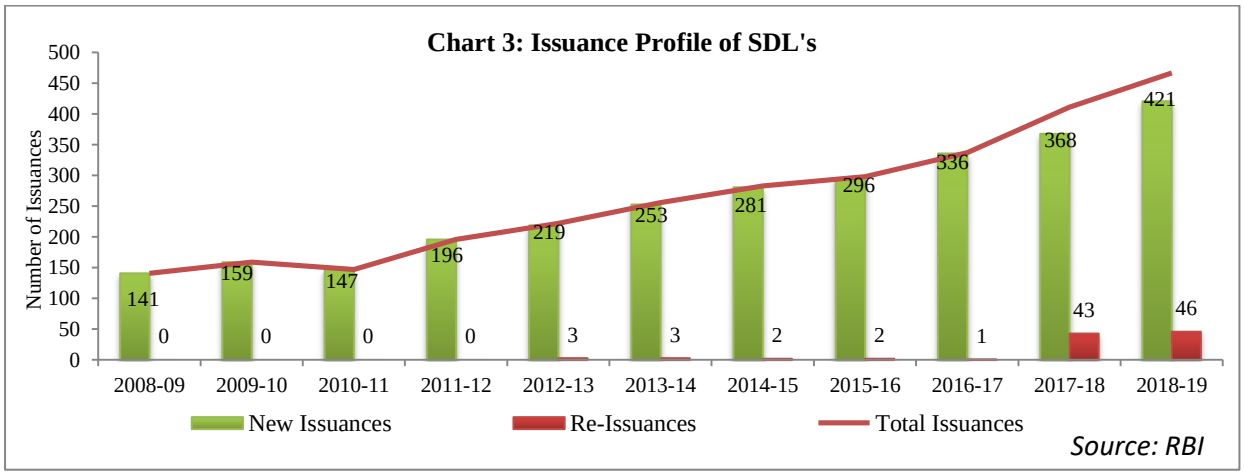
[3] As per Projected Estimate

3.4 Consolidation of Debt

The government securities market has seen gradual extinguishing illiquid and infrequently traded bonds and is focusing on the reissue of liquid bonds. In FY 2008-09, central government had 52 reissuances out of 56 issuances. In FY 2018-19, out of a total of 212 issuances by the central government, there were 206 reissuances. This policy of passive consolidation through reissuance has facilitated the consolidation of debt, improved market liquidity and helped in emergence of benchmark securities in the market.

In FY 2008-09, the state governments had 141 issuances, all of which were new issuances. Since August 2012, some states are re-issuing securities albeit the number is negligible (Chart 3). In FY 2018-19, the state governments had 46 reissuances out of 467 issuances mainly because of bunching of issues causing high repayment at one go.

The States have mostly floated new issuances. Re-issuances of SDLs by states are very few, mainly because of large repayment at one go. This has led to market fragmentation and prevented creating adequate liquidity in SDLs. Understanding the issuance profile becomes important as it indicates the extent of debt in each issuance remaining shallow given continuous new issuances.



3.5 Issuance Distribution

Between FY 2008-09 to FY 2011-12, all SDLs were 10-year issuances. Since July 2012, some State governments have issued SDLs of shorter tenors with their proportion increasing from 6% in FY 2012-13 to 15% in FY 2018-19. The tenor profile of new issuances has undergone a change in the last two years. In FY 2017-18, about 15% issuances of SDL's had tenors beyond 10 years and up to 25 years. The size of 10-year issuances fell to 79% in FY 2017-18 and in FY 2018-19, of the total new issuances, 10-year issuances constituted around 65%, while shorter tenor issuances (less than 10 years) and longer tenor issuances (more than 10 years) constituted 15% and 20% of the total new issuances, respectively (Table 2).

Table 2: New SDL Issuances by Maturity Buckets (Share in %)			
Period	**<10 Years**	**10 Years**	**>10 Years**
2006-07	-	100	-
2007-08	-	100	-
2008-09	-	100	-
2009-10	-	100	-
2010-11	-	100	-
2011-12	-	100	-
2012-13	6	94	-
2013-14	2	98	-
2014-15	6	94	-
2015-16	1	98	-
2016-17	9	85	6
2017-18	7	79	15
2018-19	15	65	20
Units: Share in percent			
Source: RBI			

3.6 Profile of Investors to SDL Issuances

Most investors of the SDLs are institutions including commercial banks, insurance companies and provident funds (PFs). There has been a gradual slowdown in the purchase of SDL's by commercial banks with their share dropping from 52% in FY 2007-08 to 34% at end-March 2019. There has been a sizeable increase in the share of insurance companies and provident funds. Table 3 gives the ownership pattern in SDLs based on primary market information.

Table 3: Ownership Pattern of State Government Securities								
Year	**Scheduled Commercial Banks**	**Insurance Cos**	**Provident Funds**	**Co-op Banks**	**Primary Dealers**	**Mutual Funds**	**FII**	**Others ***
2006-07	42.75	-	-	-	-	-	-	25.02
2007-08	52.25	22.4	9.79	-	0.55	0.02	-	14.99
2008-09	58.22	20.49	8.83	-	0.27	0.45	-	11.74
2009-10	58.46	21.71	8.09	-	0.21	0.02	-	11.51
2010-11	51.44	24.66	8.02	-	0.11	0.06	-	15.71
2011-12	51.19	25.78	7.99	3.27	4.05	0.05	0.01	7.65
2012-13	49.91	28.51	15.84	2.57	0.2	1.41	0.01	1.55
2013-14	49.67	30.45	15.04	2.74	0.24	0.83	-	1.04
2014-15	42.9	33.15	15.78	3.07	0.18	0.36	-	4.56
2015-16	42.11	32.5	15.95	3.92	0.31	1.05	0.27	3.89
2016-17	39.01	32.5	17.27	4.75	0.45	2.42	0.07	3.52
2017-18	35.77	34.11	19.66	4.77	0.51	1.64	0.23	3.3
2018-19	33.87	33.04	22.15	4.55	0.58	1.20	0.09	4.63
* Includes RBI, Financial Institutions, Corporates, State Governments and Others. Note: FII : Foreign Institutional Investors								
Units: Share in percentage								
Source: RBI								

As at end-March 2019, insurance companies (33%) and PFs (22%), who are largely investors who hold the bonds until maturity, held more than half of SDLs ownership. The participation of foreign institutional investors in the SDL market has been limited. In order to increase the participation of foreign portfolio investors (FPIs), investment limits were hiked in a phased manner to reach 2% of the outstanding stock by March 2018. In spite of the increase in investment limits, the FPI limit utilization of SDLs stood at a meager 12% of the limit for the quarter ending March 2018 because of lack of transparency and unavailability of high frequency data on state finances and state government operations [Kanungo, 2018].

3.7 SDL Outstanding across States

The SDL market is highly fragmented across multiple issuances and low outstanding volumes of each of the security, when compared to outstanding stock. As on March 2019, the number of SDLs outstanding was 3126 with a value of Rs. 27789.78 bn. The top five issuers in FY 2018-19 were Maharashtra, Uttar Pradesh, Tamil Nadu, West Bengal and Andhra Pradesh. These top five states accounted for nearly 50% of the total outstanding SDL, while the top 10 states accounted for almost 75% of the total outstanding SDL. For the period from FY 2008-09 to FY 2018-19, state wise analysis indicates that borrowings are concentrated among a few states which include Maharashtra, West Bengal, Tamil Nadu, Uttar Pradesh and Andhra Pradesh. State-wise and period-wise outstanding information of SDLs is provided in Table (4A & 4B).

Table 4A: State-wise SDL Issuance and Outstanding					
State	**No. of Issues Outstanding As of March 2019**	**Outstanding Amount* As of March 2019 (Rs. bn)**	**Auction in 2018-19 (Rs. bn)**	**Average Coupon (%) in 2018-19****	**Share in Total Outstanding Amount (%)**
Andhra Pradesh	194	2036.01	156.60	8.39	7.33
Arunachal Pradesh	23	30.08	7.19	7.96	0.11
Assam	50	305.55	64.00	8.33	1.1
Bihar	79	871.32	143.00	8.29	3.14
Chhattisgarh	56	403.20	-	-	1.45
Goa	79	110.10	23.50	8.36	0.4
Gujarat	148	1793.23	364.71	8.29	6.45
Haryana	138	1409.37	75.25	8.43	5.07
Himachal Pradesh	111	265.73	20.00	8.52	0.96
Jammu & Kashmir	93	344.84	66.84	8.46	1.24
Jharkhand	68	426.64	55.09	8.43	1.54
Karnataka	94	1578.90	195.00	8.25	5.68
Kerala	127	1297.19	170.00	8.32	4.67
Madhya Pradesh	80	1061.77	78.00	8.30	3.82
Maharashtra	134	2564.29	158.84	8.25	9.23
Manipur	41	47.24	9.70	8.13	0.17
Meghalaya	72	60.87	11.22	8.42	0.22
Mizoram	32	21.92	-	-	0.08
Nagaland	55	72.05	8.22	8.27	0.26
Orissa	40	280.31	5.00	8.19	1.01
Puducherry	40	55.30	5.25	8.40	0.2
Punjab	213	1253.76	148.31	8.38	4.51
Rajasthan	226	1940.49	301.78	8.45	6.98
Sikkim	31	44.14	10.88	8.52	0.16
Tamil Nadu	287	2740.57	385.75	8.33	9.86
Telangana	98	1041.74	12.50	8.50	3.75
Tripura	36	65.25	15.43	8.33	0.23
Uttar Pradesh	236	2853.31	460.00	8.38	10.27
Uttrakhand	80	316.52	63.00	8.40	1.14
West Bengal	165	2498.12	158.00	8.34	8.99
Total	**3126**	**27789.78**	**3173.06**	**8.35*****	**100**

**Includes SDL, Special and UDAY Bonds*
***Taking only auctions of maturity around 10 years (2027,2028,2029,2030)*
**** Simple average of the Coupon across states issuances*
Source: Authors calculations based on RBI data

Table 4B: State-wise SDL Outstanding as of Year End (Amount in Bn.)

State/Union Territory	Mar 2010	Mar 2011	Mar 2012	Mar 2013	Mar 2014	Mar 2015	Mar 2016	Mar 2017	Mar 2018	Mar 2019
Andhra Pradesh	516.22	619.83	750.89	916.87	1113.73	1266.40	1435.07	1681.84	1843.34	2036.01
Arunachal Pradesh	6.84	6.63	6.65	8.00	10.03	12.63	13.25	16.12	23.15	30.08
Assam	107.47	111.33	105.64	99.53	94.53	116.92	136.74	156.69	224.65	305.55
Bihar	161.50	176.78	201.73	259.38	312.84	379.51	497.38	673.21	762.29	871.32
Chhattisgarh	25.37	24.67	21.97	32.34	60.78	98.86	154.22	193.20	274.20	403.20
Goa	23.99	26.10	30.61	37.56	46.37	53.04	65.89	77.60	91.60	110.10
Gujarat	349.49	455.55	608.01	738.11	870.21	1004.29	1151.57	1361.02	1518.87	1793.23
Haryana	109.29	150.87	210.82	296.56	402.78	526.51	831.19	1071.28	1229.67	1409.37
Himachal Pradesh	88.35	92.24	101.47	118.09	135.65	151.96	168.60	219.14	244.65	265.73
Jammu & Kashmir	87.57	112.98	139.56	155.10	172.05	183.21	222.86	255.83	295.57	344.84
Jharkhand	73.69	77.47	86.30	117.75	143.11	187.99	291.08	338.34	386.41	426.64
Karnataka	235.26	245.63	307.70	399.20	533.26	694.19	843.33	1083.59	1243.32	1578.90
Kerala	259.73	307.43	382.39	488.10	601.83	719.60	848.46	995.32	1157.35	1297.19
Madhya Pradesh	218.28	249.21	280.44	314.07	349.78	431.50	561.40	780.51	911.76	1061.77
Maharashtra	592.89	698.75	893.97	1058.23	1250.28	1473.93	1764.92	2168.42	2533.22	2564.29
Manipur	18.03	20.25	21.18	23.15	26.19	29.74	33.01	37.79	40.57	47.24
Meghalaya	16.46	17.66	19.74	22.72	25.59	30.02	34.61	43.05	51.99	60.87
Mizoram	10.62	13.12	15.37	16.05	18.34	20.10	20.70	20.36	23.13	21.92
Nagaland	28.20	30.56	33.89	38.66	42.85	47.45	53.51	60.84	68.50	72.05
Orissa	67.83	61.60	51.14	38.06	29.21	45.65	81.28	150.93	239.31	280.31
Puducherry	11.87	17.87	23.20	26.22	31.22	35.92	40.42	45.67	59.91	55.30
Punjab	222.35	267.64	345.04	430.63	503.18	580.03	770.62	949.74	1079.22	1253.76
Rajasthan	305.44	353.81	384.85	441.49	513.66	647.15	1203.89	1570.86	1741.32	1940.49
Sikkim	12.67	12.35	12.59	13.33	15.31	18.39	23.00	28.74	52.74	44.14
Tamil Nadu	410.19	497.22	628.29	785.01	971.82	1203.26	1479.49	2057.56	2417.79	2740.57
Telangana	-	-	-	-	-	82.00	220.50	528.34	764.73	1041.74
Tripura	14.46	16.38	18.65	23.88	28.60	28.92	32.48	40.01	51.38	65.25
Uttar Pradesh	550.44	650.33	778.38	841.01	891.55	1026.67	1527.78	2145.46	2520.24	2853.31
Uttrakhand	62.30	72.06	83.94	91.94	109.30	130.22	157.51	208.32	259.62	316.52
West Bengal	587.27	671.71	879.71	1059.65	1232.89	1418.97	1628.48	1940.77	2192.81	2498.12

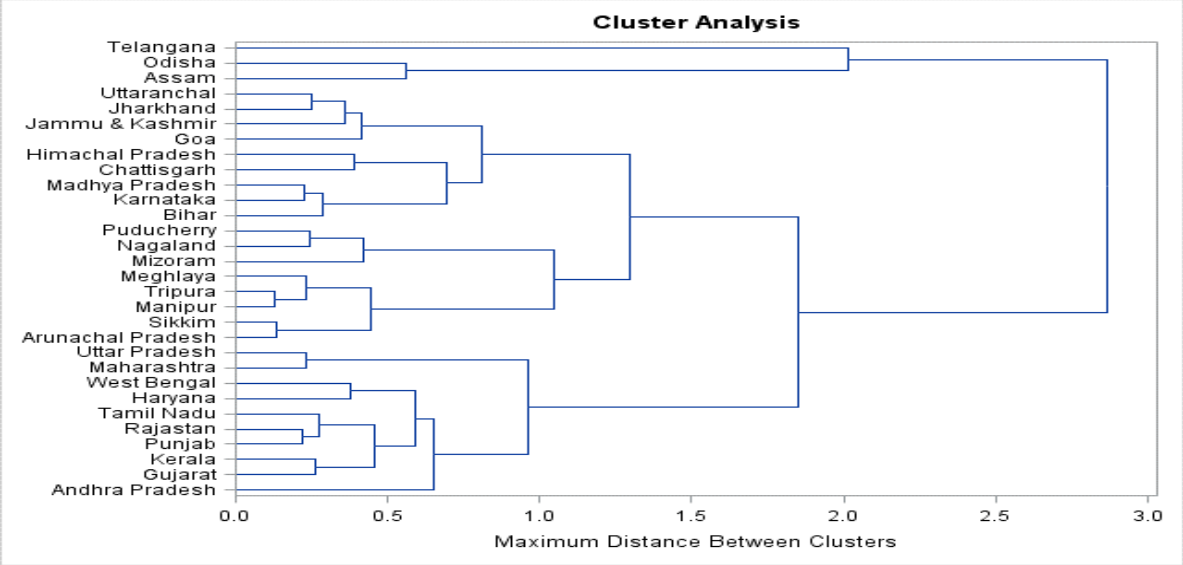
Units: Amount in Bn.

Source: Authors calculations based on RBI data

The total outstanding issue size of the States has been increasing exponentially as compared to GoI issuances. Thus an understanding of the distribution of characteristics of borrowing becomes important to identify if there are any state specific differences. Cluster analysis helps group the data, not defined by any prior, but are similar. Hierarchial clustering starts by treating each observation as a separate cluster. Then it repeatedly executes the following two steps. (1) identify the two clusters that are closest together and (2) merge the two most similar clusters. This continues until all the clusters are merged together.

The characteristics of the SDLs, including their outstanding issue size, the residual maturity and the coupon of the issuance (cost of borrowing) as at end September 2019 are considered for cluster analysis (Chart 4). The dendogram (Chart 4) indicates that there are multiple small groups, which aggregate at higher levels and no clear clusters are defined. The state of Telangana is seen to be slightly different from the others in terms of highest residual maturity (> 10 years) as compared to other states with a lower residual maturity (5-7 years). Further, Telangana, Odisha and Assam had slightly lower coupon as compared to the other states. Overall, the dendogram along with the Z-scores[4] indicates that most states have very similar characteristics and can be treated as a single group.

Chart 4 : Hierarchial Cluster Analysis based on Outstanding Issuance Size, Residual maturity and Coupon as on September 2019



3.8 Share of SDLs in the Secondary Market

Although both the supply and demand for SDL has increased over the years, the liquidity of SDLs in the secondary market remains marginal as compared to the GoI bonds. This could be due to lower outstanding issue in a security, given that there are frequent new issuances. For the entire decade from FY 2008-2019, the share of SDL trading is less than 5%, indicating the low liquidity (Table 5).

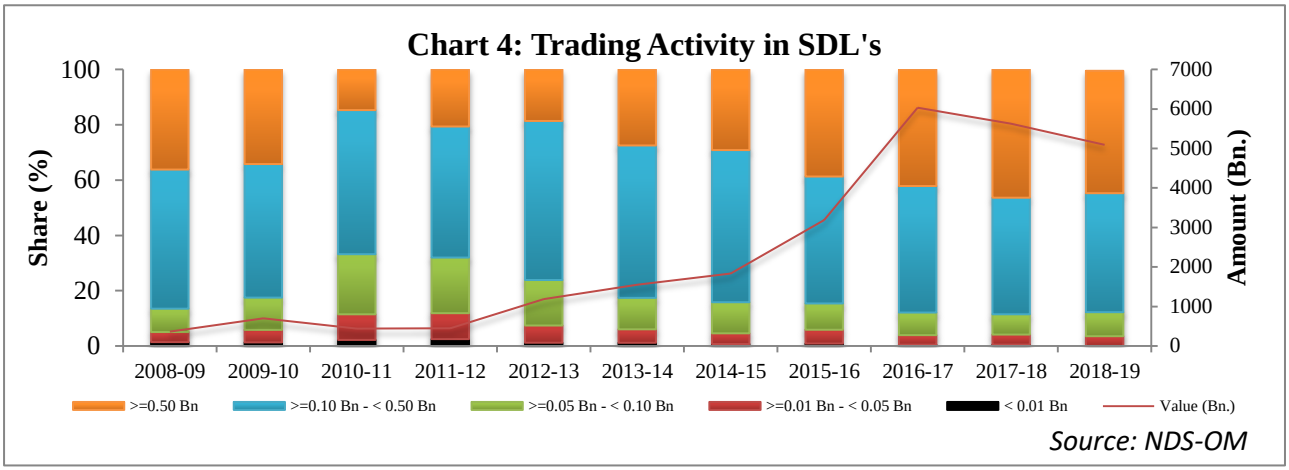
[4] The Z-scores of the individual characteristics - outstanding issue size, the residual maturity and the coupon of the issuance, indicates that most states are in the band of -2 to +2 for individual variables taken one at a time.

Table 5: Instrument-wise Share in Outright Trading (%)			
Period	**GOI Bonds**	**T-bills**	**SDL**
2008-09	90.47	7.94	1.59
2009-10	85.03	12.57	2.4
2010-11	88.96	9.52	1.52
2011-12	88.77	9.96	1.27
2012-13	89.86	8.35	1.79
2013-14	88.92	9.35	1.73
2014-15	90.09	8.11	1.8
2015-16	88.01	8.73	3.27
2016-17	90.04	6.38	3.58
2017-18	86.23	8.83	4.94
2018-19	84.53	10.02	5.45
2008 - 2019	**86.65**	**9.21**	**4.14**
Units: Share in percentage			
Source: Authors calculation based on NDS-OM data			

Further, the state wise secondary market trading activity shows that trading is highly concentrated in SDL's of a few states. Trading of SDL's mostly happens during auctions in the newly issued securities and thus the most actively traded SDL's belong to states that make frequent issuances during a particular year. The states with the most traded SDL's during the period under consideration are: Maharashtra, Tamil Nadu, Uttar Pradesh, Rajasthan and West Bengal. The top 10 states account for nearly 80% of the trading activity.

3.9 Trading Activity of SDLs

Secondary market trading volumes in the SDL has increased over the years. Over the last decade, trading peaked in FY 2012-13 to Rs. 1179.47bn, an increase of 167% over the trading volumes seen in FY 2011-12. Trading volumes moderated during the period of FY 2013-14 and FY 2014-15 and picked up again in FY 2015-16 and FY 2016-17. The volumes slowed down to Rs. 5622.52 bn in FY 2017-18, a decrease of 7% over FY 2016-17, and further to Rs. 5087.76bn in FY 2018-19, a 10% decrease over FY 2017-18. In terms of the deal-size, nearly 50% of the trades are in the range of Rs.0.1-0.5bn. There has been a gradual increase in high value deals (greater than Rs. 0.50bn) over the years (Chart 4).



3.10 Category-wise Trading Activity

Trading in SDLs is dominated by the public sector banks. Over the last decade, the public sector banks have reduced their holding and have turned net sellers while the private sector banks have been active in the SDL market as buyers. Primary Dealers and Mutual funds are the other players who are active on both sides of the market (Table 6), which may be due to higher yields it provides over corresponding GoI securities.

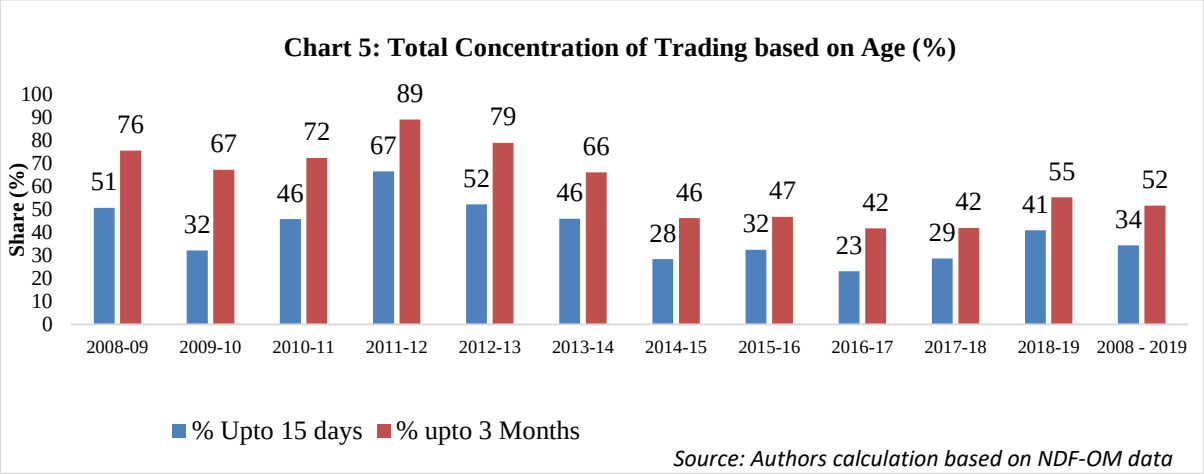
Table 6: Category-wise Share in SDL Trading

Category	2008-09		2018-19		2008-2019	
	BUY	SELL	BUY	SELL	BUY	SELL
Public Sector Banks	41.68	38.57	22.59	26.08	31.67	35.64
Private Sector Banks	20.18	17.04	29.52	24.84	24.10	19.84
Primary Dealers	9.33	25.68	10.68	25.28	8.66	20.16
Mutual Funds	6.76	7.67	8.33	8.32	8.97	8.73
Provident Funds	13	-	13.72	-	10.63	-
Co-operative Banks	3.82	3.2	2.73	2.71	5.52	4.99
Foreign Banks	2.18	6.86	4.51	8.81	3.44	6.18
Insurance Companies	1.07	0.82	3.77	2.12	3.93	2.63
Others	1.98	0.16	4.16	1.83	3.09	1.83
Units: Share in percentage						
Source: Authors calculation based on NDS-OM data						

3.11 Age-Wise Distribution of SDL Trading

The age of the security is the difference between its trade and issuance date, and would capture the time since issuance of the security. Nearly 50% of the trading is concentrated in the first three months of issuance of the security, while nearly 70% of the trading is concentrated in the first year of issuance (Table 7). Chart 5 further proves the case that most secondary market trading in SDLs is concentrated in recent issues only. This concentration has reduced in the recent years. This could however, be attributable to an increase in the reissues by certain states.

Table 7: Age Wise Distribution of SDL Trading Volume												
Buckets	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	***2008 - 19***
AUCTION DAY	7	4	9	13	16	17	12	17	9	14	23	15
ISSUANCE DAY	15	8	13	22	10	8	3	5	5	5	6	6
< 15 Days	29	20	24	32	26	21	13	10	8	9	12	13
15-30 Days	4	8	11	11	10	6	6	6	7	3	5	6
1 M-3 M	21	27	16	12	17	15	12	9	11	10	10	12
3 M-6 M	3	9	11	3	12	13	11	7	6	9	5	8
6 M -1 Y	11	10	9	3	6	13	17	9	11	3	6	8
1 Y-5 Y	10	14	7	5	3	8	24	30	31	28	8	20
5 Y-10 Y	0	0	0	1	0	0	1	6	9	18	24	11
> = 10 Y	0	0	0	0	0	0	1	1	1	0	1	1
Units: Share in percent												
Source: Authors calculations based on NDS-OM data												



3.12 SDL Valuation

As per the master circular of RBI on valuation of investment, dated July 1, 2015, the state government securities were valued applying the Yield to Maturity (YTM) method with a uniform mark-up of 25 basis points above the yield of the central government securities of equivalent maturity. UDAY bonds issued by various state governments are valued with a mark-up of 50 basis points.

Banks investing in SDLs are averse to trading because of the valuation norms which facilitate nudging up of the price of SDL in banks' books and insulation from market risks offered by Held to Maturity (HTM) dispensation. In the recent policy, the RBI has proposed that the securities issued by each state government should be valued based on observed prices, with an objective to ensure banks' bond portfolios reflect their current

market valuation. This measure could potentially discourage passive investment by banks and improve trading volumes in SDL [Kanungo, 2018].

The market currently follows the valuation of SDLs as provided by FBIL. The method relies on traded SDL prices wherever available with appropriate adjustments for non-traded securities with a look back period of 3 months to capture market movement[5]. Further, traded spread has been generally higher than the constant regulatory spread for valuation. The new methodology has done away with this flat 25 basis points spread valuation.

3.13 Term Structure effects in SDL Market Pricing

We observed that more than 90% of the total trades during the period of the study fell in the category of 8 years and above (mostly 10 year) while about 6% of the trades were in the 4-7 years. Hence, it would be difficult to make any inference on sub-sovereign term structure on stand-alone basis. The term structure of SDL has to be linked to underlying GoI term structure, since the market trades SDLs as a spread over G-Sec (RBI circular, July 2015).

The trades over the period 2012- 2019 were re-classified into seven maturity buckets - upto one year, 1-3 years, 3-5 years, 5-7 years, 7-10 years, 10-15 years and beyond 15 years. The maturity bucket-wise trading activity shows that nearly 80-90% of the trading is concentrated in the 7 to 10 year bucket (Table 8).

The SDL yield spread over the underlying Government security, for each year, has been range bound, across all the maturity buckets, except for the extreme maturity bucket, i.e. lowest maturity (in the year FY 2015-16) and the highest maturity (in the year FY 2016-17 & FY 2017-18). It may be noted that the volume weighted average spread is computed based on trades that took place over the entire year[6]. The trades in the lowest and highest maturity segment are infrequent and account for less than one percent of total trades in the year with low volumes. The same pattern exists when considering the maturity bucket-wise average spreads for various sub-state groups including all states, the top 5 states, and the next top 5 states (Table 8-10).

3.14 Market Pricing of SDL

SDL trades are executed on both the screen-based anonymous trading platform, NDS-OM and in the over-the-counter (OTC) market. The OTC trades are subsequently reported on the NDS-OM platform within a stipulated time. The trades can be broadly categorized as proprietary and constituent trades. It may be useful to check whether any pricing difference would occur simply due to the fact that the trades were OTC (as against on the trading platform) or these were constituents (as against proprietary).

[5] https://fbil.org.in/uploads/general/FBIL-SDL_Valuation_Methodology.pdf

[6] For this purpose, the SDL yields have been calculated as a weighted average of yields of individual SDLs, if they satisfy the conditions of (a) trade volume is greater than Rs.0.05bn. (b) there are atleast 3 trades in a year in a given ISIN. This process helps to remove outlier trades.

Table 8: SDL Maturity Bucket-wise Share in Trading (%) and Spreads (bps) over G-Secs * - All States														
Period	**< 1**		**>=1 to <3**		**>=3 to <5**		**>=5 to <7**		**>=7 to <=10**		**>10 to <15**		**>15**	
	Vol Share	**Spread**	**Vol Share**	**Spread**	**Vol Share**	**Spread**	**Vol Share**	**Spread**	**Vol Share**	**Spread**	**Vol Share**	**Spread**	**Vol Share**	**Spread**
2012-13	0	40	1	41	8	55	1	53	90	62	0	-	0	
2013-14	1	44	1	42	4	44	0	43	94	49	0	-	0	
2014-15	1	21	1	17	3	27	2	28	94	29	0	-	0	
2015-16	1	14	2	31	2	34	8	29	87	36	0	25	0	
2016-17	1	32	1	37	5	42	7	49	85	41	0	21	1	17
2017-18	0	35	4	44	6	44	6	53	74	45	6	34	4	24
2018-19	5	35	7	51	12	57	3	58	60	57	7	53	7	51
2012-2019	2	33	3	42	6	47	5	45	79	46	3	42	3	35
* Trades considered for Volume share and Spread computation include individual deals of >= Rs. 0.05 bn, and Min 2 trades per ISIN														
Units: Vol Share in percent and Spread in basis points														
Source: Authors calculations based on NDS-OM data														

Table 9: SDL Maturity Bucket-wise Spreads (bps) over G-Secs * - Top 5 States**								
Period	**>1**	**>=1 to <3**	**>=3 to <5**	**>=5 to <7**	**>=7 to <=10**	**>10 to <15**	**>15**	**All Tenors**
2012-13	41	36	55	49	63	-	-	61
2013-14	39	41	44	45	49	-	-	49
2014-15	23	16	24	27	29	-	-	29
2015-16	13	33	35	27	36	-	-	35
2016-17	30	37	44	49	40	14	36	41
2017-18	39	44	44	51	45	34	31	45
2018-19	39	50	57	60	57	52	59	56
2012-2019	33	41	49	46	46	41	47	45
* Trades considered for Spread computation include individual deals of >= Rs. 0.05 bn, and Min 2 trades per ISIN								
** Top 5 States include MH, TN, WB, KA, UP								
Units: Spread in basis points								
Source: Authors calculations based on NDS-OM data								

Table 10: SDL Maturity Bucket-wise Spreads (bps) over G-Secs * - Next 5 of Top 5 States **								
Period	**>1 YR**	**>=1 to <3**	**>=3 to <5**	**>=5 to <7**	**>=7 to <=10**	**>10 to <15**	**>15**	**All Tenors**
2012-13	45	51	55	61	60	-	-	60
2013-14	46	45	44	37	48	-	-	48
2014-15	16	16	28	29	29	-	-	29
2015-16	19	30	34	29	35	25	-	33
2016-17	32	39	40	48	43	26	13	43
2017-18	37	44	44	53	45	33	23	45
2018-19	35	53	55	58	57	56	45	56
2012-2019	33	45	45	43	46	45	25	45
* Trades considered for Spread computation include individual deals of >= Rs. 0.05 bn, and Min 2 trades per ISIN								
** Next 5 of Top 5 States include GJ, AP, KR, RJ, PN								
Units: Spread in basis points								
Source: Authors calculation based on NDS-OM data								

During the period between FY 2008-09 to FY 2018-19, SDL trading through NDS-OM accounted for approximately 30% of the market share, while the remaining 70% were OTC trades. During the same period, on an average, proprietary trades (i.e. trading by subsidiary general ledger account (SGL) holders) and constituent trades (i.e. constituent subsidiary general ledger account (CSGL) holders) constituted around 60% and 40%, respectively. The t-tests did not indicate any significant difference in terms of quality of trades.

The mandatory secondary market reporting of OTC deals on NDS-OM was effective from April 2013. On an average basis, yield difference reduced from 1.32 bps over the April 2008 - March 2013 period to 0.22 bps in the April 2013 to March 2019 period. The reporting of OTC deals on NDS-OM has increased transparency and resulted in better price efficiency [Annexure 2- Table 2A & 2B].

3.15 SDLs and Repo Market

In April 2007, SDL's were made eligible for repo transactions under the Liquidity Adjustment Facility (LAF) of RBI. They are also eligible as collaterals for borrowing through market repo. The trading in the repo market with SDL's as collateral has improved, albeit its low share compared to other instruments such as central government securities and treasury bills. The share of SDL's in the repo market has increased from 0.87% in FY 2008-09 to 13.56% in FY 2018-19, mostly in special repos.

4 DATA DESCRIPTION

The data on the state development loans, their issuance amount and subscription details for all the states has been taken from the press releases of auction announcements and the auction results published by the RBI. This covers the period from FY 2008-09 to FY 2018-19.

The data on fiscal indicators of states has been taken from Report on State Finances: A Study of Budgets and Handbook of Statistics on Indian States published by the RBI. The publications are available at an annual frequency. Some states are newly carved out and hence do not have information for the historical period. The data on volume, trades, participant wise activity taken on end of day data basis from NDS-OM information available on CCIL website and various CCIL publications.

As described in section (3.8), the secondary market for SDL is highly concentrated with nearly 80% of trading activity in the top 10 states and around 90% for top 15 states. In order to make any reasonable inference it is necessary that we have the consistent data for the entire period. Hence based on availability of information, further analysis is done taking the top 22 States[7] over the decade from FY 2008-09 to FY 2018-19. The structure of the data suggests the use of the panel data regression framework for analysis.

5 ECONOMETRIC MODEL TO EXPLAIN SDL PRICING

5.1 Static Panel Data Models

A dataset that provides information for various entities over a period of time is best understood under the panel data regression. The various methods of panel data analysis are pooled OLS, fixed effect (FE) and random effects (RE) model. The pooled regression model has constant coefficients, referring to both intercepts and slopes. The data is pooled and ordinary least squares regression is applied. The pooled regression disregards any cross-sectional and/or temporal effects (Equation 1). This is the base model against which the results of fixed and random effects are compared.

$$y_{it=}\beta_1 + \beta_2 x_{2it} + \beta_3 x_{3it} + e_{it} \quad (i = 1, \ldots., N, t = 1, \ldots. T) \ldots\ldots (1)$$

Fixed effects models have constant slopes but intercepts that differ according to the cross-sectional unit. In these models, while the intercept is cross-section specific, that is it differs

[7] The sample states include Andhra Pradesh (AP), Bihar (BR), Goa (GA), Gujarat (GJ), Haryana (HR), Himachal Pradesh (HP), Jammu & Kashmir (JK), Jharkhand (JH), Karnataka (KA), Kerala (KL), Madhya Pradesh (MP), Maharashtra (MH), Manipur (MN), Meghalaya (ML), Nagaland (NL), Punjab (PB), Rajasthan (RJ), Tamil Nadu (TN), Tripura (TR), Uttar Pradesh (UP), Uttarakhand (UT) and West Bengal (WB).

from individual to individual, it may or may not differ over time. The fixed effects model allows for one intercept parameter for each individual and time (Equation 2).

$$y_{it=}\beta_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + e_{it} \quad \ldots\ldots (2)$$

The method involves including a series of N-1 dummy variables for each unit and is computationally difficult with large N, since the regression will include N + k variables. It is preferable and much faster to demean the data. Thus, when N is large, then fixed effects estimation is done using data taken as deviations from the mean for each individual. This is referred to as one-way fixed effects, allowing for intercept differences across individuals. Alternatively, we can have fixed effects models which allows for intercept differences across time.

A random effects model treats the heterogeneity across individuals as a random component. The model is suitable when cross-sectional units (individuals) are drawn randomly from a large population, such as household studies (Baltagi, 2008). Also, the variation across entities is assumed to be random and uncorrelated with the independent variables included in the model (Torres-Reyna, 2007) as specified in equation (3).

$$y_{it=}\beta_1 + \beta_1 x_{2it} + \beta_3 x_{3it} + e_{it} + u_{it} \quad \ldots\ldots (3)$$

5.2 Model Selection Tests

Model specification testing in panel models involves testing for poolability, for individual or time unobserved effects, and testing for correlation between unobserved effects and the regressors. The choice of fixed effects against the pooled OLS is based on the F-test for fixed effects that determines whether all unobservable individual effects are zero. Second, the test for individual or time unobserved effects is based on Lagrange multiplier (Breusch-Pagan) tests. Third, is to determine whether fixed effects is preferred to random effects, where the Hausman test statistic is used to test for correlation between the unobserved effects and the regressors. This test indicates whether the unique errors are correlated with the regressors. Finally, to choose between pooled-OLS and random effects, the Breusch and Pagan Lagrange multiplier test is applied to test for the presence of an unobserved effect.

5.3 Controlling for Endogeneity

In economic terms, endogeneity can be interpreted as the effect of the past on the present, both on the model (dependent variable) and on the independent variables, or as the causality relationship between regressors and explained variable along the time (Labra & Torrecillas, 2018). The potential sources of endogeneity in the sub-sovereign risk premia determinants include dynamic endogeneity, unobserved heterogeneity and reverse

causality. First, a variable's current value may be influenced by its value in the preceding time period. Second, the presence of unaccounted time-invariant state specific effects, such as demography, geography, borrowing history of states', etc. may be correlated with the explanatory variables in the empirical model. Third, the fundamental factors associated with an issuer's creditworthiness may be affected by spreads.

Endogeneity bias can lead to inconsistent estimates and wrong sign of the coefficients. There is no direct way to statistically test the correlation between an endogenous variable and the error term as endogeneity bias is unobservable. Exogenous variables in a model are probably never truly exogenous (Ketokivi & McIntosh, 2017). It is almost impossible to statistically ensure that an endogeneity problem can be completely resolved (Roberts & Whited, 2012). In order to address the potential issue of endogeneity in the panel data, this paper estimates the baseline equation using a dynamic panel data models. In addition to dynamic OLS estimations, the generalized method of moments (GMM) framework is used, which uses the lagged values of the dependent variable as instruments to control for the endogenous relationship. The GMM model, generally used for panel data, provides consistent results in the presence of different sources of endogeneity, namely unobserved heterogeneity, simultaneity and dynamic endogeneity (Wintoki, Linck, & Netter, 2012). The System GMM estimator is used, as it includes an endogenous structure in the model through the use of instrumental variables, also known as lagged variables.

5.4 Dynamic Panel Data Models

Dynamic panel models are regression models that include lagged dependent variable as a regressor, thus capturing the autoregressive nature of the variable. These models are linear regression models that are generalized in two ways. First, individual effects are included, yielding a two-tiered error structure: individual-level errors and overall residual errors. Second, dependent variable is allowed to depend on its value from the previous time period, thus making the model dynamic. The model equation is given as:

$$y_{it=}\beta_0 + \emptyset \;\; y_{it-1} + \beta_i X_{it} + + v_i + e_{it} \;\; (i = 1, \ldots., N, t = 1, \ldots. T) \ldots..(4)$$

The model includes a lagged version of the dependent variable $y_{(i,\, t-1)}$, $\emptyset$ is the correlation between y_{it} and $y_{(i,\, t-1)}$, X it is a set of explanatory variables of i (individual) in t (period of time). The error term has two components: v_i for individual effects and e_{it} are observational-level errors.

The dynamic panel data models are classified into different estimators based on the use of instruments in differences or levels. The first estimation method is known as Difference GMM and was developed by Arellano and Bond in 1991. This method uses as instruments the lags in differences. Subsequently, an augmented version of the Difference-GMM model was outlined in Arellano and Bover (1995) and fully developed in Blundell and Bond (1998), known as System GMM. The method is based on a system of two equations –the

level equation, as well as the transformed one, that is the difference equation, and is thus denoted as System GMM. It uses as instrumental variables the lags in differences and levels and is suitable for panel data composed by a small period of time. The idea of using this model is to remove the reverse causality and endogenous regressors by instrumenting the first-differenced lagged dependent variable also with its past levels (Roodman, 2006).

The GMM model removes endogeneity by internally transforming the data, through the statistical process where a variable's past value is subtracted from its present value (Roodman, 2009). There are two kinds of transformation methods, known as first-difference transformation (one-step GMM) and second-order transformation (two-step GMM). The first-difference transformation in the one-step GMM involves subtracting the previous observations of a variable from its current value, which could result in the loss of observations in case of missing variable values. In order to overcome data loss due to internal transformation problem in the one-step GMM method, the use of two-step GMM was recommended by Arellano and Bover (1995). The two-step GMM applies forward orthogonal deviations, which involves subtracting the average of all future available observations of a particular variable (Roodman, 2009), thus preventing data loss. Furthermore, in the case of a balanced panel dataset, a two-step GMM model provides more efficient and consistent estimates for the involved coefficients (Arellano and Bover, 1995).

The validity of the instruments is confirmed through the Sargan test which checks for over-identifying restrictions under the null hypothesis of valid instruments. The Arellano–Bond test for autocorrelation is used to test for first-order correlation and second-order correlation in the residuals. In GMM models, heteroskedasticity is tackled by using Arellano-Bond robust VCE in the one-step estimation, and the WC-robust estimator of Windmeijer in the two-step estimation, which are both consistent in the presence of any pattern of heteroskedasticity and autocorrelation within panels.

5.5 Factors Explaining SDL Pricing

This section discusses the construction of the dependent variable and the corresponding independent variables (factors) and the purpose of selecting these variables.

5.5.1 The Dependent Variable: Spread over Corresponding Government security

The 'Yield Spread' is defined as the difference between the yield of a SDL and a comparable maturity GoI security. This spread may be computed using information on cut-off yields of the auction day or the trade day yields of SDLs. The spread has been computed by considering issuances of 10-year maturity as more than 90% of the SDL's issued during the period of study were of 10 years. [Section 3.5]

The two spreads are computed as (i) the difference between the auction yield of issuances with 10 year maturity and yield of the comparable GoI security (AUC_SPRD) and (ii) the

difference between the traded yield of SDL's with residual maturity close to 10 years and yield of the comparable government security (TRD_SPRD).

(i) $\text{AUC\_SPRD}_i = SLDYTM_{auction\ day\ cutoff\ yield\ \ of\ 10YSDL} - GSECYTM_{YTM\ of\ 10\ year\ Gsec}$ - (5)

Where Auction day cut-off yields of SDL are taken from the auction data provided by RBI and the 10-year GSEC YTMs are taken from NDS-OM.

(ii) $(\text{TRD\_SPRD}_i = SLDYTM_{traded\ yield\ \ of\ 10YSDL} - GSECYTM_{YTM\ of\ 10\ year\ Gsec}$ - (6)

We use the two-sample t-test in order to test for the difference of the yield spreads computed using the two methodologies. The results for the entire period and for each period in the sample indicate that the spread computed using either of the approach is not statistically different from one another.

The SDL auction market is primarily institutional driven with the primary purpose of providing efficient price discovery. As against this, the pricing in the secondary market would be influenced by the various factors, depending on the trade volume, the demand/supply, redistribution of the securities to a diverse market (through constituent/client deals), and market or OTC trades, among others. Hence, we continue the further analysis by computing spread using the auction information.

To ensure that there are no term structure effects on the spread, we consider only issuances of 10-year maturity as of the auction date. Hence, the spread for 10 year issuance of each state *"i"* is defined as in equation 5.

Since the number of issuances is not uniform throughout the year, we compute an average spread for each year for each state using the spreads computed on all auction days[8]. Bose et.al (2011) has considered secondary market yields for the 10Y rates on SDLs to determine the yield spread. We have however, restricted to using the auction yields as the, maturity would be strictly uniform across issuances of all states across the entire year. Also, given that the average rate is computed on an annual basis, this would make the information devoid of any other biases.

5.5.2 Determinants of SDL Yields

The two major components that drive yield spreads are default risk premium and liquidity premium. In line with the existing literature on determinants of sub-national spreads, the following proxy variables were identified for each of the risk factors. For any State, that raises capital from the market, the key element in the cost of borrowing is the capability of the State to repay the debt and this should be reflected by the fiscal indicators. The other major factor is from the market perspective that captures the availability of liquidity for

[8] The results are the same when the entire analysis is been done using weighted average spreads.

trading the securities in the secondary market and is measured by the market specific factors.

5.5.2.1 Fiscal Indicators

The fiscal indicators capture the 'fiscal health' of the state through the debt, deficit and expense measures.

Debt to State Gross Domestic Product (DEBT_GSDP)

The ability of an issuer to repay back the loan taken would be a function of its existing liabilities on the balance sheet. Greater the states debt to its gross domestic product (GDP) indicates a strain on the current resources to repay the debt. There is higher outflow in the form of principal and interest payment, thereby reducing its ability to service the existing debt obligations. Any recourse to market capital to service existing debt, would lead to higher yields and hence greater spreads.

Gross Fiscal Deficit to State Gross Domestic Product (GFD_GSDP)

Gross fiscal deficit is an indicator of the excess government expenditure as compared to the revenue it generates. The management of fiscal deficit is an important activity for all governments. While a low fiscal deficit is an approach of conservative governments, any large increases in the same would not be acceptable to the markets and will increase the cost of borrowings. In India, following the FRBM act (2003), the fiscal deficit is administratively controlled. The same prudence is applicable to the states.

Transfers from Centre to Capital Disbursement (TRANSFERS_CENTRE)

Transfers from the Centre are a form of risk-sharing across states, lowering risk premia of borrowing states relying increasingly on such grants and transfers. The extent of Centre's support is measured as the gross transfers to state scaled appropriately for the Capital Disbursement capability of the respective State. This would adjust for any inherent state specific impact. The Grants from Centre is also an indicator of implicit guarantee by the center to the state.

Capital Outlay to Capital Disbursement (CAPT OUT_CAPT DISB)

Another factor considered is the extent of capital outlay by states' towards pure developmental activities. This is measured as a ratio of the state's total capital outlay (developmental activities) to the state's total capital disbursement (excluding public accounts). An investment by the state in productive activities that lead to capital formation increases the probability to service the current debt. As against this, for an investment into populist measures, which do not generate long term returns would prove to be costly for the state for raising new borrowings. The same is justified under the clause of social obligation of the state governments.

5.5.2.2 Market Indicators

Tradability (SDL_TRD)

Tradability of SDLs, is measured as the ratio of total trading volume of the SDL of a particular state to the total outstanding issue size of the state. It is a proxy for liquidity. Higher tradability (in terms of trading value), lower will be the illiquidity premium and therefore lower spread[9].

5.6 The Regression Model

The panel data model is set with the following hypothesis on the expected sign of the independent variables [Box 1].

Box 1: Description of the Independent variables

Variable	Description	Expected Sign
DEBT_GSDP	Outstanding Liabilities as a % to GSDP	+
GFD_GSDP	Gross Fiscal Deficit as a % to GSDP	+
TRANSFERS_CENTRE	Transfers from Centre to State as a proportion of Total Capital Disbursement by the respective State	-
CAPT OUT_CAPT DISB	Total Capital Outlay (Developmental activities) as a proportion of the Total Capital Disbursement by the respective State	-
SDL_TRD	Total SDL trading Volume of the State as a proportion of the Total Outstanding Issue Size of the State	-

The base model is specified as:

$$Spread_{it} = \alpha_i + \beta_1 Debt\_GSDP_{it} + \beta_2 GFD\_GSDP_{it} + \beta_3 Transfers\_centre_{it} + \beta_4 CaptOut\_Capt\_Disb_{it} + \beta_5 SDL\_TRd_{it} + \epsilon_1 \quad - (7)$$

Without holding a bias in terms of the model selection, we estimate the pooled OLS, the fixed effects and the random effects model for the above specification. There have been studies that have used the pooled OLS based on the fact that fixed effects estimation wipes out time invariant dummy variables in the within transformation or the time demeaning process. Battaglia & Gallo (2015) used the pooled OLS estimation and have highlighted that in case of panel having fewer cross section items and shorter time period random effects estimation also tends to get affected by scarcity in the randomness of the variable. In these cases, the pooled OLS estimation with clustered robust standard errors is used to

[9] Additional market indicators such as Auction Frequency and Issuance size of the states were also considered. Correlation estimates of AUCT_FREQ, ISSUANCE_SHARE and SDL_TRD showed very high correlation between the three variables, a conclusion further supported by VIF results. Thus, in order to avoid multicollinearity, we include only SDL_TRD in the regression model.

encounter issues pertaining to heteroscedasticity and serial correlation within the same entity.

We then use the dynamic panel data models that assume a linear relationship between spreads, its lag, and the various fiscal and market indicators. These models include both the cross-sectional effects and a lagged dependent variable. The model is specified as a system of equations, based on different time periods (one per time period). The instruments applicable to each equation differ; for instance, in later time periods, additional lagged values of the instruments are available (Baum, 2014). The model includes one annual lag of the spread to allow for persistence of spreads over time.

The model is specified as:

$$Spread_{it} = \alpha_i + \beta_1 LagSpread_{it} + \beta_2 Debt\_GSDP_{it} + \beta_3 GFD\_GSDP_{it} + \beta_4 Transfers\_Centre + \beta_5 CapOut\_Capt\_Disb_{it} + \beta_6 SDL\_TRd_{it} + \epsilon_1 \quad \text{- (8)}$$

5.7 Empirical Results

The descriptive statistics and the results of the panel data regression are discussed in detail in this section.

5.7.1 Descriptive statistics

On an average SDL yield spread for the decade from FY 2008-09 to FY 2018-19 was around 53 bps, ranging from a low of 27 bps to a high of 127 bps. In FY 2008-09, there was a huge spike in the spreads, which were in the range of 60 bps to 127 bps, at an average of 90 bps. Post FY 2009, the spreads have moderated and have been in the range of 30 bps to 70 bps. The standard deviation of the spreads was highest in the year FY 2008-09 at 20 bps, while in the period from FY 2009-10 to FY 2018-19 it was in the range of 2 to 9 basis points [Table 11].

Table 11: Year-wise Summary Statistics of SDL Spreads over G-Secs of 22 States (basis points)

Period	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Mean	90	69	40	40	65	54	30	41	38	48	65
25th Percentile	76	67	37	35	61	49	28	38	36	45	62
Median	84	68	39	38	64	54	30	40	39	47	64
75th Percentile	109	72	43	43	69	58	31	43	40	49	72
Minimum	60	57	35	27	56	42	27	29	34	42	47
Maximum	127	84	51	54	72	63	35	59	43	60	80
Standard deviation	20	6	4	7	4	6	2	6	3	4	9

Units: Spread in basis points

The year FY 2008-09 also saw a sharp rise in borrowings by States (nearly a 75% increase over borrowings in FY 2007-08). There was a bunching of annual borrowings, with 87% in second half of the year, of which about 65% was during the 4th quarter. The spreads across

states were significantly high in the year 2008-09, and is attributable to the recommendations of the 12th Finance Commission under which the states were required to move towards market borrowing. This led to sudden jump in the amounts raised through new issuances by the states thus putting pressure on the borrowing costs. This year was also associated with the uncertainties caused in all financial markets due to the global financial market crisis. These uncertainties had led to funding crisis and hence in increase in cost of funds. An increase in redemptions, due to higher market borrowing of 0.5 per cent of GFD consequent to fiscal stimulus provided to the States in the aftermath of the Global Financial Crisis (GFC) 2007-08, also contributed to the rise in borrowings. The pressure on SDL yields has been attributed to this excess supply (Kanungo, 2018).

The state-wise and period-wise descriptive statistics of spreads for 22 states are summarized in Annexure 3 [Tables 3a and 3b]. During the entire period of April 2008 to March 2019, the average spreads on SDL's of states' ranged between 47 bps to 61 bps. The high spreads across states during the entire period can be mainly attributed to the market uncertainty that prevailed during the period of FY 2008-09, the period post global financial crisis.

5.7.2 Descriptive Statistics and Diagnostic Test of the Explanatory Variables

The summary statistics of the fiscal and market measures are summarized in Table 12A. The data suggests that while the various state-specific fiscal and market indicators are dispersed, the yield spreads are largely clustered. The fiscal discipline of states has deteriorated over time, while this is not reflected in the borrowing cost of states. Table 12B provides the correlation estimates of the variables.

Table 12A: Summary Statistics of Fiscal and Market Indicators (April 2008 to March 2019)

Measure	DEBT_GSDP	GFD_GSDP	TRANSFERS_CENTRE	CAPT OUT_DEV	SDL_TRD
Mean	31.32	3.25	1.95	63.82	12.41
25th Percentile	23.50	2.30	1.18	57.73	5.66
Median	29.60	2.90	1.78	65.99	10.53
75th Percentile	36.80	4.00	2.47	72.33	17.14
Minimum	16.20	-1.90	0.25	21.83	0.09
Maximum	68.00	12.40	5.30	88.69	46.28
Range	51.80	14.30	5.05	66.86	46.19
Standard deviation	10.29	1.83	1.01	12.18	8.92

Units: DEBT_GSDP, GFD_GSDP, CAP OUT_DEV, SDL_TRD in Percentage terms, and TRANSFERS_CENTRE in ratio terms.

In order to ensure that there is no high correlation between the independent variables, a test for multicollinearity was performed using the Variance inflation factors (VIF) in an OLS regression analysis. As shown in Table 13, the level of VIF for each of the independent variable is below the threshold of 10. The mean VIF is 1.30, well below 10, indicating the absence of multicollinearity among independent variables.

Table 12B: Pearson Correlation Coefficients (with Prob > |r| under H0: Rho=0, N = 242)						
	SPRD	**DEBT_GSDP**	**GFD_GSDP**	**TRANSFERS_CENTRE**	**CAPT OUT_DEV**	**SDL_TRD**
SPRD	1					
DEBT_GSDP	0.0999	1				
GFD_GSDP	0.0671	0.3684***	1			
TRANSFERS_CENTRE	-0.0749	0.4669***	-0.0479	1		
CAPT OUT_DEV	0.1097*	0.0363	-0.0327	0.1285**	1	
SDL_TRD	-0.0976	-0.2345***	0.0751	-0.2850***	-0.1397 **	1
, **, * - significant at 10%, 5%, 1% levels, respectively.*						

Table 13: Variance Inflation Factor Results		
Variable	**VIF**	**Tolerance (1/VIF)**
DEBT_GSDP	1.64	0.6110
GFD_GSDP	1.27	0.7886
TRANSFERS_CENTRE	1.43	0.6995
CAPT OUT_DEV	1.03	0.9703
SDL_TRD	1.14	0.8789

5.7.3 Panel Regression Results

The discussion in the previous sections leads us to build the hypothesis of whether the fiscal and market indicators of states impact the pricing of their market borrowings. The baseline model is estimated using an annual data for the period April 2008 to March 2019 (242 observations). The model is estimated using both static and dynamic panel data specifications.

Analysis of Static Panel Data Estimations

The above hypothesis was tested using all the three static panel data specifications (Pooled OLS, Fixed Effect and Random Effect). The selection of the model is determined by the respective tests comparing the three alternate specifications (Table 14). The Hausman test for endogeneity is applied to the panel data to see if there is a correlation between the unique errors and the regressors in the model, with the null hypothesis of no correlation between the two. The p-value of the Hausman Test is significant (p-value <0.05), suggesting that the preferred model is fixed effects and not random effects. In other words, the results indicate the presence of correlation between the explanatory variables and the error term. Next, the test was for time-fixed effects, where the null hypothesis is that there are no time-fixed effects. The results suggest the presence of significant time-fixed effects (p-value <0.01). The Breusch and Pagan test also rejects random effects specification in favor of OLS. The standard F-test was applied to check for poolability, the hypothesis that the same coefficients apply across all individuals. The results suggest that the null hypothesis of poolability cannot be rejected and there are no significant group specific effects. However,

when time-fixed effects are considered, the F-test, rejects the OLS specification in favor of Fixed effect (time) specification.

Table 14: Comparison of Various Models Based on Respective Specification Tests			
Test	**Tested**	**p-value**	**Model Selection**
Hausman	Fixed vs Random	0.013	Fixed
F-Test	OLS vs Fixed	0.305	Pooled OLS
Lagrange Multiplier Test - Time Effects	Time Fixed-Effects	0.0000	Fixed (Time)
F-Test	OLS vs Fixed (Time)	0.0000	Fixed (Time)

The results of the pooled OLS estimation and Fixed-effects estimations are reported in Table 15. The parameter estimates for all the regression specifications are based on cluster-adjusted standard errors, to correct for panel-specific autocorrelation and heteroskedasticity in the residuals. The results of pooled OLS model (Column 2 of Table 15) shows that TRANSFERS_CENTRE is significant at 1% and DEBT_GSDP is significant at 5%. Also, CAPT OUT_DEV shows a significant positive impact on spreads against an expected inverse relationship.

The results of the FE model which captures state-specific effects (Column 3 of Table 15) shows that the variable TRANSFERS_CENTRE has a significant negative impact on spreads at 1%. DEBT_GSDP has a significant impact on spreads at 10%. Higher the debt to GSDP, higher would be the loan servicing obligations for the state and hence any further borrowing would come at a greater cost. A similar finding was highlighted by Beck, et.al. (2016) for the Indian sub-sovereign bond market. On considering time fixed-effects in the panel data (Column 4 of Table 15), SDL_TRD and TRANSFERS_CENTRE show a positive significant relationship with spread at 5% and 10% significance levels, respectively. Although the relationship of these two variables with spread is significant, the signs are not consistent with the expected direction as indicated in Box 1.

Table 15 : Regression Estimates - Static Panel Data Models						
1	**2**		**3**		**4**	
	Pooled OLS		**FE (Within-Groups)**		**FE (Time Effects)**	
Variable	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
DEBT_GSDP	0.2873**	0.125	0.7534*	0.4045	-0.1577	0.1101
GFD_GSDP	0.1144	0.597	0.0401	0.5095	0.3307	0.2148
TRANSFERS_CENTRE	-3.5399***	1.0291	-7.6098***	2.175	2.3931*	0.5828
CAPT OUT_DEV	0.1773**	0.0691	0.1148	0.1363	0.0683	0.0518
SDL_TRD	-0.2101	0.1426	-0.2038	0.1682	0.1419**	0.0593
Constant	41.5515***	6.5871	-	-	-	-
No. of States	22		22		22	
Observations	242		242		242	
R-squared	0.0532		0.1483		0.8381	
Notes: (i) The significance levels are based on robust clustered standard errors. (ii) *, ** and *** denote that the variable is significant at 10%, 5%, 1% levels, respectively. (ii) The standard errors are asymptotically robust to heteroscedasticity and serial correlation for all the models.						

It is seen from Table 11 that the year FY 2008-09 was a clear outlier in terms of the behavior of the spreads. The average spreads is much higher at 90 bps in FY 2008-09 as compared to the average of 50 bps during FY 2009-10 to FY 2018-19. Similarly, the variation in spreads in FY 2008-09 is about 20 bps, which is again much higher than the variation for other periods which is around 2 to 9 bps. Considering these observations, we further re-estimate the pooled OLS and FE models with a dummy for the FY 2008-09. The results are given in Table 16.

Table 16 shows that on introducing a time dummy for the period 2008-09, the significance effect of TRANSFERS_CENTRE, DEBT_GSDP and CAPT OUT_DEV (Pooled OLS model), and DEBT_GSDP and TRANSFERS_CENTRE (FE-Within-Groups model) wanes off and they are no longer significant. It is only the dummy variable for the period 2008-09 to control for unusually high spreads that captures the variation in spreads, and it is highly significant in both the model specifications. The overall R-squared improves as compared to the specifications in Table 15.

Table 16: Regression Estimates - Static Panel Data Models (with Dummy for FY 2008-09)

1	2		3	
	Pooled OLS		FE (Within-Groups)	
Variable	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
DEBT_GSDP	0.0868	0.1257	0.1050	0.2523
GFD_GSDP	-0.1056	0.5853	-0.3640	0.5415
TRANSFERS_CENTRE	-0.7407	0.7506	-6.1655*	1.5546
CAPT OUT_DEV	0.0917*	0.045	-0.0185	0.1093
SDL_TRD	0.0525	0.1058	0.1138	0.1350
DUMMY (2008-09)	40.7832***	4.2948	39.8471***	4.3349
Constant	41.5857	5.1212	-	-
No. of States	22		22	
Observations	242		242	
R-squared	0.4090		0.4669	

Notes: (i) The significance levels are based on robust clustered standard errors. (ii) *, ** and *** denote that the variable is significant at 10%, 5%, 1% levels, respectively. (ii) The standard errors are asymptotically robust to heteroscedasticity and serial correlation for all the models.

In the presence of endogenetiy, the pooled OLS and fixed-effects static panel estimation techniques may produce biased parameter estimates. Moreover, the FE model uses only the within variance for the estimation and disregards the between variance, it does not allow the estimation of time-invariant variables (Baltagi 2001, Hsiao 2003, Wooldridge 2002). A second drawback of the FE model (and by far the less recognized one) is its inefficiency in estimating the effect of variables that have very little within variance (Plumper, Troeger, 2006). Also, the time dimension in our panel data set is relatively small; hence, the bias from using a FE estimator might be significant in the results (Santos, 2014).

In order to overcome the methodological problems of the static panel models and to address the potential issue of endogeneity, we apply the dynamic panel data models to validate our results. The dynamic panel data models address the problem of endogeneity by instrumenting the first-differenced lagged dependent variable also with its past levels (Roodman, 2006).

Analysis of Dynamic Panel Data Estimations

We estimate the two-step System GMM form of the baseline model for the period 2008-09 to 2018-19, for 22 states. The lagged values of the dependent variable are used as instruments to control for endogeneity caused by sub-sovereign specific effects. One period lag of spreads is included as an explanatory variable in the system GMM estimation to capture the persistence of spreads. We include year dummies to control for time effects in the data.

System GMM estimates are presented in Table 17. The system GMM model is well-specified based on the Sargan test, which suggests that the instruments are strong, and the Arellano–Bond test of autocorrelation, which accepts the null of no second order autocorrelation. The coefficient on the lagged dependent variable is statistically insignificant, and also none of the variables are significant, suggesting that fiscal and market factors have no role in pricing of risk premia. Overall, the regression results of the dynamic panel model provide evidence that state-specific factors have no impact on spreads.

Table 17: Regression Estimates - Dynamic Panel Data Model (System GMM)

1	2	
Variable	**Coefficient**	**Std. Error**
L_SPREAD	0.0377	0.1521
DEBT_GSDP	0.2984	0.2753
GFD_GSDP	0.2491	1.2879
TRANSFERS_CENTRE	2.0116	2.0689
CAPT OUT_DEV	-0.0643	0.1839
SDL_TRD	0.3920	0.3993
Constant	-	-
No. of States	22	
Observations	220	
R-Squared	-	
Sargen Test (p Value)	0.5175	
AR(2) Test - (p Value)	0.7651	

Notes: (i) *, ** and *** denote that the variable is significant at 10%, 5%, 1% levels, respectively. (ii) The regression includes time dummies. (iii) The System GMM model uses the lag of the dependent variables as instruments (dated t-2). (iv) The standard errors are asymptotically robust to heteroscedasticity and serial correlation.

Spreads are highly clustered across states and hence, all the sub-sovereigns can be considered as a single group. In the next section, we consider the secondary market yields of all traded SDLs and attempt to compute an expected yield for this group of sub-

sovereigns. This ex-ante measure of expected yield is computed for each auction day and compared with the corresponding ex-post cut-off auction yield.

6 DEFINING AN EX-ANTE MEASURE OF SDL AUCTION YIELD

The results from Section (5) indicate that the market assumes no state-specific risk and also that there is an implicit guarantee by the Centre to the states in pricing SDLs. This raises the question of whether observed secondary market SDL yields can provide any information about the possible cost of borrowing for a state when it comes in for new market borrowing. In this section, an attempt is made to construct an ex-ante measure of primary market SDL auction yield based on the secondary market traded yields and compare it to the ex-post measure of the SDL auction cut-off yield. This would provide insights into the price discovery process of the SDL yields in the primary market.

6.1 Data & Methodology

6.1.1 Data Description

The SDL data of the primary market (auction) and the secondary market (trading) of all states and all tenors is taken for the period from April 2012 to March 2019.

The primary market auction data has been sourced from the auction press releases and results published by the RBI. SDL issuances of all states and all tenors are considered. In order to ensure that there is no bias due to liquidity, a minimum issue size criterion had to be used. However, since the size of issuances has increased over the decade using a flat minimum criterion across all the years would be inappropriate. Thus, a period-wise analysis of the issuances was conducted to arrive at the minimum threshold criteria of issuance amount for selection of the issues to be used for computing the ex-ante yields. Table 18 gives the distribution of size of issuances, and it is noted that a minimum amount of issuance can be fixed at Rs.2bn. Issuances of states below the threshold criteria have been eliminated from further analysis.

Table 18: Distribution Analysis of SDL Issuances (%)

Issuance Amt (Bn.)	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Upto 2 Bn.	14.4	16.2	15.2	13.1	14.2	8.0	7.8
2 Bn and Above	85.6	83.8	84.8	86.9	85.8	92.0	92.2
Units : in percent							

The trading data is obtained from NDS-OM. The SDL spread is defined as the difference between the SDL yield and a similar residual maturity GoI bond yield.

Spread = Yield_SDL(t) – Yield_GoI(t), where *t* is the residual maturity of the SDL

The secondary market data of SDL's considered for computation of spread is as below:

i. Traded SDL's with a deal value of minimum Rs.0.05bn
ii. SDL's with minimum of three trades for a particular state and an aggregate traded value of Rs.0.5bn.

6.1.2 Methodology for Calculation of Estimated SDL Auction Yield

The Spread of SDLs over underlying GoI securities is likely to be constant for all trades across different maturities of a particular day, as (i) SDLs do not have credit risk and (ii) the liquidity is more or less same for all SDLs. Further, the pricing does not incorporate any state specific factors. Based on the below logic, the following two specifications of the ex-ante SDL auction yield measures are derived based on the secondary market traded information.

1. On the auction day (t),
    a. get all the auction issuance details
    b. Compute, M0 = the weighted average maturity of all auction issuances as of day (t)
    c. Compute, G0(t) = the Government security yield corresponding to maturity M0
2. Computing SDL Spread using Method 1:
    a. On the auction day (t), consider the SDL secondary market trading data,
    b. Filter the SDL trades based on the criteria on minimum 3 trades and an aggregate trade value of Rs. 0.50 bn
    c. Compute, Estimated SDL Yield = ESDLY1(t) = volume weighted average yield of surviving SDL trades as of day (t)
    d. Compute M1(t) = volume weighted average maturity of these trades
    e. Compute G1(t) = the Government bond yield corresponding to M1(t)
    f. Estimated Spread1 = *ESDLY1(t) – G1(t)*
3. Computing SDL Spread using Method 2:
    a. Consider all SDL secondary market trading data on each day, day following the last auction day(t0) to current auction day(t)
    b. Select SDLs with minimum 3 trades and an aggregate trade value of Rs. 0.50bn
    c. Compute, Estimated SDL Yield2 = ESDLY2(i) = volume weighted average yield of all surviving SDL trades computed for each day(i) between day(t0) and day(t)
    d. Compute M2(i) = volume weighted average maturity of all these trades, computed for each day(i) between day (t0) and day (t) [Distribution of t_t].
    e. Compute G2(i) = for each day(i) between day (t0) and day (t), compute the Government bond yield corresponding to M2
    f. Estimated *Spread2(i) = ESDLY2(i) – G2(i)*, computed for each day(i) between the two auction days

4. The two specifications for estimated yield are given as:
    a. Estimated Yield1(EY1)$_t$ = G0(t) + Spread1(t) - (9)
    b. Estimated Yield2(EY2)$_t$ = G0(t) + Average(Spread2(i)) - (10)
5. Auction yield (AY) = the weighted average yield of all issuances on the day of the auction.

An illustration for the estimated yield calculation has been provided in Annexure (4).

6.2 Ex-ante measure of SDL Auction Yield: Results

The ex-ante estimated yields computed using the two specifications are compared with the actual yield on the auction day. Annexure 5 [Charts (5A)] indicates the movement of the auction yield and the estimated yield for each of the financial year from FY 2012-13 to FY 2018-19. The charts (5A) and also the results in (Table 19) indicate that the two yields move together. The dispersion in yields has increased marginally in FY 2017-18 and FY 2018-19.

The ex-ante estimated yield (EY1) computed as an average spread as of the auction day and the ex-ante estimated yield (EY2) based on the average of the daily spread for all days between two auction days closely resemble the ex-post observed auction yield. This would imply that the SDL auction yield is simply a constant spread across corresponding government security yield for all issues irrespective of maturity and the issuer state. Any increase or decrease in SDL yield levels closely mimicked the underlying government yield of similar maturity. This also indicates that the credit risk of various states is not treated differently thus giving no weight to state specific factors.

The two-sample t-test is used to analyze the mean and variance structure, and to check the statistical significant differences between the two series, the actual observed auction yield and the estimated yield[10]. As seen from Table 19, for the entire period the mean and variance structures of the auction yield with the ex-ante estimated yield (EY1 and EY2) are found to be statistically similar to one another. The year wise result also indicates that the variance of the auction yield is not statistically different from the ex-anted estimated yield (EY1) as indicated by the Folded F-stats. Similarly, the year-wise means of the auction yield and the estimated yield (EY1) are not statistically different from one another as indicated by Pooled t-stats. We also find that there is no significant difference in the variance and mean of auction yield and estimated yield (EY2). There is an exception for the FY 2015-16, were the variance of the two series is different, while the means were statistically same as indicated by the Satterthwaite t-stats. The results are also confirmed by the correlation and regression analysis for the estimated and actual auction yields (Annexure 6).

[10] The results are also confirmed by the regression analysis for the estimated and actual auction yields provided in Annexure 6.

The analysis is further validated by considering the top 5 states. These are the top states in terms of trading and borrowing activity in the SDL market, for each of the sub-time periods. The results indicate that SDL yields closely mirror the movement of yield in the government securities market. The spread over the underlying government securities yield is constant, irrespective of the states considered. An inherent assumption of support from the Centre to pay back the debt seems to prevail, preventing the state-wise discrimination of pricing. Overall, the conclusion that SDL yields closely follow the underlying sovereign yield movement is validated by using the entire sample of all states and a sub-sample of top 5 states. Further, it can be concluded that primary market auction cut-off yields converge towards the prevailing secondary market yields.

Table 19: T-Test Results of Auction Yield and Estimated Yields (All States)

Period	Variable	No. of Days	Mean	Std Dev	Equality of Variances	Equality of Means	
					Folded F-Stat	Pooled (T-Stat)	Satterthwaite (T-Stat)
2012-2019	**Auction Yield**	**217**	**8.3044**	**0.6524**			
	Estimated Yield 1		**8.2818**	**0.6446**	**1.02**	**0.36**	**-**
	Estimated Yield 2		**8.2536**	**0.6349**	**1.06**	**0.82**	**-**
2012-13	Auction Yield	27	8.8483	0.1864			
	Estimated Yield 1		8.8341	0.1858	1.01	0.28	-
	Estimated Yield 2		8.8278	0.1709	1.19	0.42	-
2013-14	Auction Yield	26	9.0740	0.7209			
	Estimated Yield 1		9.0502	0.6917	1.09	0.12	-
	Estimated Yield 2		9.0172	0.6611	1.19	0.3	-
2014-15	Auction Yield	25	8.7087	0.4846			
	Estimated Yield 1		8.6924	0.488	1.01	0.12	-
	Estimated Yield 2		8.7012	0.4911	1.03	0.05	-
2015-16	Auction Yield	24	8.2478	0.1749			
	Estimated Yield 1		8.2422	0.1709	1.05	0.11	-
	Estimated Yield 2		8.1702	0.115	2.31**	-	1.81
2016-17	Auction Yield	28	7.4689	0.4074			
	Estimated Yield 1		7.4822	0.3988	1.04	-0.12	-
	Estimated Yield 2		7.4867	0.398	1.05	-0.17	-
2017-18	Auction Yield	38	7.7044	0.3265			
	Estimated Yield 1		7.6634	0.3076	1.13	0.56	-
	Estimated Yield 2		7.6417	0.2853	1.31	0.89	-
2018-19	Auction Yield	49	8.3606	0.2203			
	Estimated Yield 1		8.3161	0.2223	1.02	0.99	-
	Estimated Yield 2		8.2572	0.2072	1.13	2.39	-

*** indicates significance at 5%.*

7 EFFICIENT VALUATION OF SDL

The earlier section (6) defines an estimated ex-ante measure of SDL auction yield. It is seen to be close to the realized auction yield (Table19). This ex-ante estimate of the primary market cut-off yield provides an indication of the cost of borrowing for any new SDL. The results indicate that the SDL value was a constant spread over the underlying GSEC. Extending this argument further, defining an ex-post measure of SDL spreads linked to their maturity, created based on the secondary market traded information, can provide a good benchmark for valuation of non-traded, special and UDAY bonds.

This section, seeks to extend the above argument to create an ex-post measure for valuation of non-traded SDLs. The analysis is done using all SDL trades in the secondary market over the period April 2012 to March 2019, computing a estimated yield and comparing the same with the actual traded yield.

7.1 Data and Methodology

7.1.1 Data Description

The estimated yield is computed using the transaction level data of SDL's on the NDS-OM platform. The estimated yield is computed for all trading days. Trade data for outright trades in SDL's (other than special SDL's and UDAY bonds) are considered. Yields are estimated for all trades of SDL's with a deal value of minimum Rs. 0.05bn. The data used for the estimation of estimated yield is summarized in Table 20.

Table 20: Summary Description of Data used for Computation of Daily Estimated Yields

Panel A – SDL Trades								
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2012-2019**
No. of Obs (Trades)	8256	8922	9462	13676	19232	18669	21970	100187
No. of States	26	26	30	30	30	30	30	30
Trading Days	242	243	237	241	241	241	242	1687
Maturity Bucket	**Trades based on Maturity Buckets**							
<= 1 Y	51	150	120	178	251	133	754	1637
> 1 Y to <= 3 Y	117	92	240	378	339	878	1641	3685
> 3 Y to <= 5 Y	594	382	352	427	1008	1624	2676	7063
> 5 Y to <= 7 Y	49	68	303	1440	1787	1661	976	6284
> 7 Y to <= 10 Y	7445	8230	8447	11247	15662	12726	14026	77783
> 10 Y to <= 15 Y	-	-	-	6	134	1165	1433	2738
> 15 Y	-	-	-	-	51	482	464	997
Notes: Includes only SDL trades with deal value of Rs.0.05bn and above								
Panel B – SDL Trades with minimum 3 trades per ISIN								
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2012-2019**
No. of Obs (Trades)	5398	5789	4733	7809	11211	10701	14877	60518

No. of States	22	22	24	22	25	25	26	26
Trading Days	228	224	218	235	240	240	241	1626
Maturity Bucket	**Trades based on Maturity Buckets**							
<= 1 Y		43	32	34	56	10	248	423
> 1 Y to <= 3 Y	44	32	42	75	61	109	407	770
> 3 Y to <= 5 Y	426	237	89	72	256	282	1152	2514
> 5 Y to <= 7 Y	18	23	103	358	451	377	306	1636
> 7 Y to <= 10 Y	4910	5454	4467	7270	10254	8555	11200	52110
> 10Y to <= 15Y	-	-	-	-	98	987	1179	2264
> 15 Y	-	-	-	-	35	381	385	801
Notes: : (I) Includes only SDL trades with deal value of Rs.0.05bn and above (ii) SDLs with minimum 3 trades per ISIN								

Panel C-- SDL Trades with minimum 2 trades per ISIN								
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2012-2019**
No. of Obs (Trades)	6740	7317	6665	10299	14565	13577	17913	77076
No. of States	23	25	26	27	30	30	30	30
Trading Days	240	237	236	241	241	241	242	1678
Maturity Bucket	**Trades based on Maturity Buckets**							
<= 1 YR	16	93	56	92	190	34	428	909
> 1 YR to <= 3 YR	68	50	96	143	135	321	843	1656
> 3 YR to <= 5 YR	510	291	167	182	444	590	1782	3966
> 5 YR to <= 7 YR	34	47	171	756	855	697	558	3118
> 7 YR to <= 10 YR	6112	6836	6175	9122	12784	10411	12556	63996
> 10 YR to <= 15 YR				4	114	1089	1317	2524
> 15 YR					43	435	429	907
Notes: : (i) Includes only SDL trades with deal value of Rs.0.05bn and above (ii) SDLs with minimum 2 trades per ISIN								

7.1.2 Methodology for Computing Daily Measure of Estimated SDL Yield

The estimated SDL yield is calculated as below:

1. On the trade day (t),
    a. Consider all the SDL trades (other than special SDL's and UDAY bonds) with deal value of 0.05bn and above
    b. Compute, MT0 = the residual maturity from the settlement date of each ISIN as of day (t)
    c. Compute, GS0(t) = the Government security yield corresponding to maturity MT0

2. Classification of SDL trades into maturity buckets,
    a. Classify into maturity buckets based on the residual maturity (maturity). The trades are grouped into seven maturity buckets as follows:

Bucket	Residual Maturity (Years)
1	<= 1 YR
2	> 1 YR to <= 3 YR
3	> 3 YR to <= 5 YR
4	> 5 YR to <= 7 YR
5	> 7 YR to <= 10 YR
6	> 10 YR to <= 15 YR
7	> 15 YR

3. Computing SDL Spread for each maturity bucket (m) using **Method 1**:
    a. On the trade day (t), consider the SDL secondary market trading data,
    b. Filter to only SDL trades based on the criteria on minimum traded value of Rs. 0.05bn
    c. Select SDLs with minimum 3 trades per ISIN
    d. Compute, SDLYLD1(t,m) = volume weighted average yield of surviving SDL trades as of day (t) and maturity bucket (m)
    e. Compute MT1(t,m) = volume weighted average maturity of these trades as of day (t) and maturity bucket (m)
    f. Capture GS1(t,m) = the Government security yield corresponding to MT1(t,m)
    g. Spread1 = SDLYLD1(t,m) – GS1(t,m)

4. Computing SDL Spread for each maturity bucket (m) using **Method 2**:
    a. On the trade day (t), consider the SDL secondary market trading data,
    b. Filter to only SDL trades based on the criteria on minimum traded value of Rs. 0.05 bn
    c. Select SDLs with minimum 2 trades per ISIN
    d. Compute, SDLYLD2(t,m) = volume weighted average yield of surviving SDL trades as of day (t) and maturity bucket (m)
    e. Compute MT2(t,m) = volume weighted average maturity of these trades as of day (t) and maturity bucket (m)
    f. Compute GS2(t,m) = the Government security yield corresponding to MT2(t,m)
    g. Spread2 = SDLYLD2(t,m) – GS2(t,m)

5. Computing SDL Spread for each maturity bucket (m) using **Method 3**:
    a. On the trade day (t), consider the SDL secondary market trading data,
    b. Filter to only SDL trades based on the criteria on minimum traded value of Rs. 0.05bn
    c. Select SDLs with atleast one trade per ISIN

d. Compute, SDLYLD3(t,m) = volume weighted average yield of surviving SDL trades as of day (t) and maturity bucket (m)
e. Compute MT3(t,m) = volume weighted average maturity of these trades as of day (t) and maturity bucket (m)
f. Compute GS3(t,m) = the Government security yield corresponding to MT3(t,m)
g. Spread3 = SDLYLD3(t,m) – GS3(t,m)

6. Computing SDL Spread for each maturity bucket (m) using **Method 4**:
   a. Spread of the most liquid maturity bucket (lqm)
   b. Spread4 = SDLYLD3(t,lqm) – GS3(t,lqm)

7. Computing SDL Spread for each maturity bucket (m) using **Method 5**:
   a. Average Spread of all traded maturity buckets on day (t) based on minimum 3 trades per ISIN criteria (Method 1)

8. Computing the Applicable Spread:
   a. The spread for maturity bucket (m) on day (t) is based on Method 1.
   b. In case there are no sufficient trades in a particular maturity bucket (m) on day (t) and hence no spread could be computed for that maturity bucket based non Method 1, the following approach is used in the order of:
      i. Spread for maturity bucket (m) on day (t) based on Method 2 (minimum 2 trades per ISIN), or
      ii. Spread for maturity bucket (m) on day (t) based on Method 3 (atleast one trade per ISIN), or
      iii. Spread for maturity bucket (m) on day (t) based on Method 4 (spread of liquid maturity bucket based on Method 3), or
      iv. Spread for maturity bucket (m) on day (t) based on Method 5 (Average Spread of all traded maturity buckets based on Method 1)
9. The estimated (model) yield for each trade (i) is computed as:
   a. Model Yield $(MY1)_i$ = GS0(t) + Applicable Spread (t,m)

An illustration for the model yield calculation has been provided in Annexure (7).

7.2 Estimation Results

In order to study the accuracy of the SDL model yields vis-à-vis the SDL traded yield, we use the mean absolute error (MAE). Table 21 shows the descriptive statistics of MAE in basis points. For the entire sample the MAE is 4 bps, while the standard deviation is 5 bps. The difference between the model and traded yield is between 0-5 bps for more than 70% of the entire sample of 100187 trades for the period April 2012 to March 2019. It is

between 5-10 bps for 18% of the trades, while it is more than 10 bps for the remaining 9% of the entire sample.

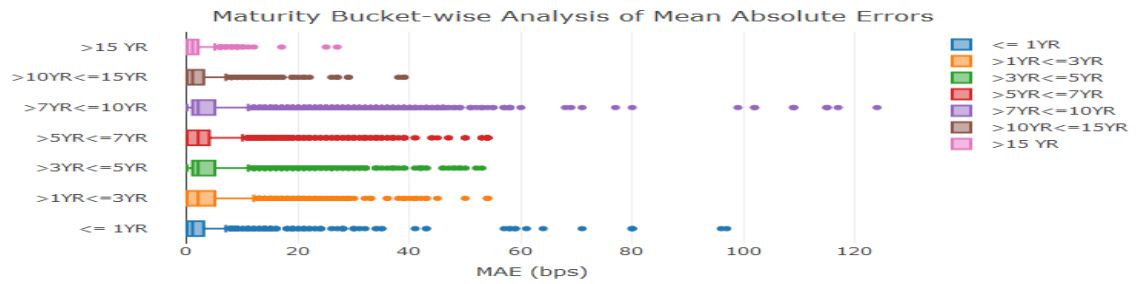
Table 21A : Summary Statistics of Absolute Error (bps)								
	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2012-2019
No. of Observations (Trades)	8256	8922	9462	13676	19232	18669	21970	100187
Mean	2.57	3.76	2.26	3.59	5.4	4.18	3.52	3.84
Min	0	0	0	0	0	0	0	0
Max	79.56	124.44	21.69	58.37	108.61	57.66	96.66	124.44
Std Dev	3.1	5.7	2.42	4.72	6.48	5.3	4.69	5.13
Table 21B: Error Analysis across sub-periods (%)								
Error Range (bps)	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2012-2019**
0	20	16	21	17	12	17	16	16
>=1 to <5	63	58	66	57	48	53	60	56
>=5 to <10	14	19	11	18	23	19	17	18
>=10 to <50	3	8	2	8	17	11	7	9
>=50	0	0	0	0	0	0	0	0

A granular analysis of the MAE based on maturity buckets are shown in Table 22. The MAE for the most liquid bucket with residual maturity of 7 to 10 years is 4 bps, while it is around 3 bps for the other maturity buckets. Chart 7 shows the behavior of yield errors based on maturity.

Table 22: Summary Statistics of Mean Absolute Error (bps) - based on maturity-buckets								
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2012-2019**
MAE (bps)	2.57	3.76	2.26	3.59	5.40	4.18	3.52	3.84
Maturity Buckets								
<= 1 YR	3.39	2.55	1.70	1.19	3.20	3.57	4.51	3.45
> 1 YR to <= 3 YR	1.77	1.83	2.15	2.67	2.47	3.65	5.89	4.24
> 3 YR to <= 5 YR	1.61	2.32	1.99	2.21	4.78	4.64	4.71	4.03
> 5 YR to <= 7 YR	1.31	2.00	1.47	2.02	4.87	4.86	4.03	3.86
> 7 YR to <= 10 YR	2.66	3.89	2.31	3.92	5.65	4.38	3.07	3.89
> 10 YR to <= 15 YR	-	-	-	1.00	1.97	2.07	2.72	2.41
> 15 YR	-	-	-	-	0.51	1.39	1.81	1.54

Overall, this estimated measure seems to provide a good proxy measure of SDL yields. Post the auction of these securities, it is seen that the secondary market trading is rather sparse. Most bonds shift to the HTM (held-to-maturity) category in the first few months. However, as per regulation all market participants need to mark to market these securities. A consistent stable valuation measure for these non-traded securities, the special SDLs and UDAY bonds would help fill the gap. The model discussed above can thus be used as a reasonable valuation benchmark to price non-traded SDL securities.

Chart 7: Maturity Bucket-wise Analysis of Mean Absolute Errors



8 CONCLUSION

Over the last decade, the state borrowings from banks and financial institutions, their loans and advances from the Centre and public accounts items have reduced, while market borrowings by States have increased. Using standard economic rationale, a differential pricing would be expected across the states, where a state with stronger fiscal prudence would have lower credit risk and liquidity risk and thus would command a lower spread as compared to the state with a weaker fiscal.

This study considers data from FY 2008 to FY 2019 for 22 states. It attempts to explain whether the spread of various states over the years can be explained by any of the state specific fiscal or market factors. None of the fiscal or market indicators were significant.

The recent mandate by the regulator (RBI Report, October 2017) to move towards greater market based pricing would be expected to raise/or reduce the cost of borrowing for the states based on their capacity to pay back the debt without support from the centre. Currently, there seems to be an implicit subsidy that is happening through the centre, between states having better fiscal prudence to states that do not.

Another key finding of this paper is based on the observation that SDL costs are a flat spread over the underlying government security rates. The SDL auction cut-off yields are a function of the SDL spreads as observed in the secondary market. This further supports the case that the entire price discovery in SDL yields on auction days is linked to the G-sec yield behavior. This finding holds for all states, a sub-sample of states and for sub-periods further supporting the case that SDL pricing is a rudimentary process.

Most SDL issuances move out of trading to HTM category. Given the regulatory requirement for daily MTM of these securities, an ex-post measure is designed based on the secondary market information. The suggested measure is found to be stable and consistent, and could be used for valuation of non-traded SDLs, special SDLs and UDAY bonds.

Development of the SDL market has been one of the major policy objectives. This study provides key insights into the current SDL pricing. It suggests that the credit risk of states is

being transferred to the government securities market as the pricing in the SDL market is heavily dependent on the government securities market, thereby increasing the implicit cost of government borrowing.

In order to achieve the objective of market driven pricing of SDLs, there is a need to streamline the borrowing programme of states to ensure regular auction through a robust borrowing calendar such that the borrowing is spread out evenly throughout the year. In order to differentiate the fiscal prudence of various states, the periodic availability of state finance data and its reliability is essential. Borrowings through bond issuance can pose a challenge for small states. The high cost of SDL issuance when spread over a low volume of bonds, could limit this financing option for smaller states with lesser funding requirements. The funding requirements of small states could thus be pooled and financed through Special Purpose Vehicle (SPV) mechanism. This could result in lower issuance costs due to economies of scale in pooling borrowings of small states into a larger bond issuance, and better liquidity by packaging smaller issuances into a larger issuance, thereby making it more attractive to subscribers.

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2. Report of the Twelfth Finance Commission (2005-2010), Nov, 2004.

ANNEXURE – 1

Chronology of Developments in the Issuance of SDL's	
Year	**Auction Developments**
Upto 1998	Issuance of SDL's through traditional tranche method at pre-determined coupon and notified amounts for each State.
1998-1999	Issuance of SDL's through auction method (with pre-determined notified amount but without pre-determined coupon) or Tap method (with pre-determined coupon but without pre-determined notified amount).
2001-02	Issuance of SDL's through Umbrella Tap tranche method.
April' 2006 onwards	Complete Switch over to issuances of SDL's through auction route.
October'2017 onwards	Auction of SDL's on a weekly basis.

ANNEXURE -2

Table 2A: T-Test Results of SDL Yields of NDS-OM and OTC Trades							
Period	**Variable**	**No. of Days**	**Mean**	**Std Dev**	**Equality of Variances**	**Equality of Means**	
					Folded F-Stat	**Pooled (T-Stat)**	**Satterthwaite (T-Stat)**
2008-2019	NDS-OM	1886	8.2842	0.6385	1.02	-0.12	-
	OTC		8.2867	0.6451			
2008-09 to 2012-13	NDS-OM	571	8.5051	0.4921	1.02	-0.46	-
	OTC		8.5183	0.4875			
2013-14 to 2018-19	NDS-OM	1315	8.1883	0.6704	1.02	0.09	-
	OTC		8.1861	0.6785			
Notes- Criteria for Computation of Weighted average SDL Yields:(i) Only SDL's - Special SDL's and UDAY Bonds excluded (ii) Deals having value of Rs. 0.05bn and above (iii) SDL's (ISIN) having at least three trades on a given day							
Source: Authors calculation based on NDS-OM data							

Table 2B: T-Test Results of SDL Yields of Proprietary and Constituent Trades							
Period	**Variable**	**No. of Days**	**Mean**	**Std Dev**	**Equality of Variances**	**Equality of Means**	
					Folded F-Stat	**Pooled (T-Stat)**	**Satterthwaite (T-Stat)**
2008-2019	PROP	1915	8.2872	0.6459	1.03	0.77	-
	CSGL		8.3031	0.6357			
2008-09 to 2012-13	PROP	599	8.5181	0.4887	1.05	0.49	-
	CSGL		8.5317	0.4771			
2013-14 to 2018-19	PROP	1316	8.1821	0.6806	1.03	0.64	-
	CSGL		8.1990	0.6709			
Notes- Criteria for Computation of Weighted average SDL Yields:(i) Only SDL's - Special SDL's and UDAY Bonds excluded (ii) Deals having value of Rs. 0.05bn and above (iii) SDL's (ISIN) having at least three trades on a given day							
Source: Authors calculation based on NDS-OM data							

ANNEXURE - 3

Table 3A: Year-wise Spreads of 22 States (basis points)												
State	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2008-09 to 2018-19**
AP	76	69	41	34	62	63	35	42	41	42	47	50
BR	120	84	41	51	69	57	28	59	43	43	78	61
GA	83	70	35	35	62	46	28	38	38	48	63	50
GJ	76	72	38	38	61	53	28	35	37	45	64	50
HR	111	68	43	44	63	58	30	38	38	50	50	54
HP	81	57	39	40	59	49	29	29	43	49	80	50
JK	100	71	43	54	71	47	32	39	39	52	67	56
JH	105	77	51	41	68	62	31	45	43	60	75	60
KA	119	66	37	43	60	60	30	41	40	45	73	56
KL	65	67	36	42	65	49	31	39	39	43	63	49
MP	94	67	36	49	70	58	28	43	35	49	54	53
MH	105	67	37	39	65	54	27	39	35	49	62	53
MN	63	63	35	27	56	51	33	37	34	45	69	47
ML	109	74	38	31	65	57	31	36	36	47	77	55
NL	110	69	42	53	69	57	33	47	39	47	62	57
PB	60	67	39	34	61	53	29	40	42	47	69	49
RJ	84	68	39	38	61	50	27	40	36	49	63	50
TN	85	64	38	35	62	46	29	39	37	45	61	49
TR	127	68	38	42	64	49	33	45	34	51	62	56
UP	80	77	44	36	63	42	31	41	39	46	72	52
UT	72	73	46	37	72	57	28	43	39	47	59	52
WB	64	59	44	37	70	62	31	44	40	49	68	52

Table 3B: Descriptive Statistics of Spreads of 22 States (basis points) - (April 2008 to March 2019)							
State	**Mean**	**25th Percentile**	**Median**	**75th Percentile**	**Min**	**Max**	**Std.Dev**
AP	50	41	42	63	34	76	15
BR	61	43	57	78	28	120	26
GA	50	35	46	63	28	83	17
GJ	50	37	45	64	28	76	16
HR	54	38	50	63	30	111	22
HP	50	39	49	59	29	81	18
JK	56	39	52	71	32	100	20
JH	60	43	60	75	31	105	21
KA	56	40	45	66	30	119	25
KL	49	39	43	65	31	67	14
MP	53	36	49	67	28	94	19
MH	53	37	49	65	27	105	22
MN	47	34	45	63	27	69	15
ML	55	36	47	74	31	109	25
NL	57	42	53	69	33	110	21
PB	49	39	47	61	29	69	14
RJ	50	38	49	63	27	84	17
TN	49	37	45	62	29	85	17
TR	56	38	49	64	33	127	27
UP	52	39	44	72	31	80	18
UT	52	39	47	72	28	73	16
WB	52	40	49	64	31	70	14

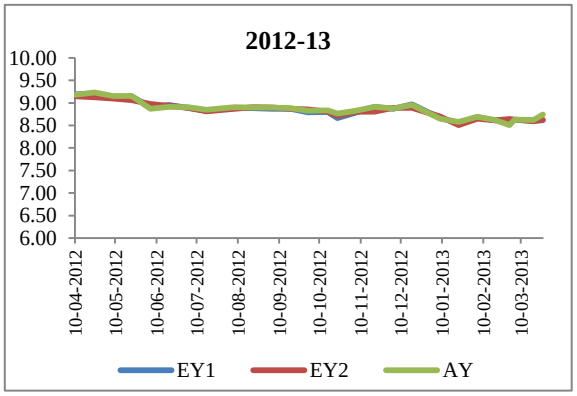
ANNEXURE - 4

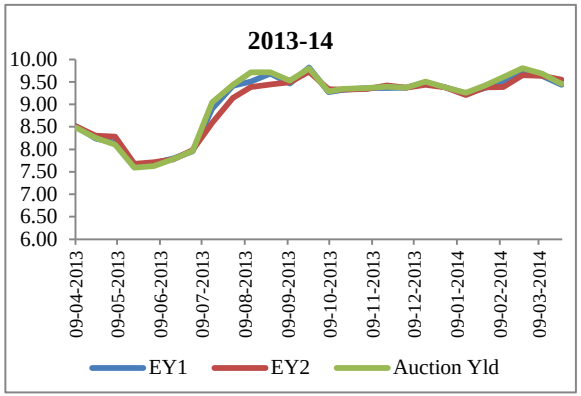
Table 4A: Computation of Ex-Ante Auction Yield										
Auction Date	Auction Data		Trading Data					Estimated Yield (TY)		Auction Yield
	WAM of Issuances (M0)	Gsec Yield of WAM (Issuances)	SDL WAY (%)	WARM of Trades (Yrs) M1(t)	Gsec Yield of WARM (Trades)	Spread				
		G0(t)	SDLY1(t)		G1(t)	Spread1 = SDLY1(t) – G1(t)	Spread 2	G0(t) + Spread1(t)	G0(t) + Average(Spread2(i))	Auction Yield (WAV)
01-Oct-12	8.61	8.23	8.79	7.61	8.23	0.57	0.63	8.79	8.86	8.83

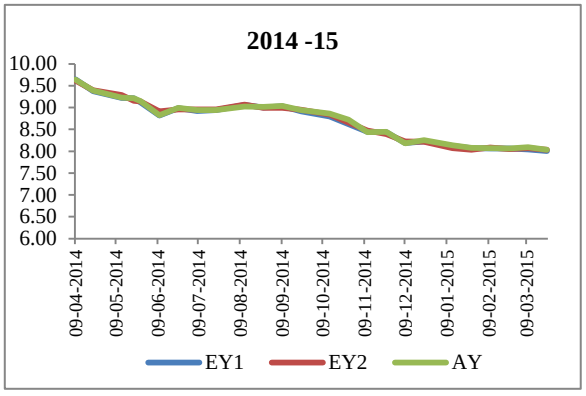
Table 4B: Computation of Spread			
	Trade Date	Spread1	Spread2(i)
Auction Date	18-Sep-12	0.61	
	20-Sep-12	0.63	Average Spread from 20-09-2012 [day (t0)] to 01-10-2012 [day (t)]
	21-Sep-12	0.65	
	24-Sep-12	0.63	
	25-Sep-12	0.63	
	26-Sep-12	0.65	
	27-Sep-12	0.66	
	28-Sep-12	0.62	
Auction Date	**01-Oct-12**	0.57	**0.63**

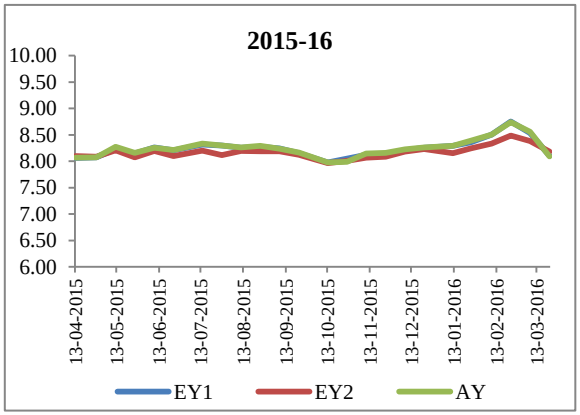
ANNEXURE -5

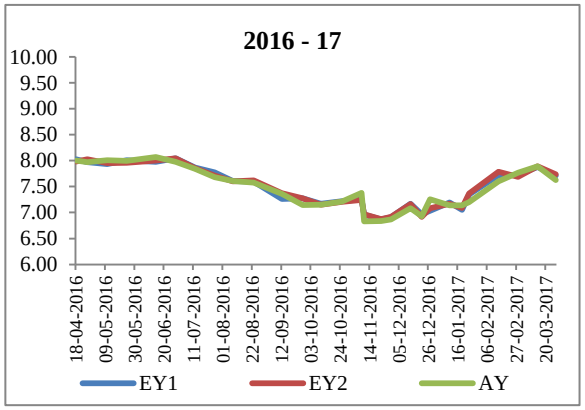
Chart 5A : Estimated SDL Yields (EY1 and EY2) vs. SDL Auction Yield (AY) - All States

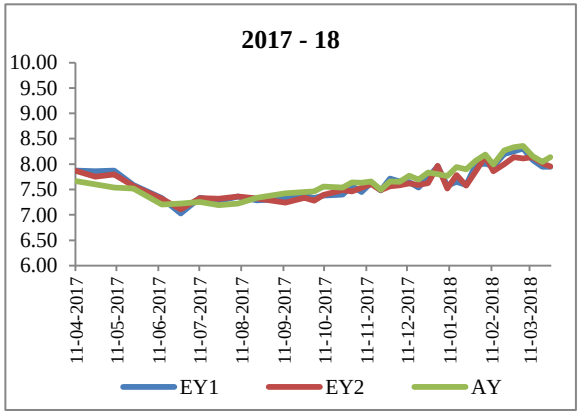












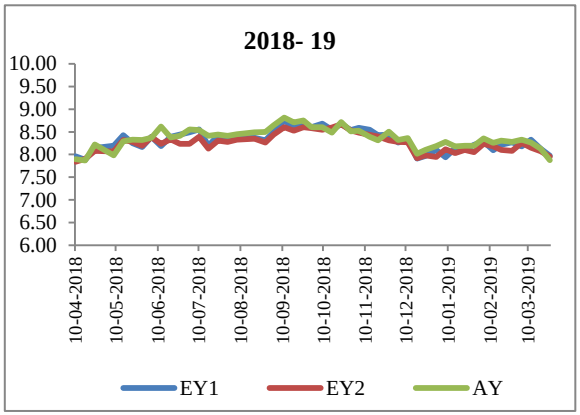


Chart 5B: Distribution of Errors (RN)

RN = Estimated SDL Yield (EY1) - SDL Auction Yield (AY) (for All States)

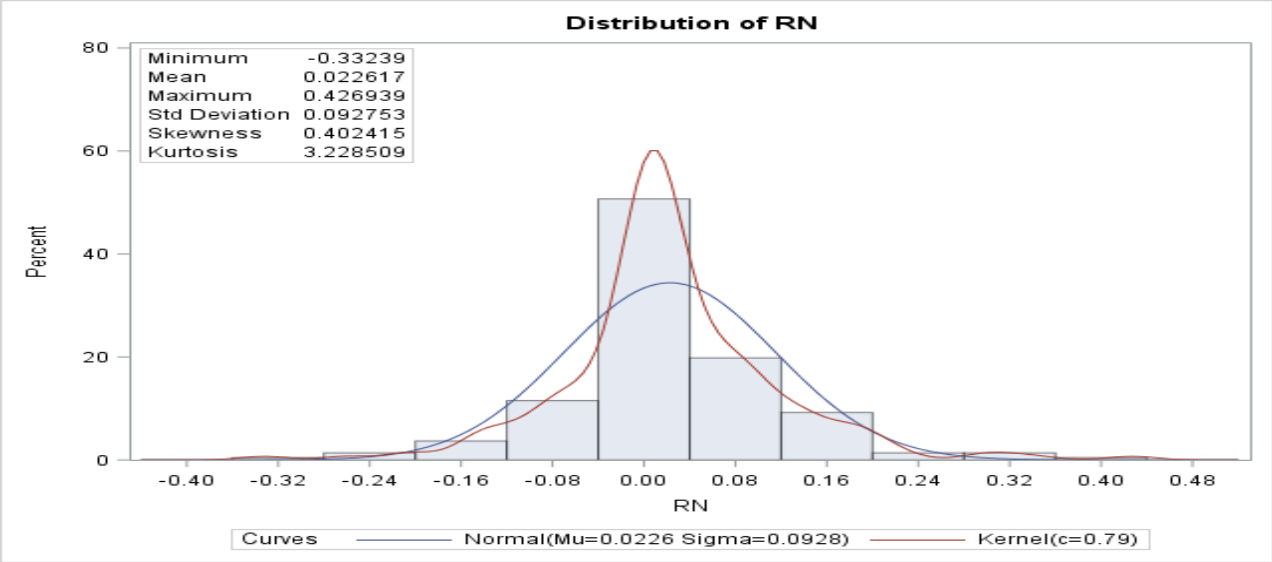
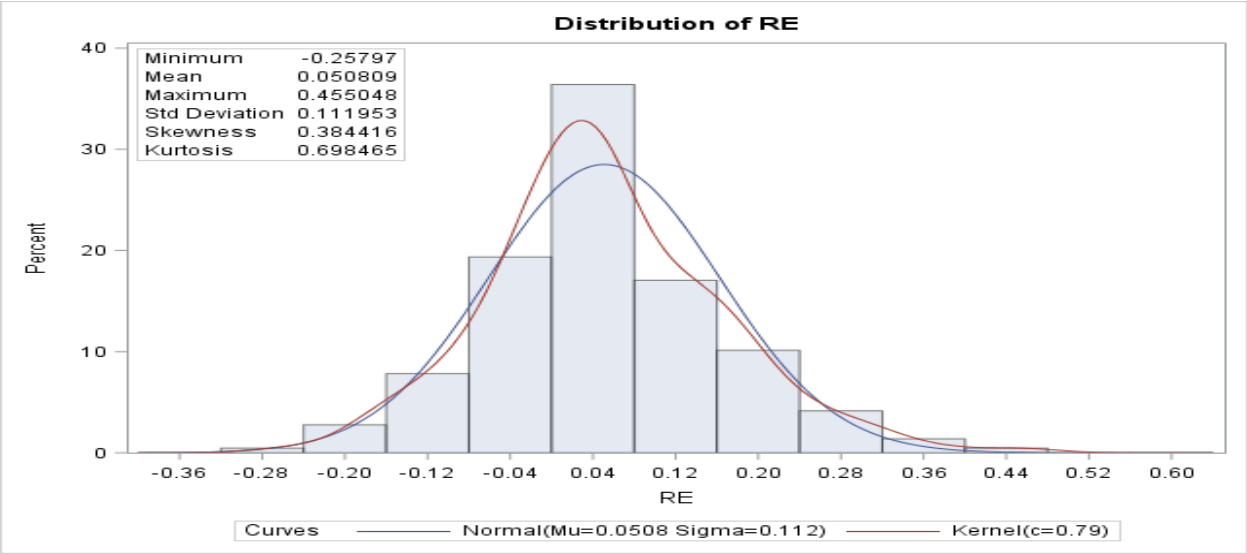


Chart 5C: Distribution of Errors (RE)

RE = Estimated SDL Yield (EY2) - SDL Auction Yield (AY) (for All States)



ANNEXURE – 6

Table 6A: Pearson Correlation Coefficients (with Prob > |r| under H0: Rho=0, N = 217)			
	Estimated Yield 1	**Estimated Yield 2**	**Auction Yield**
Estimated Yield 1	1		
Estimated Yield 2	0.9924***	1	
Auction Yield	0.9899***	0.9852***	1
*Notes: (i) *, ** and *** denote that the variable is significant at 10%, 5%, 1% levels, respectively.*			

Table 6B: Regression Results of Auction Yields and Estimated Yields						
Variable	**Estimate**	**OLS Estimated**			**Root MSE**	**R-squared**
		Standard Error	***t* Value**	**Pr > |t|**		
At Level						
Intercept	0.005869	0.0816	0.07	0.9427	0.0931	0.9797
EY1	1.002***	0.0098	101.96	<.0001		
Intercept	-0.0491	0.0996	-0.49	0.6227	0.1123	0.9705
EY2	1.012***	0.012	84.13	<.0001		
At First Difference						
Intercept	-0.1647	0.7024	-0.23	0.8148	10.3181	0.6353
D_EY1	0.7821***	0.0405	19.31	<.0001		
Intercept	-0.1412	0.7815	-0.18	0.8568	11.4778	0.5487
D_EY2	0.8445	0.0524	16.13	<.0001		
*Notes: (i) *, ** and *** denote that the variable is significant at 10%, 5%, 1% levels, respectively.*						

ANNEXURE – 7

Table 7 : Illustration of the Estimated Yield Calculation for Traded SDL's															
Trade Date	**ISINNO**	**Description**	**Maturity Date**	**Volume (Cr.)**	**Residual Maturity (Yrs)**	**Maturity Bucket**	**Gsec Yield**	**Spread 1**	**Spread 2**	**Spread 3**	**Spread 4**	**Spread 5**	**Applicable Spread**	**Model SDL Yield**	**Traded SDL Yield**
21-08-2018	IN2220080021	6.73% MH GS 2019	14-01-2019	5.00	0.39	1	6.92		0.38	0.41	0.50	0.43	0.38	7.29	7.32
21-08-2018	IN3120090045	8.11% TN GS 2019	30-10-2019	5.00	1.19	2	7.38	0.39	0.38	0.37	0.50	0.43	0.39	7.77	7.75
21-08-2018	IN1920090041	8.05% KA GS 2019	25-11-2019	5.00	1.26	2	7.42	0.39	0.38	0.37	0.50	0.43	0.39	7.80	7.75
21-08-2018	IN2220140213	8.04% MH SDL 2025	25-02-2025	5.00	6.51	4	8.01			0.34	0.50	0.43	0.34	8.34	8.34
21-08-2018	IN3320150300	7.98% UP SDL 2025	14-10-2025	5.00	7.14	5	8.02	0.52	0.51	0.50	0.50	0.43	0.52	8.54	8.34
21-08-2018	IN1520150120	8.46% GJ SDL 2026	10-02-2026	10.00	7.46	5	8.03	0.52	0.51	0.50	0.50	0.43	0.52	8.55	8.34
21-08-2018	IN3320150383	8.83% UP SDL 2026	24-02-2026	10.00	7.50	5	8.03	0.52	0.51	0.50	0.50	0.43	0.52	8.55	8.46
21-08-2018	IN2920150264	8.55% RJ SDL 2026	09-03-2026	25.00	7.54	5	8.03	0.52	0.51	0.50	0.50	0.43	0.52	8.55	8.46
21-08-2018	IN3120150211	8.53% TN SDL 2026	09-03-2026	15.00	7.54	5	8.03	0.52	0.51	0.50	0.50	0.43	0.52	8.55	8.46
21-08-2018	IN3320150391	8.58% UP SDL 2026	09-03-2026	20.00	7.54	5	8.03	0.52	0.51	0.50	0.50	0.43	0.52	8.55	8.46
21-08-2018	IN3120160053	8.07% TN SDL 2026	15-06-2026	5.00	7.81	5	8.02	0.52	0.51	0.50	0.50	0.43	0.52	8.54	8.34
21-08-2018	IN3320160168	8.08% UP SDL 2026	15-06-2026	5.00	7.81	5	8.02	0.52	0.51	0.50	0.50	0.43	0.52	8.54	8.35
21-08-2018	IN3120180093	8.46% TN SDL 2030	21-08-2030	5.00	11.99	6	7.97	0.39	0.40	0.40	0.50	0.43	0.39	8.36	8.46
21-08-2018	IN2820180080	8.49% PN SDL 2033	08-08-2033	58.00	14.96	6	8.06	0.39	0.40	0.40	0.50	0.43	0.39	8.45	8.46