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# A Study on Yield Spreads and Liquidity Measures in the Indian Bond Market

by

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# A STUDY ON YIELD SPREADS AND LIQUIDITY MEASURES IN THE INDIAN BOND MARKET

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## Abstract

This paper studies the effect of liquidity and other trading activities on yield spreads in the Indian bond market. The wholesale debt market (WDM) and corporate bond market segments are both examined in our paper. We have used the study of Subrahmanyam *et al* (2009) as a reference tool and adapted their study for the Indian bond market.[1] We use time series data for the last 10 years for the Wholesale Debt Market, and the last 4 years for the Corporate Bond Market[2]. To our knowledge this is the first time this data has been used to study bond market liquidity in India, in recent times. Our search indicated that the last significant work was in 2003.[3] This was a study of the imperfections in the Indian corporate bond market and the relationship between yields and market measures like liquidity, ratings, frequency of trading. We have used wider, more recent datasets and enlarged the scope to consider Government securities as well. Our dataset also allows us to consider the impact of the recent crisis in the financial markets worldwide.

We test the hypothesis that liquidity measures and trading activity explain yield spreads. The explanatory power of the variables considered, provide an insight into the Indian bond market. We find good evidence regarding the significance of liquidity measures on yield spreads.

Keywords: Liquidity, Bond Rating, Yield Spread

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[1] Marti Subrahmanyam, Nils Friewald and Rainer Jankowitsch, 2009

[2] We gratefully acknowledge the historical data provided by the National Stock Exchange, Mumbai for the Wholesale Debt Market segment

[3] Sucshismita Bose, Dipankar Coondoo, 2003

## Introduction

The inspiration for this study came from an important paper published by Subrahmanyam (2009)where they have studied the US fixed income market and tried to glean patterns regarding

Ericcson *et al.* (2005) develop a structural model to capture liquidity and credit risk for bonds, using US corporate bond data for a period spanning 15 years.[8] The effect of illiquidity on yield spreads is felt to be more predominant in those cases where default is more likely to occur. Their model predicts the shape of the term structure of liquidity spreads and the effect of default risk on it. Their model also predicts, in line with earlier work of Amihud and Mendelson (1986), that liquidity spread is a decreasing function of maturity of the bond. They use two liquidity proxies: liquidity risk in Treasury markets and age of the bond.[9]

Mahanti *et al.* (2005) proposed a new measure of liquidity called 'latent liquidity' for corporate bonds to glean information about bonds with higher liqubo4l0395c [( )6(9)Tj 11.91072 0 0 12 337 corporate bonds between 2003 and 2007, they have found out that bid-ask bounce explains only part of the illiquidity in bonds. They have also found a rise in illiquidity during times of crises.

Lubomir (2009) has studied Yankee bonds (bonds of foreign issuers in US markets) and concluded that liquidity explains 1% of daily changes in yield spreads. In effect, credit risk from the economy has a bigger role to play in affecting yield spreads than liquidity r

## Regression Model

To study the above relationship, we use the model used in Subrahmanyam *et al.* (2009) which is presented below.[19]

$$(\text{Yield Spread})_{it}$$

*ZRa*

Subrahmanyam *et al (2009)* have suggested the use of zero return as a proxy for liquidity.[23] The zero return is used to track the staleness of price data that we use. It takes the value ‘1’ if the price on 2 consecutive days remains the same and a value ‘0’ otherwise. Zero return is observed when the price over two days remains unchanged and yields a zero return. A value of ‘1’ over a period of time is more likely to be construed as a measure of illiquidity. The intuition is that bond prices that stay constant at a particular value are more likely to do so owing to lack of liquidity.

## Methodology

In this paper, we first have a look at the model that we follow for studying yield spreads and define the variables used. Then we look at the sources of our data and describe all approximations and assumptions made in our analysis. Finally we interpret the results that we obtain.

### Yield Spread

The yield spread of a corporate bond can be interpreted as the penalty that is added to the yield to maturity of a benchmark Treasury bond. The penalty is added to account for relative illiquidity of a corporate bond as compared to the Treasury bond. We use the yield spread as a proxy for liquidity because a wider spread is associated with a higher credit risk or a higher risk of default. So investors are apprehensive about buying securities with greater yield spread and hence these securities trade below the yield curve. Also as an incentive for the investors, the securities with huge yield spreads usually trade at a discount or else they need to offer huge coupons to counter this.

### Explanatory Variables

Both trading activity variables and liquidity indicators are included in the basket of explanatory variables. For instance the volume index would address the impact on yield spread due to increase or decrease in trading volumes. Whereas a liquidity indicator like Price Dispersion Index refers to the impact on yield spread due to change in transaction costs. To ensure that no

[23] Marti Subrahmanyam, Nils Friewald and Rainer Jankowitsch, 2009

The first approximation we had to make was due to the fact that we did not have the daily data for volumes traded for each corporate bond from Bloomberg. To overcome this data limitation, we assume the volumes to be proportional to the total volumes of 10 year bonds traded on each day. Since the volume measure always occurs in the numerator and denominator of all the explanatory variables, the proportionality constant is eliminated. The only variable where this does not occur is the Roll measure. In this case, the regression coefficient (slope variable) is a constant of proportionality and it adjusts itself when we actually perform the regression. We are interested in the t-statistic and a proportionality constant on the explanatory variable is not going to affect the regression coefficient. In addition, as we shall see later, the Roll measure is deemed economically insignificant.

In the second case, the corporate debt data from the NSE, we do have data on daily volumes traded. But the corporate debt markets are thin and trades for any particular bond do not happen on a daily basis. So when we calculate the yield spreoedo(t)-().2(o)-e3rme.1(t) Tw [(we as)-14.3or

The basis for the selection of the benchmark security is that the duration of both the to-be-compared bond and the benchmark security should be the same. So based on this condition, we compare 2011, 2017, 2022 maturing bonds against 2015, 2019, 2020 maturing benchmarks respectively. In case of lack of data for either the benchmark or the to-be-compared bond on a particular day, we do not take the trade on that day and accordingly, the adjustments are made in the formula for the lack of data. For instance, while computing the returns on a particular day, say November 3rd 2010, if we do not have data for November 2nd, we use data from November 1st and then adjust the daily returns accordingly

In all the cases, we have assumed the price data to be log-normally distributed. Therefore the returns are normally distributed. We factor in liquidity, by using volume weighted price when computing returns.

In dealing with the first set of corporate bonds data, to calculate Rolls measure and Price Dispersion indicators, different instances of prices and volumes are required on each trading day. (Intra-day prices and volumes). We overcome the non-availability of intra-day data, by replacing the concept of different price and volume instances on each day with the corresponding data for 10 consecutive trading days. This is done for both price and volume. This is the closest approximation to the ideal case. Also since there is not much trading, we assume there would not be appreciable price and volume variation in a few days.

In dealing with the second set of corporate bonds, as mentioned earlier we had data for volumes traded on each day, but were handicapped by the fact that the bonds were not traded on a daily basis and that intra-day data was not available for the bonds. So we chose not to include price dispersion in our analysis for this data, as intra-day data requirement is essential to calculate coeofe s(e).7(.6( e35.8d(e).7( T s(e).7(t)t)-25( t)-247D -./Ff 11.9772 0 0 12 72.0001 709.1160.318/Cs6

Null Hypothesis 1:

$H0_1$: Trading variables and liquidity indicators do not affect the liquidity (or the illiquidity) of a bond in the market.

Test for $H0_1$: Regress the change in yield spread of a bond on the indicators mentioned above (Equation 1). We expect the coefficients of regression to be equal to zero. We test for significance using the t-statistic.

Null Hypothesis 2:

$H0_2$: The credit ratings of a corporate bond do not play a role in determining liquidity.

Test for $H0_2$: Repeat the above process of regressing yield spread change for 2 corporate bonds with credit ratings of A++ and A+++. We have 2 expectations here.

I. The corporate yield spread of A++ may not be greater than that of A+++
II.

## Impact on Liquidity during Crisis & other Time Periods

Next, we proceed to regress the bond yield spreads against various parameters as indicated before. But the additional point is to see how the yield spreads react for different time periods. For this we have split the 2005-2010 yield spread data into 2 parts. One is during the financial crisis, which extended from Jul 2008 to Mar 2009. The period of non-crisis, 2005-2008 forms the second part of our analysis. We repeat this for both A+++ and A++ rated corporate bonds.

### A++ during crisis

Here we analyze the impact on the yield spread of AA+ corporate bond during the financial crisis by performing the regression for the yield spread against the liquidity and trading parameters, as before. It can be seen that $R^2$ (3.18%) rises significantly when compared to previous cases. This could be explained as follows: Suppose the yield spread for the AA+ bond increased by 5 bps. People expect a further dip in bond pricing or increase in yield by selling these corporate bonds and holding on to treasury bonds during the time of crisis. We also see that the P value for the same has become more statistically significant than before when AA+ yield spread was regressed for the full time series. Likewise Amihud Number also achieves greater statistical significance in this case.

We can see from table 4 that the t-statistics of Amihud number and the lagged value of yield spread appear significant. The F-value also increases implying the greater proportion of explained variance to unexplained variance in the system, which is desirable.

### A++ during non-crisis

We consider the A++ bonds during the period of non-crisis, 2005-2008. We perform the regression as before. We can see from table 5 that the t-statistic of Amihud number appears significant. The $R^2$ value is on the lower side, something that we have observed consistently and which we will discuss in the next section.

### A+++ during crisis

Now we repeat the same process with A+++ rated corporate bonds. Significantly, from table 6, the $R^2$ value is the highest at 5.18%. We see that during the times of crisis, the Amihud measure has a negative regression coefficient on the yield spread change. This can be explained as follows. A+++ is the highest credit rating and therefore the lowest credit risk. During times of bond and greater the trip costs, greater the Roll Measure value and hence greater yield spread. So we had expected a positive correlation coefficient.

From the regression tests, we obtain mixed results. For example, in case of 2011 Vs 2015 security comparison (Table 9), we find the t-statistic to be very high (8.74) at a confidence level of 95% for price dispersion. This is further verified by the very small p-value (which indicates the probability of obtaining a critical value that would lead to a rejection of the null hypothesis). But in the other 2 cases, the t-statistic corresponding to price dispersion was found to be small. This meant that we cannot reject the null hypothesis that the yield spread change does not depend on price dispersion.

Likewise, incase of 2011 Vs 2015 bonds (Table 9) and 2020 Vs 2022 bonds (Table 11) the t-statistic corresponding to the ‘difference in the number of trades between two adjacent days’ round trip costs for a particular bond and greater the trip costs, greater the Roll Measure value

Additionally it has to be pointed out that there has been one instance where the t-statistics are not really significant. On a broad scale, these three variables appear statistically significant and this was as expected.

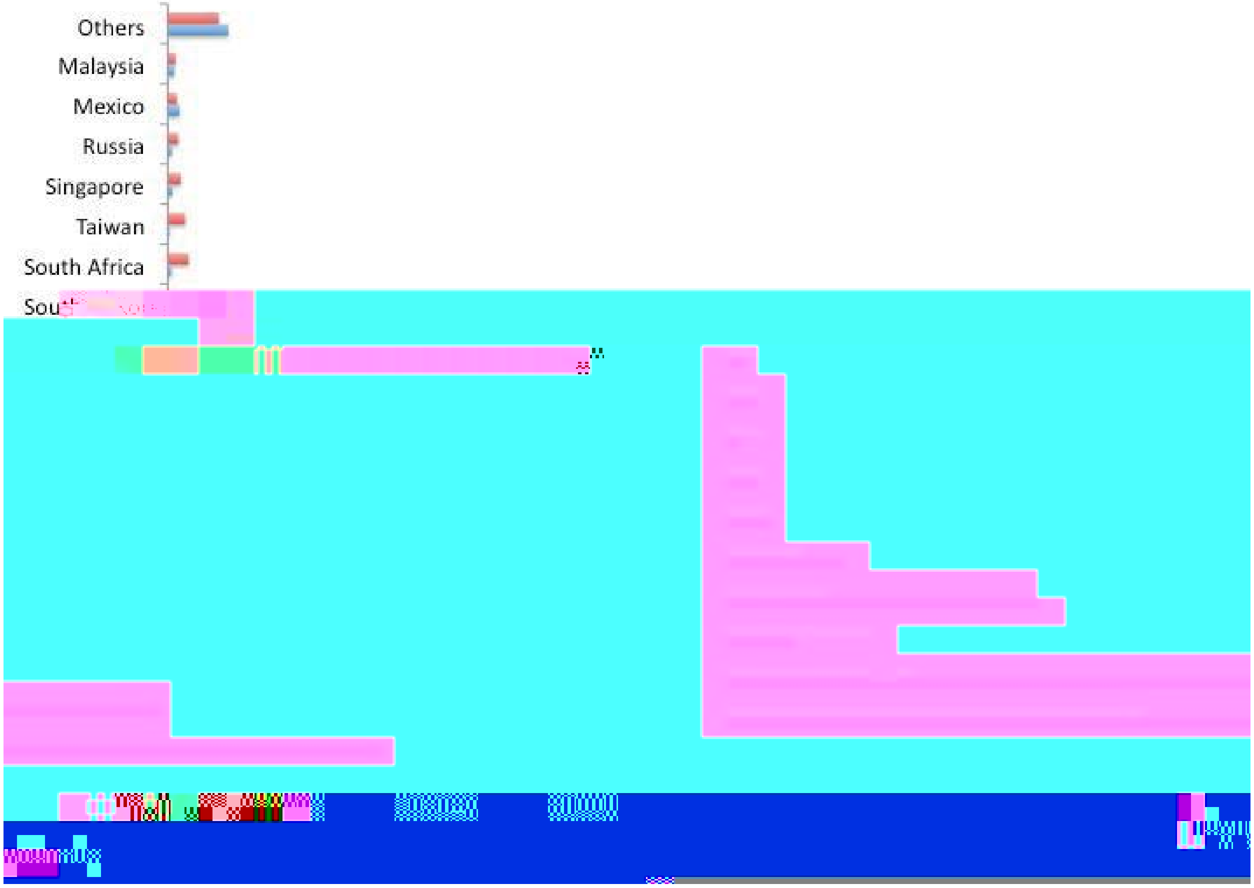
Among other measures, it has been observed that zero-return and roll measure appear statistically insignificant. We have already cited the lack of economic significance of the zero return. Similarly the roll measure, deemed economically insignificant, also provided for very less impact in the original paper (Subrahmanyam *al* (2009)).[30]

In conclusion, despite lack of data coupled with the lack of depth in the market, there is a fair amount of support for several of the liquidity proxies that we have used.

[30] Ibid.

## Appendix

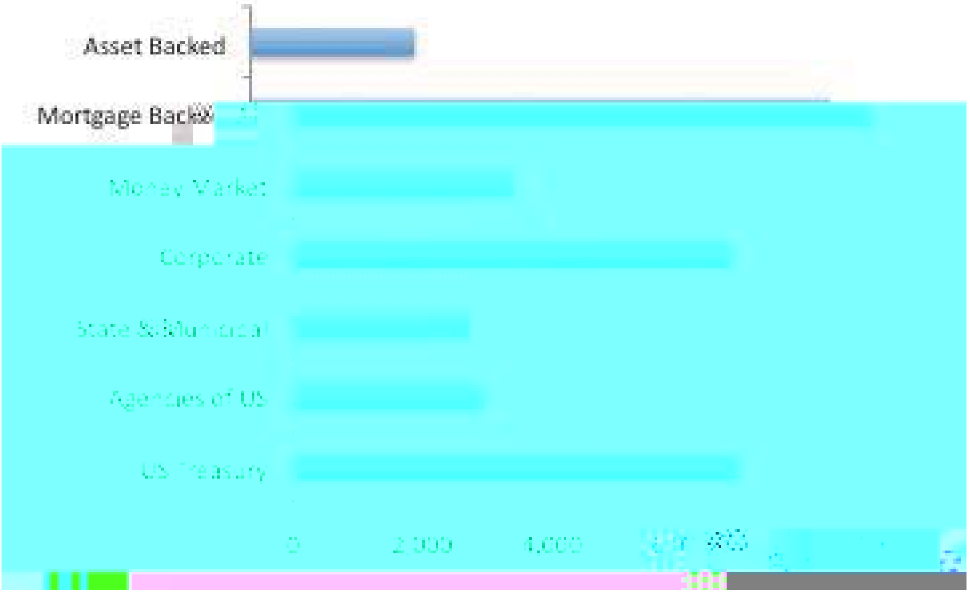
Figure 1: *[illegible] US$ [illegible] (2009)*




*[illegible]*

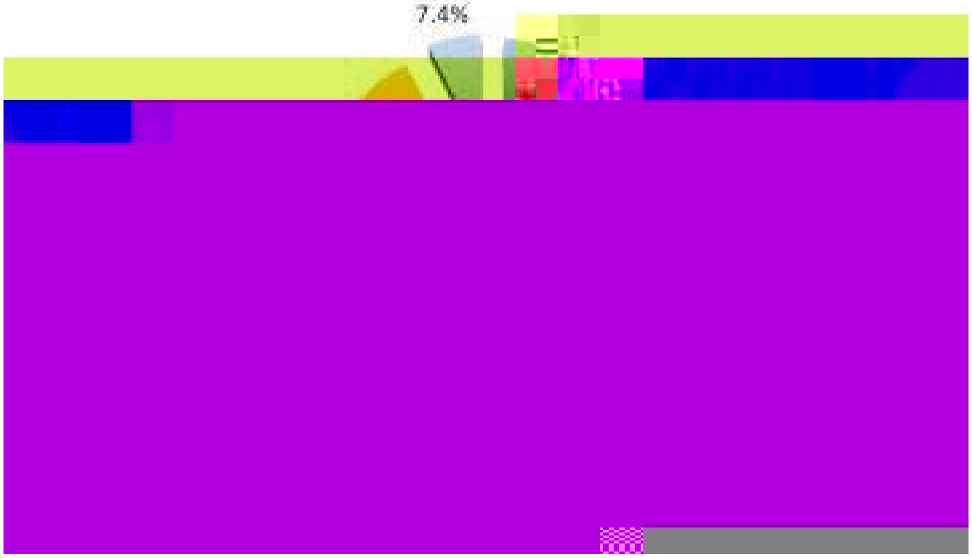
*2009*

Figure 2: *US BdMkOg*



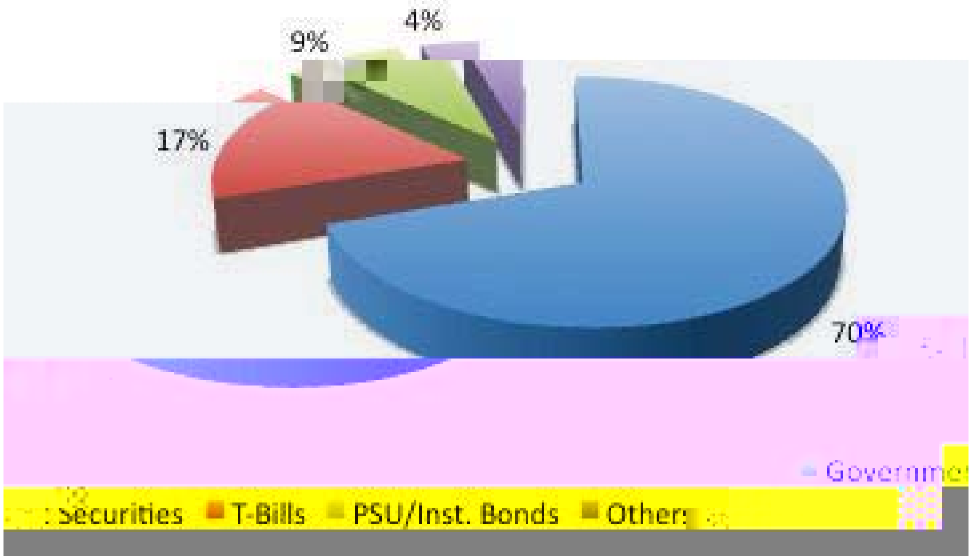

*Sa BkflaShAsAbAijdlFiap* *lg*
*2009*

Figure 3: *US [illegible]*




*[illegible]* *[illegible]*
*2009*

Figure 4: *IdDeMkCpn*




*SoNbSkEgId*

Table 1: Indian Debt Market Outstanding

| Issuer/Securities | Amount raised in Primary market (US$ Mln) | | Turnover in secondary market | |
|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Government | 64,044 | 85,709 | 1,407,893 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

Source: National Stock Exchange, India

Table 2: *R[illegible] A++ 10 [illegible]*

*[illegible]*

Table 3: *R[illegible] A+++ 10 [illegible]*
*[illegible]*

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | 0.00117 | 0.00237 | 0.49607 | 0.61993 |
| Price disp | -0.12399 | 0.08915 | -1.39069 | 0.16457 |
| Roll Measure | 0.04238 | 0.03451 | 1.22812 | 0.21963 |
| Amihud Measure | 0.00253 | 0.00124 | 2.04424 | 0.04114 |
| Zero Return Measu | -0.01045 | 0.02170 | -0.48160 | 0.63017 |
| ln(Vol(t)/Vol(t-1)) | 0.00795 | 0.00513 | 1.54966 | 0.12147 |
| Spread (t-1) | -0.05886 | 0.02818 | -2.08889 | 0.03692 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 6 | 0.08213 | 0.01369 | 1.96440 | 0.06778 |
| R Square | 0.00932 | | | | |

Table 4: R[illegible]A++ 10 [illegible]

[illegible]

Table 5: *R*[illegible]*A++ 10 y*[illegible]

[illegible]

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | 0.00000 | 0.00354 | 0.00002 | 0.99999 |
| Price disp | 0.12726 | 0.12869 | 0.98889 | 0.32294 |
| Roll Measure | -0.04620 | 0.05202 | -0.88803 | 0.37472 |
| Amihud Measure | 0.00317 | 0.00189 | 1.67913 | 0.09342 |
| Zero Return Measu | 0.01770 | 0.03124 | 0.56650 | 0.57117 |
| ln(Vol(t)/Vol(t-1)) | 0.00629 | 0.00763 | 0.82500 | 0.40955 |
| Spread(T-1) | -0.00943 | 0.03044 | -0.32.255(d)-24(-68(-)-11(v)-24(a)0(l)-8539(n9(0 | |

Table 6: *R[illegible] A+++ 10 [illegible]*

Table 7: *R[illegible] A+++ 10 [illegible]*

|  | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | 0.00003 | 0.00268 | 0.01212 | 0.99033 |
| Price disp | -0.15020 | 0.09762 | -1.53864 | 0.12418 |
| Roll Measure | 0.05792 | 0.03948 | 1.46711 | 0.14264 |
| Amihud Measure | 0.00334 | 0.00144 | 2.32166 | 0.02044 |
| Zero Return Measure | -0.00887 | 0.02370 | -0.37436 | 0.70821 |
| ln(Vol(t)/Vol(t-1)) | 0.01082 | 0.00579 | 1.87011 | 0.06174 |
| Spread (t-1) | -0.05470 | 0.03031 | -1.80443 | 0.07144 |

ANOVA

|  | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|

Table 8: [illegible]

| Correlation Matrix | Price disp | Roll Measure | Amihud Measure | Zero Return Measure | Volume Index | SpreadT-1) |
|---|---|---|---|---|---|---|
| Price disp | 1 | 0.94448 | 0.01493 | -0.00573 | -0.00506 | 0.05825 |

Table 9: *R[illegible]CG 2011 [illegible]CG 2015 [illegible]*

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | 0.00031 | 0.00150 | 0.20972 | 0.83395 |
| Change in Daily Vol | 0.00000 | 0.00000 | 0.16681 | 0.86757 |
| Daily Diff in no of trades | 0.00032 | 0.00020 | 1.57525 | 0.11563 |
| Price Dispersion | 0.00950 | 0.00109 | 8.74272 | 0.00000 |
| Roll Measure | -0.00290 | 0.00485 | -0.59707 | 0.55064 |
| Amihud Measure | 0.29579 | 0.19185 | 1.54179 | 0.12355 |
| Zero Return Measu | -0.00322 | 0.01786 | -0.18020 | 0.85704 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 6 | 0.09228 | 0.01538 | 16.18270 | 0.00000 |
| R Square | 0.11627 | | | | |

Table 10: *R[illegible] CG 2017 [illegible] CG 2019 [illegible]*

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | -0.00026 | 0.00283 | -0.09282 | 0.92610 |
| Change in Daily Vol | 0.00000 | 0.00000 | -1.39686 | 0.16336 |
| Daily Diff in no of trades | 0.00017 | 0.00020 | 0.89086 | 0.37363 |
| Price Dispersion | 0.00909 | 0.01851 | 0.49108 | 0.62368 |
| Roll Measure | 0.00019 | 0.00859 | 0.02218 | 0.98231 |
| Amihud Measure | 1.87271 | 6.54160 | 0.28628 | 0.77484 |
| Zero Return Measure | 0.00026 | 0.02885 | 0.00911 | 0.99274 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 6 | 0.00433 | 0.00072 | 0.87571 | 0.51283 |
| R Square | 0.01509 | | | | |

Table 11: *R[illegible] CG 2020 [illegible] CG 2022*
*[illegible]*

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | 0.00115 | 0.00315 | 0.36487 | 0.71554 |
| Change in Daily Vol | 0.00000 | 0.00000 | 1.49716 | 0.13569 |
| Daily Diff in no of trades | -0.00051 | 0.00029 | -1.75674 | 0.08026 |
| Price Dispersion | -0.00530 | 0.01983 | -0.26740 | 0.78939 |
| Roll Measure | -0.00162 | 0.00930 | -0.17393 | 0.86207 |
| Amihud Measure | 0.37244 | 0.44513 | 0.83669 | 0.40362 |
| Z11oo Return Measure | 0.00410 | 0.00653 | 0.62772 | 0.53080 |

Table 12: [illegible] 8% 2014 [illegible]

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | -0.00753 | 0.01825 | -0.41277 | 0.68012 |
| Roll Measure | 0.02311 | 0.10299 | 0.22441 | 0.82261 |
| Zero Return Measure | 0.00753 | 0.14343 | 0.05253 | 0.95815 |
| Change in Daily Vol | 0.00000 | 0.00000 | -2.23965 | 0.02596 |
| Amihud Measure | -11.26154 | 5.69707 | -1.97673 | 0.04913 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 4 | 0.15638 | 0.03910 | 1.93169 | 0.10555 |
| R Square | 0.02886 | | | | |

Table 13: *R[illegible] 10% 2017 [illegible]*
*[illegible]*

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|

Table 14: *R[illegible] 10% 2011 [illegible]*
*[illegible]*

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | -0.01170 | 0.01431 | -0.81760 | 0.41403 |
| Roll Measure | 0.10578 | 0.07633 | 1.38576 | 0.16653 |
| Zero Return Measure | -0.00879 | 0.12897 | -0.06815 | 0.94569 |
| Change in Daily Vol | 0.00000 | 0.00001 | -0.21825 | 0.82734 |
| Amihud Measure | 0.00000 | 0.00001 | 0.87375 | 0.38274 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 4 | 0.17231 | 0.04308 | 0.87321 | 0.47988 |
| R Square | 0.00800 | | | | |

Table 15: [illegible]

*a* [illegible] *(A++ & A+++)*

*b* [illegible]

| Variables | Period | | |
|---|---|---|---|
| | [illegible] 2011 | 2014 [illegible] 2017 | 2017 [illegible] |
| intercept | -0.41 | 0.46 | -0.82 |
| roll measure | 1.35 | 0.22 | -0.72 |
| zero measure | [illegible] | 0.65 | 0.71 |
| [illegible] | [illegible] | [illegible] | [illegible] |
| amihud no | -1.97 | 1.19 | 0.97 |

*c* [illegible]

| Variables | Period | | |
|---|---|---|---|
| | 2011 vs 2015 | 2017 vs 2019 | 2020 vs 2022 |
| [illegible] | [illegible] | [illegible] | [illegible] |
| vol change | 0.1668 | -4.38 | 1.49 |
| [illegible] | [illegible] | [illegible] | [illegible] |
| price dispersion | [illegible] | [illegible] | [illegible] |
| roll measure | -0.5971 | 0.0001 | -0.17 |
| [illegible] | [illegible] | [illegible] | [illegible] |

Table 16:

Table 17: *S[illegible] AAA ([illegible])*

| Yield Spread Change (T) | Price disp | Roll Measure | Amihud Measure | Zero Return Measure | Daily Vol Change | Yield Spread Change(T-1) |
|---|---|---|---|---|---|---|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 | 1 | 0.00000 | 0 |
| 0.11110 | 0.00000 | 0.00000 | 0.76614 | 0 | -0.08019 | 0 |
| -0.03970 | 0.00000 | 0.00000 | -0.38241 | 0 | 0.00000 | 0.11110 |
| 0.01030 | 0.00000 | 0.00000 | 0.27129 | 0 | 0.02446 | -0.03970 |
| -0.00090 | 0.00000 | 0.00000 | 2.83079 | 0 | -0.02658 | 0.01030 |

Table 18: *Sl[illegible] G-Se (2011 [illegible] 2015 M[illegible]B[illegible])*

Change in Yield

Table 19: *Sp(ll)agfCpBd(7.75% p2014 )jn*

| Change in Yield Spread | Roll Measure | Zero Return Measure | Daily Vol Change | Amihud Measure |
|---|---|---|---|---|
| 0.1325 | 0.16642 | 0 | 1500 | -0.00314 |
| -0.0302 | 0.16642 | 0 | -1000 | -0.00020 |
| 0.0343 | 0.16642 | 0 | 3500 | 0.00007 |
| 0.0998 | 0.16642 | 0 | -3500 | 0.00026 |
| -0.0859 | 0.16642 | 0 | -500 | 0.00308 |
| -0.1204 | 0.16642 | 0 | 500 | -0.00355 |
| 0.0993 | 0.16642 | 0 | 0 | 0.00180 |
| 0.2022 | 0.16642 | 0 | 500 | -0.00174 |
| -0.1036 | 0.02443 | 0 | -250 | -0.00007 |
| 0.0391 | 0.02443 | 0 | 0 | 0.00015 |
| -0.0434 | 0.02443 | 0 | -250 | 0.00140 |
| -0.1226 | 0.02443 | 0 | 1000 | -0.00023 |
| -0.2724 | 0.02443 | 0 | -1500 | 0.00514 |
| 0.2501 | 0.02443 | 0 | 4500 | -0.00640 |
| 0.0112 | 0.02443 | 0 | -2500 | 0.00009 |
| -0.0316 | 0.02443 | 0 | 6500 | -0.00008 |
| -0.0294 | 0.02443 | 0 | -7500 | -0.00002 |
| 0.0659 | 0.02443 | 0 | 0 | 0.00009 |
| -0.0267 | 0.02443 | 0 | 0 | -0.00014 |
| -0.0102 | 0.02443 | 0 | 0 | 0.00013 |
| -0.0302 | 0.02443 | 0 | 0 | -0.00001 |
| 0.0095 | 0.02443 | 0 | -1000 | 0.00021 |

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