

On the Analysis of Corporate Bond Trades

Khizar Qureshi ¹

Dimensional Fund Advisors
Research

September 3, 2015

¹Collaborators: Massi DeSantis, PhD, Research, Alan Hutchison, Trading

Agenda

- 1 Overview
- 2 Data
- 3 Methodology
- 4 Characterization
- 5 Liquidity
- 6 Next Steps
- 7 Appendix

Background/Motivation

- A deeper understanding of TRACE may enable traders to take advantage of dealer liquidity constraints
- The term structure of a bond, as well as its credit spread is rich in information
- The evolution of the market can be understood by studying trades

Background/Motivation



“You can only have two.”

—Henry F. Gray, Head of Global Equity Trading and Vice President, Dimensional Fund Advisors

²Source: Plecha, D, et al.

Background/Motivation



3

Figure 1: Dimensional's patient and flexible approach provides advantages in trade price

³Source: Plecha, D., et al.

Data

- TRACE: Trade Reporting and Compliance Engine (2013-2014)
 - ① FINRA-Supported System
 - ② Dealers report within 15 minutes of execution:
 - Trade price ($\%par$)
 - Trade size ($\leq 5m$) par
 - Execution date and time
 - ③ Available since July 2002
 - Computational Ability
 - Sample size
- Binding data set: Barclays US Aggregate Index

Literature Review

- Edwards, A.K., et. al. (2007) "Corporate Bond Market Transaction Costs and Transparency," *Journal of Finance*, 1421-1451, June 2007.
- Dimensional Fund Advisors (2010) "TRACE-Bringing Efficiency and Transparency to the Bond Market" *Dimensional White Paper Series*, 1-3, October 2010.
- Fama, E. (2003) "Update of the Research Underlying Dimensional's Bond Strategies" *Dimensional White Paper Series*, 1-8, September 2003.
- Plecha, D. (2005) "Fixed Income Investing" *Dimensional White Paper Series*, 1-11, January 2005.
- Davis, J.L. (2000) "The Information in the Term Structure," *Dimensional White Paper Series*, 1-16, October 2000.

Classification

Trade Type

- Retail: Non-Interdealer, Quantity $\leq 100,000$ of par
- Institutional: Non-Interdealer, Quantity $\geq 100,000$ of par
- Interdealer: Interdealer, \forall Quantity

Classification

Maturity (Years)

- ≤ 1
- 1 – 3
- 3 – 5
- 5 – 10
- 10 – 20
- 20+

Classification

Credit Spread (Basis Points above US Treasury)

- $\delta \leq 50$
- $50 \leq \delta \leq 100$
- $100 \leq \delta \leq 180$
- $180 \leq \delta$

Arrival/Trade Rate

- \mathcal{N} = Number of Trades
- \mathcal{T} = Time

$$\lambda_i = \mathbb{E} \left[\frac{N}{T} \right] \quad (1)$$

- $\mathcal{N} = \sum_{t=0}^T N_t$
- $T \in [0, 504]$

Frequency

- Trading Day: Unique day with at least one trade (\mathcal{D})
- Total Time: Reported time in seconds (\mathcal{T})
- $\forall \mathcal{T} \in [0, 504]$, *and* $\mathcal{D} \leq \mathcal{T}$,

$$\mathcal{F} = \frac{\mathcal{D}}{\mathcal{T}} \in [0, 1] \quad (2)$$

Trade Size Value

$$\mathcal{TV}_i = \frac{P_i Q_i}{100} \quad (3)$$

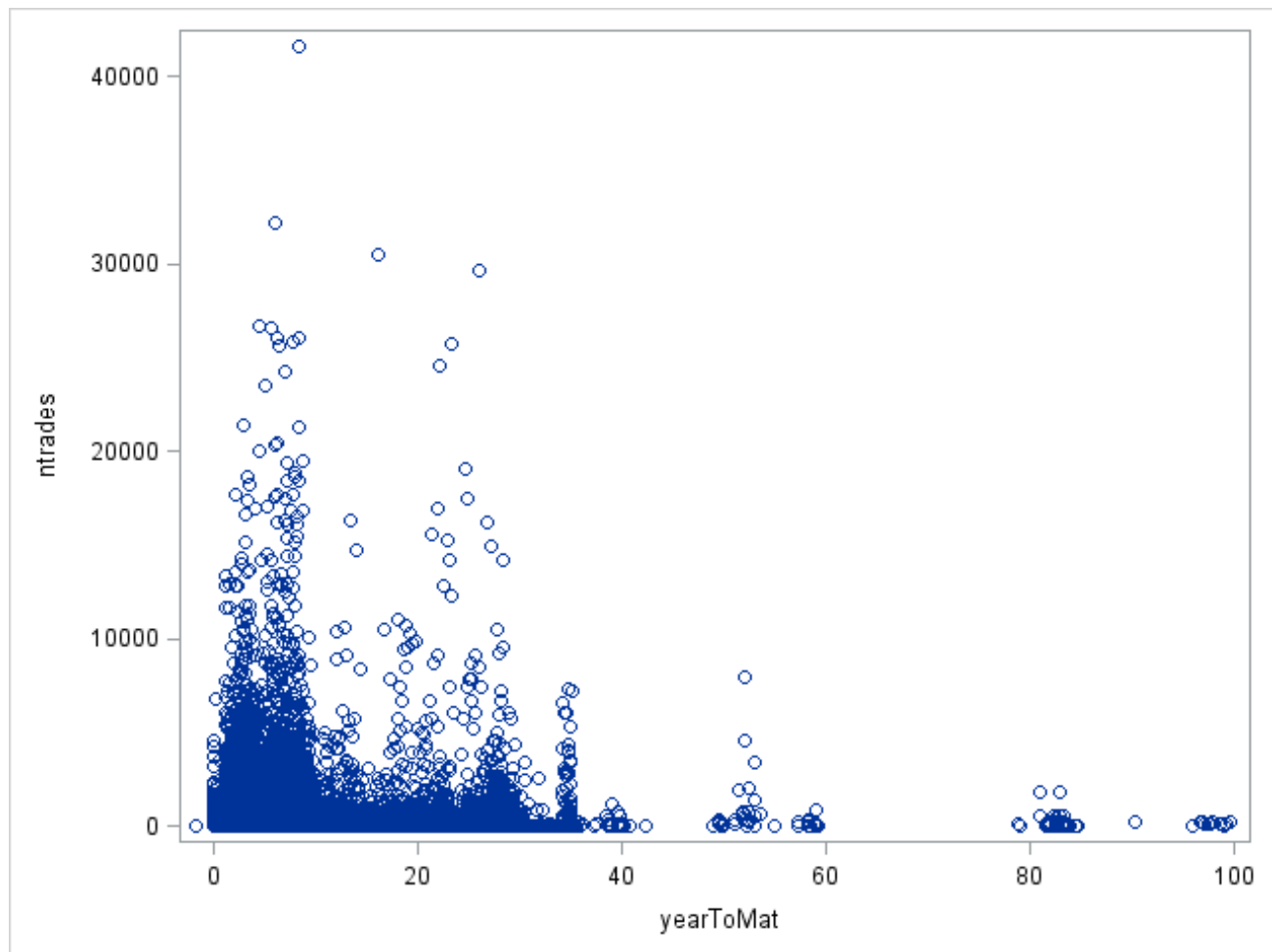
- Trade Value: The dollar amount exchanged in one trade
- Unique for each cusip, and reset on every trade

Volume

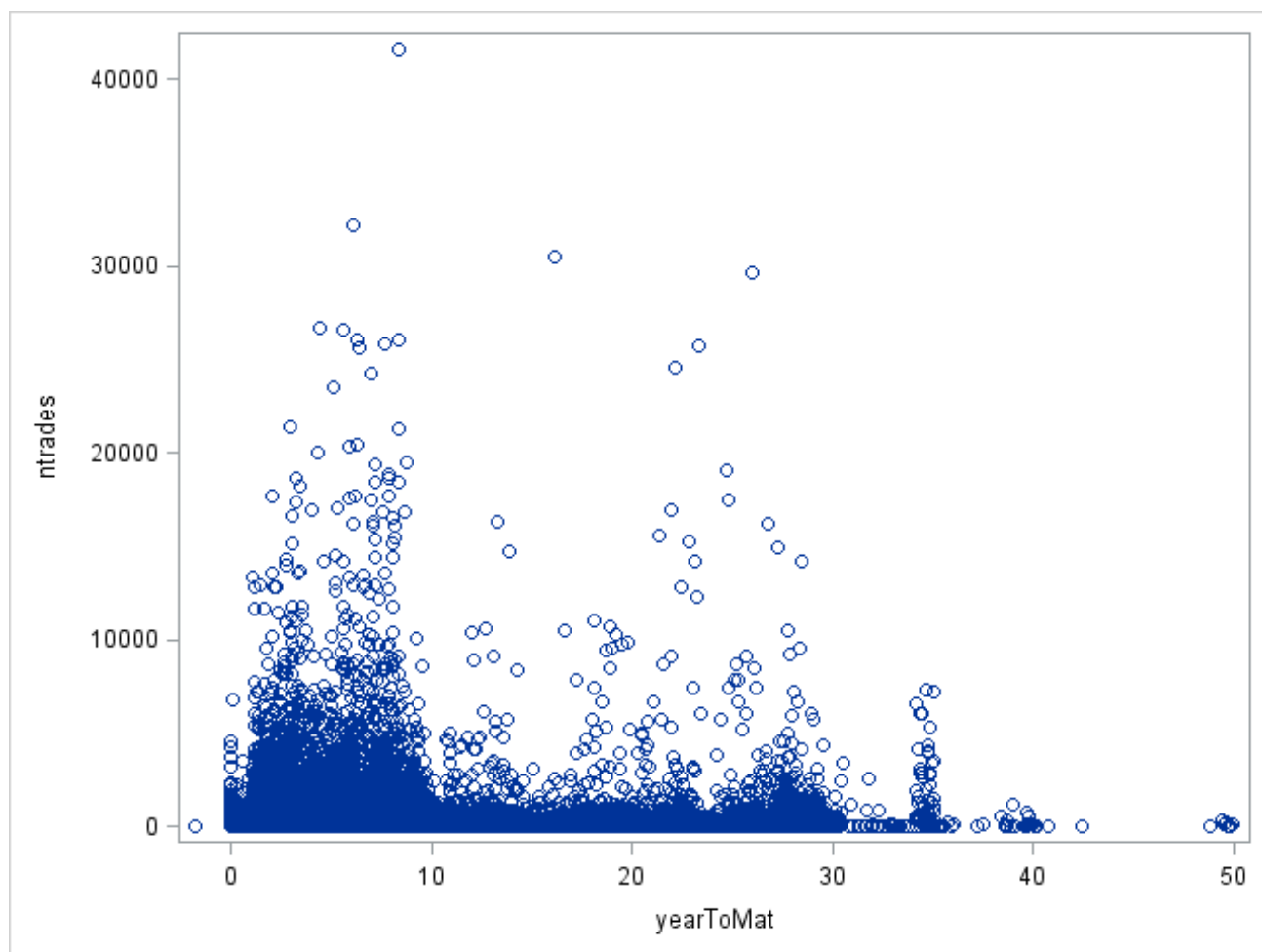
$$\mathcal{V}_{\rangle} = \sum_j \frac{P_i Q_i}{100} = \sum_j \mathcal{T} \mathcal{V}_{\rangle} \quad (4)$$

- Volume: The net dollar amount traded in a day per cusip
- Unique for each cusip, and reset on every new date

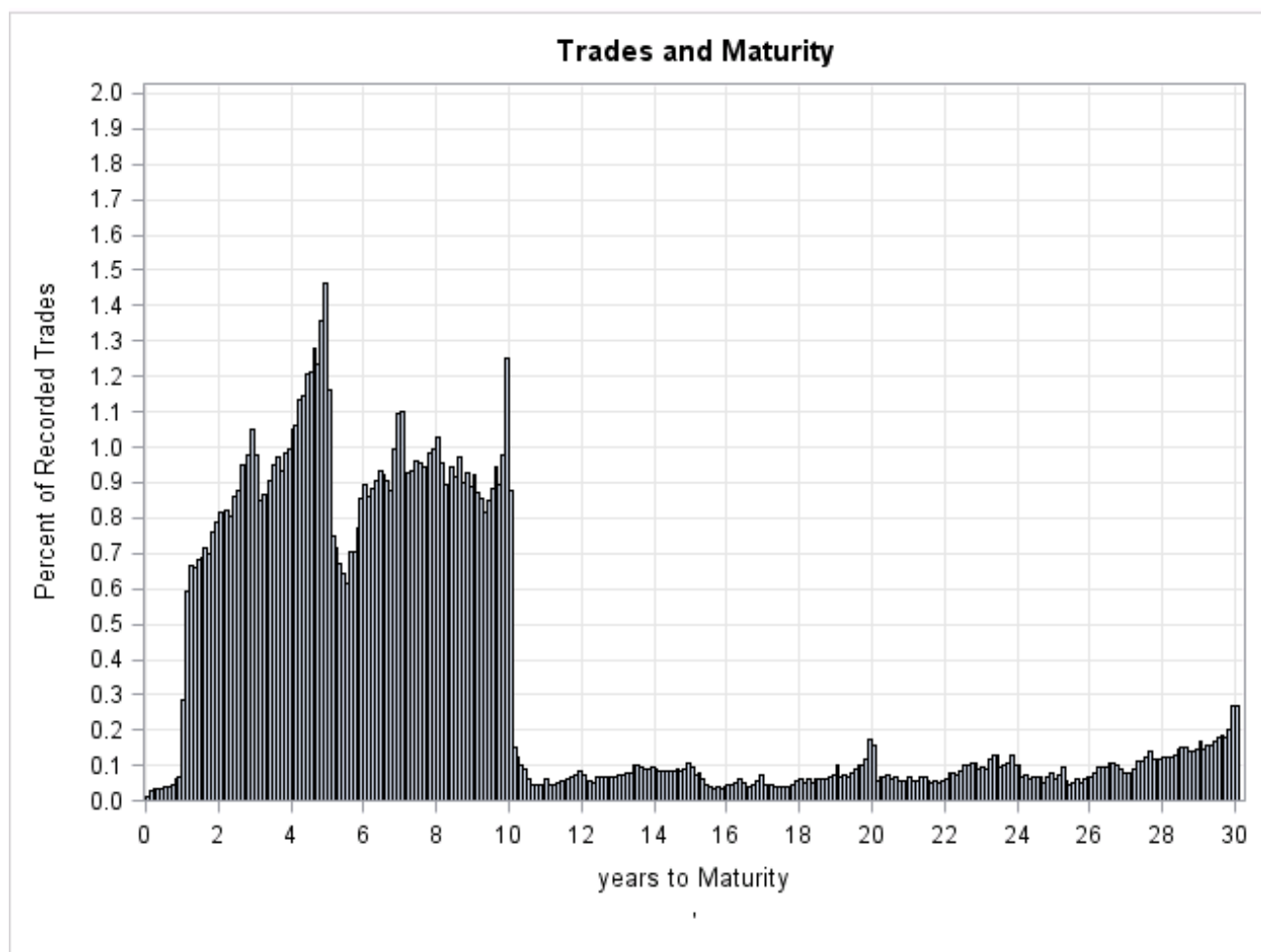
Univariate Distribution: Maturity



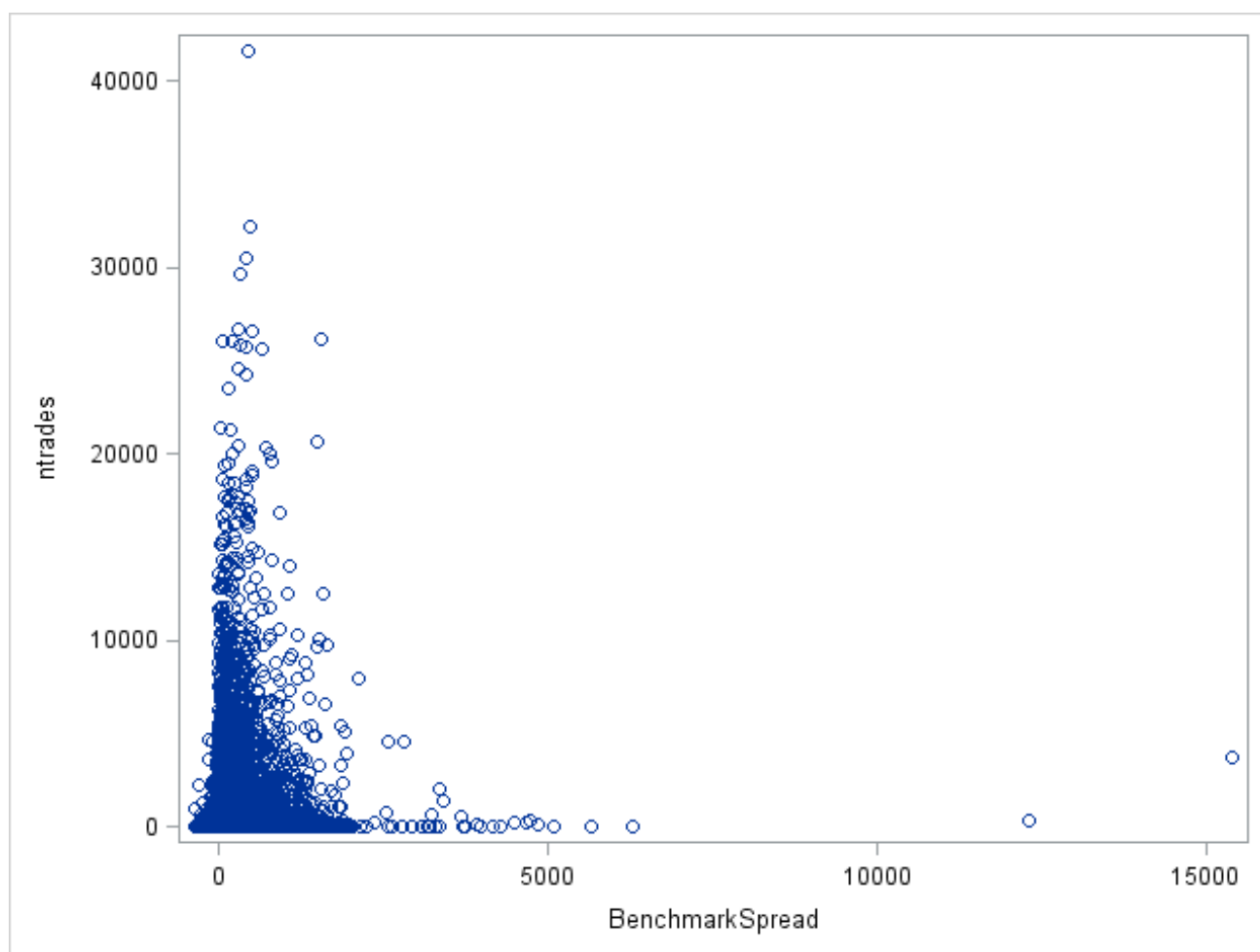
Univariate Distribution: Maturity



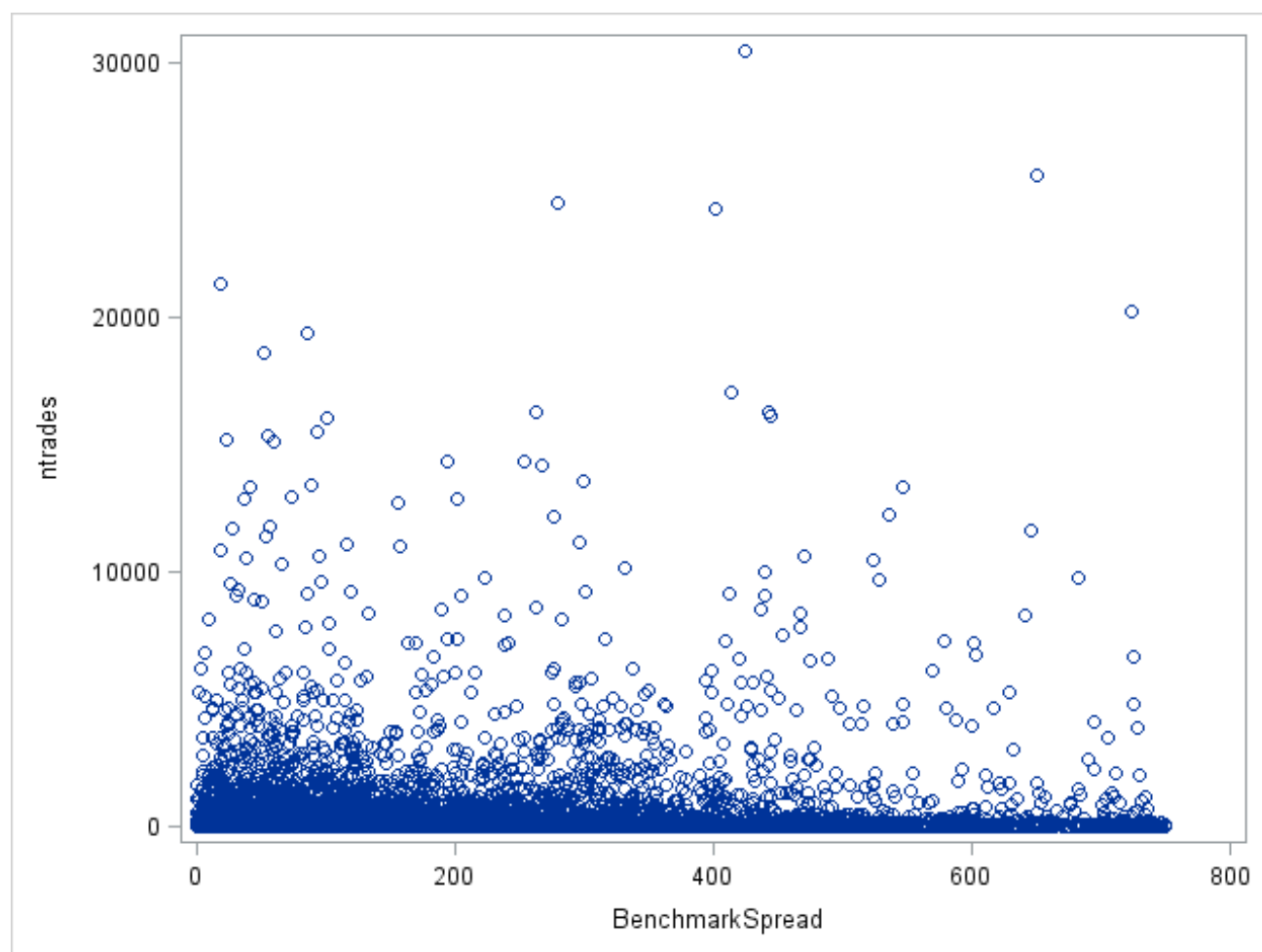
Histogram: Maturity



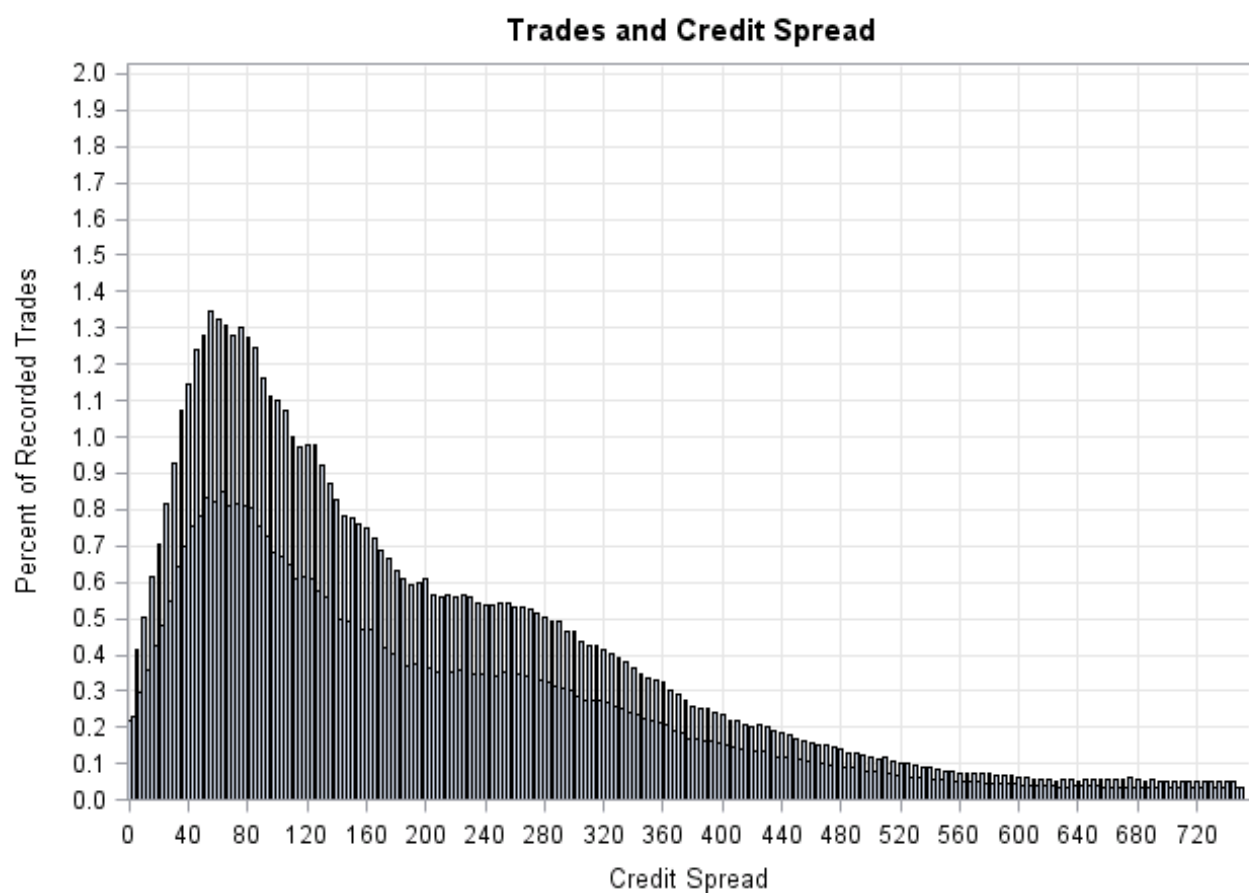
Univariate Distribution: Credit Spread



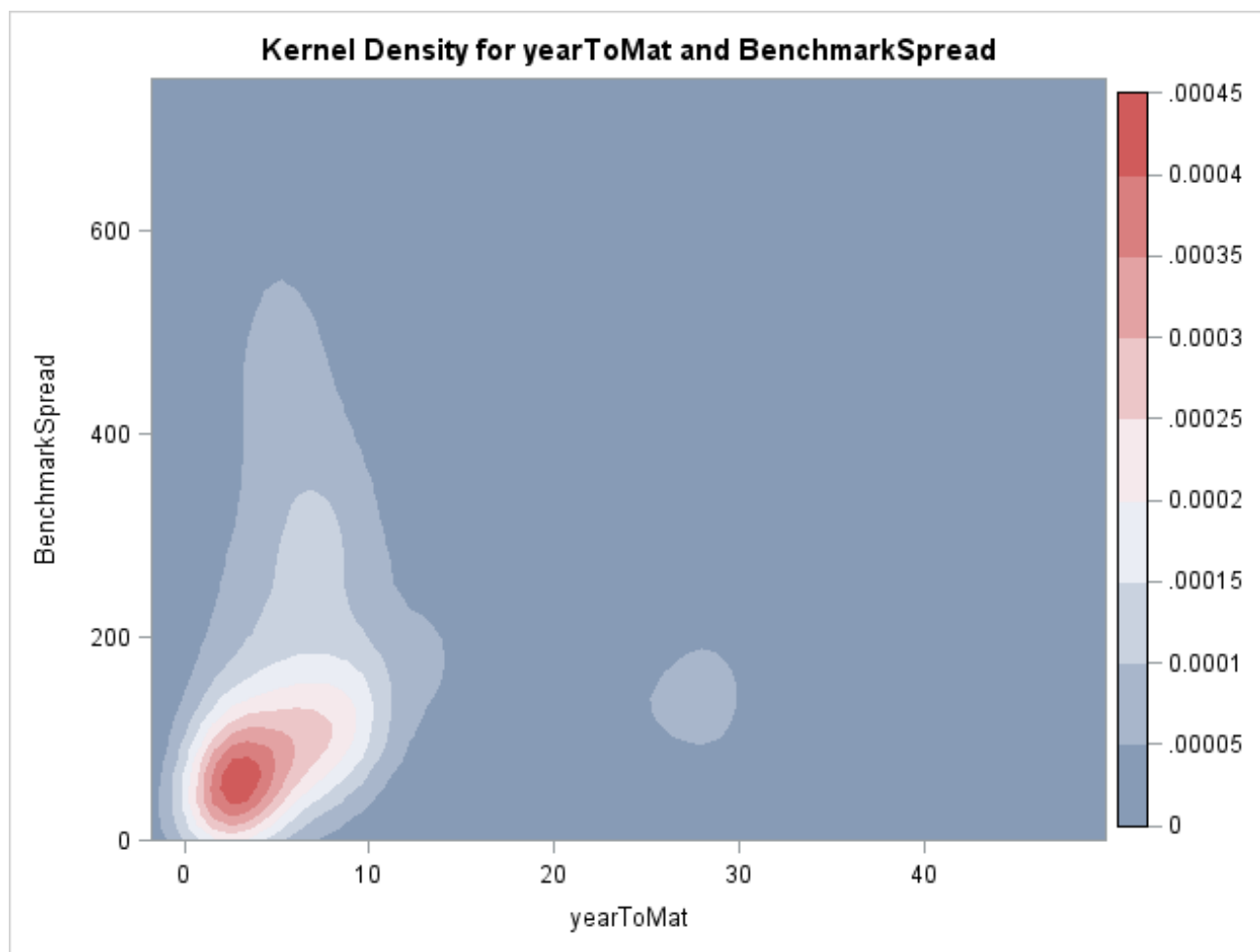
Univariate Distribution: Credit Spread



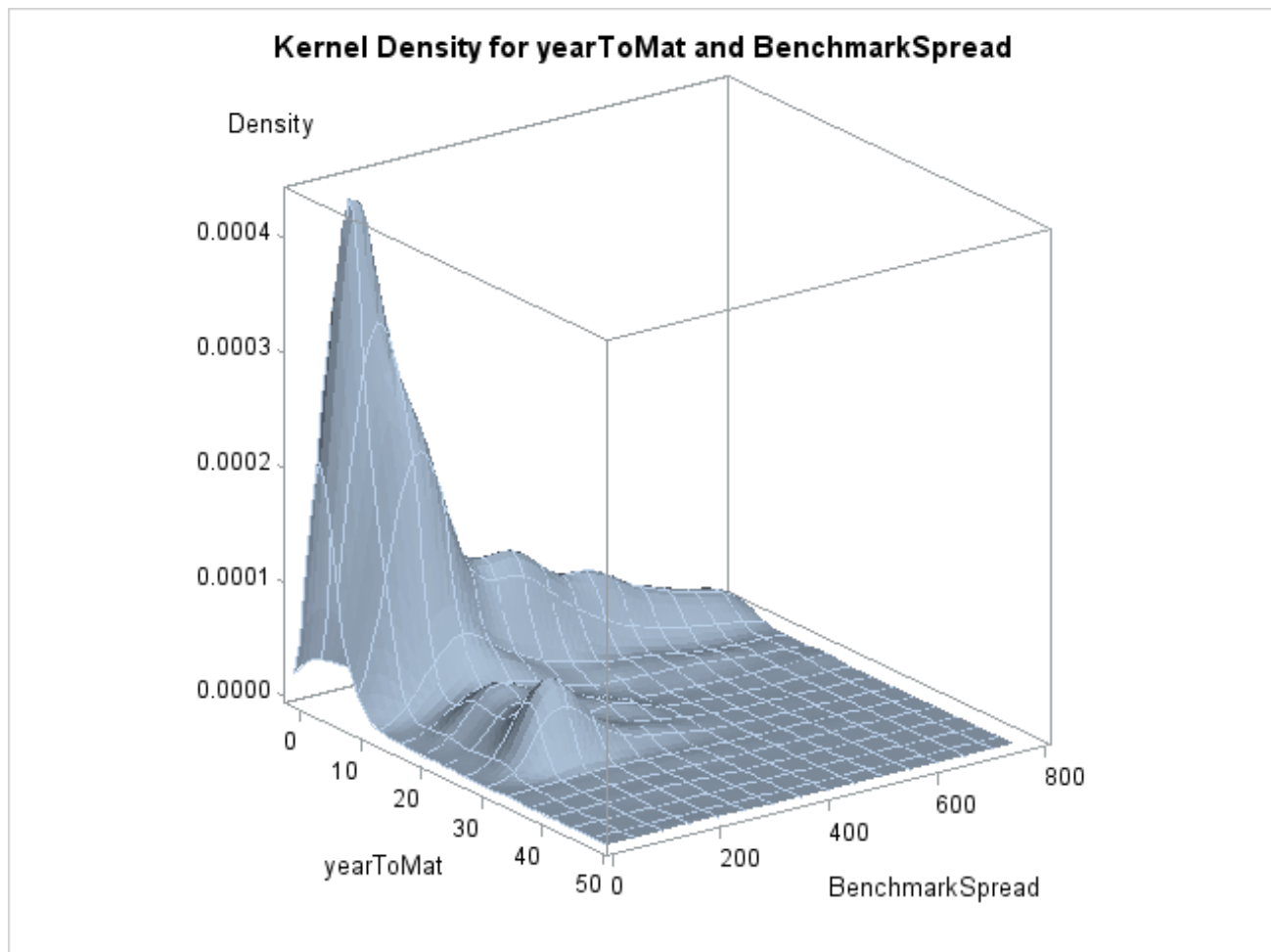
Histogram: Credit Spread



Multivariate Distribution

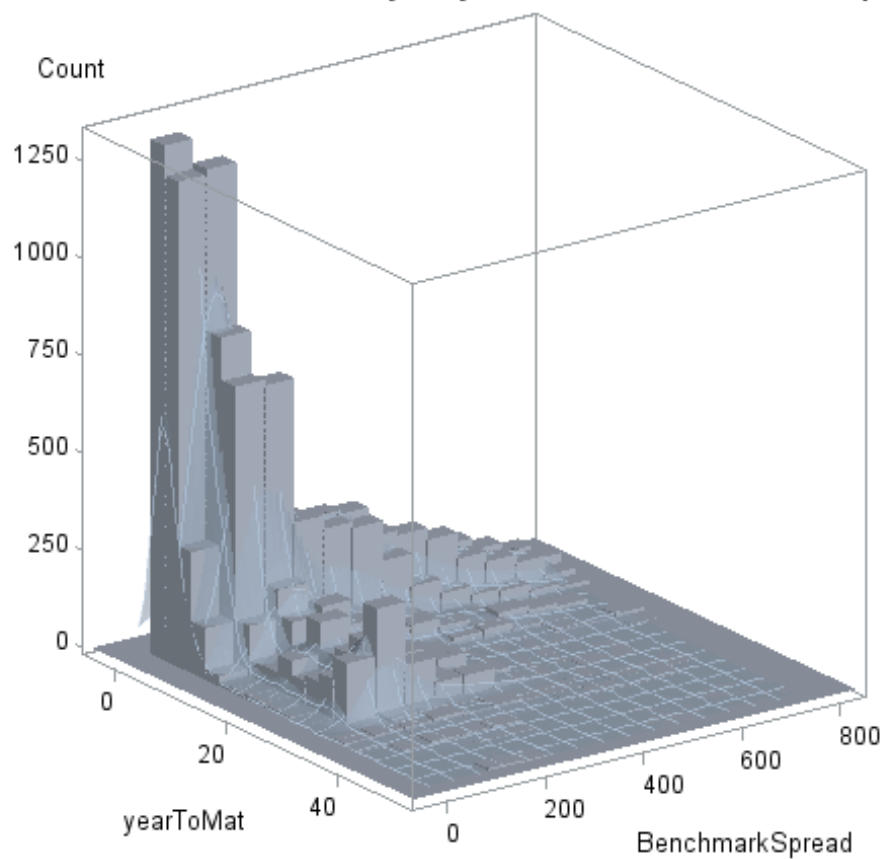


Multivariate Distribution



Multivariate Distribution

Distribution and Kernel Density for yearToMat and BenchmarkSpread



Summary Tables: Number of Trades

Table 1: By maturity: Dense in 5-10, 20+

Number of Trades Across Cusips	Sample Size	Mean	P5	P25	Median	P75	P95
All	14,917,217.00	2,499.70	35.00	301.00	1,030.00	2,939.00	10,372.00
1 Year	813,402.00	1,863.62	23.00	237.00	791.00	2,121.00	7,353.00
1-3 Year	2,254,355.00	1,734.01	33.00	270.00	867.00	2,298.00	6,479.00
3-5 Year	3,130,825.00	2,324.62	43.00	349.00	1,097.00	2,891.00	9,049.00
5-10 Year	6,106,588.00	3,006.61	46.00	381.00	1,261.00	3,524.00	12,669.00
10-20 Year	1,082,399.00	1,845.14	15.00	116.00	439.00	1,885.00	8,451.00
20+ Year	1,529,648.00	2,764.21	35.00	268.00	947.00	3,286.00	12,323.00

Summary Tables: Number of Trades

Table 2: By trade type: Dense in Retail

Number of Trades Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	2,499.70	35.00	301.00	1,030.00	2,939.00	10,372.00
Interdealer	5,522,367.00	2,646.63	42.00	346.00	1,153.00	3,199.00	10,737.00
Institutional Size Customer	3,787,763.00	1,732.28	21.00	184.00	639.00	1,836.00	7,249.00
Retail	5,607,087.00	2,873.40	47.00	383.00	1,283.00	3,524.00	11,571.00

Summary Tables: Number of Trades

Table 3: By spread: Dense in 180+

Number of Trades Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	2,499.70	35.00	301.00	1,030.00	2,939.00	10,372.00
Missing	1,295,275.00	1,488.04	13.00	163.00	609.00	1,670.00	5,690.00
50 bps	1,947,516.00	2,043.83	48.00	369.00	1,067.00	2,624.00	7,728.00
50-100 bps	2,619,434.00	2,083.67	40.00	289.00	921.00	2,492.00	8,600.00
100-180 bps	2,846,224.00	2,094.23	31.00	236.00	790.00	2,412.00	8,881.00
180 bps+	6,208,768.00	3,215.14	42.00	380.00	1,364.00	3,937.00	13,269.00

Summary Tables: Trades Per Day

Table 4: By maturity: Longer bonds trade at a higher rate

Trades/Day Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	4.96	0.07	0.60	2.04	5.83	20.58
1 Year	813,402.00	3.70	0.05	0.47	1.57	4.21	14.59
1-3 Year	2,254,355.00	3.44	0.07	0.54	1.72	4.56	12.86
3-5 Year	3,130,825.00	4.61	0.09	0.69	2.18	5.74	17.95
5-10 Year	6,106,588.00	5.97	0.09	0.76	2.50	6.99	25.14
10-20 Year	1,082,399.00	3.66	0.03	0.23	0.87	3.74	16.77
20+ Year	1,529,648.00	5.48	0.07	0.53	1.88	6.52	24.45

Summary Tables: Trades Per Day

Table 5: By trade type: Institutional bonds trade at lower rates

Trades/Day Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	4.96	0.07	0.60	2.04	5.83	20.58
Interdealer	5,522,367.00	5.25	0.08	0.69	2.29	6.35	21.30
Institutional Size Customer	3,787,763.00	3.44	0.04	0.37	1.27	3.64	14.38
Retail	5,607,087.00	5.70	0.09	0.76	2.55	6.99	22.96

Summary Tables: Trades Per Day

Table 6: By spread: Rate increases with spread

Trades/Day Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	4.96	0.07	0.60	2.04	5.83	20.58
Missing	1,295,275.00	2.95	0.03	0.32	1.21	3.31	11.29
50 bps	1,947,516.00	4.06	0.10	0.73	2.12	5.21	15.33
50-100 bps	2,619,434.00	4.13	0.08	0.57	1.83	4.94	17.06
100-180 bps	2,846,224.00	4.16	0.06	0.47	1.57	4.79	17.62
180 bps+	6,208,768.00	6.38	0.08	0.75	2.71	7.81	26.33

Summary Tables: Trade Size Value

Table 7: By maturity: Trade size bi-modal

Trade Size in Value Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	718.93	6.75	21.97	67.65	443.98	3,438.53
1 Year	813,402.00	922.09	6.00	20.35	67.34	508.15	6,023.33
1-3 Year	2,254,355.00	727.93	6.11	21.09	61.40	400.34	4,029.69
3-5 Year	3,130,825.00	634.01	6.05	21.45	58.28	393.02	2,330.76
5-10 Year	6,106,588.00	713.87	8.46	24.06	85.54	523.18	2,466.54
10-20 Year	1,082,399.00	455.97	7.04	20.23	47.94	168.89	2,018.85
20+ Year	1,529,648.00	977.73	8.05	26.75	93.05	612.53	6,196.49

Summary Tables: Trade Size Value

Table 8: By trade type: Maximum at Institutional

Trade Size in Value Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	718.93	6.75	21.97	67.65	443.98	3,438.53
Interdealer	5,522,367.00	490.94	6.04	20.47	51.86	225.73	2,142.86
Institutional Size Customer	3,787,763.00	2,047.08	201.27	401.20	1,028.46	2,095.73	9,916.27
Retail	5,607,087.00	46.28	4.63	18.45	32.92	60.12	129.68

Summary Tables: Trade Size Value

Table 9: By spread: Only high spread below average

Trade Size in Value Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	718.93	6.75	21.97	67.65	443.98	3,438.53
Missing	1,295,275.00	841.29	4.60	20.52	79.25	696.58	4,064.98
50 bps	1,947,516.00	780.54	5.89	20.75	60.15	386.82	4,893.73
50-100 bps	2,619,434.00	808.90	5.83	20.92	56.86	370.35	5,331.39
100-180 bps	2,846,224.00	925.21	6.82	22.35	63.86	486.90	6,153.99
180 bps+	6,208,768.00	541.56	9.38	23.61	79.79	451.75	2,114.79

Summary Tables: Dollar Volume

Table 10: By maturity: 20+ vs. 10-20, despite sample size

Mean Dollar Volume Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	2,512,604.00	674,409.98	2,178.57	52,273.31	272,403.66	792,569.30	2,615,030.11
1 Year	185,473.00	656,513.47	1,316.01	52,272.36	312,259.90	866,159.61	2,572,796.30
1-3 Year	467,702.00	567,679.24	2,542.92	67,959.99	276,800.09	739,935.19	2,138,129.73
3-5 Year	499,014.00	637,726.22	3,299.22	72,558.57	281,919.71	767,244.60	2,395,930.33
5-10 Year	889,157.00	828,197.61	3,506.72	89,452.38	346,040.46	935,263.51	3,158,950.93
10-20 Year	205,525.00	204,462.94	510.19	5,301.75	21,252.64	122,536.10	965,683.29
20+ Year	265,733.00	792,527.56	3,047.37	53,298.36	316,055.29	964,760.72	3,182,156.96

Summary Tables: Dollar Volume

Table 11: By trade type: Retail and Institutional similar, despite TS

Mean Dollar Volume Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	2,512,604.00	674,409.98	2,178.57	52,273.31	272,403.66	792,569.30	2,615,030.11
Interdealer	595,113.00	627,331.81	1,243.59	25,206.26	208,111.64	703,610.54	2,583,887.51
Institutional Size Customer	964,185.00	728,421.27	11,425.53	113,491.78	349,162.59	879,649.46	2,639,457.17
Retail	953,306.00	649,171.46	1,149.39	25,703.06	227,353.50	749,311.01	2,605,321.45

Summary Tables: Dollar Volume

Table 12: By spread: High-grade below average, despite trade rate

Mean Dollar Volume Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	2,512,604.00	674,409.98	2,178.57	52,273.31	272,403.66	792,569.30	2,615,030.11
Missing	296,941.00	526,264.47	734.57	20,465.94	198,748.40	672,843.33	2,169,792.71
50 bps	401,657.00	748,623.44	6,923.37	136,141.88	424,417.76	979,107.25	2,504,102.95
50-100 bps	482,915.00	762,855.65	4,244.85	83,492.66	322,093.19	888,796.74	2,949,704.71
100-180 bps	532,966.00	733,987.54	1,941.94	34,900.34	252,371.61	806,831.81	3,008,565.37
180 bps+	798,125.00	598,879.93	1,914.68	41,411.80	214,377.37	662,937.05	2,412,400.20

Summary Tables: Frequency

Table 13: By maturity: Highest frequency in short bonds

Frequency of Days with a Trade Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	28.5%	1.4%	9.1%	23.4%	44.4%	72.4%
1 Year	813,402.00	32.2%	1.4%	11.1%	28.4%	50.8%	75.4%
1-3 Year	2,254,355.00	31.1%	1.8%	10.7%	26.4%	48.4%	75.2%
3-5 Year	3,130,825.00	28.0%	1.8%	9.9%	23.4%	42.3%	69.8%
5-10 Year	6,106,588.00	29.3%	1.6%	9.7%	24.4%	45.6%	73.0%
10-20 Year	1,082,399.00	21.6%	0.4%	3.4%	13.3%	34.7%	68.1%
20+ Year	1,529,648.00	25.9%	1.0%	7.9%	20.2%	39.9%	69.2%

Summary Tables: Frequency

Table 14: By trade type: Lowest frequency in institutional

Frequency of Days with a Trade Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	28.5%	1.4%	9.1%	23.4%	44.4%	72.4%
Interdealer	5,522,367.00	28.8%	1.6%	9.5%	23.8%	44.4%	72.6%
Institutional Size Customer	3,787,763.00	25.7%	0.8%	6.9%	19.8%	40.5%	69.6%
Retail	5,607,087.00	30.2%	1.8%	10.5%	25.8%	46.8%	73.6%

Summary Tables: Frequency

Table 15: By spread: Low spreads trade at highest frequency

Frequency of Days with a Trade Across Cusips	Sample Size	Average	P5	P25	Median	P75	P95
All	14,917,217.00	28.5%	1.4%	9.1%	23.4%	44.4%	72.4%
Missing	1,295,275.00	26.8%	0.6%	6.9%	21.2%	43.5%	70.0%
50 bps	1,947,516.00	35.3%	2.6%	15.5%	33.5%	53.2%	75.4%
50-100 bps	2,619,434.00	29.6%	1.6%	10.1%	25.0%	45.8%	73.6%
100-180 bps	2,846,224.00	26.0%	1.2%	8.3%	21.0%	39.7%	68.3%
180 bps+	6,208,768.00	27.5%	1.4%	8.3%	21.6%	42.9%	72.4%

Volume as a Measure of Liquidity

- V =Volume
- t =Time: $0 \leq t \leq T$
- $\mathcal{L} = \frac{V_t}{V_0} = f(t)$

Median Distribution

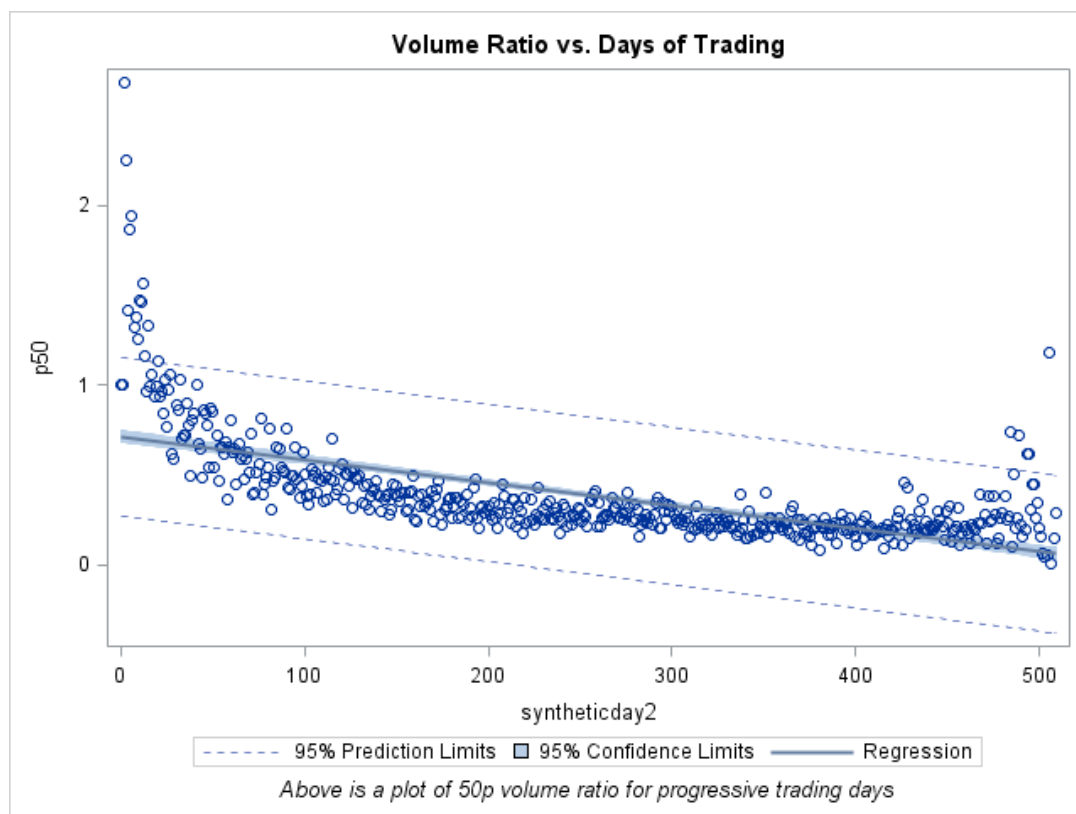


Figure 5: $\beta = -0.00129$, $t = -19.04$

Mean Distribution

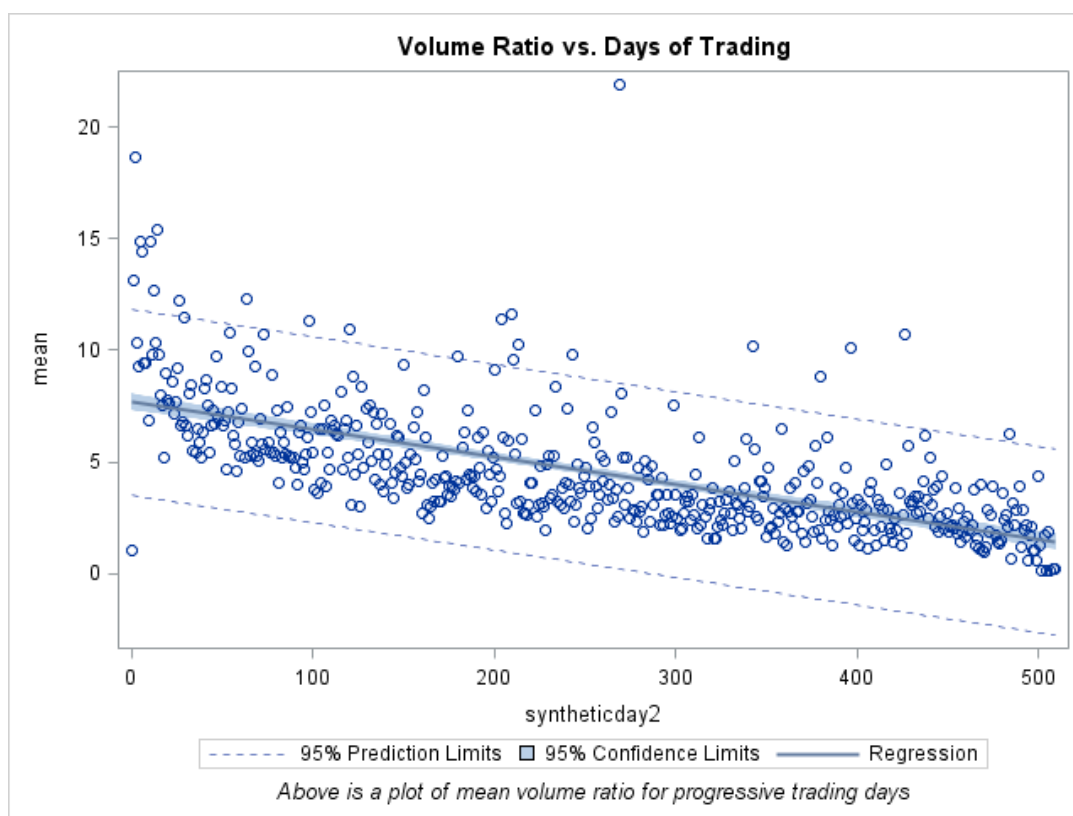


Figure 6: $\beta = -0.0123$, $t = -19.25$

90th Percentile Distribution

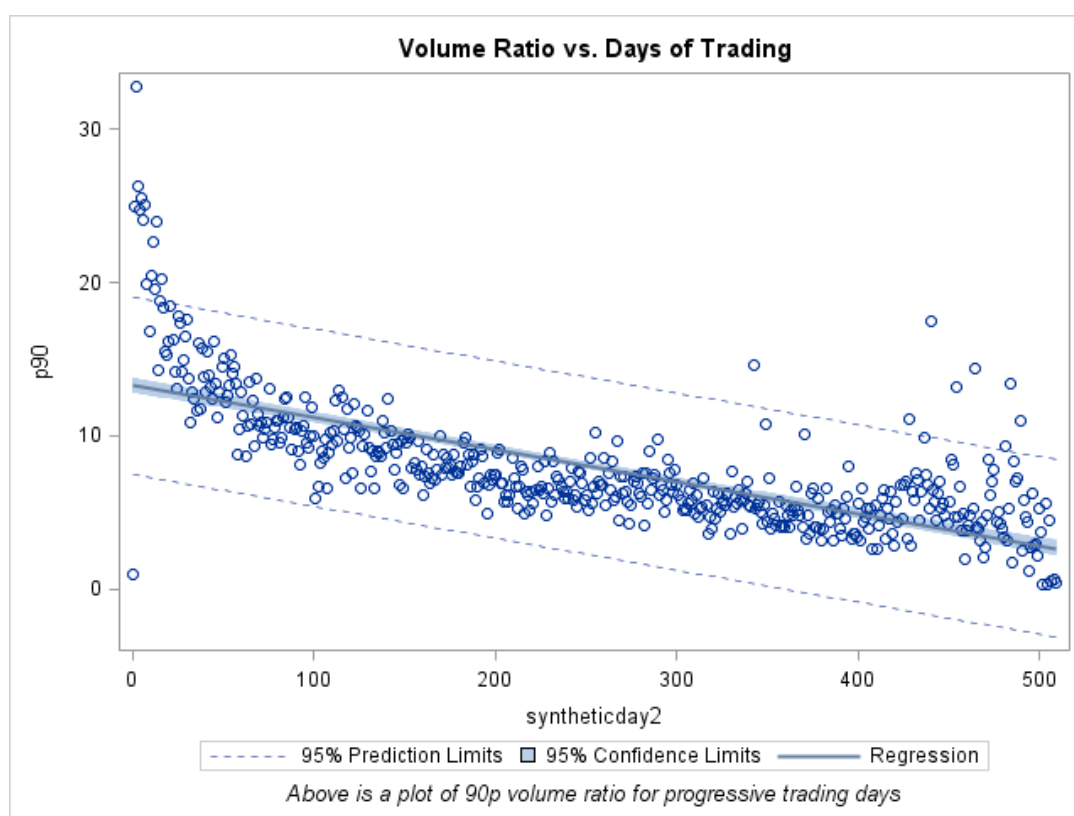


Figure 7: $\beta = -0.02083$, $t = -23.50$

10th Percentile Distribution

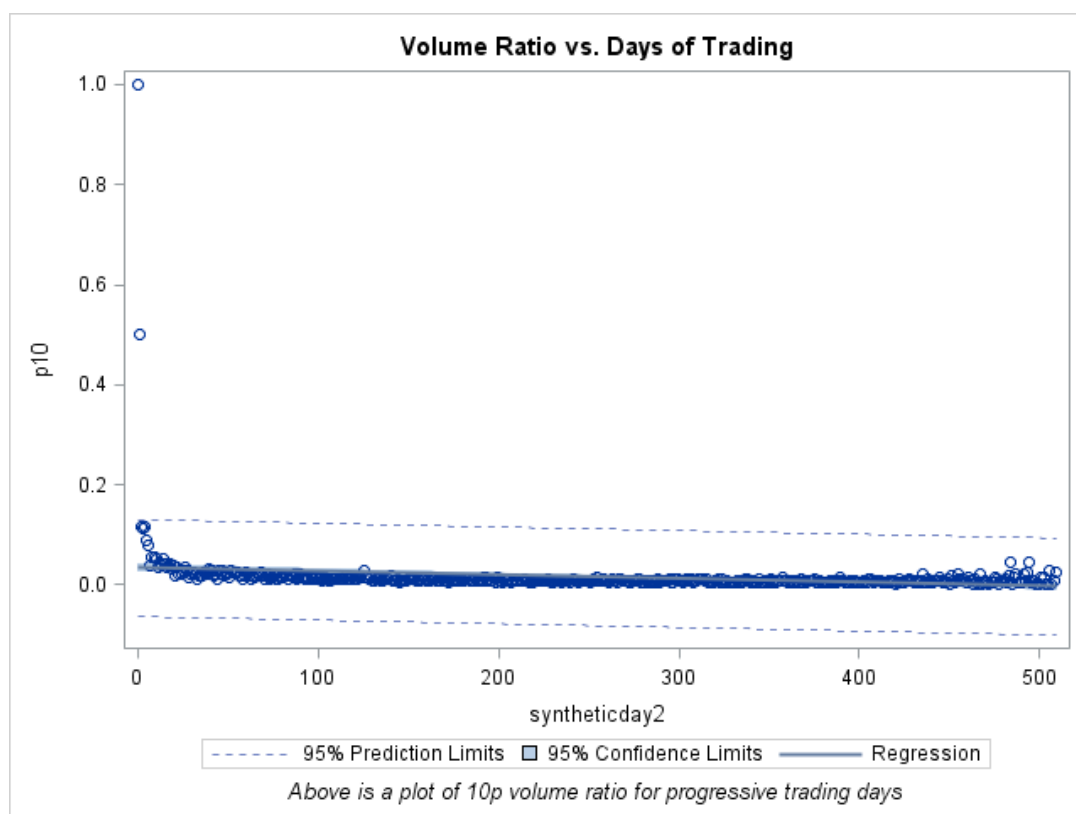


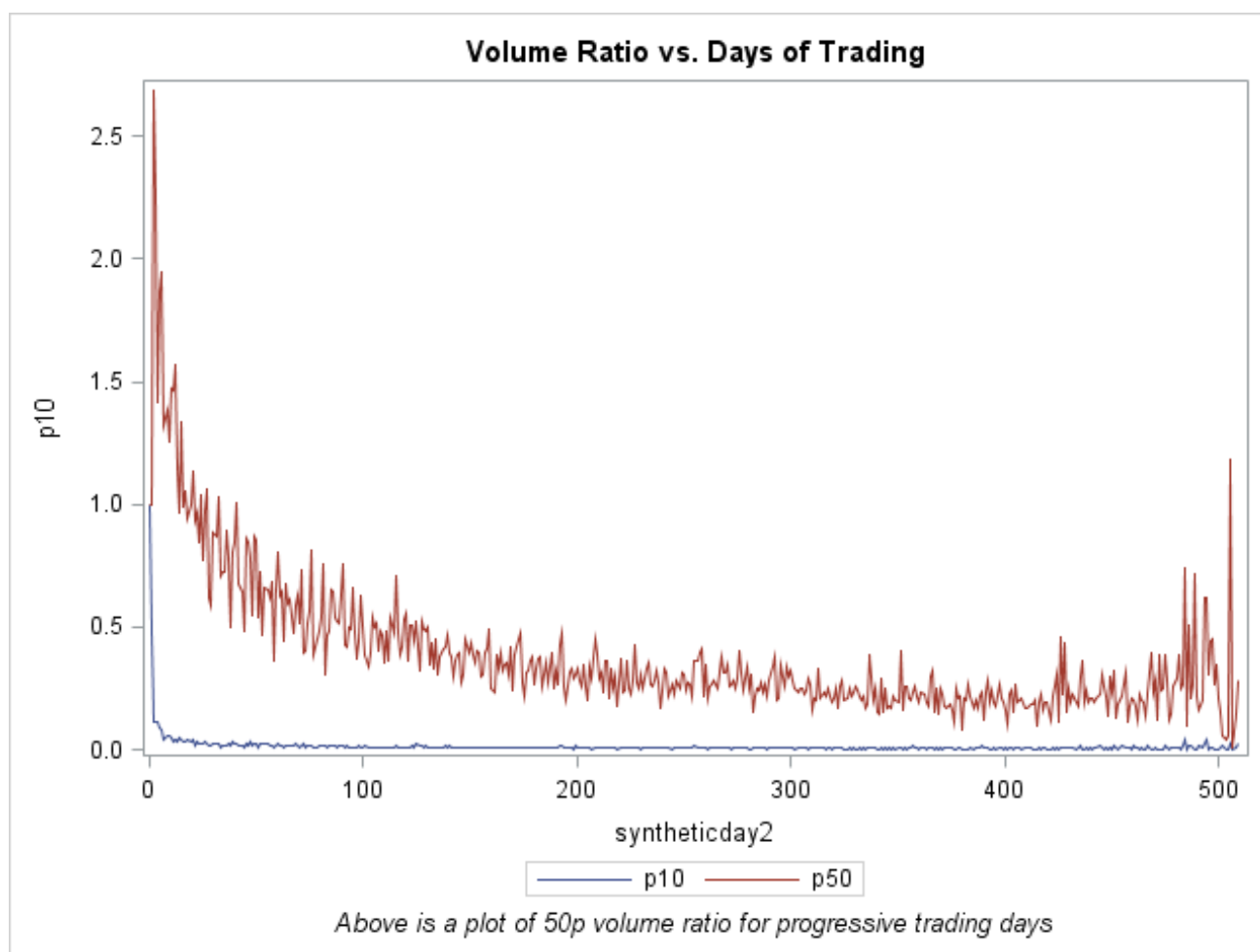
Figure 8: $\beta = -0.000073$, $t = -4.92$

Median Distribution-Log



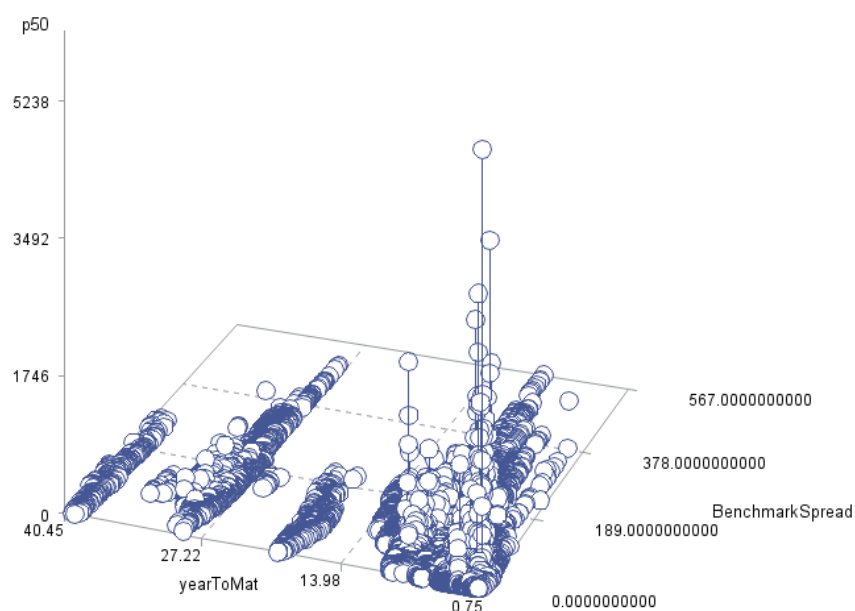
Figure 9: $\beta = -0.25867$, $t = -39.28$

10th and 50th Percentile Distribution



Volume Ratio Characterization

Volume Ratio vs. Days of Trading



Above is a plot of 50p volume ratio for progressive trading days

Figure 11: Above is the distribution of volume ratio as a function of spread and maturity

Next Steps

Characterization

- L^P normalization of summary stats
- Cost Regulation via Characteristics
- Use exact issue dates to determine days, rather than 504

Liquidity

- Larger buckets of initial volume for sample size
- Quantile Regression on Maturity, Benchmark Spread

References

- ① Edwards, A.K., et. al. (2007) "Corporate Bond Market Transaction Costs and Transparency," *Journal of Finance*, 1421-1451, June 2007.
- ② Fama, E. (2003) "Update of the Research Underlying Dimensional's Bond Strategies" *Dimensional White Paper Series*, 1-8, September 2003.
- ③ Plecha, D. (2005) "Fixed Income Investing" *Dimensional White Paper Series*, 1-11, January 2005.
- ④ Davis, J.L. (2000) "The Information in the Term Structure," *Dimensional White Paper Series*, 1-16, October 2000.
- ⑤ Last, F. (2010) "TRACE-Bringing Efficiency and Transparency to the Bond Market" *Dimensional White Paper Series*, 1-3, October 2010.

Background/Motivation

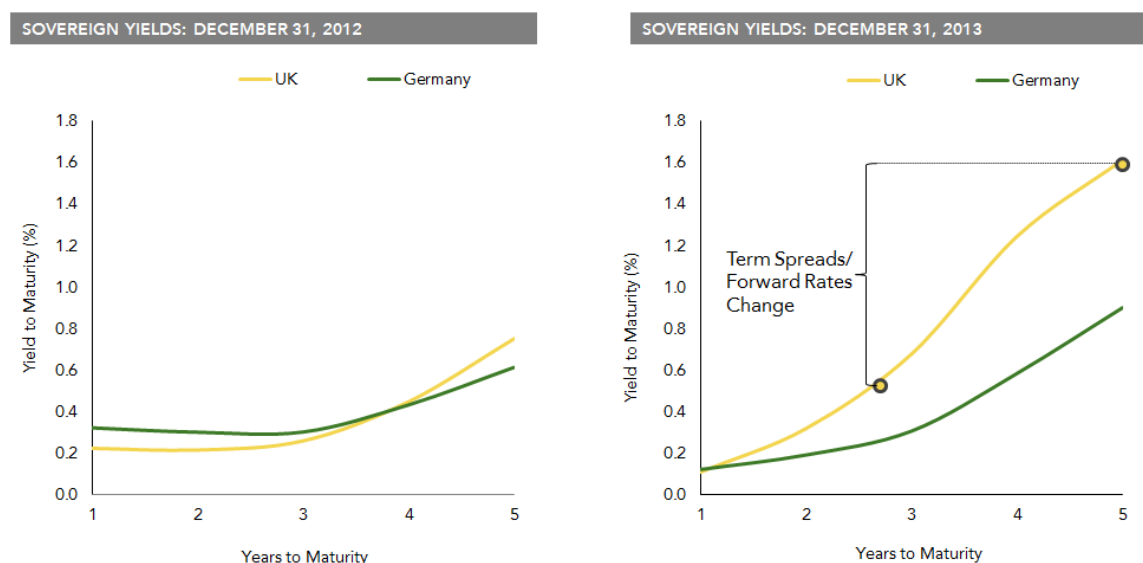


Figure 12: If markets are efficient, and term structures are not constant, then there may be information embedded within term structures

⁴Source: Citi Yield Book

Background/Motivation

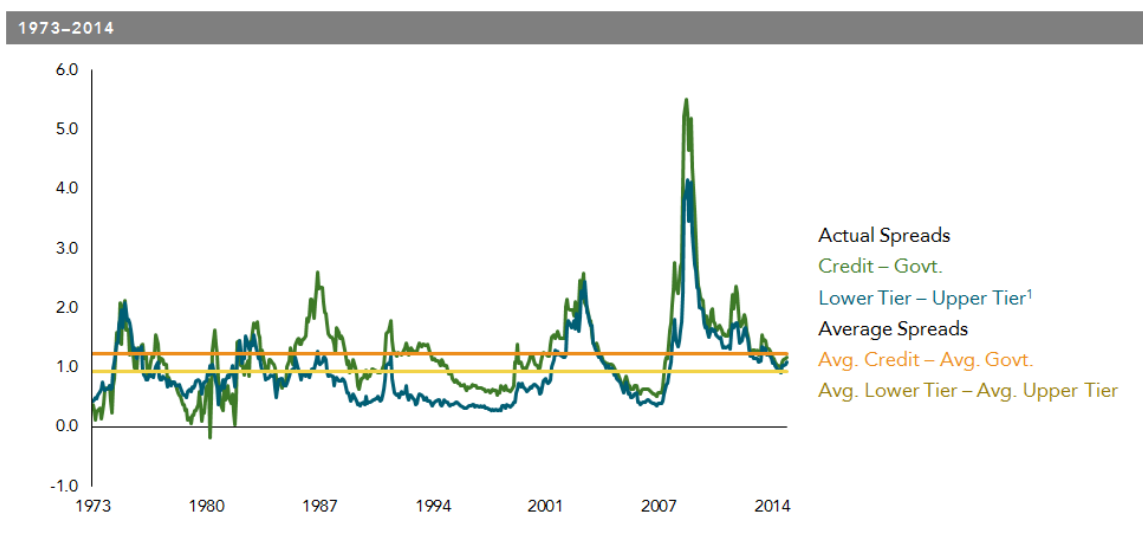


Figure 13: If markets are efficient, and term structures are not constant, then there may be information embedded within credit spreads

⁵Source: Barclays Capital Intermediate Indices