

Background material for discussion topic #1:
Where can increased transparency further financial stability?

Moderator: Sarah Dahlgren

Financial Market Transparency: Issues and Recommendations

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I. Charge

Edward Lazear was asked to consider two or three issues that bear on current financial market transparency and to recommend action. Lazear enlisted the support of Darrell Duffie (Stanford), Abbie Smith (University of Chicago), Ingrid Werner (Ohio State University) and Dimensional Fund Advisors' research group to identify important issues, provide background research and propose solutions.

The following report was assembled by the team and reflects the collective views of the authors. The recommendations are based on the knowledge of the group and on the research compiled by Dimensional's research team, attached as appendices to this report.

II. Overview

There are significant weak spots in the reporting of financial transactions, including off-exchange transactions and fixed-income markets in particular. Of off-exchange financial transactions, there is only piecemeal coverage. For publicly issued equities, transactions are eventually reported, but not necessarily quickly or with all of the most relevant information, including the venue type. Dark trading of equities (in many forms beyond dark pools) is said to be significant, but we don't have the data necessary to analyze off-exchange trading comprehensively. Corporate and municipal bond transactions are reasonably well covered by TRACE, but FINRA has recently requested comments on a proposed pilot project to significantly delay TRACE transactions reporting for a significant set of corporate bond trades. Several other key asset classes, such as treasuries, repo, foreign exchange, and commodities, have limited reporting, relative to their importance and the value of price discovery to investors.

III. Dark venue reporting of equity transactions.

a. Issue

Dark venues comprise a significant fraction of today's securities markets, even those that are on paper transparent. For example, in US equity markets, roughly one third of the transactions volume of exchange-listed equities is executed off-exchange. There is no pre-trade transparency for these trades. (This is the essence of a dark venue.) Post-trade reporting cannot usually be traced back to the venue at which trades were actually executed, at least in publicly available databases. Instead, the reporting of all off-exchange trades takes place on one of several Trade Reporting Facilities (TRFs). Starting in June 2014, FINRA has been collecting weekly aggregate trading volume per security and venue. These data are available to the public,¹ but are released with a two-week lag for Tier 1 national market system (NMS) stocks (that is, stocks in the S&P 500 index, the Russell 1000 index, and certain exchange traded products). Data for the other NMS stocks and OTC equity securities is delayed for an additional two weeks. FINRA recently proposed to expand OTC equity trading volume data published on its web site. This would be a step in the right direction.² Trades from lit exchanges are reported in real-time with venue identifiers – this should also be possible for dark-venue trades. There is on average no difference in the size of trades reported through lit exchanges (where bids and offers are posted publicly) and through dark venues, so the risk of front running should not be much if any larger for trades executed in dark venues than for those executed in lit venues. It is far from clear that faster and

¹ <https://www.finra.org/media-center/news-releases/2014/finra-makes-dark-pool-data-available-free-investing-public>

² https://www.finra.org/sites/default/files/notice_doc_file_ref/Regulatory-Notice-18-28.pdf

more precise reporting would impinge heavily on the trading strategies of buy-side or the ability of market makers to lay off risks related to their liquidity provision. The potential gains in liquidity and market efficiency, on the other hand, seem significant. Moreover, weak reporting creates incentives for increasing dark trading to the potential detriment of exchange price discovery and market depth. Better transactions reporting would aid research that could lead to potential market improvements.

b. Recommendations: Enhance transaction reporting by

1. Broadening the set of trades for which complete transaction details are reported, including venue type. Specifically:
 - a. Develop a list of reportable venue types, which distinguishes venues by key trade protocol and other features.
 - b. Develop a plan to test and eventually mandate comprehensive reporting of all transactions of all exchange-listed equities, including reporting of venue type.
 - c. Develop standards for comprehensive transactions reporting, based on the shortest practicable lag between trade and reporting, along the lines of SEC Rule SBSR for securities-based derivatives transaction reporting³ and FINRA reporting of corporate bond transactions.
2. Shortening the time frame for comprehensive FINRA reporting of OTC equities trade volumes to a weekly or more frequent basis, by security and venue.

IV. Reporting of other financial transactions

- a. Corporate bonds: Although TRACE (trade reporting and compliance engine) has enhanced the post-trade evaluation of corporate bond trades, we still lack systematic collection of pre-trade prices, meaning quotes. Asquith, Covert, and Pathak (2019) show that TRACE for corporate bonds was associated with a significant reduction in estimated trading costs, around \$600 million a year, and that high-yield bonds disproportionately contribute to the cost savings.⁴
- b. Municipal securities: A similar reporting system applies to trades in municipal securities through the Municipal Securities Rulemaking Board's (MSRB) Real-time Transaction Reporting System (RTRS), which was implemented in January 2005. Information is publicly available through its Electronic Municipal Market Access (EMMA) website. Wu (2018) shows that municipal bond trading costs declined significantly following the introduction of trade reporting, by 51% (77 bps) for dealer-to-customer trades, and by 55% for retail-sized customer trades (96 bps).⁵

³ See "SEC Adopts Additional Rules Related to Security-Based Swap Transaction Reporting," SEC Press Release regarding Rule SBSR, July, 2016, at <https://www.sec.gov/news/pressrelease/2016-139.html>

⁴ <http://home.uchicago.edu/~tcovert/webfiles/trace.pdf> See also: Michael A. Goldstein, Edith S. Hotchkiss, and Erik R. Sirri, "Transparency and Liquidity: A Controlled Experiment on Corporate Bonds," *Review of Financial Studies*, vol. 20, no. 2 (2007); Hendrik Bessembinder, William Maxwell, and Kumar Venkataraman, "Market Transparency, Liquidity Externalities, and Institutional Trading Costs in Corporate Bonds," *Journal of Financial Economics*, vol. 82 (2006).

⁵ <http://www.msrb.org/~media/Files/Resources/Transaction-Costs-for-Customer-Trades-in-the-Municipal-Bond-Market.ashx?la=en> See also Richard C. Green, Burton Hollifield, and Norman Schurhoff, "Financial Intermediation and the Costs of Trading in an Opaque Market," *Review of Financial Studies*, vol. 20, no. 2 (2007).

- c. US Treasuries: TRACE reporting of U.S. treasuries transactions is available only to a limited set of regulators. The public still does not have access to transactions reporting for treasuries. Minutes⁶ of the Meeting of the Treasury Borrowing Advisory Committee of the Securities Industry and Financial Markets Association, April 30, 2019, state that “Debt Manager Taylor provided a summary of primary dealer feedback related to secondary market treasury securities transaction data collected by the Financial Industry Regulatory Authority (FINRA) through its Trade Reporting and Compliance Engine (TRACE). He reminded the Committee that the data is currently provided only to the official sector, and that a potential policy for public dissemination is still being evaluated. At this time, The U.S. Treasury Department is seeking further information on the reporting process and the possibility for data enhancements.” Research already cited regarding the improvements in market liquidity and investor trading costs that are associated with immediate post-trade transactions reporting suggest that investors would benefit from public real-time release of TRACE transactions reports, which are already available to regulators. Given the associated increases in market liquidity of U.S. treasuries, particularly off-the-run treasuries, investors would be willing to pay more for U.S. treasuries when auctioned in the primary market, thus lowering the cost to U.S. taxpayers of funding the U.S. government.
- d. FINRA Pilot study: In spite of the generally positive effects of transparency on trading costs, the Fixed Income Market Structure Advisory Committee (FIMSAC) recently advised the SEC to study the effects of reducing transparency for large trades in corporate bonds. The argument for such a move is that market participants feel that there is a lack of liquidity in the corporate bond market, and they blame this on ‘excessive transparency.’ Essentially, bond dealers argue that competitors are able to front run them as they try to lay off large positions, and that this got worse after the financial crisis.⁷ In turn, FINRA was instructed to create a pilot program (Regulatory Notice 19-12).⁸ The proposed pilot studies two primary changes recommended by the FIMSAC: an increase to the current dissemination caps for corporate bond trades, and the delayed dissemination of any information about trades above the proposed dissemination caps for 48 hours. If enacted as a general approach, this would reduce price discovery and could easily disadvantage buy-side investors when shopping with dealers, judging from prior empirical research. That would in turn raise trading costs, and thus ultimately costs to corporations for funding their businesses.
- e. There are few rules regarding the public reporting of currency and commodity⁹ transactions. Over-the-counter derivatives transactions reporting is now required by Dodd-Frank, although the data are still relatively difficult to access.¹⁰

⁶ <https://home.treasury.gov/news/press-releases/sm679>

⁷ The evidence on this claim is mixed. IOSCO (2019) lays out the arguments in its report: <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD634.pdf>

⁸ “Regulatory Notice 19-12: FINRA Requests Comment on a Proposed Pilot Program to Study Recommended Changes to Corporate Bond Block Trade Dissemination,” FINRA, at <https://www.finra.org/rules-guidance/notices/19-12>

⁹ For the impact of commodity price discovery, see Thorsten Martin, “Real Effects of Price Transparency: Evidence from Steel Futures,” Working Paper, Bocconi University, June 3, 2019, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3299384

¹⁰ For relevant information on EU reporting, see Jorge Abad, Iñaki Aldasoro, Christoph Aymanns, Marco D’Errico, Linda Fache Rousová, Peter Hoffmann, Sam Langfield, Martin Neychev, and Tarik Roukny, “Shedding Light on Dark Markets: First Insights from the New EU-Wide Derivatives Dataset,” European Systemic Risk Board,

- f. Data on wholesale securities financing transactions, including repos and securities lending agreements, are spotty and difficult to obtain, as has been reported by the Fed and the Office of Financial Research. In its 2016 annual report,¹¹ the Financial Stability Oversight Council recommended a permanent and comprehensive collection of repo transactions data. In February, 2019, The Treasury Department’s Office of Financial Research announced¹² data collection of centrally cleared repo transactions, comprising roughly 25% of all U.S. repo transactions, noting that the Federal Reserve collects data on roughly another 25% of U.S. repo transactions. This leaves a gap in the record of data, even that available to regulators, of around half of transactions in the U.S. repo market. The opacity of this market implies costs associated with lack of ability to monitor financial stability and costs associated with market liquidity, given the opacity of the market to investors. Further, regulators and market participants were caught by surprise in mid-September 2019 by sudden spikes in U.S. treasury repo rates. Average financing rates available to dealers in the so-called GCF market jumped in a single day from near 2.1% to roughly 10%. Even the Federal Reserve’s new benchmark repo index, the Secured Overnight Financing Rate (SOFR), jumped from roughly 2% to over 5%. The SOFR benchmark is intended by regulators and market participants to replace LIBOR as the main U.S. dollar interest-rate benchmark. For numerous reasons related to financial stability and market efficiency, regulators and the public, including investors and researchers, should have comprehensive transparency into repo and other securities financing transactions data.
- g. A securities lending transaction is similar in most respects to a repurchase agreement, and can be used as a substitute for repos. Markets covering sec lending suffer from important gaps in transactions reporting data. Baklanova (2015)¹³ writes that “Private vendors sell granular data on securities lending that they collect from industry participants, including custodians, prime brokers, asset managers, and hedge funds. However, these data collections are voluntary (and are thus incomplete) and do not include data elements about counterparties or collateral management that are essential for market monitoring purposes. No systematic, targeted data collection is conducted for the benefit of regulators or the investing public.” The securities lending market, in general, is extremely opaque from the viewpoint of both pre-trade and post-trade price transparency. The competitiveness and thus efficiency of the securities lending market is correspondingly weak. With the 2010 passage of the Dodd-Frank Act, in Section 984(b), Congress directed the SEC to adopt rules that increase the transparency of information available to brokers, dealers, and investors concerning securities lending. However, according to the

Occasional Paper Series No. 11, September 2016, available at https://www.esrb.europa.eu/pub/pdf/occasional/20160922_occasional_paper_11.en.pdf; and Evangelos Benos, Richard Payne, and Michalis Vasios, “Centralized Trading, Transparency, and Interest Rate Swap Market Liquidity: Evidence from the Implementation of the Dodd–Frank Act,” Bank of England Working Paper, 2019, forthcoming, *Journal of Financial and Quantitative Analysis*.

¹¹ <https://www.treasury.gov/initiatives/fsoc/studies-reports/Documents/FSOC%202016%20Annual%20Report.pdf>

¹² See “Ongoing Data Collection of Centrally Cleared Transactions in the U.S. Repurchase Agreement Market,” Office of Financial Research, Treasury, 12 CFR Part 1610 RIN 1505–AC58, at https://www.financialresearch.gov/data/files/fr-notice_ofr_cleared_repo_rule.pdf

¹³ See Viktoria Baklanova, “Repo and Securities Lending: Improving Transparency with Better Data,” Office of Financial Research, Brief Series 15-03, U.S. Treasury Department, April 2015, at <https://www.financialresearch.gov/briefs/files/OFRbr-2015-03-repo-sec-lending.pdf>

web site by which the SEC discloses rule making mandated by the Dodd-Frank Act, the SEC has not yet issued proposed rules covering this transparency requirement.¹⁴

h. Recommendations:

1. Research suggests that rapid reporting of bond transactions, with trade-size reports that are capped under current TRACE standards, generates expected costs associated with front running that are small in comparison with the gains associated with post-trade transparency. Unless and until there is new and strong evidence to the contrary, the proposed pilot dissemination cap should not result in the proposed delays in transaction reporting, even for transaction sizes that exceed the proposed increased transaction cap (which would be raised under the proposal to \$10MM for IG transactions and \$5MM for non-IG transactions).
2. Announce a plan by the U.S. Treasury Department for a timely completion of a determination in favor of public real-time dissemination of TRACE reporting of U.S. treasuries transactions, barring a finding of strong evidence that such transactions reporting would harm investors or raise the costs to taxpayers for funding the U.S. government.
3. In coordination with other agencies, develop plans for comprehensive transactions databases for the repo and securities lending markets, and rapid public transactions reporting. Transactions records and public reporting should be designed in recognition of the option of market participants to substitute between repurchase agreements and securities lending agreements, for the same financial instruments or packages of instruments.
4. Conduct a study of the costs, benefits, technical feasibility, and potential useful scope of systematic transactions reporting in the foreign exchange and high-activity commodities markets.
5. Review the effectiveness of already mandated transactions reporting and swap data repositories for the U.S. swap and securities-based swap markets, with a focus on accuracy and usability.

¹⁴ See “Implementing the Dodd-Frank Wall Street Reform and Consumer Protection Act Mandatory Rulemaking Provisions,” under “Other,” at <https://www.sec.gov/spotlight/dodd-frank.shtml#>

Appendix A:

Municipal Bond Transaction Reporting

MSRB (Municipal Securities Rulemaking Board) Trade Reporting (EMMA)

Overview

EMMA Dissemination Rules

- MSRB requires dealers to submit all municipal securities trades with customers and with other dealers within 15 minutes of the time of trade.
- The following transactions shall not be reported under Rule G-14:
 1. Transactions in securities without assigned CUSIP numbers;
 2. Transactions in Municipal Fund Securities; and
 3. Inter-dealer transactions for principal movement of securities between dealers that are not inter-dealer transactions eligible for comparison in a clearing agency registered with the Commission.
- Electronic Municipal Market Access (EMMA) disseminates market transparency data, which includes real-time prices and yields at which bonds and notes are bought and sold, for most trades occurring on or after January 31, 2005.
- Trades with a par amount over \$5 million will indicate par value as “MM+” until five (5) weekdays (including holidays) after the stated trade date, at which time the par will be unmasked (i.e., the trade will be re-disseminated with the par value shown).

Literature Review

EMMA Improves Transparency and Lowers Transaction Costs

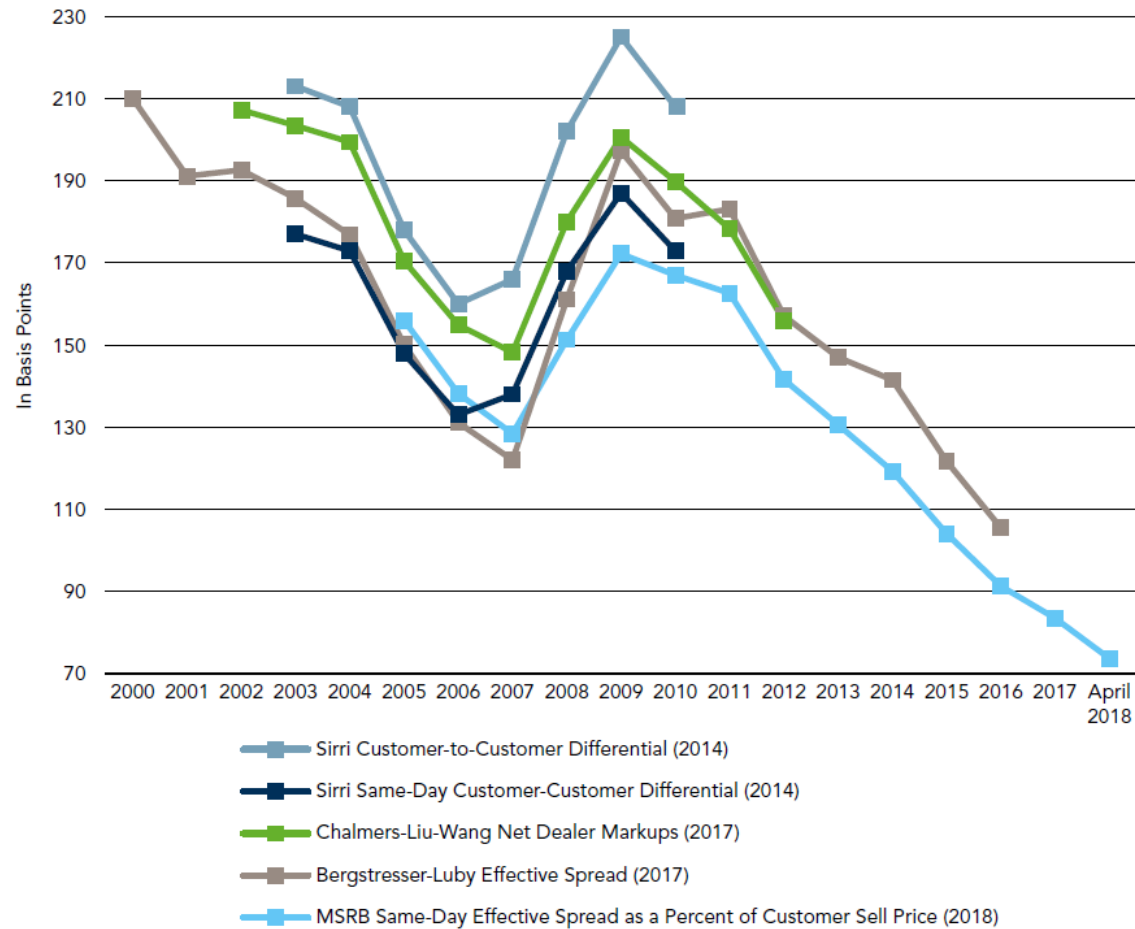
Summary: Most empirical research has found significant decline in Muni transaction cost after 2005.

Paper	Notes
Harris & Piwowar (2006)	The authors estimated transaction costs from a one-year (November 1999 - October 2000) sample of municipal bonds and found that transaction costs decrease with trade size but increase with instrument complexity, time to maturity and time since issuance, and do not depend on trade frequency. The authors attributed these results to the general lack of price transparency in the municipal bond market.
Green, et al. (2007)	This paper confirmed the findings in Harris and Piwowar (2006). They found that the dealers exercise substantial market power, which decreases in trade size and increase in the complexity of the trade for the dealer.
Sirri (2014)	The author calculated the total customer-to-customer differentials (transaction costs) during the period from 2003 to 2010 and found there was a statistically significant decline in the differential after the implementation of the MSRB's RTRS in January 2005.
Bergstresser & Luby (2017)	They measured trading costs for the period from 2000 to 2016 and illustrated a downward trend in transaction costs during the covered period.
Chalmers, et al. (2017)	They examined the impact of the RTRS trade reporting on customer trading costs, for the period from 2002 through 2012. They concluded that the 2005 initiation of the RTRS and the real-time dissemination of trade data had a statistically significant downward effect on municipal bond transaction costs.
Wu (2018)	Between 2005 and April 2018, the average effective spread for all dealer-to-customer municipal securities trades declined by 51 percent to 73 basis points; for retail-sized customer trades, the decrease of 55 percent, to 80 basis points. The findings of this analysis indicate that market-wide technological advancements as well as MSRB's regulatory activities to protect investors and enhance transparency likely accounted for a significant portion of this downward trend.

Effective Spread Measure Comparison

There is significant downward trend in Muni Transaction Costs

Comparison of Effective Spread Measures



Note: Municipal variable rate securities are excluded from this analysis.
 Information provided by Dimensional Fund Advisors. Source: Appendix B in Wu (2018)

Municipal Bond Trading Analysis

Muni MSRB trade data

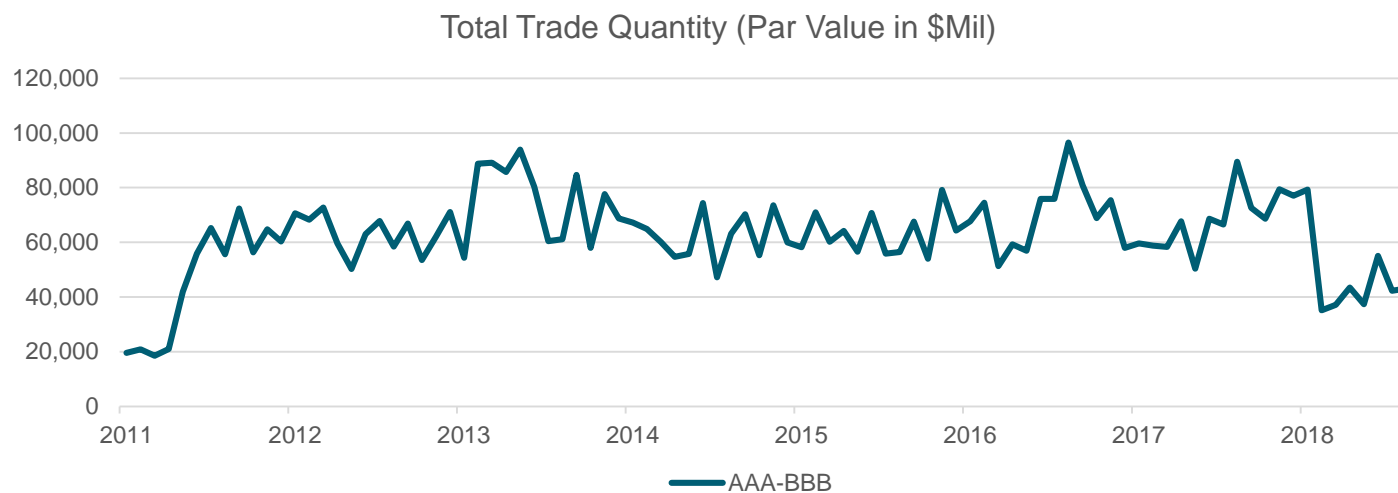
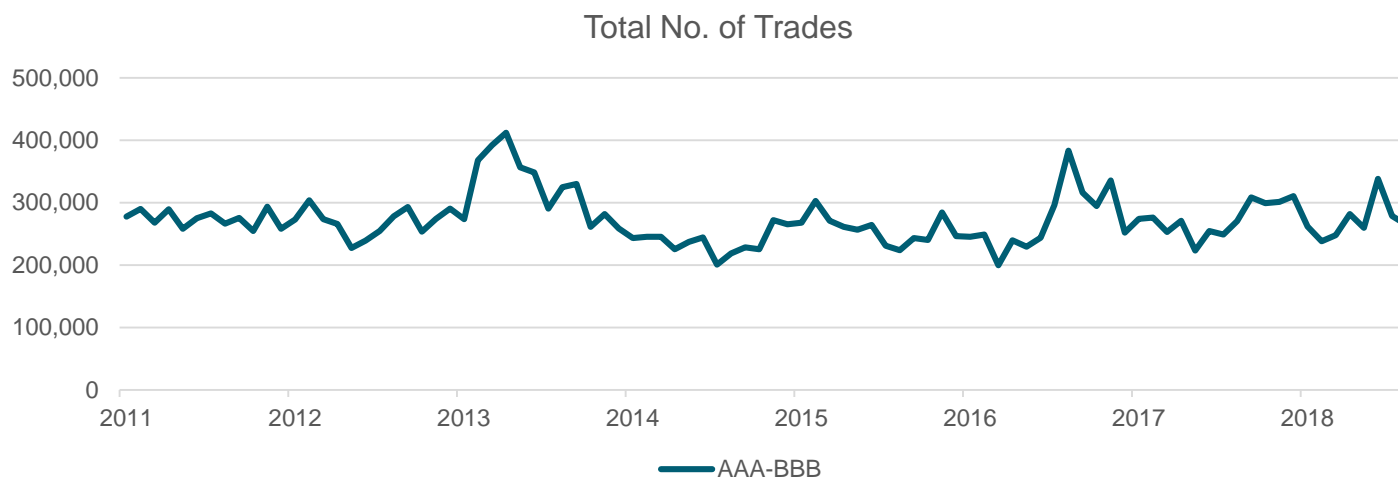
Summary statistics Based on Bloomberg/Barclays US Muni Index Universe

Time Series Average of Monthly Number of Issues and Total Market Value By Calendar Year
(Bloomberg/Barclays US Muni Index Universe)

Year	No. of Issues	Total Market Value (in \$Mil)	No. of Traded Issues	Market Value of traded issues (In \$Mil)
2012	46,404	1,332,822	22,552	860,906
2013	46,684	1,305,028	24,516	882,992
2014	46,138	1,312,911	22,433	845,114
2015	47,539	1,362,785	22,684	854,759
2016	49,283	1,415,418	23,149	868,735
2017	50,657	1,419,183	24,896	892,459
2018	53,375	1,470,246	28,236	965,667

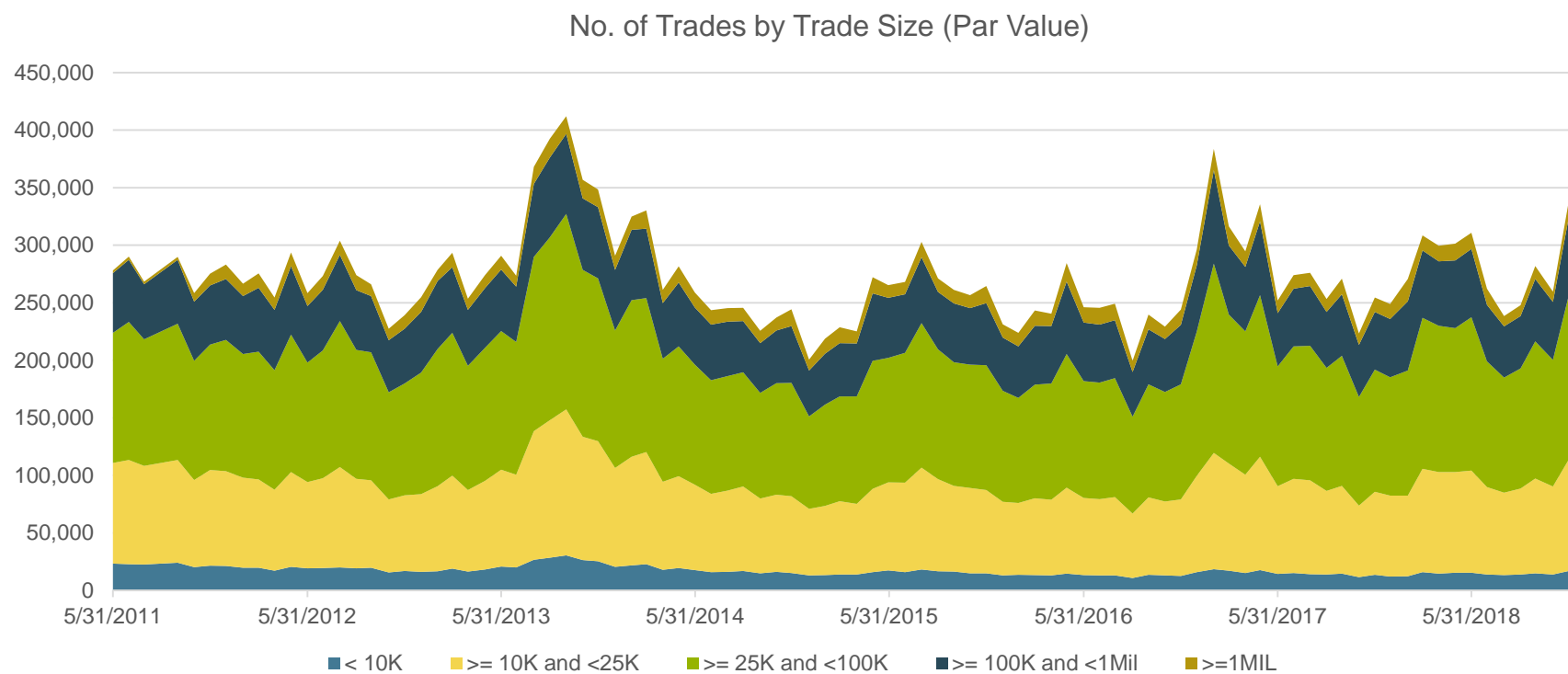
Muni MSRB trade data

Monthly Number of Trades and Total Trade Quantity



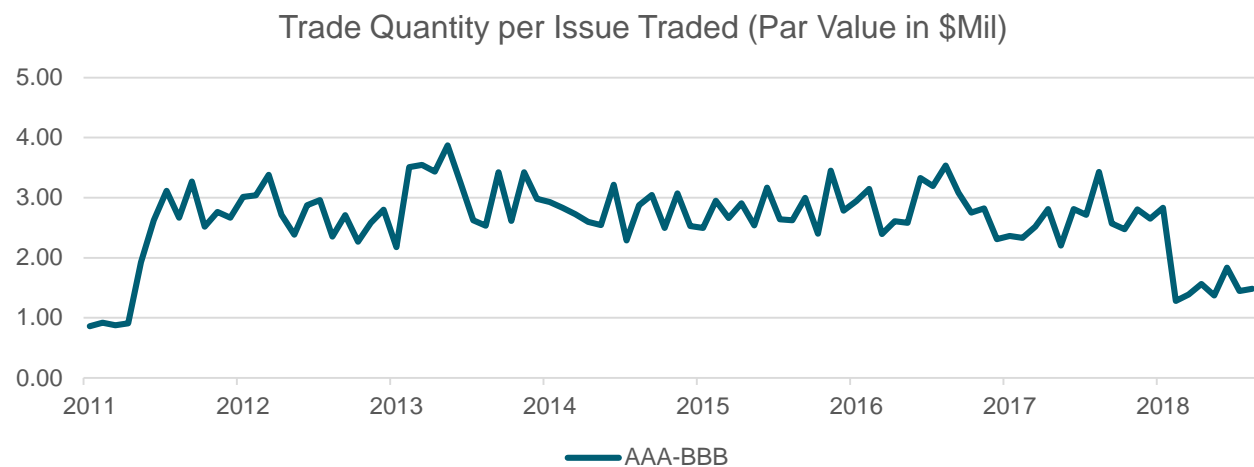
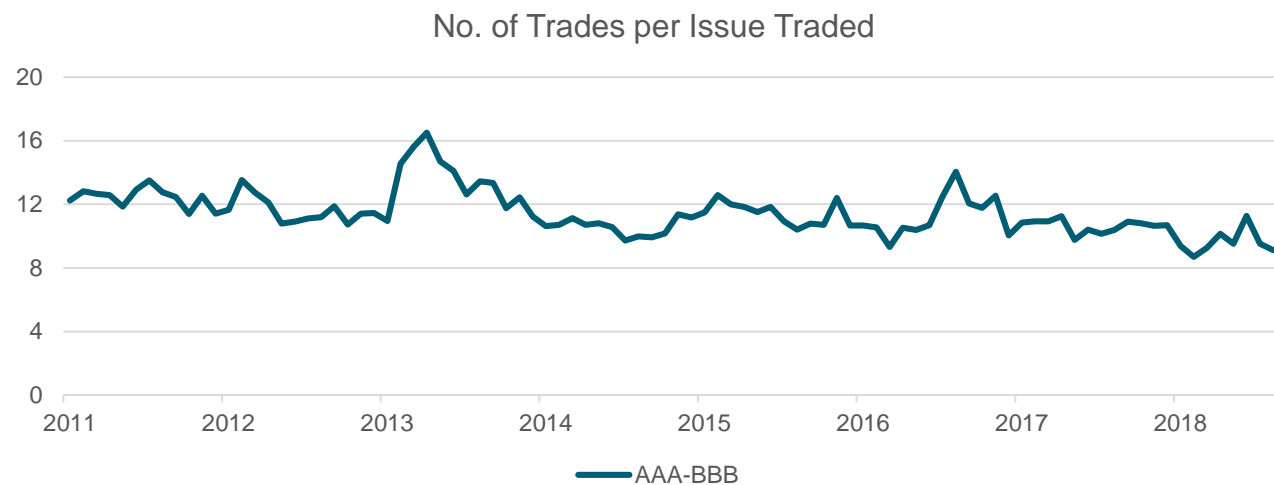
Muni MSRB trade data

Monthly Number of Trades By Trade Size



Muni MSRB trade data

Monthly Number of Trades and Trade Quantity per Issue Traded



US Treasury Transaction Reporting

US Treasury Transaction Reporting

Overview

Current Treasury Transaction Reporting

- FINRA members are required to report to TRACE certain transactions in Treasury securities starting July 10, 2017.
- The Treasury TRACE data are not currently available to public.
- Analyses on Treasury market structure based on TRACE data are available on the Treasury Department website.

Treasury TRACE Data Principles

- Do no harm
- Fund the deficit at the least cost
- Do not unduly favor one group
- Improve market structure and technological evolution
- Foster cross-agency understanding

Next Steps

- The Treasury Department has recommended to FINRA to release the aggregated data on Treasury volumes weekly for public dissemination, with the first publication in early 2020.

Appendix

References

Harris, Larry and Michael Piwowar. "Secondary Trading Costs in the Municipal Bond Market," *Journal of Finance*, Volume 61, 2006

Green, Richard, Burton Hollifield and Norman Schürhoff. "Financial Intermediation and Costs of Trading in an Opaque Market," *Review of Financial Studies*, Volume 20, 2007

Sirri, Erik. "Report on Secondary Market Trading in the Municipal Securities Market," MSRB July 2014.

Bessembinder, Maxwell and Kumar Venkataraman. "Market Transparency, Liquidity Externalities, and Institutional Trading Costs in Corporate Bonds," *Journal of Financial Economics*, Volume 82, 2007.

Chalmers, John, Yu (Steve) Liu and Z. Jay Wang, "The Differences a Day Makes: Timely Disclosure and Trading Efficiency in the Muni Market," Working Paper, September 2017.

Wu, Simon. "Transaction Costs for Customer Trades in the Municipal Bond Market: What is Driving the Decline?". MSRB, July 2018.

Appendix B:

TRACE Pilot Program

TRACE Pilot Program

Overview

Current TRACE Dissemination Protocols

- All trade information (except for trade size > Dissemination Cap) is disseminated with 15 mins of the time of execution.
- For large-size trades in corporate bonds, FINRA releases the trade size as “5MM+” (for IG) and “1MM+” (for non-IG)¹.

FIMSAC Recommendation for Pilot Program

- Increase the dissemination cap to \$10MM (for IG) and \$5MM (for non-IG).
- Delay dissemination of any information about trades above the proposed dissemination caps for at least 48 hours.

1. The full, uncapped size of trades above the caps is later published as part of an historical dataset six months after the calendar quarter in which they are reported.

Literature Review

Most of the empirical literature generally reached similar conclusions: that improved post-trade transparency is associated with lower transaction costs and price dispersion and not associated with greater trading volume for actively traded, recently issued and IG bonds.

Paper	Notes
Bessembinder, et al. (2006)	Used insurance company transaction data before July 2002 to find that improved information in disseminated bonds improved market quality for nondisseminated bonds. This study also showed a reduction in institutional trading costs around the initiation of TRACE reporting in July 2002.
Goldstein, et al. (2007)	Studied a set of BBB-rated bonds, phased into price dissemination in April 2003. They reported that transaction costs on newly transparent bonds declined relative to bonds that experienced no transparency change, except for very large trades. They also reported that transaction costs declined as trade sizes increased, and did not demonstrate further decline on average for sizes above 1,000 bonds.
Edwards, et al. (2007)	Also studied the impact of transparency on transactions costs. Looking at data for the period between January 2003 and January 2005, they found that dissemination was associated with lower trading costs for corporate bonds with larger issue size, better credit quality, more recently issued bonds and bonds closer to maturity.
Asquith, et al. (2019)	Measures transparency's effect on trading activity and costs for the entire corporate bond market. Even though trading costs decrease significantly across all types of bonds, trading activity does not increase and, by one measure (cf. number of trades), decreases. Transparency affects high-yield bonds differently than investment grade bonds. High-yield bonds have the largest decrease in trading activity, 71.1%, and in trading costs, 22.9%. High-yield bonds also disproportionately contribute to the estimated reduction in total trading costs of \$600 million a year.

Corporate Bond Trade Activity

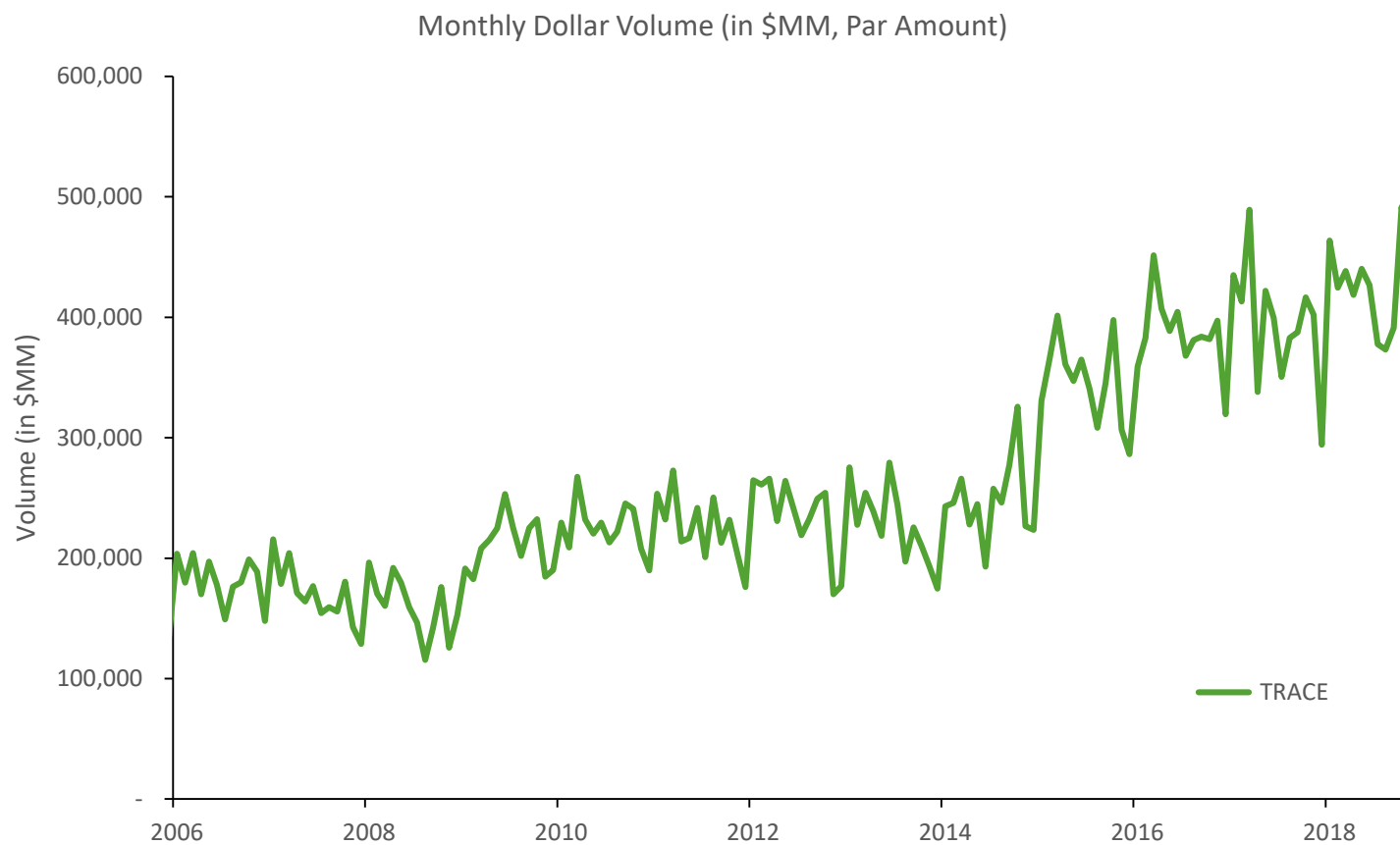
US Corporate Bond Market

2006 - 2018

As of Beginning of Each Calendar Year	Number of Issues	Number of Issuers	Total Amount Outstanding (in \$MM, Par Amount)	Total Market Value (in \$MM)
2006	4235	1287	2,127,281	2,204,949
2007	4385	1318	2,302,039	2,376,712
2008	4534	1309	2,595,887	2,607,612
2009	4586	1238	2,799,142	2,430,977
2010	5029	1298	3,153,804	3,301,795
2011	5507	1449	3,497,520	3,773,343
2012	5852	1545	3,779,062	4,103,147
2013	6476	1659	4,251,208	4,796,641
2014	6999	1737	4,681,047	4,996,415
2015	7430	1792	5,057,424	5,422,974
2016	7854	1767	5,578,576	5,599,768
2017	8005	1703	5,981,453	6,241,030
2018	7631	1640	6,167,138	6,531,032

Monthly Trade Volume

Jan 2006 – Dec 2018



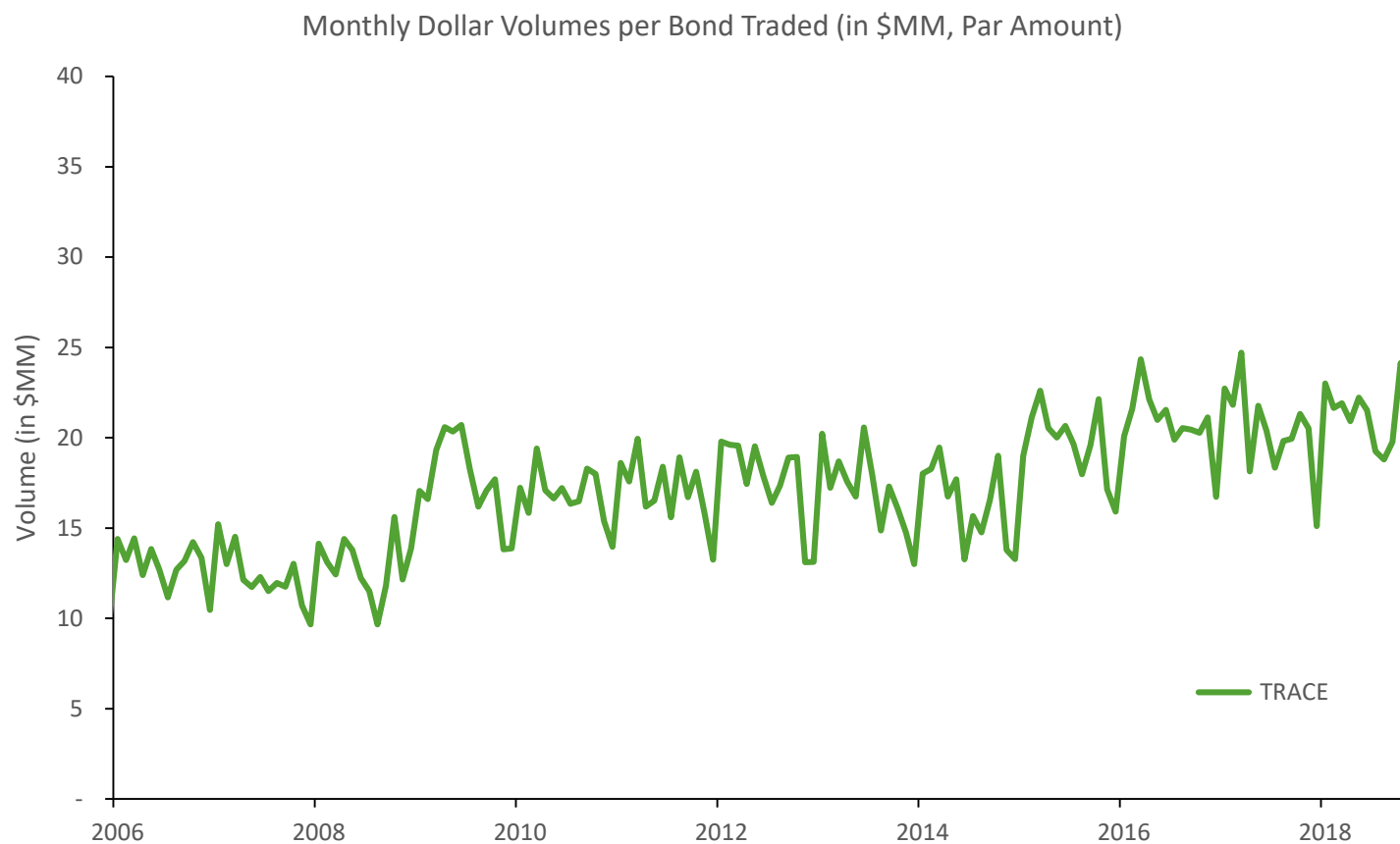
Monthly Number of Trade

Jan 2006 – Dec 2018



Monthly Trade Volume per Bond Traded

Jan 2006 – Dec 2018



Monthly Number of Trades per Bond Traded

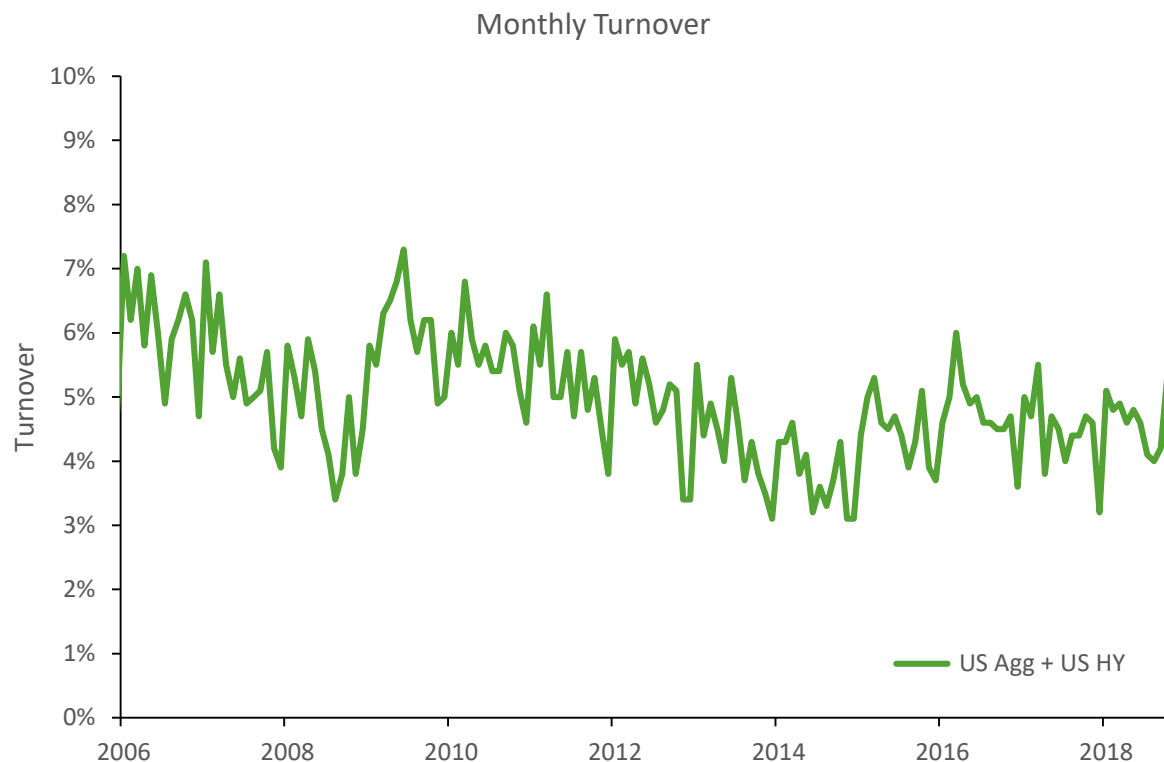
Jan 2006 – Dec 2018



Turnover in Corporate Bonds

Jan 2006 – Dec 2018

Year	Total Turnover ¹
2006	73.7%
2007	64.4%
2008	56.0%
2009	72.5%
2010	67.7%
2011	62.8%
2012	59.2%
2013	51.6%
2014	45.3%
2015	54.0%
2016	57.1%
2017	53.7%
2018	55.0%

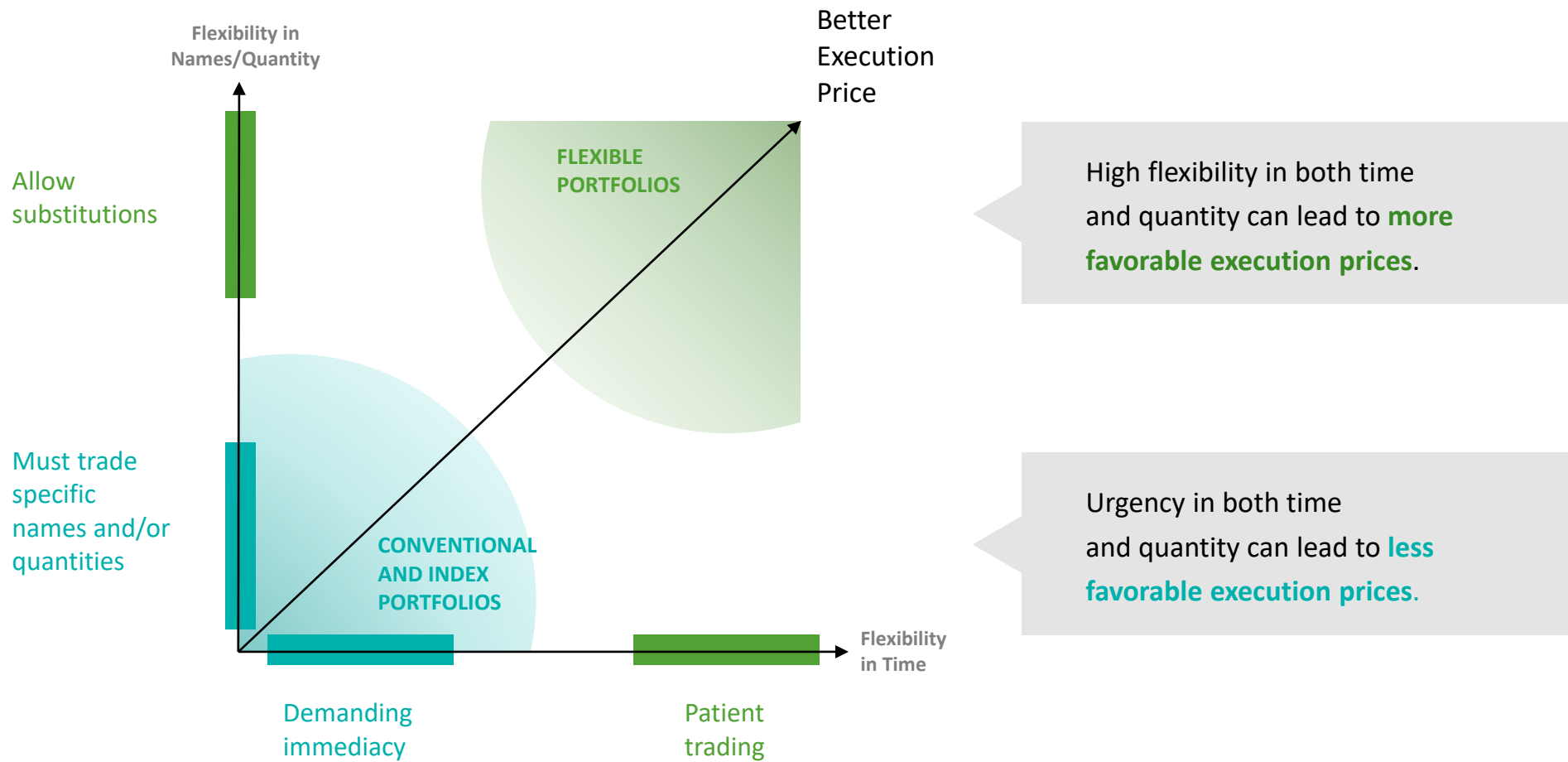


Source: Dimensional calculation based on corporate bond trade data in TRACE and Bloomberg/Barclays data. Includes corporate bonds in Bloomberg US Aggregate Bond and US High Yield Bond Index universe that have trade records in TRACE.

1. Turnover is defined by FINRA in their regulatory notice 19-12 as the aggregate trading activity as a fraction of total bonds outstanding. We use (Total trade volume Par-Value in a month / Total Amount Outstanding Par-Value of bonds reported in TRACE as of last month end) of the bonds in US Agg and US HY indexes for each month to calculate turnover. Annual total Turnover is the sum of monthly turnovers in the calendar year.

Trade Cost Analysis

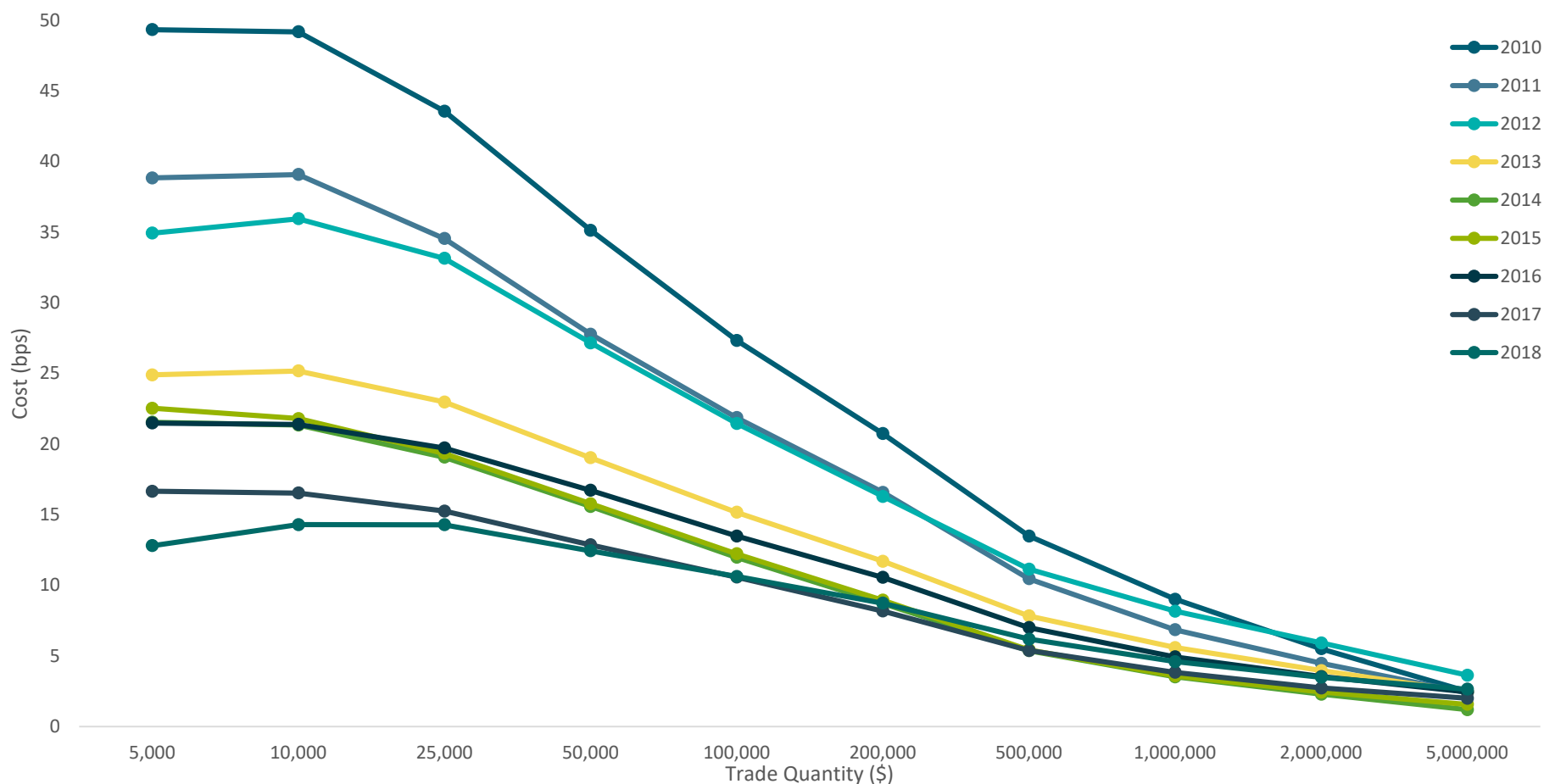
Drivers of Trading Costs: Price, Quantity, Time



Trade Cost Estimates for US Corporate Bond Market

Paying attention to trade size can reduce costs

2010–2018,¹ GROUPED BY YEAR



1. Date range based on data availability.

2. Cost estimates are based on the bid-ask spread and exclude commissions.

3. Cross-sectional averages for each trade exclude bonds that were not traded at that specific volume during that time-period.

Estimating Trade Costs

Methodology

Trade costs are based on half-spread estimates for all US corporate bonds reported in the TRACE dataset from 2010 to 2018, using a methodology similar to that of Edwards, Harris, and Piwowar (2007). To compute the trade costs, coefficients were estimated from a time series regression for each bond-year combination containing more than 30 trades:

$$\log\left(\frac{P_t}{P_{t-1}}\right) - y_{t-1}(T_t - T_{t-1}) = c_0(Q_t - Q_{t-1}) + c_1\left(\frac{Q_t}{S_t} - \frac{Q_{t-1}}{S_{t-1}}\right) + c_2(Q_t \log(S_t) - Q_{t-1} \log(S_{t-1})) + b_0 MktIndex_{t-1,t} + \varepsilon_{t-1,t} \quad (1)$$

where *MktIndex* is the return of the Barclay's US Credit Index from time $t - 1$ to t , y_t , Q_t , P_t , S_t , T_t are the yield, direction of trade (sell =1, buy =-1), price, trade quantity, and day of trade, respectively. Intuitively, coefficients c_0 , c_1 , c_2 control for the price difference between trades at time $t - 1$ and t due to the bid-ask spread and coefficient b_0 controls for the market movement between these two trades.

Costs for each bond were computed around selected trade quantities S_t using the following cost model:

$$C = c_0 + c_1 \frac{1}{S_t} + c_2 \log(S_t) \quad (2)$$

where coefficients c_0 , c_1 , c_2 are estimates directly from (1). S_t are chosen based on the most frequent trade sizes observed in the market.

Inverse variance weighted averages ($IV(C)$) of C were computed across all bonds, including bond costs in the average only when a trade near quantity S_t was observed. $IV(C)$ were computed for different credit groups as well as years. For credit groups, $IV(C)$ was averaged across 9 years.

References

Asquith, P., T. Covert, and P. Pathak. “The Effects of Mandatory Transparency in Financial Market Design: Evidence from the Corporate Bond Market (April 8, 2019)”. Available at SSRN: <https://ssrn.com/abstract=2320623> or <http://dx.doi.org/10.2139/ssrn.2320623>

Bessembinder, H., W. Maxwell, and K. Venkataraman. 2006. “Market Transparency, Liquidity Externalities, and Institutional Trading Costs in Corporate Bonds.” *Journal of Financial Economics*, 82, 251-288.

FINRA Regulatory Notice 19-12 (April 12, 2019) (“Notice”), available online at <https://www.finra.org/industry/notices/19-12>.

Goldstein, M., E. Hotchkiss, and E. Sirri. 2007. “Transparency and Liquidity: A Controlled Experiment on Corporate Bonds.” *Review of Financial Studies* 20 (2), 235-273.

Edwards, A., L. Harris, and M. Piwowar. 2007. “Corporate Bond Market Transparency and Transaction Costs.” *Journal of Finance*, 62 (3), 1421-1451.

Disclosures

Simulated strategy returns and characteristics are based on a model/backtested simulation. The performance was achieved with the retroactive application of a model designed with the benefit of hindsight; it does not represent actual investment performance. Backtested simulated performance is hypothetical (it does not reflect trading in actual accounts) and is provided for informational purposes only. The securities held in the simulation may differ significantly from those held in client accounts. Simulated performance does not reflect the impact that economic and market factors might have had on the advisor's decision making if the advisor were actually managing client money. This strategy was not available for investment in the time periods depicted. Actual management of this type of simulated strategy may result in lower returns than the backtested results achieved with the benefit of hindsight. Past performance (including simulated past performance) does not guarantee future or actual results. The simulated performance shown is gross performance, which includes the reinvestment of dividends and other earnings but does not reflect the deduction of investment advisory fees and other expenses.

Compiled by Dimensional using data provided by TRACE (FINRA) and Bloomberg/Barclays. Based on corporate bonds in the universe of Bloomberg/Barclays US Aggregate Bond Index and US High Yield Index.

Past performance (including hypothetical past performance) does not guarantee future or actual results. The simulated performance shown is "gross performance," which includes the reinvestment of dividends but does not reflect the deduction of investment advisory fees and other expenses. A client's investment returns will be reduced by the advisory fees and other expenses it may incur. For example, if a 1%

annual advisory fee were deducted quarterly and a client's annual return were 10% (based on quarterly returns of approximately 2.41% each) before deduction of advisory fees, the deduction of advisory fees would result in an annual return of approximately 8.91% due, in part, to the compound effect of such fees. Indices are not available for direct investment. Their performance does not reflect the expenses associated with management of an actual strategy. It is not possible to invest directly in an index.