Capital Commitment and Illiquidity in Corporate Bonds*

Hendrik Bessembinder, W.P. Carey School of Business, Arizona State University

Stacey Jacobsen, Cox School of Business, Southern Methodist University

William Maxwell, Cox School of Business, Southern Methodist University

Kumar Venkataraman, Cox School of Business, Southern Methodist University

Initial Draft: March 2016

*The authors thank the Finance Industry Regulatory Authority (FINRA) for provision of data, and Indraneel Chakraborty, Jonathan Sokobin, Elliot Levine, Steve Joachim, and in particular Alie Diagne and Ola Persson for comments.

Capital Commitment and Illiquidity in Corporate Bonds

Abstract

We use a comprehensive sample of U.S. corporate bond trades from 2003 to 2014 that includes dealer identifiers to assess liquidity and dealers' capital commitment. We find that customer trade execution costs have decreased over time, despite a temporary increase during the financial crisis. However, several alternative measures of market quality, including turnover, dealers' capital commitment, the likelihood that trades are completed on a principal basis, interdealer trading, and dealers' propensity to hold positions overnight were not only degraded during the financial crisis but failed to return to pre-crisis levels in more recent years. Difference-in-difference analyses of TRACE initiations in 2003-04 and 2014 provide no evidence that public transaction reporting contributed, which leaves regulatory initiatives implemented in the wake of the financial crisis as potential explanations for the changes in bond market liquidity. On balance, the evidence indicates that the role of corporate bond dealers has changed in recent years, as dealers are less inclined to trade on a principal basis, and more inclined to prearrange a customer trades in a search-and-match brokerage role.

I. Introduction

The liquidity of the corporate bond market has attracted substantial recent attention from practitioners, regulators, and academics alike. While at least three academic studies document substantial reductions in the trade execution costs paid by corporate bond customers after the introduction of transaction reporting through the TRACE system during the 2002 to 2005 period, a number of observers have also reported that corporate bond trading became more difficult post-TRACE.[1] More recently, concerns regarding possible reductions in corporate bond market liquidity have become widespread. For example, Daniel Gallagher, former Commissioner of the U.S Securities and Exchange Commission (SEC) expressed concern that "A lack of liquidity in corporate-bond markets could pose a 'systemic risk' to the economy." The Finance Industry Regulatory Authority (FINRA) issued an "investor alert" to "educate investors about bond liquidity, and the potential for decreased liquidity …." Reductions in corporate bond market liquidity have been attributed by some to regulations adopted in the wake of the 2008-2010 financial crisis. For example, Pacific Investment Management Company (PIMCO) asserts that "the combination of post-crisis capital and liquidity regulations and a lower return environment has made banks less able and willing to function as market makers." Others point to real time trading reporting as an explanation for reduced liquidity, and have proposed in particular that transaction reporting be delayed in the case of large customer-to-dealer trades.[2]

However, not all observers are convinced that liquidity in the corporate bond markets has deteriorated. Some assert that concerns regarding bond market liquidity arise from traditional bond dealers' desire to maintain their "privileged market position."[3] Janet Yellen, chair of the U.S. Federal

---

[1] See Schultz (2001) for early evidence on corporate bond trading costs, and Bessembinder, Maxwell and Venkataraman (2006), Edwards, Harris and Piwowar (2007), and Goldstein and Hotchkiss (2007) for assessments of the impact of TRACE on trade execution costs. Bessembinder and Maxwell (2008) provide summary of the studies and an overview of related issues surrounding transparency in corporate bonds.

[2] See, for example, "US Banks push for delay in reporting corporate bond trades", Financial Times, April 26, 2015. Available at http://www.ft.com/cms/s/0/c4176a68-ea8f-11e4-a701-00144feab7de.html#axzz3tI4IGSe7.

[3] "Overlooking the Other Sources of Liquidity", Wall Street Journal, July 26, 2015, available at http://www.wsj.com/articles/overlooking-the-other-sources-of-liquidity-1437950015.

Reserve, stated "It's not clear whether there is or is not a problem" (with liquidity in bond markets), and added that "it's a question that needs further study."

Our goal in this paper is to provide a comprehensive analysis of liquidity in the corporate bond markets in the years since 2002. In addition to documenting how liquidity and dealer behavior has evolved over time, we assess the effects of both public transaction reporting through the TRACE system and post-crisis financial reforms such as the Volcker rule limiting proprietary trading by financial institutions and the Dodd-Frank act, which increased capital requirements for many institutions. To do so, we study an enhanced database of transactions in U.S. corporate bonds covering the 2003 to 2014 period, made available to us for this purpose by FINRA. In addition to transaction prices our data includes masked dealer identities, which allows us to directly assess changes in dealer inventories, dealers' propensity to carry inventory positions overnight, as well as the relative frequency of principal vs. agency trading. Our data also contains transactions reported to FINRA but not disseminated to the public, including trade prices for publicly-traded bonds phased into TRACE reporting during the 2003 to 2005 as well as prices for privately-traded 144A bonds, which were not disseminated to the public until June 2014. We exploit the 144A data to compare liquidity measures across bonds with and without public trading reporting during the financial crisis and during the period thereafter, when regulatory reforms such as the Volcker Rule and the Dodd-Frank act were implemented. We are also able to examine changes in liquidity and dealer inventory around the time that 144A bonds were phased into public transaction reporting. Finally, we are able to observe actual trade sizes, which facilitates the study of block trading in particular.

We consider five subperiods. TRACE transaction reporting, which has been shown to be associated with reduced transaction costs, was phased in for most publicly-traded bonds by the end of 2005. We designate January 2003 to December 2005 as the "TRACE phase-in" period. We designate the January 2006 to June 2007 period as the "benchmark" period, characterized by transaction reporting for public bonds, but prior to the onset of the financial crisis. We define July 2007 to April 2009 as the

"financial crisis" period, and May 2009 to June 2012 as the "post-crisis" period. Finally, we designate July 2012 to May 2014 as the "Dodd-Frank" period.[4]

This assignment of dates to subperiods is necessarily somewhat subjective. We follow earlier authors in specifying the financial crisis period to begin in July 2007 (see Friewald, Jankowitsch and Subrahmanyam, 2012) and end at April 2009 (see Dick-Nielsen, Feldhutter, and Lando, 2012). The Dodd-Frank act was signed into law on July 21, 2010. However, provisions of the Dodd-Frank Act were implemented in phases, with some effective dates as long as five years after the signing. We focus in particular on the period from July 2012 onward, when the Volcker rule restrictions on proprietary trading by financial institutions were fully in effect.

We document a number of striking findings, including that dealer concentration, while relatively high, has trended down over time. In recent years, individual dealers trade more bonds on average, and an average bond is traded by more dealers, results that suggest increased competition in market making for corporate bonds. Overall, customer trade execution costs have decreased from 2003 to 2014, though most of the decrease occurred during the period when publicly-traded bonds were phased into TRACE from 2003 to 2005.

We construct several measures of the extent to which dealers commit capital to accommodate customer trades. These include the proportion of total customer trades completed on a principal rather than an agency basis, the proportion of total trades that are interdealer, the change in dealer capital committed relative to volume and relative to amount outstanding, and the proportion of block volume taken into overnight inventory. The results, perhaps not surprisingly, show that trade execution costs rose dramatically and all measures of dealer capital commitment declined during the financial crisis period. However, trading costs declined in the post-crisis period, and by the Dodd-Frank period were only slightly elevated as compared to the pre-crisis benchmark period. In contrast, measures of dealer

[4] We end most of our analyses at the end of May 2014, even though we have data through February 2015, because TRACE reporting was introduced for 144A bonds at the end of June 2014. We consider data through February 2015 in our analysis specifically focused on the effects of TRACE reporting.

capital commitment generally did not revert to pre-crisis levels, and some measures worsened during the Dodd-Frank period as compared to the crisis period.

It is possible that the most notable reductions in bond market liquidity do not manifest themselves during normal trading, but emerge when the market is stressed. To shed light on this possibility, we study the most active dealer on days when customer trading activity is unusually high. The results imply that a larger proportion of stressful day activity is conducted on an "effectively agent" basis, that a larger proportion of stressful day activity is offset by opposite direction trades on the stressful day, and that dealers commit overnight capital to accommodate stressful day inventory less often during the Dodd-Frank period relative to the benchmark period. For high yield bonds, the decline in dealers' capital commitment during the Dodd-Frank period is more striking. Collectively, the evidence indicates that the role of corporate bond dealers has changed in recent years, as dealers are less inclined to play the role of a market maker and more inclined to prearrange a customer trade in a search-and-match role as a broker.

We assess the extent to which TRACE transaction reporting contributes to the decrease in dealer willingness to commit capital observed in the recent years. To do so, we conduct "difference-in-difference" analyses for the months surrounding TRACE introduction, for two distinct samples. In the first, we assess measures of dealer capital commitment before and after the introduction of TRACE for publicly-traded bonds during 2002 to 2005. In the second, we assess the same measures in the months surrounding the June 30, 2014 introduction of TRACE for non-public 144A bonds. Strikingly, we find no indication of changes in the dealer capital commitment variables after TRACE introduction, in either sample. These results indicate that it is unlikely that TRACE transaction reporting is responsible for dealer's decreased willingness to commit capital to corporate bond trades in recent years. However, the fact that measures of capital commitment did not improve in the years after the financial crisis and that some of these measures have worsened in the most recent years is consistent with the reasoning that regulatory initiatives such as the Volcker rule and the Dodd-Frank Act have reduced dealers' willingness to commit capital to market making in bonds.

The rest of the paper is organized as follows. We discuss the related literature in Section II and provide a description of the data sources and sample selection in Section III. Summary statistics on dealer participation and trading cost estimates are discussed in Section IV. Section V presents the main results of the study on principal participation, capital commitment and liquidity provision on stressful days over the sample period and the analysis on the impact of TRACE transaction reporting. We summarize the results and present implications of the study in Section VI.

II. The Related Literature

While the literature on market making and liquidity is vast, the majority of researchers' attention has been focused on stock markets. Schultz (2001) provides the first systematic evidence regarding corporate bond trading, using a database of insurance company trades. He documents that even institutional trades in corporate bonds incurred transactions costs that were large relative to those observed in equity markets.

The implementation of TRACE transaction reporting lead to a significant increase in academic research focused on corporate bonds.[5] The phased introduction of TRACE transaction reporting during the period 2002 to 2005 triggered at least three studies including Edwards, Harris, and Piwowar (2006), Bessembinder, Maxwell, and Venkataraman (2006) and Goldstein, Hotchkiss, and Sirri (2007), each of which concluded that TRACE led to substantial reductions in the trade execution costs paid by customers.

Dick-Nielsen, Feldhutter, and Lando (2012) and Friewald, Jankowitsch and Subrahmanyam (2012) each document that corporate bond liquidity was substantially degraded during the recent financial crisis. Bao, Pan, and Wang (2011) show that corporate bond illiquidity is greater than can be attributed to bid-ask spreads alone, implying that larger trades incur costs attributable to price impact. Bao and Pan (2013) show that illiquidity contributes to the observed volatility of bond prices. Feldhutter (2012)

[5] Researchers have also studied closely related markets. Au and Covert (2013) examine the market for borrowing corporate bonds (which facilitates the ability to short take short positions), reporting a downward time trend in borrowing costs. Das, Kalimipalli, and Nayak (2014) argue that the advent of CDS trading has made bond markets less efficient and have not improved market liquidity. Loon and Zong (2014) find that post-trade transparency in the CDS market surrounding the advent of a central clearing led to improvements in liquidity and trading activity.

shows that variation in trade prices across small vs. large trades is a useful measure of illiquidity for corporate bonds. Mahanti, Nashikkar, Subrahmanyam, Chacko and Mallik (2008) construct a measure to capture "latent" liquidity in illiquid markets and test it using corporate bond trade data. More broadly, Marshall, Nguyen and Visaltanachoti (2012) examine common liquidity measurements in markets with low-frequency trading.

The literature has also considered relations between liquidity and pricing in corporate bonds. Chen, Lesmond and Wei (2007) and Lin, Wang and Wu (2011) document that illiquid bonds have significantly higher yield spreads, and that decreases in bond liquidity leads to reduced yield spreads. Friewald and Nagler (2015) show that dealer inventories are significantly related risk-adjusted bond returns.

Green (2007) and Green, Hollifield and Schurhoff (2007) provide theoretical models to help understand the strategic interactions of participants in markets characterized by limited transparency. Cespa and Foucault (2014) show that a lack of liquidity can hinder efficient price discovery, and that reductions in liquidity can be self-reinforcing due to increases in information asymmetry.

Two recent papers examine aspects of execution quality in the corporate bond market. Harris (2015) documents that "trade-throughs", i.e., transactions where the price is inferior to the posted bid or ask quotation are not infrequent in corporate bond markets. O'Hara, Wang and Zhou (2015) document that more active insurance companies receive better transactions prices for similar trades as compared to less active insurance companies, particularly when the insurance company trades with the dominant dealer in the bond.

Goldstein and Hotchkiss (2011) examine a dataset that covers the July 2002 to July 2008 period and that, like ours, includes dealer identification variables. They focus on institutional size trades, and document that dealers are less likely to hold an overnight inventory position in those bonds that are traded less frequently on average. Our results go beyond those of Goldstein and Hotchkiss (2011) in several dimensions, including that we study the implementation of TRACE reporting for 144A bonds in 2014, we

measure dealer behavior during times of market stress, and we study several measures of dealers willingness to commit capital to bond trading, all in a sample that extends into 2015.

III. Data Sources and Descriptive Statistics

To analyze corporate bond market liquidity, we rely on an enhanced version of the TRACE data, provided by FINRA. The data includes unmasked trade size[6], dealer id, and trade information for 144a bonds[7]. Our analysis relies on trade date, trade report time, trade price, trade size, buy or sell indicator, interdealer transaction indicator, FINRA's principal or agent indicator, a TRACE dissemination indicator (if the trade terms were disseminated to the public or not), primary market indicators, and dealer ID.

The full sample includes 85.02 million trades, beginning with the initial implementation of TRACE in July 2002 and extending through February 2015. Table 1 reports the sample size and the effects of data filters that we implement. We exclude all canceled and corrected trades. We also delete medium-term notes from the sample, as they trade very infrequently and are generally considered to be distinct from traditional corporate bonds. We also eliminate any bond that trades less than 5 times over the sample period and bonds that we cannot match to the Fixed Income Securities Database (FISD). The FISD database provides the descriptive information on issue size, issue date, call features, maturity date, and bond rating.[8] We exclude all trades in any bond with a transaction size greater than the bond's issue size, and bonds with FISD action type of "reopening" (issuance of additional debt on an existing issue) and bonds with missing dissemination dates. Finally, we exclude primary market transactions. After these filters, the sample is comprised of 65.14 million transactions in 40,659 distinct CUSIPs.

To study dealer behavior, we focus on a sub-sample of the most active dealers identified as follows: we identify all dealers ranked in the top 25 based on trading volume in any given year or over the

[6] In the standard TRACE dataset, trade sizes above $5MM for investment grade bonds are reported as $5MM+ and trade sizes above $1MM for high yield bonds are reported as $1MM+. Unmasked trade sizes become available to all researchers via TRACE/WRDS after an 18 month lag.
[7] 144A bonds transactions are reported to FINRA but did not become TRACE eligible until June 30, 2014.
[8] In order to track the number of bonds outstanding as well as when bonds disappear, we utilize FISD to track the maturity date and if the bonds were called over our sample period. We confirm a sample of bonds that are deemed as called on FISD with Bloomberg as well as examine that accuracy of the call information on FISD and find it to be a good tracking mechanism.

full 2002-2015 period. We then retain dealers with at least 5% of the total trading volume in any sample year. The above classification yields 15 dealers (Top 15) who trade in 37,491 distinct CUSIPS. Collectively, the Top 15 dealers participate in 16.79 million transactions (after the filters described) during the sample period. Of these, they commit their own capital (by criteria described in the next section) in 14.01 million transactions. They participate in 9.48 million transactions with customers, as opposed to other dealers. The top 15 dealers account for 26 percent of the post-filter transactions and 65 percent of dollar trading volume. The latter statistic indicates that the most active dealers' trades are significantly larger than those facilitated by other dealers.

Table 2 reports on corporate bond trading activity on an annual basis from 2003 to 2014. Corporate bond trading averaged between $1.8 trillion and $2.9 trillion between 2003 and 2009. Trading activity has surged since then, to slightly over $3.8 trillion per year from 2010 to 2012, and to over $4.2 trillion per year in both 2013 and 2014.

This rapid increase in trading activity appears to be at odds with widely expressed concerns that liquidity in corporate bond markets has been in decline. This apparent contradiction is explained in part by the increase in the dollar value of corporate bonds outstanding, which has grown from $2.0 trillion (10,238) in 2003 to over $5.5 trillion in 2013 and 2014 (13,118), due to new issuance activity (see Figure 1). Trading activity relative to the amount outstanding has been generally trending downward, from 113% in 2003 to a financial crisis low point of 62% in 2008, then recovered to over 80% in 2009 and 2010, but has since declined again to about 75% (see Figure 2).

Table 2 also reports on the volume of trading disseminated through TRACE and volume not so disseminated. TRACE was implemented in stages, with a first set of five hundred bonds becoming TRACE eligible on July 31, 2002 and with trades in most publicly traded bonds being disseminated through TRACE by February 7, 2005.[9] As a consequence, market wide measures for the 2003 to 2005 period are affected by the fact that most bonds are traded in an opaque manner early in the sample while

[9] The exceptions were new issues and large trades in lightly traded bonds, which were disseminated to the public by January 2006.

most are subject to transaction reporting during the later years. The bonds whose trades were not reported through TRACE after February 2005 are private 144a bonds, which were almost all high yield.[10] The volume of trading with public reporting grew rapidly from $1.2 trillion in 2003 to approximately $1.9 trillion in 2006 and 2007 (reflecting in part the increased number of bonds eligible for TRACE reporting), before dropping to $1.6 trillion in 2008. TRACE-reported volume continued to grow thereafter, exceeding $3 trillion in each year since 2010. Volume not disseminated through TRACE declined rapidly from $1.08 trillion in 2003 to $200 billion in 2005 as transaction reporting was phased in for public bonds. Following the financial crisis trading activity in non-TRACE disseminated bonds also grew rapidly, exceeding $700 billion in each year from 2010 to 2013, before declining during 2014 as 144A bonds became eligible for transaction reporting.

III. Data Description and Trading Costs through Time

A. Dealer Characteristics

Table 3 reports a number of statistics related to dealer activity in the corporate bond market based on both customer and interdealer volume. We provide results for the overall sample and for subsamples based on credit rating and TRACE dissemination of trades. Several results are noteworthy.

First, the market exhibits substantial dealer concentration, as the fifteen largest dealers hold a market share ranging from 67% to 82% of the market. The degree of dealer concentration increased from 75% of trading by the top 15 dealers in the TRACE phase in period to 82% during the benchmark period, before declining to 67% in the post-crisis and Dodd-Frank periods. The market for high yield bonds has been somewhat more concentrated in recent years as compared to that for investment grade bonds, as the top 15 dealers share of the former has exceeded 70% in the post-crisis and Dodd-Frank periods, compared to less than 63% for the latter. In general the market for TRACE-reported bonds has also been somewhat more concentrated in recent years, with the market share of the top 15 dealers averaging about 66% since

[10] Note also that bonds originally issued as 144a are in some cases later registered with SEC, at which point they become public bonds subject to TRACE transaction reporting.

the financial crisis, while the corresponding market share for non-TRACE (144A) bonds has averaged about 74% over the same periods.

It can also be observed on Table 3 that interdealer trading has decreased as a proportion of overall trading over time. Gao, Schultz and Song (2015) note that interdealer trading facilitates risk sharing by allowing dealers to lay off unwanted inventory in trades with other dealers. For the full sample, interdealer volume as a percentage of total volume was 27% during the TRACE phase in and the benchmark period, but has declined to 19% during the Dodd-Frank period. Interdealer volume has generally comprised a higher percentage of total volume for investment grade as compared to high yield bonds and for TRACE-reported bonds as compared to trading in bonds without public transaction reporting. The number of interdealer trades as a percentage of total trades displays similar patterns across time and across subsamples, but is always greater than the percentage of interdealer volume, implying that interdealer trades tend to be smaller on average than customer-to-dealer trades.

Table 3 also shows that the number of dealers trading each individual bond as well as the number of bonds traded by each of the top 15 dealers has increased substantially over time. For the full sample, the number (among the top 15) of dealers trading a given bond ranged from 4.6 to 5.2 through the financial crisis, before increasing to 6.4 in the post crisis and Dodd-Frank periods. The number of bonds traded on average by the top 15 dealers increased from slightly over 4,200 during the benchmark and crisis periods to nearly 8,000 during the post-crisis and Dodd-Frank periods. These trends are quite similar across investment grade and high yield bonds, and with the exception of decreases attributable to bonds being phased into transaction reporting during the 2003 to 2005 period, for both TRACE-eligible and non-TRACE bonds.

Finally, we examine the percentage of customer-dealer trading volume conducted on an agency rather than a principal basis. TRACE reporting requirements call for a dealer to report a trade as a principal trade if the dealer takes ownership, i.e. if the trade can "hit the books." By this standard, almost all dealer-intermediated trades are coded as principal trades. We consider also a broader definition, where trades are defined as effectively being agent trades if the transaction is offset by an opposite-direction

trade within one minute. Given that the median bond trades only once every few months (see, for example, Edwards et al, 2007), it seems reasonable to infer that most offsetting transactions that occur within one minute were in fact prearranged, implying that dealer capital was not meaningfully at risk in the deal. We refer to principal trades that are offset within one minute as "effectively-agent" trades. Figure 3, Panel A, plots the six month moving average of the proportion of trades that reported as Agency and those classified by the one-minute algorithm as effectively-agent trades.

Results, also reported on Table 3, verify that the percentage of customer-dealer volume explicitly identified as being completed on an agency basis is small, ranging from 0.3% during the financial crisis to 0.9% during the TRACE phase-in and benchmark periods and 1.5% during the Dodd-Frank period. A considerably larger proportion of trades are captured by our "effectively agent" calculation. Most notably, during the financial crisis 7.1% of volume and 15.3% of trades are "effectively agent," as compared to only 0.3% explicitly identified as such. During the Dodd Frank period 7.6% of volume and 13.6% of trades were effectively agent, compared to 5.7% of volume and 7.0% of trades during the benchmark period.

On balance the data in Table 3 indicates a movement toward a more competitive market for the trading of corporate bonds. While the most active dealers do retain a large market share, their share has declined over time, more dealers trade each bond, and each dealer has traded far more bonds in recent years. On the other hand more trades are effectively completed on an agency basis, particularly during the financial crisis, as compared to the benchmark period.

B. Trade Execution Costs Over Time

We estimate customers' trade execution costs by means of indicator variable regressions, similar to Bessembinder, Maxwell, and Venkataraman (2006). We obtain estimates for each year, and for several subsamples. We report results for all trades, and for trade size categories, including small (less than $100,000), medium (between $100,000 and $1 million), large (between $1 million and $5 million) and block (greater than $5 million). We also report results across credit rating and issue size groups, relying on monthly data from the FISD database. In particular, we assign bonds to issue size tercile portfolios on

an annual basis, relying on the distribution of issue sizes in January of each year. We also report result separately for TRACE-eligible and non-TRACE bonds.

The trading cost estimates are obtained by regressions of ΔPst, the percentage change in the trade price for a given security from an observed trade at time 's' to the next observed trade at time 't', on ΔQ_{st} = $Q_t - Q_s$, where Q_s and Q_t are indicator variables that equal one for customer buys and negative one for customer sells at times s and t. The resulting slope coefficient estimates trade execution costs, and can be interpreted as the average amount by which the price that customers pay to purchase a security from a dealer exceeds the average amount received when customers sell the security to the dealer.[11] The analysis includes all customer-dealer trades (i.e. deletes inter-dealer trades), except for the first sample trade for any bond issue, since the dependent variable (price change) is missing. To improve the precision of the trading cost estimate we include in the regression changes in control variables that can be anticipated to also affect bond prices. Each control variable is measured as the change from the beginning of the trading day that includes trade s to the end of the trading day that includes trade t.[12]

Table 4 reports the resulting trading cost estimates. Focusing first on the full sample, it is noteworthy that average trade execution costs have decreased over time, from 0.58% in the TRACE phase-in period to 0.42% in the Dodd-Frank period. The overall decline in average trade execution costs was interrupted during the financial crisis, as average costs increased from 0.49% in the benchmark period to 0.68% in the crisis period. However, trade execution costs were reduced to 0.60% in the post-crisis period and declined to the lowest level observed, 0.42% during the most recent Dodd-Frank period. That is, our estimates of average market-wide customer trading costs do not support the widely-expressed concerns that corporate bond market quality has deteriorated in recent years.

---

[11] Estimation is based on the pooled sample using the Generalized Method of Moments. Each trade is weighted by the inverse of the square root of the elapsed time since the prior trade for the bond.

[12] The control variables include the percentage change in the Barclay's Capital U.S. 7-10 Year Treasury Bond Index, the percentage change in the S&P500 Index, the percentage change in the Barclays Capital U.S. Corporate Bond Index, the percentage change in 7-10 Year Treasury Index in excess of the percentage change in the 3-month Treasury Index, and the percentage change in the Barclay's Capital U.S. High Yield Bond Index in excess of the percentage change in the Barclay's Capital U.S. Corporate Bond Index.

Table 4 also reports on mean and median trade sizes. Average trade sizes are large for the full sample, ranging from $0.78 million during the financial crisis period to $1.05 million in the benchmark period. The median trade size is much smaller, ranging for the full sample from $29,000 during the financial crisis period to $51,000 in the Dodd-Frank period. However, the relatively few trades in excess of $5 million account for over fifty percent of total dollar volume in every period of the sample.

Trading costs declined over time for each of the trade size categories we consider. The largest decline is observed for retail-sized transactions of less than $100,000, from 0.82% during the TRACE phase-in period to 0.61% during the Dodd-Frank period, but trading cost also decline for medium-sized trades (from 0.32% to 0.27%) large-sized trades (from 0.25% to 0.20%), and block trades (from 0.20% to 0.17%). However, with the exception of small trades, there is no evidence of a decrease in trading costs from the benchmark period (after TRACE was implemented for public bonds) to the Dodd Frank period. Consistent with the prior literature, we also find that trading costs decline with trade size. For example, during the Dodd-Frank period, we estimate trading costs of 0.61% for small trades, 0.27% for medium trades, 0.20% for large trades and 0.17% percent for block trades.

Trade execution costs are generally larger for high-yield as compared to investment grade bonds, and trading costs declined over time for both groups. During the TRACE phase-in period the average trade execution cost for investment grade bonds was 0.59%, compared to 0.54% for high yield bonds. By the last subperiod, average trade execution costs declined to 0.40% for investment grade bonds and 0.47% for high yield bonds. It can also be observed on Table 4 that average trade execution costs are consistently higher for small as compared to large issue sizes, and that the decline over time in trade execution costs for small issue sizes has been modest, from 0.67% during the TRACE phase-in period to 0.63% during the Dodd-Frank period.

Turning to bonds with and without TRACE dissemination of trade prices, we observe that execution costs have decreased through time for TRACE-eligible bonds, from 0.53% during the TRACE phase-in period to 0.44% during the most recent period. For bonds without TRACE trade reporting, we observe a large decline between TRACE phase-in period and base line period. However many opaque

bonds during the TRACE phase-in sample were registered bond (i.e., non-144A bonds with a high proportion of retail sized trades) and all the registered bonds became transparent by February 2005. Thus the decline in trading costs can be attributed to the shift in clientele from retain investors in non-144a bonds to institutional investors in 144A bonds.

Average trade execution costs are much lower for bonds without TRACE transaction reporting, particularly after 2005. This result may seem surprising, in light of the prior evidence that TRACE trade reporting is associated with lower trade execution costs. It can be attributed to the fact that after 2005 only non-public 144A bonds are traded without transaction price reporting. Transactions in 144A bonds tend to involve institutions rather than individuals, and average trade sizes are much larger for 144A bonds, each of which has been documented in prior studies to be associated with lower trade execution costs. Thus, the lower execution costs for non-TRACE bonds after 2005 reflects that trades in 144A bonds tend to be large and institutional. In Section IV.E below we assess changes in trading costs for 144A bonds as they were phased into TRACE reporting during 2014.

On balance, the results for customer trade execution costs do not support the reasoning that corporate bond liquidity has deteriorated dramatically in recent years. Trade execution costs decreased substantially with the phase-in of TRACE reporting for public bonds. Execution costs rose during the financial crisis, but moderated thereafter. On average, customer trade execution costs are lower in the recent Dodd-Frank period than in any preceding period.

IV. Dealer capital commitment and market quality

We show in the preceding section that average trade execution costs for corporate bonds have, despite an increase during the financial crisis, on balance decreased over time, and are moderately lower in the recent Dodd-Frank years as compared to the benchmark years preceding the financial crisis. However, trade execution costs pertain to trades that are successfully completed. As such they cannot account for difficulty in completing trades, or for costs associated with trades that were desired but never completed. It has been asserted that trading is more difficult in recent years, and that dealers are recently

less willing to commit inventory to market making. We next examine a number of alternative measures of market quality, focusing in particular on dealers' willingness to commit capital to market making and on the execution of larger trades.

Since many dealers transact infrequently and it is impractical to study all dealers, we focus for this analysis on the fifteen most active dealers within each calendar year. We assign each bond transacted by a dealer to one of twelve portfolios, based on whether the bond is or is not eligible for TRACE-transaction reporting, whether the bond is of small, medium, or large issue size, and whether the bond is investment-grade or high-yield. We construct a number of market quality measures (described below) on a monthly basis. This analysis therefore includes up to 180 (twelve portfolios times fifteen dealers) observations per month.

A. Empirical measures

We construct the following variables for each dealer-month-portfolio:

- **Dealer volume relative to bond issue size**. This measure is included to assess the extent to which dealers facilitate trading, relative to the overall size of the bond market.
- **Average trade size**. This measure helps to assess whether market participants are able to execute large trades.
- **Percentage of trades and trading volume completed on a principal basis**. These are direct measures of dealers' willingness to commit their own capital to bond trading. Here, we exclude "effectively agent" trades, as described in Section III.
- **Percentage of trades and trading volume completed with other dealers**. These measures shed light on the effectiveness of risk sharing among dealers.
- **Time-Weighted daily capital commitment.** We measure capital commitment at the time of each completed trade in a portfolio as the absolute value of the difference between the dealer's accumulated principal buy volume and the dealer's accumulated principal sell

volume to that point in the day.[13] Note that the capital commitment variable is zero if the dealer's purchases on a principal basis are balanced equally to its sales, and increases to the extent that that the dealer's purchases vs. sales are unbalanced, in either direction. We then compute the average of these capital commitment measures within each dealer-portfolio-day, weighting each observation by the time for which the capital is committed (i.e., until the next trade, or if no trade occurs then until the end of the day). Finally, we scale the measure by market-wide volume for bonds in the portfolio and by the amount outstanding for bonds in the portfolio.

- **Percentage of block volume offset by end of day.** This measure is computed for each bond-day where the TRACE data shows a single trade of $10 million or larger. In cases where a given dealer buys a block, the measure is one minus the dealer's cumulative daily sell volume scaled by the block amount. In cases where a given dealer sells a block, the measure is one minus the dealer's cumulative daily buy volume scaled by the block amount.
- **Time-weighted inventory on block days.** This measure is computed for each bond-dealer-day where a trade of $10 million or larger is reported. For the relevant bond, we record cumulative daily trading completed on a principal basis by the dealer who participated in the block trade, and weight each observation by the elapsed time until the next trade by that dealer in that bond, or until the end of the day. This measure is scaled by the block amount then averaged over the portfolio-dealer-month.
- **Volume-weighted effective spread on blocks.** This measure is computed for each bond-dealer-day where a trade of $10 million or larger is reported. For blocks sold by a dealer, this measure is the block price less the dealer's weighted average purchase price on the same day in the same bond. For blocks purchased by a dealer, this measure is the dealer's weighted

[13] The capital commitment variable is computed across all bonds in the dealer portfolio, rather than on a bond-by-bond basis. The capital commitment measure focuses on inventory acquired since the beginning of the day. The alternative of focusing on levels of inventory is not viable in the absence of data on dealer's beginning-of-sample inventory. To the extent that dealers end each day with their desired level of inventory, the present measure can be viewed as deviations of inventory from the desired level.

average selling price on the same day in the same bond less the block price. This measure is computed on an absolute and a percentage basis then averaged over the portfolio-dealer-month.

Having constructed these variables, we estimated pooled time series regressions using the measures constructed for each dealer-portfolio-month as dependent variables. For this analysis we use data from January 2006 to May 2014.[14] The estimation includes dealer fixed effects, and standard errors that are clustered by portfolio-dealer. Prior research from equity markets (e.g., Hameed, Kang and Viswanathan (2010), Comerton-Forde et al (2010)) reports that lower stock market performance reduces dealers' propensity to supply liquidity, via its impact on their market making profits. We include in these regression several control variables that capture one-month lagged market conditions in the stock and bond market, as well as bond attributes for the portfolio-month, including:

- Natural logarithm of average issue size for bonds in the portfolio,
- Natural logarithm of average bond age (time since issue) for bonds in the portfolio,
- The return to the Barclays Capital U.S. Corporate Bond Index,
- The return to the S&P 500 index,
- Change in volatility of the Barclays Capital U.S. Corporate Bond Index,
- The change in the CBOE stock market volatility index (VIX),
- The change in 3-month LIBOR.

B. Empirical results regarding dealer behavior and capital commitment

The results of this analysis are reported on Tables 5 and 6. Coefficients estimated for the control variables indicate that older bonds are associated with lower trading volume (column 1) and less capital commitment (column 3). The estimated coefficients on the stock market return in columns (3) and (4) coefficient are positive, indicating that dealers are more willing to transact on a principal basis when

[14] The analysis therefore excludes the TRACE phase-in period, to focus on the post-TRACE environment, and the sample period after June 2014 when all corporate bonds became transparent.

when the recent stock return is larger. This result is consistent with that previously reported for stock markets. The coefficient estimate on VIX in column (4) is positive, indicating that dealers are more likely to transact on a principal basis when recent volatility is high, a result consistent with Anand and Venkataraman (2016) who show that market makers in equity markets earn higher risk adjusted profits when volatility is high. More surprising, positive coefficient estimates in columns (3) and (4) indicate that dealers are more inclined to trade on a principal basis when LIBOR rates are higher.

Column 1 of Table 5 pertains to dollar trading volume scaled by the amount outstanding. Coefficient estimates on each of the three sub-period indicator variables are negative and significant, indicating reduced bond turnover in each period subsequent to the January 2006 to 2007 benchmark period. The coefficient for the Dodd-Frank period is the smallest however, indicating a partial recovery of bond turnover in the most recent time interval.

Results in Column 2 of Table 5 indicate that average trade sizes have also declined relative to the benchmark period. These decreases are economically large, ranging from -$660,000 during the financial crisis to -$1.18 million during the most recent Dodd-Frank interval.[15] Large reductions in average trade size in the Dodd-Frank period relative to the benchmark period are consistent with the reasoning that it is more difficult to execute large corporate bond trades in recent years.

Results reported in columns (3) and (4) of Table 5 indicate that dealers participated on a principal basis less often, both as a percentage of trades (column 4) and as a percentage of volume (column 3), in each period subsequent to the benchmark period. Coefficients on the three indicator variables are statistically significant, but do not differ significantly from each other, in either column (3) or (4). This implies that dealer capital commitment has not recovered in the post-financial crisis periods.

Results reported in columns (5) and (6) of Table 5 indicate that interdealer trading has declined, both as a percentage of trades (column 5) and as a percentage of volume (column 6), in each period subsequent to the benchmark period. Reductions in interdealer trading are consistent with the reasoning

[15] The reductions in trade sizes reported on Table 5 are large relative to the sample overall trade sizes reported on Table 4. This reflects that the most active dealers engage in larger trades overall as compared to the broad market.

that risk sharing across dealers has deteriorated in the post-benchmark years. Coefficient estimates on the three indicator variables are all statistically significant, and the coefficient for the Dodd-Frank interval is more negative and differs significantly from the other two coefficients, in both columns (5) and (6), implying that interdealer trading decreased further in the Dodd-Frank period as compared to the financial crisis period.

On balance, the results reported in Table 5 are consistent with a more difficult trading environment in recent periods as compared to the January 2006 to June 2007 benchmark period. Trading volume relative to amounts outstanding has declined, average trade sizes decreased, measures of dealer principal trading declined, the proportion of trades and trading completed on a principal basis declined, as did the proportion of trading that was dealer-to-dealer. Deterioration of these measures during the financial crisis is not surprising or unanticipated. More noteworthy is the fact that these measures did not broadly recover, and that some worsened, during the Dodd-Frank period.

Results reported in the prior section showed that average trading costs increased during the financial crisis, but recovered fully and were lowest in the Dodd-Frank period. Column (7) of Table 5 reports results obtained when the dependent variable is average customer trade execution costs on a portfolio-month basis.[16] In contrast to simple means reported on Table 4 results, the regression specification used for Table 7 includes control variables. The resulting coefficient estimates on each of the time period indicator variables are positive, indicating higher average trade execution costs relative to the benchmark period. The coefficient estimate for the Dodd-Frank period of .0323 is positive and marginally significant, but significantly smaller than coefficient estimates for the crisis and post-crisis periods. That is, the results reported in Column (7) of Table 5 indicate that trading costs recovered after the financial crisis, but unlike the Table 4 evidence, show that trading costs remain marginally higher in the Dodd-Frank period as compared to the benchmark period.

[16] Here, trading costs are estimated for bonds in each of the twelve (trace vs. non-trace, small, medium or large size, and subject or not-subject to TRACE reporting) portfolios on a monthly basis.

Table 6 reports results of similar empirical specifications, applied to dealer capital commitment and block trading. Results for the dealer capital commitment variable, reported in Columns (1) and (2) of Table 6 are arguably the most important for assessing the hypothesis that dealers have curtailed their commitment to providing liquidity in the corporate bond market.

Notably, each of the coefficients estimated on the period indicator variables in columns (1) and (2) of Table 6 is negative and statistically significant, indicating reduced dealer capital commitment relative to the January 2006-June 2007 benchmark period. The coefficients estimated on the Dodd-Frank period indicators are larger in absolute magnitude as compared to those on the financial crisis and post-crisis indicators. That is, the results reported on Table 6 not only indicate reduced dealer capital commitment during the financial crisis, they also indicate that capital commitment was further reduced during the Dodd-Frank period, as opposed to recovering to pre-crisis levels.

Figure 4 displays the six-month moving average of dealer capital commitment, relative to trading volume and amount outstanding for registered, investment and high yield bonds over the sample period. The plots also support the interpretation that dealer capital commitment experienced a sharp decline during the financial crisis, and that dealer capital commitment as a percentage of amount outstanding (aggregate trading volume) in the Dodd Frank period is similar to (lower than) levels observed during the financial crisis. Specifically, for both investment grade and high yield bonds the decrease is from approximately 0.7% of aggregate volume in 2006 to 0.4% in 2014. The overall trend apparent on Figure 4 is a decline in dealer's capital commitment over time.

Column (3) of Table 6 reports results for block dollar volume (trades of $10 million or more) relative to total dollar volume Coefficient estimates on each of the three time period indicators are negative and statistically significant, indicating reductions in block trading activity relative to the benchmark period. The coefficient estimate for the Dodd-Frank period does not differ significantly from that for the crisis period, indicating that block trading activity did not recover in the wake of the financial crisis. A reduction in block trading activity is consistent with the reasoning that it is more difficult to transact large trades in corporate bonds in recent years.

Columns (4) and (5) of Table 6 report results obtained when the dependent variables are the percentage of block volume offset by the end of the trading day and the time-weighted inventory carried by the dealer on the block day, respectively. Each coefficient estimate on the time period indicator variables in column (4) is positive and statistically significant, while each corresponding coefficient estimate in column (5) is negative and statistically significant. Together, these results indicate that dealers are less likely to hold bond positions acquired in block trades in inventory in the years subsequent to the January 2006 to June 2007 benchmark period, as average inventories on block-trade days are smaller and a larger percentage of the block is offset by opposite-direction trading on the same day. Coefficient estimates for the Dodd-Frank period are larger in absolute magnitude as compared to estimates for the financial crisis period, and these differences are statistically significant. That is, the results indicate that dealer's reluctance to hold block trade positions in inventory has significantly worsened during the Dodd-Frank period as compared to the financial crisis period.

In columns (6) and (7) of Table 6 we report results obtained when the dependent variable is the effective bid-ask spread on block trades, on an absolute and a percentage basis, respectively. Coefficient estimates on the time period indicator variables are uniformly positive and statistically significant, indicating that customer's effectively pay a higher price to execute block trades in the years subsequent to the benchmark period. During the financial crisis period the percentage effective spread for block trades increased by an economically substantial twenty basis points relative to the benchmark period. The increase moderated thereafter, to six basis points in the post-crisis period and to five basis points in the Dodd-Frank period. However, effective spreads for block trades remained modestly higher in the Dodd-Frank period as compared to the benchmark period.

On balance, the results reported in Tables 5 and 6 indicate a more difficult corporate bond trading environment in recent years. Trading costs overall and for block trades increased substantially during the financial crisis, and (after allowing for control variables) remain slightly elevated in the Dodd-Frank period as compared to the January 2006 to June 2007 benchmark period. More notably, our measures of

dealer capital commitment not only deteriorated during the financial crisis, but failed to recover or became worse during the most recent Dodd-Frank period.

C. Dealer Actions on Stressful Days

The results reported in the previous section indicate that, on average, dealer's willingness to commit capital to bond trading has deteriorated in recent years. However, the reductions we document are arguably not commensurate with the degree of anxiety expressed by some observers regarding bond market liquidity. It is possible that the most notable reductions in bond market liquidity do not manifest themselves during normal trading, but emerge when the market is stressed. To shed light on this possibility, we examine dealer trading behavior on days when customer trading activity is unusually high.

In particular, we examine bond/days when customer-to-dealer trading volume exceeds the average customer-dealer volume for the same bond over the prior six months by two standard deviations. On each of those days, we focus on the activity of the single most active dealer. This reflects our understanding that an institutional customer typically delegates the execution of a large block to a single dealer. Our intent in focusing on the most active dealer on active days is to learn about dealer behavior at times when customers demand unusually large quantities of liquidity and may be seeking to transact large blocks.[17] We restrict the analysis to bond/days when the most active dealer's activity is economically large, by also requiring that active dealer volume with customers on the date exceeds $1 million.[18]

These criteria generate a sample of 390,624 stressful bond-days. For each of these, we divide the most active dealer's total trading into three categories. The first, is "effectively agent" volume, i.e. that reported to FINRA as agency as well as volume offset in trades with either customers or other dealers within one minute. The second, which we will refer to as "reversed principal" is volume that is

[17] This analysis potentially captures a broader set of block trades as compared to the trades in excess of $10 million considered in the prior section. Days with very heavy trading activity are often characterized by a series of moderately large transactions rather than a single large block (even on a single side of the market). That is, it appears that negotiations over large desired transactions often lead to several smaller trades rather than a single large trade.

[18] We also assess results when requiring active dealer volume to exceed $3 million and $5 million, and reach very similar conclusions.

completed on a principal basis but is offset by opposite-direction volume by the end of the trading day. The third, which we refer to as "overnight capital" is volume that is completed on a principal basis that is not offset by the end of the trading day, i.e., that is absorbed as a change in overnight inventory.

We also assess customer trading costs on days when dealers are stressed by computing measures of customers' trade execution costs from the block trading literature introduced by Kraus and Stoll (1972), and also implemented by Bessembinder and Venkataraman (2004). More specifically, we proceed as follows. First, we create an indicator variable, D, that equals one if the stressed dealer has more customer buy volume than customer sell volume on the stressful day, and that equals negative one otherwise. Second, we create a bond-specific stressful day price variable, P, that is the volume weighted average price (VWAP) for customer buy trades with the stressed dealer if $D = 1$ and that is the volume weighted average price for customer sell trades with the stressed dealer if $D = -1$. Third, we create a bond-specific pre-trade benchmark price $PreP$, using the most recent daily VWAP observed prior to the stressful day for the bond. Finally, we create a post-trade benchmark price, $PostP$, using the first daily VWAP observed subsequent to the stressful day.[19] The total execution costs and the temporary component of the price change are then measured for each stressful day as:

Total execution cost on stressful day = $D * (P - PreP)$, and

Temporary component of price change = $D * (P - PostP)$

In addition, we compute the permanent component of price change of the stressful day activity as:

Permanent component = Total execution cost - Temporary component = $D * (PostP - PreP)$.

As in Kraus and Stoll (1972), the total execution cost is an estimate of customer's costs of completing the block transaction. The temporary component of price change is an estimate of the dealer's market-making revenue, while the permanent component of price change is an estimate of the information content of the stressful day activity, i.e. the effect of the trading activity on the level of bond price

[19] We consider up to a maximum of five days before and after the stressful day. If either the pre or post trade benchmark prices are not available the stressful day is excluded from the trading cost calculations.

Table 7 reports results obtained when we implement regressions that include the same explanatory variables as Tables 5 and 6. Panel A reports results for all bonds on stressful days, while Panel B reports results when the dependent variable is computed separately for investment grade and high yield bonds, and the regressors include the interaction of time period and high-yield indicator variables.

Focusing first on results in columns (1) to (3) of Table 7, Panel A, we observe positive and significant coefficient estimates on the time period indicators in columns (1) and (2), and negative and significant coefficient estimates on the time period indicators in column (3). These results imply that a larger proportion of stressful day activity is conducted on an effectively agent basis, that a larger proportion of stressful day activity is offset by opposite direction trades on the stressful day, and that dealers commit overnight capital to accommodate stressful day inventory less often in the years after the January 2006 to June 2007 benchmark. Coefficient estimates are generally similar across the financial crisis and the Dodd-Frank indicator variables, implying that the reduction in dealers' willingness to commit capital on stressful days is as severe during the Dodd-Frank period as during the financial crisis.

Results reported in columns (4) to (6) of Table 7 reveal positive and significant coefficient estimates on the time indicators when the dependent variable is the estimated total execution costs (column 4) and temporary price change (column 6) on stressful days, and small and mainly insignificant coefficient estimates on estimated permanent price change (column 5). That is, customers paid more to complete trades on stressful days in the years following the January 2006 to June 2007 benchmark period, and the increase passed through to dealer revenue, as opposed to being attributable to increases in price impact on stressful days. However, the coefficient estimates on the Dodd-Frank indicator variables in columns (4) and (6) are statistically and economically smaller as compared to corresponding coefficient estimates on the financial crisis indicator. That is, while total execution costs and temporary component of price change surrounding stressful days are larger in the Dodd-Frank period than in the benchmark period, the increase is substantially less than during the financial crisis.

Results reported on Panel B of Table 7 indicate that changes in outcomes after the benchmark period often differed for high yield as compared to investment grade bonds, but not in a straightforward

manner. Most notably the increase in the proportion of stressful day trading volume that is reversed by offsetting trades before the end of the day (column 2) is smaller for high yield as compared to investment grade bonds during the financial crisis period. Further the customer's total execution cost on stressful days (column 4) is lower for high yield as compared to investment grade bonds during the financial crisis. However, these results may be due in part to a selection effect. In an unreported analysis, we find that trading activity of high yield relative to investment grade bonds experienced a sharp decline during the financial crisis period. The crisis period coefficients for high yield bonds may therefore represent an atypical sample of high yield bond block transactions between well-connected buy-side institutions and their network of dealers. This interpretation is supported by a smaller permanent component of price change observed for high yield bonds relative to investment grade on stressful days during the financial crisis (column 5).

Results in column (2) indicate that a larger proportion of stressful day activity in investment grade bonds is offset by the end of day during the Dodd-Frank period relative to the benchmark period. The impact during the Dodd-Frank period is more than twice as large for high yield relative to investment grade bonds. Similarly, results in column (3) show that dealers commit less overnight capital to accommodate stressful day inventory in investment grade bonds during the Dodd-Frank period, and that the decline is dealer capital commitment is even larger for high yield bonds. These results imply that dealers are more likely to reverse their stressful day inventory in high yield bonds by the end-of-day, implying that dealers are particularly unwilling to bear overnight inventory risk when facilitating customer trades in high yield bonds in the Dodd-Frank period. We also find that dealer revenues after accounting for the information content of stressful day activity (column 6) are in fact smaller for high yield than investment grade bonds in the Dodd Frank period.

Figure 5 plots the proportion of large-dealer stressful day inventory that is carried over night for transparent bonds with issue size greater than $1 billion. For investment grade bonds, the percentage of stressful day trading activity that the dealer commits to overnight capital averaged around 70% during the 2005 to 2007 period, declined to approximately 50% in 2009, and then rebounded subsequent to financial

crisis to 70% in 2010. However, we observe a significant decline in the capital commitment after 2010, to approximately 60%. For high yield bonds, the decline in dealers' capital commitment during the Dodd-Frank period is more striking - the percentage of stressful day trading activity that is carried overnight is reduced from approximately 40% in the 2005 to 2007 period to approximately 35 or less since 2010.

Collectively, the evidence indicates that the role of corporate bond market intermediaries has changed in recent years, as dealers are less inclined to commit capital in a market making role and more inclined to prearrange a customer trade in a search-and-match role as a broker.

D. The Role of TRACE transaction reporting

Some market observers have expressed the view that the public reporting of transaction prices through the TRACE system contributes to dealers' reduced willingness to commit capital to bond trading. For example, a recent survey of industry participants reported that "Many of the market participants we spoke to felt that increased transparency (e.g. through TRACE) had undermined liquidity."[20] The reasoning expressed is that since trading activity in most corporate bonds is sparse, market participant may be able to make inferences regarding inventory positions and future trades based on information about a given trade, particularly if it is large. Some market participants, including prominent buy side institutions, have proposed delayed reporting of large transactions to allow dealers to trade out of their inventory positions before other market participants are aware of them. In response, regulators are considering proposals to allow dealers a longer period of time before they report large transactions.

In this section, we investigate the extent to which the introduction of post-trade transparency impacts dealers' willingness to commit capital by trading in a principal capacity. To assess this possibility directly, we obtain "difference-in-difference" estimates of the effect of TRACE reporting, using regressions analogous to those reported in Tables 5 and 6. We construct two samples. The first focuses on public bonds phased into TRACE in March 2003, April 2003 and October 2004. The second

[20] Available at http://www.oliverwyman.com/content/dam/oliver-wyman/global/en/2015/mar/2015_Wholesale_Investment_Banking_Outlook.pdf.

focuses on non-public 144A bonds, for which transaction reporting was introduced on June 30, 2014. The first sample includes bonds with high levels of participation from retail investors, while in contrast only qualified institutional investors can participate in the 144A market. For each bond phased into TRACE reporting the sample includes also control bonds that do not experience a change in transparency, but are similar to event bonds in terms of investment grade vs. high yield status and issue size.

We focus on the six months before and after each phase of the TRACE initiation.[21] Also, instead of including indicator variables that pertain to calendar time periods, we include (i) an indicator variable, TREATED, that equals one for those bonds where transaction reporting is initiated, and zero for control bonds that were either subject to TRACE reporting or not subject to TRACE reporting throughout the sample period, (ii) an indicator variable, POST, that equals one for months after the relevant TRACE event and that equals zero for the months before the TRACE event, and the product of the two indicator variables. The key coefficient estimate is that obtained on the product of TREATED and POST, which estimates the change in the dependent variable from the period before to after TRACE reporting is initiated, for treated bonds relative to control bonds.

Results obtained for the 2003 and 2004 initiation of TRACE reporting for publicly-traded bonds are reported in Panel A of Table 8, while analogous results for the 2014 initiation of TRACE reporting for 144A bonds are reported on Panel B of Table 8. Focusing first on the 2003 and 2004 events, the estimated coefficient on TREATED is positive and significant, indicating higher outcomes for treated firms prior to transaction reporting initiation, for average trade size, capital commitment relative to amount outstanding, average holding period and interdealer volume. The estimated coefficient on the POST indicator is positive and significant, indicating higher outcomes on the dependent variable for all sample bonds in the months after TRACE reporting is initiated, for average trade size, daily capital commitment relative to amount outstanding, average holding period, and interdealer volume relative to total volume. Turning to the key coefficient estimate, that on the product of POST and TREATED, we

[21] For example, for bonds phased into TRACE reporting during March 2003 the sample includes data from September 2002 to September 2003, but does not include March 2003.

observe mostly insignificant results. The exceptions are a significant positive coefficient on trading volume relative to amount outstanding and a weakly significant positive coefficient on daily capital commitment. That is, the difference-in-difference analysis applied to the 2003 and 2004 TRACE initiation events for publicly traded bonds reveals slight increases in trading activity and capital commitment due to TRACE, and provides no evidence of degraded market quality.

In Panel B of Table 8 we report analogous results obtained using data from 2014 and focusing on 144A bonds as the treated sample. Here we observe significant coefficients on the TREATED variable in most columns, indicating that 144A bonds differed from publicly traded control bonds prior to the initiation of transaction reporting. In particular, 144A bonds had lower volume relative to amount outstanding, larger average trade sizes, higher daily capital commitment relative to amount outstanding, longer holding periods, less trading on a principal basis, and a lower proportion of interdealer trades. We also observe significant coefficients on the POST variable in several columns of Table 8, Panel B, indicating different outcomes in the second half of 2014 as compared to the first half for the full sample. In particular, dollar volume, average trade size, daily capital commitment relative to amount outstanding, and interdealer trading all decreased significantly for the full sample in the second half of 2014.

Most importantly, the estimated coefficient on the product of POST and TREATED is insignificant in all columns of Table, Panel B, with the lone exception of the positive coefficient in column (1) for dollar volume relative to amount outstanding. That is, the difference-in-difference estimates from the 2014 sample indicate no effects of TRACE transaction reporting other than a slight increase in trading activity.

Further, formal tests of the hypothesis that the POST*TREATED coefficients are equal across the 2003-2004 and 2014 events are not rejected for most dependent variables. The exceptions are for average trade size and daily capital commitment relative to amount outstanding, where 144A bonds experience a larger increase, and the proportion of interdealer trades where 144A bonds experience a decrease relative to registered bonds.

In the preceding section we documented substantial declines in trading activity relative to amount outstanding and in measures of dealer capital commitment during the financial crisis as compared to a benchmark period before the financial crisis, and we found that these measures in general did not fully recover and in some cases worsened in the Dodd-Frank period as compared to the financial crisis period. Our difference-in-difference results focused on the initiation of transaction reporting for public bonds in 2003-2004 and for 144A bonds in 2014 provide no evidence to support the reasoning that the degraded liquidity in corporate bond markets in recent years is attributable to public transaction reporting through TRACE.

V. Conclusions

Concerns that liquidity in corporate bond markets is deteriorating are widespread. We conduct a comprehensive analysis of all corporate bond trading, whether prices were disseminated to the public or not, over the 2003 to 2014 period, and obtain a number of results relevant in evaluating these concerns.

We document that dealer concentration is relatively high, in the sense that the fifteen most active dealers generally execute more than 60% of overall volume. However, dealer concentration has trended down over time, individual dealers trades more bonds on average, and an average bond is traded by more dealers on average in recent years, results which suggest increased competition in market making for corporate bonds. Overall, customer trade execution costs have decreased from 2003 to 2014, though most of the decrease occurred during the period when publicly traded bonds were phased into TRACE from 2003 to 2005, and trade execution costs were temporarily elevated during the financial crisis period.

While our analysis of dealer concentration and customer trading costs provide little evidence to support the notion that corporate bond market liquidity has deteriorated in recent years, we conduct a broader analysis that does indicate possible concerns. We document that a number of measures of dealer capital commitment, dealer willingness to complete trades on a principal basis, interdealer trading, and dealer propensity to carry inventory overnight were degraded during the financial crisis as compared to a pre-crisis benchmark period. Perhaps more surprisingly, these measures in general did not revert to pre-

crisis levels in the years after the financial crisis abated, and in some cases became worse during the most recent Dodd-Frank period as compared to the financial crisis period. Our analysis of dealers market-making behavior on stressful days characterized by abnormal liquidity demand from customers suggest that dealers are less willing to commit overnight capital to accommodate stressful day inventory, and in particular, for high yield bonds, in recent years.

We conduct a difference-in-difference analysis focusing on both the 2003-2004 initiation of transaction reporting for public bonds and the 2014 initiation of transaction reporting for 144A bonds, and find no evidence that TRACE reporting is associated with degraded market quality. While our results cannot definitively rule out other explanations, they are quite consistent with the reasoning that the role of bond market dealers has changed in the years since the Dodd Frank act was implemented, as dealers are less inclined to commit capital in a market making capacity, but more inclined to facilitate pre-arranged trades more akin to a brokerage capacity.

References

Acharya, VV, Y. Amihud, and ST Bharath, 2013, Liquidity risk of corporate bond returns: conditional approach, *Journal of Financial Economics*, v110i2, 358-386.

Anand, A, Venkataraman, K, 2016, Market conditions, fragility and the economics of market making, *Journal of Financial Economics,* forthcoming.

Asquith, P., A. Au, T. Covert, 2013, The market for borrowing corporate bonds, *Journal of Financial Economics*, v107i1, 155-182.

Bao, J, J. Pan and J.Wang, 2011, The illiquidity of corporate bonds, *Journal of Finance*, v66i3, 911-946.

Bao, J and J. Pan, 2013, Bond illiquidity and excess volatility, *Review of Financial Studies*, v26i12, 3068-3103.

Bessembinder, H. and W. Maxwell, 2008, Markets: Transparency and the corporate bond market. *The Journal of Economic Perspectives, 22*(2), 217-234.

Bessembinder, H., W. Maxwell, and K. Venkataraman, 2006, Market transparency, liquidity externalities, and institutional trading costs in corporate bonds. *Journal of Financial Economics, 82*(2), 251.

Bessembinder, H., Venkataraman, K., 2004, Does an electronic stock exchange need an upstairs market? *Journal of Financial Economics, 73*(1), 3-26.

Cespa, G. and T. Foucault, 2014, Illiquidity contagion and liquidity crashes, *Review of Financial Studies*, v27i6, 1615-1660.

Chen, Long, David Lesmond and Jason Wei, 2007, Corporate yield spreads and bond liquidity, *Journal of Finance*, v52i1, 119-149.

Comerton-Forde, C., Hendershott, T., Jones, C., Moulton, P., Seasholes, A.S., 2010, Time variation in liquidity: the role of market-maker inventories and revenues. Journal of Finance 65, 295–331.

Das, S., M. Kalimipalli, and S. Nayak, 2014, Did CDS trading improve the market for corporate bonds? *Journal of Financial Economics*, v111i2,495-525.

Dick-Nielsen, J., P. Feldhutter, D., Lando, 2012, Corporate bond liquidity before and after the onset of the subprime crisis, *Journal of Financial Economics*, v103i3, 471-492.

Easley, D; T. Hendershott, and T. Ramadorai, 2014, Leveling the trading field, *Journal of Financial Markets*, v17, 65-93.

Edwards, A, L. Harris, and M. Piwowar, 2007, Corporate bond market transaction costs and transparency, *Journal of Finance*, v63i3,1421-1451

Feldhutter, P, 2012, The same bond at different prices: Identifying search frictions and selling pressures, *Review of Financial Studies*, v25i4, 1155-1206.

Friewald, Nils, Rainer Jankowitsch and Marti G. Subrahmanyam, 2012, Illiquidity or credit deterioration: A study of liquidity in the US corporate bond market during financial crises, *Journal of Financial Economics*, v105i1, 18-36.

Friewald, Nils and Florian Nagler, 2015, Dealer inventory and the cross-section of corporate bond returns, *working paper*.

Harris, Larry, 2015, Transaction costs, trade throughs, and riskless principal trading in corporate bond markets, *working paper*.

Hendershott, T. and A. Madhavan, 2015, Click or call? Auction versus search in the over-the-counter market, *Journal of Finance*, v70i1, 419-447.

Gao, Pengjie, Paul Schultz and Zhaogang Song, 2015, Liquidity in a market for unique assets: specified pool and TBA trading in the mortgage backed securities market, working paper.

Goldstein, Michael and Edith Hotchkiss, 2011, Know when to hold them, know when to fold them: Dealer behavior in highly illiquid risky assets, *working paper*.

Green, R., 2007, Presidential address: Issuers, underwriters syndicates, and aftermarket transparency, Journal of Finance, v62i4, 1529-1550.

Green, R., B. Hollifield and N. Schurhoff, 2007, Financial intermediation and the costs of trading in an opaque market, Review of Financial Studies, v20n2, 275-314.

Hameed, A., Kang,W., Viswanathan, S., 2010, Stock market declines and liquidity. *Journal of Finance*, v65, 257–294.

Comerton-Forde, Carole, Terrence Hendershott, Charles Jones, Pamela Moulton, Mark Seasholes , 2010, Time Variation in Liquidity: The role of market-maker inventories and revenues, *Journal of Finance,* v65i1*, 295-331.*

Kraus, A, Stoll, H., 1972. Price impacts of block trading on the New York Stock Exchange. *Journal of Finance, v27*, 569–588.

Lin, Hai, Junbo Wang and Chunchi Wu, 2011, Liquidity risk and expected corporate bond returns, *Journal of Financial Economics*, v99i3, 628-650.

Loon, YC and ZDK Zhong, 2014, The impact of central clearing on counterparty risk, liquidity, and trading: Evidence from the credit default swap market, *Journal of Financial Economics*, v112i1, 91-115.

Mahanti, Sriketan, Amrut Nashikkar, Marti Subrahmanyam, George Chacko and Gaurav Mallik, 2008, Latent liquidity: A new measure of liquidity, with an application to corporate bonds, *Journal of Financial Economics,* v88i2, 272-298.

Marshall, BR, NH Nguyen, NH and N.Visaltanachoti, 2012, Commodity liquidity measurement and transaction costs, *Review of Financial Studies*, v25i2, 599-638.

O'Hara, Maureen, Yihui Wang, and Xing Zhou, 2015, Best execution of corporate bonds, *working paper*.

Schultz, Paul, 2001, Corporate bond trading costs: A peek behind the curtain, Journal of Finance, i56v2, 677-698.

Vayanos, D., J. Wang, 2012, Liquidity and asset returns under asymmetric information and imperfect competition, *Review of Financial Studies*, v25i5, 1339-1365.

Table 1
Sample Description

The table below reports a description of the data. Corporate bond trade data is from TRACE (Trade Reporting and Compliance Engine) and bond descriptive data is from the Mergent Fixed Income Securities Database (FISD). The sample period is July 2002 to February 2015.

	# Cusips	# Trades
All Cusips with TRACE trade data	95,340	85,020,077
Exclude medium term notes	67,620	73,537,432
Exclude bonds having less than 5 trades over the sample period	56,565	73,513,359
Exclude cusips that do not match to FISD	41,950	68,950,401
Exclude transactions with trade size > issue size	41,218	68,486,729
Exclude cusips with FISD Action Type "Repoening"	40,836	66,350,670
Exclude cusips with missing dissemination date	40,830	66,348,966
Exclude primary market transactions	40,659	65,142,380
Top 15 Dealers	37,491	16,799,567
% of cusips and # trades	*92%*	*26%*
% of total volume	*NA*	*65%*
Principal Analysis Sample Description:		
Exclude interdealer trades	34,837	9,489,694
Inventory Analysis Sample Description		
Exclude agency trades	35,976	14,013,738

Table 2
Market Statistics

The following table provides descriptive statistics on the size of the corporate bond market between 2003 and 2014. Measures are computed using the full sample of 40,659 cusips described in Table 1.

	Trading Volume (in Billions)	Corporate Bond Outstanding Amount (in Billions)	# of Corporate Bonds Outstanding	Trading Volume Relative to Amount Outstanding	TRACE Reported Volume	Volume not Disseminated on TRACE
2003	2,289	2,031	10,238	1.13	1,212	1,078
2004	1,975	2,051	11,652	0.96	1,219	756
2005	1,966	2,203	12,798	0.89	1,745	220
2006	2,248	2,512	13,342	0.89	1,940	307
2007	2,229	2,770	13,862	0.80	1,872	357
2008	1,799	2,881	13,331	0.62	1,620	179
2009	2,931	3,666	13,189	0.80	2,554	377
2010	3,869	4,691	15,534	0.82	3,166	703
2011	3,899	5,085	15,303	0.77	3,146	753
2012	3,884	5,497	15,169	0.71	3,034	850
2013	4,293	5,696	14,335	0.75	3,340	953
2014	4,246	5,588	13,118	0.76	3,764	482

Table 3
Dealer Statistics

The following table reports dealer statistics for all dealers reporting to TRACE and for the top 15 dealers described in Table 1. Statistics are reported for five periods over the January 2003 to May 2014 period for the full sample, for investment grade and high yield bonds, and for TRACE reported and non-disseminated bonds. The full sample results include statistics on trades reported as 'Agency' by FINRA and trades 'reversed' within one minute using our algorithm. Trades are classified as 'reversed' when an exact offsetting quantity (either a customer or interdealer trade) occurs or a combination of 2-3 trades offsets the customer trade within 60 seconds prior or subsequent to the trade.

	January 2003 - December 2005	January 2006 - June 2007	July 2007 - April 2009	May 2009 - June 2012	July 2012 - May 2014
Full Sample					
Top 15 Dealer Market Share by Volume	74.6%	81.6%	74.9%	67.3%	67.2%
Interdealer Volume / Total Volume	27.4%	27.5%	22.8%	22.9%	19.1%
# Interdealer Trades / Total Trades	31.6%	35.3%	37.5%	42.2%	40.3%
Characteristics for Top 15 Dealers					
# Dealers Trading a Bond	5.2	4.8	4.6	6.4	6.4
# of Bonds Dealer Trade	4,722	4,248	4,200	7,919	7,765
% of Volume Reported as Agent by FINRA	0.9%	0.9%	0.3%	0.7%	1.5%
% of Volume Reported as Agent by FINRA or Trades Reversed Within 1 min.	7.1%	5.7%	7.1%	6.2%	7.6%
% of Trades Reported as Agent by FINRA or Trades Reversed Within 1 min.	10.6%	7.0%	15.5%	18.2%	13.6%
Investment Grade					
Top 15 Dealer Market Share by Volume	72.9%	78.5%	70.0%	62.9%	62.2%
Interdealer Volume / Total Volume	30.0%	29.8%	24.3%	24.8%	20.9%
# Interdealer Trades / Total Trades	32.7%	36.1%	38.1%	42.2%	40.5%
Characteristics for Top 15 Dealers					
# Dealers Trading a Bond	4.6	4.2	4.2	6.1	6.3
# of Bonds Dealer Trade	3,288	2,795	2,986	5,429	5,544
High Yield					
Top 15 Dealer Market Share by Volume	73.2%	60.1%	60.6%	70.4%	70.8%
Interdealer Volume / Total Volume	22.0%	23.7%	19.8%	19.3%	15.8%
# Interdealer Trades / Total Trades	28.6%	34.2%	35.6%	42.1%	39.9%
Characteristics for Top 15 Dealers					
# Dealers Trading a Bond	6.2	6.2	6.4	6.9	6.8
# of Bonds Dealer Trade	1,650	1,523	1,318	2,525	2,282
TRACE Reported					
Top 15 Dealer Market Share by Volume	75.2%	80.6%	73.8%	66.1%	65.8%
Interdealer Volume / Total Volume	29.9%	28.2%	23.3%	24.1%	20.5%
# Interdealer Trades / Total Trades	34.2%	35.6%	37.8%	42.8%	41.2%
Characteristics for Top 15 Dealers					
# Dealers Trading a Bond	5.0	4.7	4.6	6.4	6.5
# of Bonds Dealer Trade	3,452	3,827	3,815	6,791	6,552
Not Disseminated on TRACE					
Top 15 Dealer Market Share by Volume	73.4%	89.3%	85.5%	74.8%	73.7%
Interdealer Volume / Total Volume	22.1%	22.5%	17.9%	15.8%	12.5%
# Interdealer Trades / Total Trades	26.9%	28.9%	22.7%	20.3%	19.1%
Characteristics for Top 15 Dealers					
# Dealers Trading a Bond	4.0	6.0	5.7	6.3	5.9
# of Bonds Dealer Trade	2,767	423	389	1,134	1,219

Table 4
Annual Estimates of Transaction Costs on Customer Trades - 2003-2014

The table reports estimated trade execution costs paid by customers in customer-to-dealer trades for the sample of bonds identified in Table 1. Transaction costs are estimated following the regression based model implemented by Bessembinder, Maxwell, and Venkataraman (2006).

Period	**TRACE phase-in period** January 2003 - December 2005	**Baseline period** January 2006 - June 2007	**Financial crisis period** July 2007 - April 2009	**Post crisis period** May 2009 - June 2012	**Dodd Frank period** July 2012 - May 2014
Full Sample					
Bid Ask Spreads (%)	0.58%	0.49%	0.68%	0.60%	0.42%
Monthly number of trades	141,254	109,133	127,864	243,090	352,500
Average Trade Size	795,750	1,049,750	781,050	784,350	863,500
Median Trade Size	30,000	39,850	28,850	32,000	50,750
By Trade Size					
Spreads: <=100K Trades	0.81%	0.71%	0.93%	0.82%	0.61%
% of Total Volume	2%	2%	2%	2%	2%
Spreads: >100K & <=1 million	0.32%	0.25%	0.47%	0.37%	0.27%
% of Total Volume	8%	7%	9%	9%	10%
Spreads: >1 million & <=5 million	0.25%	0.19%	0.34%	0.26%	0.20%
% of Total Volume	36%	33%	38%	34%	35%
Spreads: >5 million	0.20%	0.17%	0.32%	0.22%	0.17%
% of Total Volume	54%	58%	51%	55%	53%
Investment Grade - Spreads (%)	0.59%	0.44%	0.75%	0.60%	0.40%
Average Trade Size	745,600	1,092,300	673,050	724,600	783,350
High Yield - Spreads (%)	0.54%	0.56%	0.52%	0.59%	0.47%
Average Trade Size	910,150	987,550	1,102,700	928,150	949,450
Large Issue Size - Spreads (%)	0.48%	0.32%	0.67%	0.44%	0.31%
Average Trade Size	1,065,750	1,492,200	890,550	1,032,550	1,023,400
Medium Issue Size - Spreads (%)	0.52%	0.39%	0.62%	0.58%	0.41%
Average Trade Size	957,850	1,328,000	843,650	798,800	855,450
Small Issue Size - Spreads (%)	0.67%	0.63%	0.72%	0.81%	0.63%
Average Trade Size	577,795	686,700	587,000	482,150	548,700
Transparent Bonds - Spreads (%)	0.53%	0.51%	0.70%	0.62%	0.44%
Average Trade Size	840,650	969,800	726,850	698,750	755,000
Opaque Bonds - Spreads (%)	0.66%	0.12%	0.27%	0.17%	0.14%
Average Trade Size	721,300	2,900,200	2,441,050	2,580,050	2,384,050

Table 5
Portfolio Time Series Regressions: Market Quality and Liquidity Measures

This table reports portfolio time series regression results over the January 2006 to May 2014 period. Each regression includes three time period indicators; the benchmark period is January 2006 to June 2007. The trading cost variable is computed at the portfolio-month level and all other variables are computed at the portfolio-dealer-month level. Bonds are placed in twelve portfolios based on TRACE status, investment grade and high yield, and small, medium, and large issue size. With exception to the trading cost variable, which is computed using the entire sample of dealers, all dependent variables are computed using the top 15 dealers described in Table 1. Regressions 1-6 include portfolio-dealer fixed effects and clustered standard errors. The trading cost regression (Regression 7) is estimated using weighted least squares (based on the number of trades used to estimate spreads each portfolio-month), portfolio fixed effects, and robust standard errors. All regressions include portfolio bond characteristics and market controls. Tests for statistical differences between time periods are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. Trades are classified as 'principal' if not reported as 'Agency' by FINRA or 'reversed' within one minute. Trades are classified as 'reversed' when an exact offsetting quantity (either a customer or interdealer trade) occurs or a combination of 2-3 trades offsets the customer trade within 60 seconds prior or subsequent to the trade. Trading costs are estimated following the regression based model implemented by Bessembinder, Maxwell, and Venkataraman (2006).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dollar Volume/ Amount Out.	**Average Trade Size**	**Principal Volume / Total Volume**	**Principal %**	**# Inter-dealer Trades / Total Trades**	**# Inter-dealer Volume / Total Volume**	**Trading Cost**
July 2007 - April 2009	-0.0021***	-662,477.2***	-0.0451***	-0.047***	-0.028***	-0.050***	0.2424**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)
May 2009 - June 2012	-0.0016***	-884,711.1***	-0.0341***	-0.046***	-0.023**	-0.062***	0.1617***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.026)	(0.000)	(0.000)
July 2012 - May 2014	-0.0014***	-1,178,753.4***	-0.0339***	-0.055***	-0.046***	-0.104***	0.0323*
	(0.000)	(0.000)	(0.006)	(0.001)	(0.000)	(0.000)	(0.071)
Ln (Average Issue Size)	0.0006	763,313.2**	0.0268	0.027	-0.003	0.037	-0.0269
	(0.155)	(0.033)	(0.334)	(0.467)	(0.942)	(0.129)	(0.589)
Ln (Average Bond Age)	-0.0008***	40,630.8	-0.0215***	-0.025***	-0.013	-0.021***	-0.0416
	(0.000)	(0.722)	(0.001)	(0.002)	(0.120)	(0.004)	(0.247)
Corp Bond Index Return (t - 1)	0.0006	601,791.5	0.0272	0.063*	-0.033	-0.105***	0.2430***
	(0.116)	(0.190)	(0.486)	(0.099)	(0.211)	(0.000)	(0.007)
Stock Market Index Return (t - 1)	0.0058***	3,756,735.6***	0.1085*	0.145**	-0.031	0.077**	-0.2682***
	(0.000)	(0.000)	(0.092)	(0.016)	(0.409)	(0.046)	(0.002)
Chg. Corp Bond Index Volatility (t - 1)	0.0044***	3,556,244.4	-0.1213	-0.034	-0.066	-0.094	0.4620**
	(0.000)	(0.310)	(0.398)	(0.781)	(0.417)	(0.277)	(0.043)
Chg. in VIX (t - 1)	0.0001***	63,166.6***	0.0014	0.003**	-0.002**	-0.001	-0.0029
	(0.000)	(0.000)	(0.421)	(0.039)	(0.031)	(0.221)	(0.304)
Chg. in 3-Month Libor (t - 1)	-0.0003**	-254,435.0	0.0249**	0.022*	-0.008	-0.024***	-0.0832***
	(0.015)	(0.107)	(0.038)	(0.057)	(0.322)	(0.010)	(0.005)
Constant	-0.0001	-7,378,629.3	0.6020	0.605	0.515	-0.047	0.9695
	(0.979)	(0.132)	(0.104)	(0.225)	(0.270)	(0.886)	(0.187)
Observations	16,396	16,006	15,246	15,246	16,006	16,006	1,210
Adjusted R-squared	0.595	0.301	0.434	0.504	0.846	0.847	0.767
Portfolio-Dealer Fixed Effect	YES	YES	YES	YES	YES	YES	Portfolio
Test: Jul 07-Apr 09 = May 09-Jun 12	***	***	ns	ns	ns	ns	***
Test: Jul 07-Apr 09 = Jul 12-May 14	***	***	ns	ns	*	***	***
Test: May 09-Jun 12 = Jul 12-May 14	**	***	ns	ns	***	***	***
Unit of Observation	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Month

Table 6

Portfolio Time Series Regressions: Dealer Capital and Block Trading

This table reports portfolio time series regression results over the January 2006 to May 2014 period. Each regression includes three time period indicators; the benchmark period is January 2006 to June 2007. The dealer capital variables are computed at the portfolio-dealer-day level and all other variables are computed at the portfolio-dealer-month level. Bonds are placed in twelve portfolios based on TRACE status, investment grade and high yield, and small, medium, and large issue size. All dependent variables are computed using the top 15 dealers described in Table 1. All regressions include portfolio-dealer fixed effects and clustered standard errors, portfolio bond characteristics, and market controls. Tests for statistical differences between time periods are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. 'Time-Weighted Daily Capital' refers to daily unsigned, time-weighted changes in capital for each dealer. This measure is scaled by aggregate volume (across all dealers) in Regression 1 and total amount outstanding for bonds in this sample in Regression 2. 'Block' refers to a single large trade by a dealer of at least $5 million. To compute '% of Block Offset by End of Day', for each cusip-day with a block trade, we identify the largest block based on quantity and if the block is a buy (sell), we cumulate the quantity of sells (buys) for the day. The percent offset is the ending cumulative quantity divided by the block size. To compute 'Volume-Weighted Inventory on Block Day / Block Size', for each cusip-day with a block trade, we compute time-weighted absolute inventory scaled by block size. To compute 'Volume Weighted Average Price Differential between Block Buys (Sells) and Related Sells (Buys)', for each cusip-day with a block trade, we identify the largest block based on quantity. If the block is a buy (sell), we compute the weighted average price (based on quantity) of sells (buys) for the day and compare to the block price (e.g., buy (sell) block price - weighted average price of sell (buy) trades for the day). This measure is shown in levels and as a % difference.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Time-Weighted Daily Capital / Agg. Volume	**Time-Weighted Daily Capital / Amt Out.**	**Block Volume / Total Volume**	**% of Block Offset by End of Day**	**Volume-Weighted Inventory on Block Day / Block Size**	**Vol. WA Price Diff. b/t Block Buy (Sell) and Related Sells (Buys)**	**% Vol.-Weighted Price Diff. b/t Block Buy (Sell) and Related Sells (Buys)**
July 2007 - April 2009	-0.0026***	-0.000034***	-0.048***	0.065***	-0.126***	0.166***	0.204***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
May 2009 - June 2012	-0.0079***	-0.000037***	-0.033***	0.060***	-0.150***	0.072**	0.062*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.039)	(0.069)
July 2012 - May 2014	-0.0100***	-0.000042***	-0.041***	0.133***	-0.242***	0.062***	0.046***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Ln (Average Issue Size)	0.0027***	0.000010***	0.046**	0.086**	0.001	0.044	0.092**
	(0.000)	(0.000)	(0.015)	(0.012)	(0.976)	(0.182)	(0.026)
Ln (Average Bond Age)	-0.0002	-0.000002**	0.008	-0.015	0.021	0.058***	0.074***
	(0.399)	(0.037)	(0.135)	(0.257)	(0.125)	(0.001)	(0.000)
Corp Bond Index Return (t - 1)	0.0003	0.000005	0.033	-0.050	0.079	0.510	0.462
	(0.906)	(0.327)	(0.416)	(0.528)	(0.371)	(0.138)	(0.195)
Stock Market Index Return (t - 1)	0.0076***	0.000064***	0.314***	-0.270***	0.484***	-0.092	-0.171
	(0.002)	(0.000)	(0.000)	(0.004)	(0.000)	(0.783)	(0.629)
Chg. Corp Bond Index Volatility (t - 1)	-0.0089	0.000019	-0.008	0.338	-0.755**	-0.007	-0.189
	(0.149)	(0.195)	(0.947)	(0.202)	(0.018)	(0.991)	(0.785)
Chg. in VIX (t - 1)	0.0000	0.000001***	0.005***	-0.006**	0.010***	0.004	0.004
	(0.671)	(0.000)	(0.000)	(0.021)	(0.000)	(0.675)	(0.667)
Chg. in 3-Month Libor (t - 1)	-0.0013*	-0.000007***	-0.064***	0.022	-0.035	-0.014	-0.026
	(0.096)	(0.000)	(0.000)	(0.282)	(0.163)	(0.638)	(0.453)
Constant	-0.0171*	-0.000063**	-0.414	-0.673	0.666	-0.640	-1.347**
	(0.052)	(0.014)	(0.103)	(0.152)	(0.241)	(0.163)	(0.019)
Observations	333,342	333,342	16,006	12,280	12,280	11,020	11,020
Adjusted R-squared	0.136	0.158	0.440	0.386	0.349	0.001	0.004
Portfolio-Dealer Fixed Effect	YES	YES	YES	YES	YES	YES	YES
Test: Jul 07-Apr 09 = May 09-Jun 12	***	**	**	ns	*	**	***
Test: Jul 07-Apr 09 = Jul 12-May 14	***	***	ns	***	***	***	***
Test: May 09-Jun 12 = Jul 12-May 14	***	***	ns	***	***	ns	ns
Unit of Observation	Portfolio-Dealer-Day	Portfolio-Dealer-Day	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Dealer-Month	Portfolio-Dealer-Month

Table 7
Portfolio Time Series Regressions: Stressful Day Large Dealer Analysis

This table reports portfolio time series regression results over the January 2006 to May 2014 period. Each regression includes three time period indicators; the benchmark period is January 2006 to June 2007. The table reports the behavior of the single most active dealer on days with unusually large volume. We examine bond/days when customer-to-dealer trading volume exceeds the average customer-dealer volume for that bond over the prior six months by two standard deviations. On each of those days, we focus on the activity of the single most active dealer in the sample of top 15 dealers. To identify bond/days when the active dealer's activity is economically large, we also require that active dealer trading activity (both buying and selling in the bond cusip) exceed $1,000,000, which results in a final sample of 390,624 bond days. For each of these stressful days, we divide the most active dealer's total trading activity into three categories. The first, which we refer to as "Effectively Agent" is comprised of agency volume, including both volume reported to FINRA as agency trades and volume that is offset, either with a customer or another dealer, within one minute by opposite-direction volume. The second, which we will refer to as "reversed principal" is volume that is completed on a principal basis that is offset by opposite direction volume by the end of the trading day. The third, which we refer to as "overnight capital" is volume that is completed on a principal basis that is not offset by the end of the trading day, i.e., that is absorbed as a change in overnight inventory. In addition, to gauge customer trading costs on these stressful days, we compute the total execution cost, permanent component of price change and the temporary component of price change of the block trade. The benchmark period is January 2006-June 2007. All variables are computed at the portfolio-month level. Bonds are placed in twelve portfolios based on TRACE status, investment grade and high yield, and small, medium, and large issue size. With exception to the trading cost variable, which is computed using the entire sample of dealers, all dependent variables are computed using the top 15 dealers described in Table 1. All regressions include portfolio fixed effects and robust standard errors, portfolio bond characteristics, and market controls. All regressions are estimated using weighted least squares; weights are based on the number of stressful event days used to estimate measures in each portfolio-month.

Panel A: Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)
	% of Stressful Day Trade Activity that is "Effectively Agent"	**% of Stressful Day Trade Activity that is Reversed by End-of-Day**	**% of Stressful Day Trade Activity where Dealer commits Overnight Capital**	**Total Execution Cost**	**Permanent component of price change**	**Temporary component of price change**
July 2007 - April 2009	2.855***	8.540***	-11.395***	0.163***	0.031	0.135***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.117)	(0.000)
May 2009 - June 2012	0.906***	6.039***	-6.945***	0.073***	0.019*	0.055***
	(0.002)	(0.000)	(0.000)	(0.000)	(0.075)	(0.000)
July 2012 - May 2014	2.123***	8.596***	-10.719***	0.034***	-0.005	0.033***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.631)	(0.000)
Ln (Average Issue Size)	0.966	0.615	-1.581	0.030	-0.004	0.060***
	(0.260)	(0.672)	(0.327)	(0.254)	(0.889)	(0.009)
Ln (Average Bond Age)	0.340	-0.535	0.196	0.041***	0.032**	0.015
	(0.302)	(0.415)	(0.796)	(0.003)	(0.048)	(0.210)
Corp Bond Index Return (t - 1)	5.565*	16.172**	-21.736**	0.333**	0.182	0.078
	(0.094)	(0.048)	(0.020)	(0.048)	(0.328)	(0.639)
Stock Market Index Return (t - 1)	-1.951	-13.608	15.560	-0.720***	-0.429*	-0.607***
	(0.601)	(0.102)	(0.102)	(0.004)	(0.096)	(0.000)
Chg. Corp Bond Index Volatility (t - 1)	11.142	34.850	-45.993	-0.243	-0.975	0.701
	(0.318)	(0.187)	(0.147)	(0.665)	(0.141)	(0.140)
Chg. in VIX (t - 1)	0.008	-0.144	0.136	-0.018***	-0.011	-0.009*
	(0.942)	(0.583)	(0.648)	(0.007)	(0.138)	(0.090)
Chg. in 3-Month Libor (t - 1)	0.976	1.610	-2.586	-0.096**	-0.041	-0.062
	(0.260)	(0.426)	(0.285)	(0.036)	(0.353)	(0.163)
Constant	-7.411	46.394**	61.014**	-0.490	-0.025	-0.835**
	(0.553)	(0.031)	(0.010)	(0.204)	(0.958)	(0.015)
Observations	1,209	1,209	1,209	1,209	1,206	1,207
Adjusted R-squared	0.777	0.823	0.873	0.229	0.022	0.155
Portfolio Fixed Effect	YES	YES	YES	YES	YES	YES
Test: Jul 07-Apr 09 = May 09-Jun 12	***	***	***	***	ns	***
Test: Jul 07-Apr 09 = Jul 12-May 14	**	ns	ns	***	*	***
Test: May 09-Jun 12 = Jul 12-May 14	***	***	***	***	***	***
Unit of Observation	Portfolio-Month	Portfolio-Month	Portfolio-Month	Portfolio-Month	Portfolio-Month	Portfolio-Month

Panel B: Stressful Day Aanalysis: Investment Grade versus High Yield bonds

	(1)	(2)	(3)	(4)	(5)	(6)
	% of Stressful Day Trade Activity that is "Effectively Agent"	**% of Stressful Day Trade Activity that is Reversed by End-of-Day**	**% of Stressful Day Trade Activity where Dealer commits Overnight Capital**	**Total Execution Cost**	**Permanent component of price change**	**Temporary component of price change**
High Yield	6.958***	21.846***	-28.804***	0.064***	0.041***	0.025**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.025)
July 2007 - April 2009	1.573***	10.773***	-12.346***	0.208***	0.058**	0.142***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)	(0.000)
May 2009 - June 2012	1.294***	4.374***	-5.668***	0.116***	0.021**	0.098***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.048)	(0.000)
July 2012 - May 2014	3.418***	4.819***	-8.237***	0.081***	0.015	0.060***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.122)	(0.000)
July 2007 - April 2009 x High Yield	2.031**	-6.334***	4.302***	-0.103***	-0.074*	-0.001
	(0.011)	(0.000)	(0.001)	(0.003)	(0.051)	(0.974)
May 2009 - June 2012 x High Yield	1.950***	1.700*	-3.650***	-0.078***	-0.004	-0.074***
	(0.004)	(0.065)	(0.001)	(0.000)	(0.834)	(0.000)
July 2012 - May 2014 x High Yield	1.007	7.368***	-8.375***	-0.087***	-0.053***	-0.027**
	(0.197)	(0.000)	(0.000)	(0.000)	(0.002)	(0.042)
Controls	YES	YES	YES	YES	YES	YES
Observations	1,209	1,209	1,209	1,209	1,206	1,207
Adjusted R-squared	0.777	0.823	0.873	0.229	0.022	0.155
Portfolio Fixed Effect	NO	NO	NO	NO	NO	NO
Unit of Observation	Portfolio-Month	Portfolio-Month	Portfolio-Month	Portfolio-Month	Portfolio-Month	Portfolio-Month

Table 8
Impact of TRACE

This table reports portfolio regression results for trade statistics for the 6 months preceding and following transparency events. Panel A reports 2003-2004 transparency events in March 2003, April 2003, and October 2004. Panel B reports the 2014 transparency event in June 2014. 'Post-TRACE' refers to the 6 months subsequent to the Trace shock. 'TREATED' refers to a portfolio of bonds experiencing the transparency event. The dealer capital variables are computed at the portfolio-dealer-day level and all other variables are computed at the portfolio-dealer-month level. Bonds are placed in twelve portfolios based on TRACE status, investment grade and high yield, and small, medium, and large issue size. Portfolios of control firms that do not experience a transparency shock but are similar to treatment firms in terms of investment grade/high yield and issue size are included in the analysis. All dependent variables are computed using the Top 15 dealers described in Table 1. All regressions include dealer fixed effects, portfolio bond characteristics, and market controls. Standard errors are clustered at the dealer level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dollar Volume/ Amount Out.	**Average Trade Size**	**Time-Weighted Daily Chg. in Capital / Agg. Volume**	**Time-Weighted Daily Chg. in Capital / Amt Out.**	**Principal Volume / Total Volume**	**Principal %**	**# Inter-dealer Trades / Total Trades**	**# Inter-dealer Volume / Total Volume**
Panel A: 2003-2004 Transparency Events For Non-144A Bonds								
Post-TRACE Period	0.0000	218,112.8***	-0.0007***	0.000006*	0.0100	0.005	0.004	0.018**
	(0.905)	(0.004)	(0.008)	(0.093)	(0.449)	(0.667)	(0.583)	(0.032)
TREATED	0.0011***	194,091.2***	-0.0002	0.000032***	0.0031	-0.004	0.015***	0.021***
	(0.000)	(0.001)	(0.264)	(0.000)	(0.698)	(0.661)	(0.005)	(0.001)
Post x TREATED	0.0009***	-66,538.5	0.0000	0.000008*	-0.0018	0.002	0.012	0.006
	(0.006)	(0.127)	(0.947)	(0.083)	(0.825)	(0.823)	(0.111)	(0.186)
Ln (Average Issue Size)	0.0023***	502,644.7***	0.0019***	0.000051***	0.0595**	0.016	0.066***	0.071***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.015)	(0.611)	(0.000)	(0.000)
Ln (Average Bond Age)	-0.0052***	31,194.4	0.0010***	-0.000030***	0.0288	-0.018	0.025	-0.030
	(0.000)	(0.882)	(0.005)	(0.002)	(0.106)	(0.467)	(0.293)	(0.107)
Corp Bond Index Return (t - 1)	0.0144***	3,090,831.4***	-0.0089***	0.000229***	-0.0723	0.097	0.033	0.085
	(0.003)	(0.005)	(0.005)	(0.001)	(0.637)	(0.320)	(0.798)	(0.616)
Stock Market Index Return (t - 1)	-0.0151*	-1,185,421.7	0.0238***	-0.000129	0.2919	0.032	0.187	0.337
	(0.062)	(0.463)	(0.000)	(0.177)	(0.170)	(0.850)	(0.375)	(0.195)
Chg. Corp Bond Index Volatility (t - 1)	0.0086	2,143,455.0	-0.0771***	-0.000001	-0.9999	-0.425	-1.708*	-1.411
	(0.653)	(0.727)	(0.000)	(0.998)	(0.178)	(0.554)	(0.068)	(0.136)
Chg. in VIX (t - 1)	-0.0003	-96,348.2	0.0009***	-0.000003	0.0127	-0.000	0.010	0.017
	(0.289)	(0.147)	(0.000)	(0.406)	(0.199)	(0.999)	(0.300)	(0.165)
Chg. in 3-Month Libor (t - 1)	0.0035	-1,958,821.0***	0.0041*	-0.000005	0.1449	0.107	0.018	0.067
	(0.279)	(0.009)	(0.055)	(0.870)	(0.294)	(0.289)	(0.855)	(0.559)
Constant	-0.0054	-4,369,415.2*	-0.0236***	-0.000490***	-0.0067	0.735	-0.538**	-0.457**
	(0.340)	(0.064)	(0.002)	(0.000)	(0.981)	(0.123)	(0.017)	(0.011)
Observations	2,527	2,526	52,749	52,749	2,352	2,352	2,526	2,526
Adjusted R-squared	0.425	0.435	0.088	0.099	0.471	0.486	0.873	0.841
Dealer Fixed Effects/S.E.s Clustered at Dealer Level	YES	YES	YES	YES	YES	YES	YES	YES

Panel B: 2014 Transparency Event For 144A Bonds	(1) Dollar Volume/ Amount Out.	(2) Average Trade Size	(3) Time-Weighted Daily Chg. in Capital / Agg. Volume	(4) Time-Weighted Daily Chg. in Capital / Amt Out.	(5) Principal Volume / Total Volume	(6) Principal %	(7) # Inter-dealer Trades / Total Trades	(8) # Inter-dealer Volume / Total Volume
Post-Transparency Period	-0.0008***	-182,250.6***	0.0004	-0.000003***	-0.0165	-0.008	-0.019*	-0.016**
	(0.002)	(0.004)	(0.472)	(0.002)	(0.387)	(0.664)	(0.053)	(0.026)
Transparency Shock	-0.0025***	1,155,725.2***	-0.0049***	0.000008***	-0.0869***	-0.053	-0.187***	-0.045**
	(0.007)	(0.002)	(0.006)	(0.003)	(0.009)	(0.164)	(0.001)	(0.040)
Post x Shocked	0.0006**	-126,270.1	0.0006	-0.000001	0.0263	0.032	-0.005	-0.004
	(0.049)	(0.191)	(0.333)	(0.142)	(0.210)	(0.108)	(0.608)	(0.541)
Ln (Average Issue Size)	0.0008***	333,883.7***	-0.0000	0.000003**	0.0261***	0.014	0.018**	0.034***
	(0.001)	(0.000)	(0.916)	(0.015)	(0.001)	(0.139)	(0.023)	(0.000)
Ln (Average Bond Age)	-0.0021*	224,880.3	-0.0016*	-0.000000	-0.0117	-0.045	0.063**	0.037**
	(0.057)	(0.384)	(0.089)	(0.702)	(0.777)	(0.260)	(0.021)	(0.030)
Corp Bond Index Return (t - 1)	-0.0316***	-1,987,482.2	0.0275**	-0.000103**	0.1227	0.069	0.123	-0.126
	(0.002)	(0.211)	(0.013)	(0.015)	(0.825)	(0.883)	(0.475)	(0.627)
Stock Market Index Return (t - 1)	-0.0886***	-11906968.6***	0.0723**	-0.000338***	0.0990	0.068	-0.428	-0.357
	(0.001)	(0.004)	(0.015)	(0.001)	(0.867)	(0.893)	(0.221)	(0.412)
Chg. Corp Bond Index Volatility (t - 1)	-0.0348***	-222,031.7	0.0096	-0.000092	0.4169	0.464	-0.443	0.197
	(0.006)	(0.961)	(0.755)	(0.239)	(0.728)	(0.690)	(0.230)	(0.761)
Chg. in VIX (t - 1)	-0.0025***	-285,372.1***	0.0019**	-0.000009***	0.0038	0.007	-0.010	-0.013
	(0.001)	(0.010)	(0.015)	(0.001)	(0.834)	(0.669)	(0.312)	(0.289)
Chg. in 3-Month Libor (t - 1)	0.0247***	4,297,663.2**	-0.0303**	0.000109***	-0.2771	-0.144	0.128	0.046
	(0.000)	(0.043)	(0.022)	(0.001)	(0.409)	(0.547)	(0.472)	(0.803)
Constant	0.0032	-3,835,129.0**	0.0105*	-0.000016	0.5775**	0.810***	0.049	-0.270*
	(0.427)	(0.023)	(0.055)	(0.313)	(0.010)	(0.003)	(0.774)	(0.063)
Test Post x Shocked: 2003-2004 effect = June 2014 effect	ns	***	ns	***	ns	ns	**	ns
Observations	1,751	1,732	38,326	38,326	1,628	1,628	1,732	1,732
Adjusted R-squared	0.493	0.455	0.012	0.137	0.308	0.502	0.869	0.934
Dealer Fixed Effects/S.E.s Clustered at Dealer Level	YES	YES	YES	YES	YES	YES	YES	YES

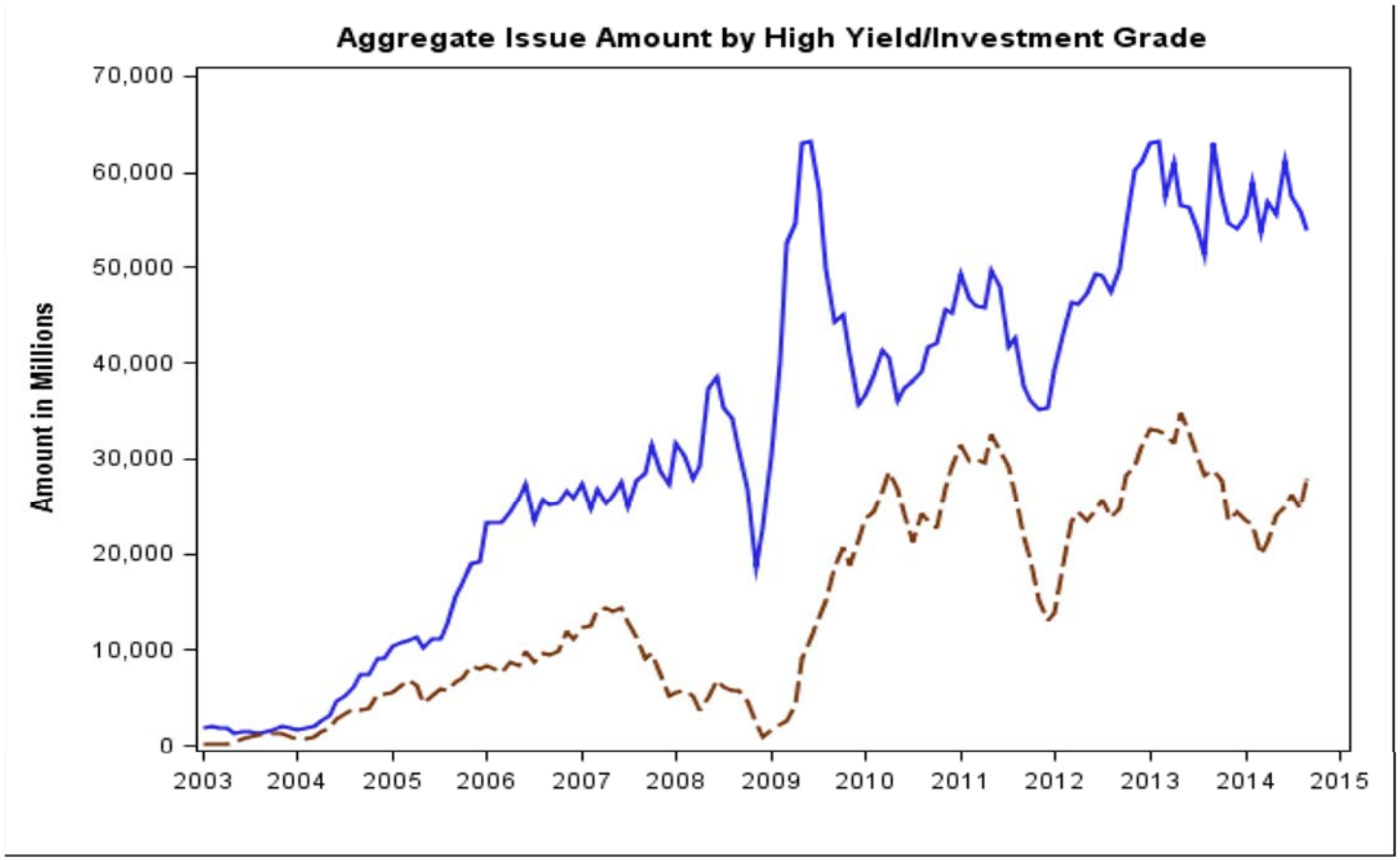

Figure 1: This figure shows the six-month moving average aggregate value of new issues over the January 2003 to September 2014 period. The solid blue line refers to investment grade issues and the dashed brown line refers to high yield issues.

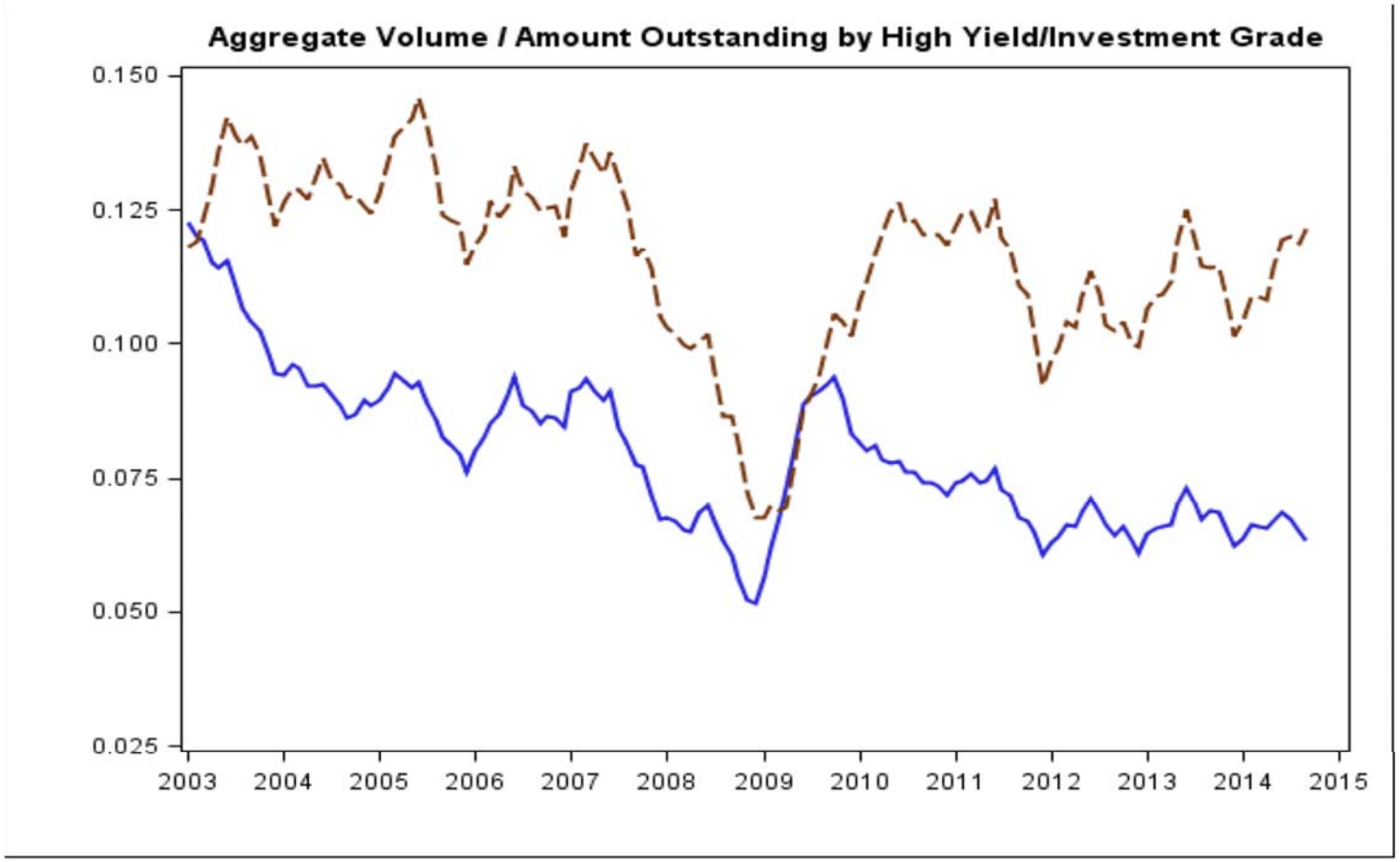

Figure 2: This figure shows the six-month moving average aggregate trading volume scaled by total amount outstanding over the January 2003 to September 2014 period. The solid blue line refers to investment grade issues and the dashed brown line refers to high yield issues.

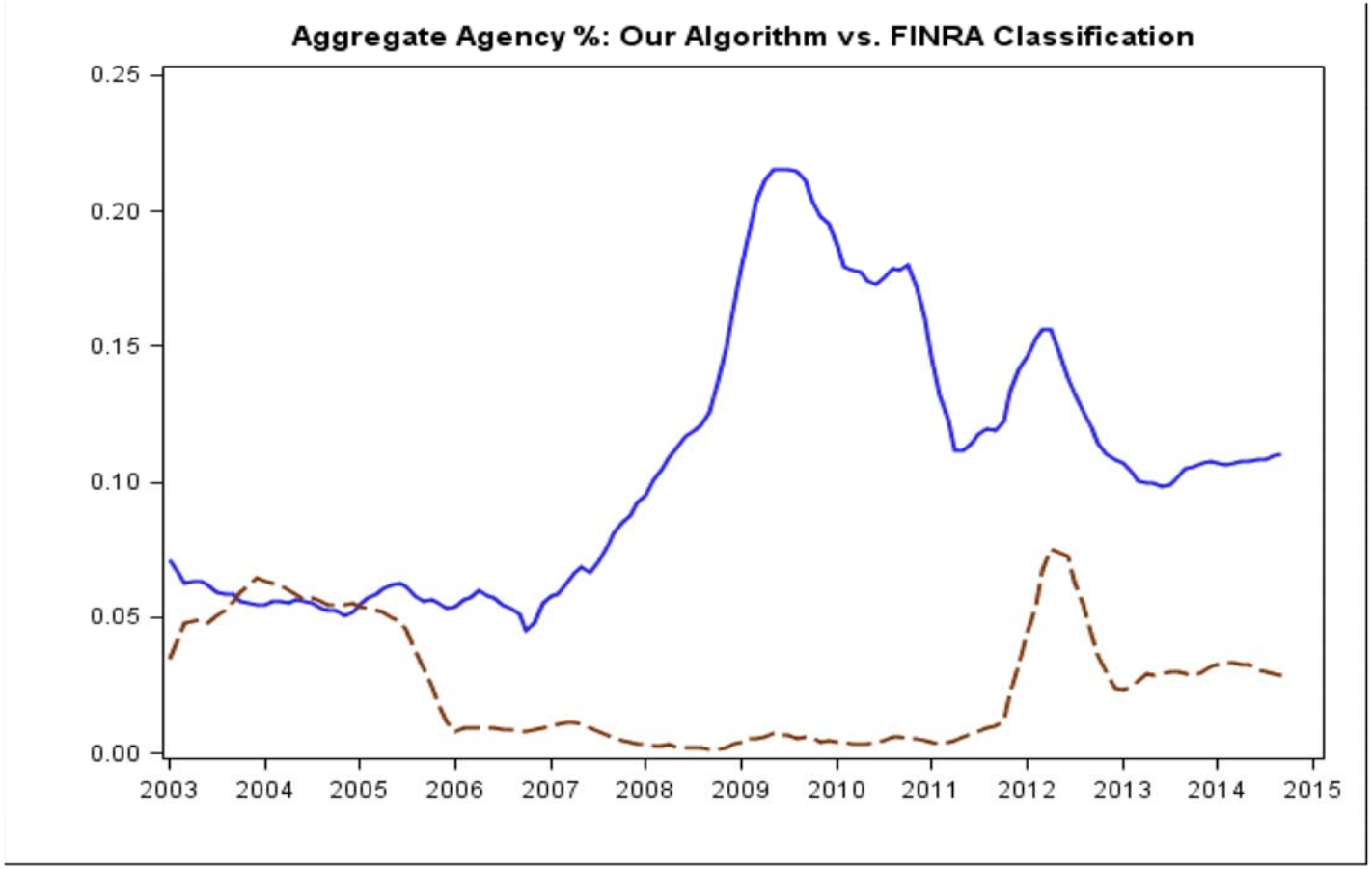

Figure 3: This figure shows the six-month moving average percent of customer trades for the top 15 dealers that are done on an agency basis for non-144A bonds over the January 2003 to September 2014 period. The solid blue line refers to trades classified as agency by our 60-second algorithm (but not classified as agency by FINRA) and the dashed brown line refers to trades classified as agency by FINRA. Trades within the first 14 days of the offering date are excluded.

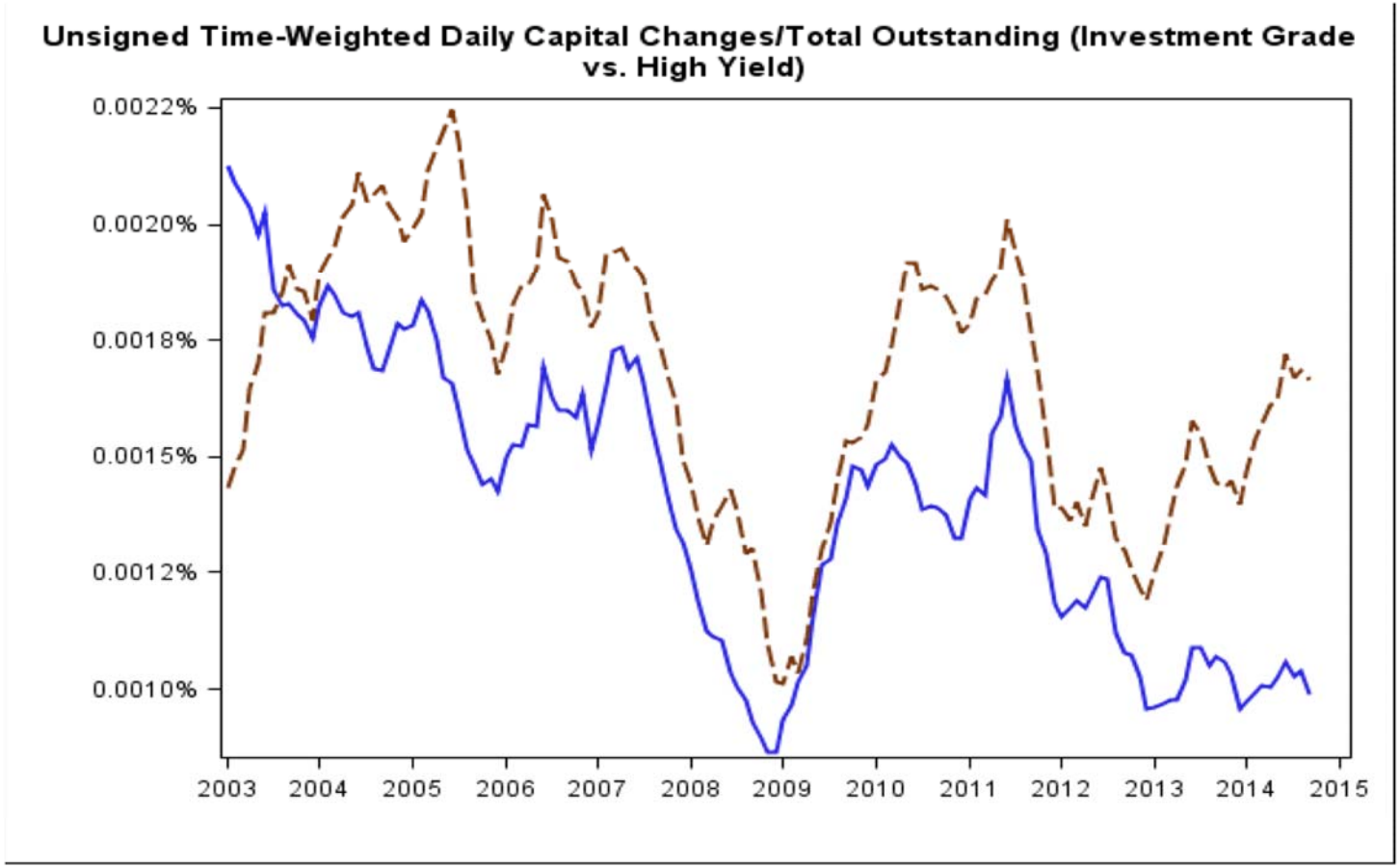

Figure 4a: This figure shows the six-month moving average unsigned time-weighted changes in daily capital scaled by total amount outstanding for the top 15 dealers for investment grade and high yield non-144A bonds over the January 2003 to September 2014 period. The solid blue line refers to investment grade bonds and the dashed brown line refers to high yield bonds. Dealer-month observations are value-weighted by dealer volume in the current month.

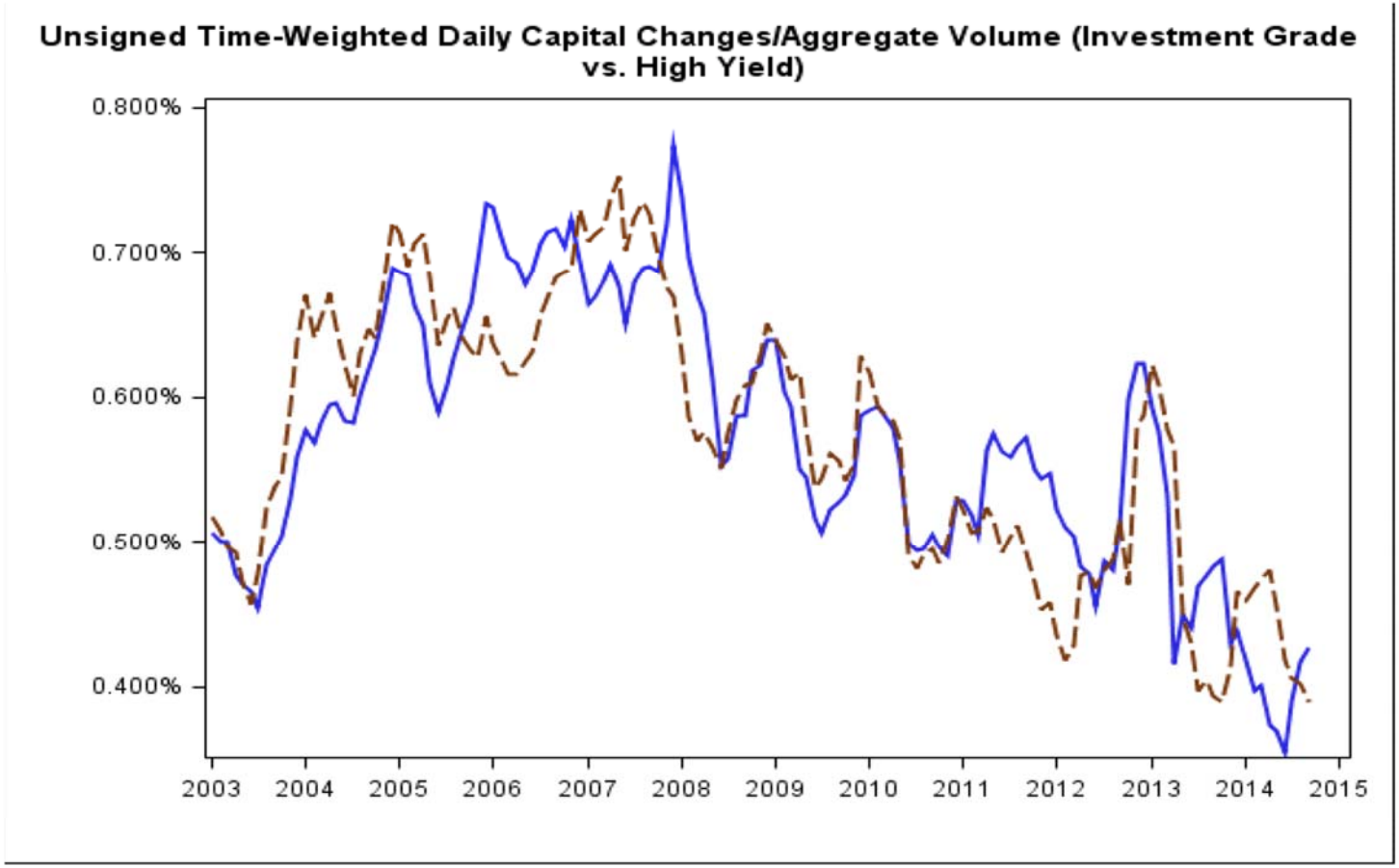

Figure 4b: This figure shows the six-month moving average unsigned time-weighted changes in daily capital scaled by aggregate volume for the top 15 dealers for investment grade and high yield non-144A bonds over the January 2003 to September 2014 period. The solid blue line refers to investment grade bonds and the dashed brown line refers to high yield bonds. Dealer-month observations are value-weighted by dealer volume in the current month.

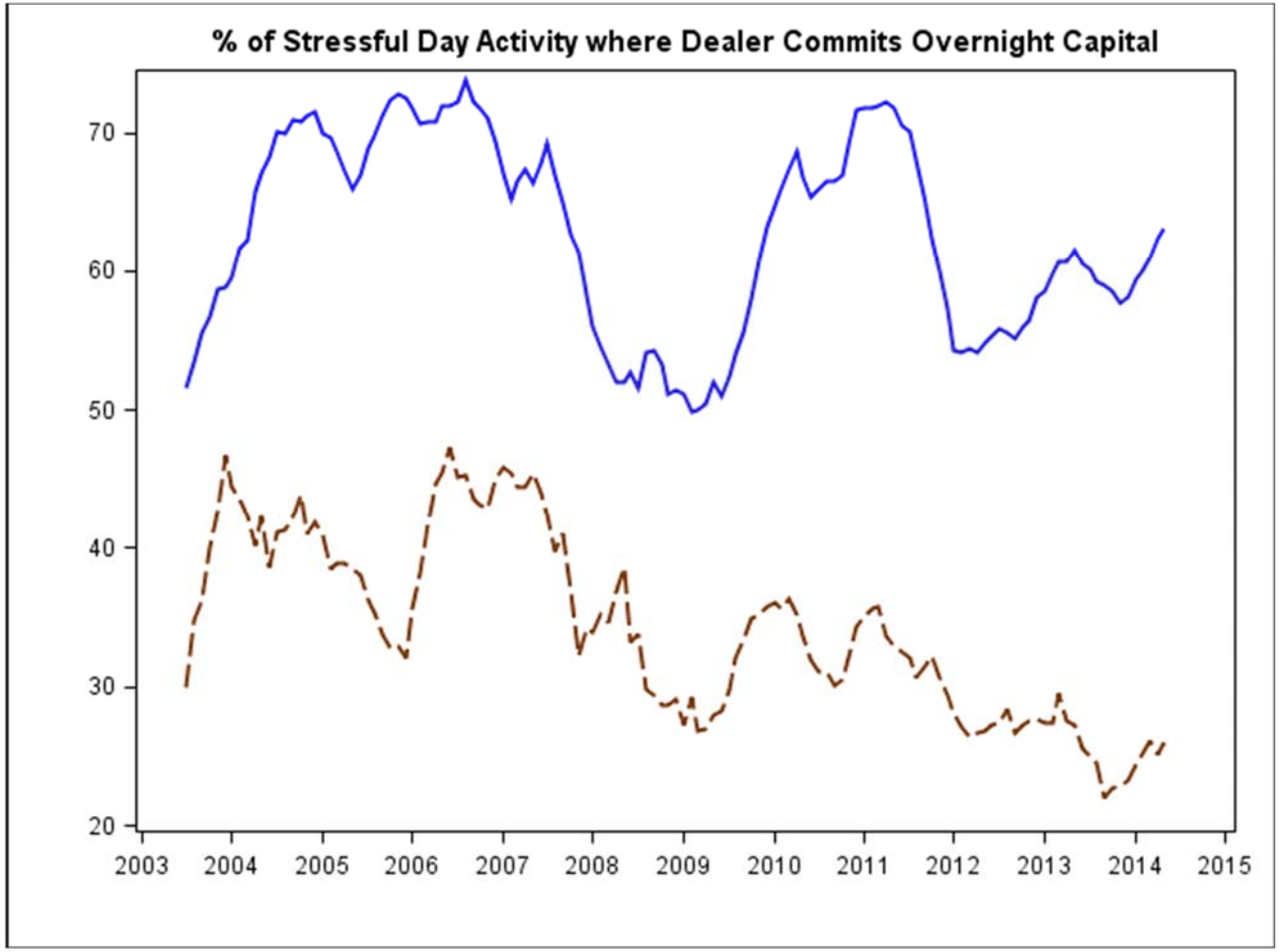

Figure 5: This figure shows the six-month moving average percent of stressful day block trading activity where the dealer commits overnight capital over the June 2003 to May 2014 period. We consider stressful days when trading activity of the large dealer exceeds $3 million in the bond. The solid blue line refers to a portfolio of bonds that are transparent, investment grade, and have an issue size greater than $1 billion and the dashed brown line refers to a portfolio of bonds that are transparent, high yield, and have an issue size greater than $1 billion.