Capital Commitment and Illiquidity in Corporate Bonds*

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We study trading costs and dealer behavior in U.S. corporate bond markets from 2006 to 2016. Despite a temporary spike during the financial crisis, trade execution costs have not increased notably over time. However, alternative measures, including dealer capital commitment over various time horizons, turnover, block trade frequency, and average trade size not only decreased during the financial crisis, but continued to decline afterward. These declines are attributable to bank-affiliated dealers, as non-bank dealers have increased their market commitment. The evidence supports that liquidity provision in the corporate bond markets is evolving away from the traditional commitment of dealer capital to absorb customer imbalances and toward dealers playing more of a matching role, and that post-crisis regulations focused on banking contributed.

The liquidity of the corporate bond market has attracted substantial recent attention from practitioners, regulators, and academics. The financial crisis of 2007-2009 saw the broad deterioration of liquidity in both equity (e.g., Anand, Irvine, Puckett, and Venkataraman, 2013) and corporate bond (e.g., Dick-Nielsen, Feldhutter, and Lando, 2012; Friewald, Jankowitsch, and Subrahmanyam, 2012) markets. However, while Anand et al. (2013) find that equity market liquidity recovered after the financial crisis, concerns regarding corporate bond market liquidity appear to have become more widespread in recent years. For example, Daniel Gallagher, former Commissioner of the U.S. Securities and Exchange Commission (SEC) during 2015 expressed concern that "A lack of liquidity in corporate-bond markets could pose a 'systemic risk' to the economy."[1] A 2016 Greenwich Associates study reports that among 400 credit investors interviewed, more than 80% indicated that reduced liquidity in corporate bonds limits their investment strategies.[2]

Concerns regarding corporate bond market liquidity have been attributed by some observers to post-crisis regulatory initiatives. For example, Pacific Investment Management Company (PIMCO) asserts that "the combination of immediate-post-crisis capital and liquidity regulations and a lower return environment has made banks less able and willing to function as market makers."[3] However, not all observers are convinced that liquidity in the corporate bond markets has deteriorated. Some assert that concerns regarding bond market liquidity comprise a "myth" and arise from traditional bond dealers' desire to maintain their "privileged market position."[4] Janet Yellen, chair of the U.S. Federal Reserve, stated "It's not clear whether there is or is not a problem" (with liquidity), and added that "it's a question that needs further study."[5]

Our goal in this paper is to provide an analysis of liquidity and key aspects of dealer behavior in the corporate bond market over the 2006 to 2016 period. We are particularly interested in assessing market quality in the years following the financial crisis, and in evaluating potential explanations for the changes observed. To do so, we use an enhanced version of the TRACE database of transactions in U.S. corporate bonds, made available by FINRA. In addition

[1] http://www.bloomberg.com/news/articles/2015-03-02/corporate-bond-market-poses-systemic-risk-sec-s-gallagher-says.
[2] https://www.greenwich.com/press-release/2017-liquidity-starved-bond-investors-could-get-relief-block-trading-solutions-and
[3] http://www.barrons.com/articles/a-look-at-bond-market-liquidity-1440103954.
[4] "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.
[5] http://blogs.wsj.com/economics/2015/07/15/fed-chairwoman-janet-yellens-report-to-congress-live-blog/.

to the standard TRACE data, the data we study includes masked dealer identities, which allows us to directly assess activity at the dealer level, as well as unmasked trade sizes and transactions in privately-traded 144A bonds.

We document that, despite an increase during the financial crisis period, average customer trade execution costs for corporate bonds in aggregate have not increased markedly over time. We estimate that round trip transaction costs during the 2014 to 2016 period averaged 0.42%, as compared to 0.40% during the 2006 to 2007 pre-crisis period. However, average trading costs are affected by shifts in the composition of trading. Investment-grade bonds, which tend to be more liquid, grew from 58% of market trading before the financial crisis to 69% in recent years. At the same time, the share of overall trading accounted for by the largest bond issues (issue size of $1 billion or more) grew from 37% to 52%, while that of trades most likely to be facilitated by electronic venues increased from 3% to 10%. While trading costs in these segments decreased slightly over time, we document modest increases in trading costs for bonds in less-liquid segments of the market.

In addition, it is important to recognize that execution costs measure the price concession for completed trades, and do not capture either customers' difficulty in arranging trades or the implicit costs associated with trades that were desired but not completed. We therefore consider a number of additional measures, including dealers' capital commitment measured at the intraday, overnight, and weekly horizons, turnover, average trade size, block trade frequency, and principal volume. The results, not surprisingly, show that all measures of dealer commitment declined during the financial crisis. More informative, most measures of dealer commitment did not revert to pre-crisis levels and many measures worsened during the most recent years. All of the measures we consider point to significantly lower dealer capital commitment in the most recent 2014 to 2016 period, and many point to significantly lower capital commitment in the recent years vs. the financial crisis period itself.

We consider possible causes for declines in dealer capital commitment in the most recent period. Post-crisis reforms in bank regulation, including the Volcker Rule and Basel III requirements, while directly focused on banking rather than market making activities, may have affected dealers' willingness or ability to commit capital to the provision of liquidity in the corporate bond market. At the same time, traditional telephone-based dealer trading faces increasing competition. The U.S. Treasury department estimates that electronic platforms (the

most important of which are “request-for-quotation” systems rather than limit order books) have captured fifteen percent or more of customer-to-dealer market share in recent years, with the electronic share higher for investment grade than for high yield bonds. Simultaneously, corporate bond ETFs allow investors to gain exposure to corporate bond returns without directly trading in the dealer market. Though bond ETFs have grown rapidly grown from 0.2% (net asset value to bonds outstanding) to 4.1% over our sample period they remain substantially smaller than equity market ETFs due to the presence of regulatory barriers. [6] Further, the institutions that create ETFs and the Authorized Participants who create and redeem shares still trade in the underlying, relatively illiquid market.

To distinguish between explanations, we compare outcomes across dealers that are affiliated with banks and non-bank dealers. We find that the decreases in dealer capital commitment in recent years are entirely attributable to bank-affiliated dealers. Non-bank dealers increase intraday, overnight, and weekly capital commitment, turnover, and principal volume as compared to the pre-crisis period, while all of these measures deteriorated in recent years for bank-affiliated dealers. This result supports the interpretation that post-crisis regulations focused on banking have contributed to dealers’ reduction in capital commitment to the corporate bond market in recent years. Our results also support the prediction of Duffie (2012) that non-bank dealers will step into the void left by banks. However, non-banks dealers are significantly smaller than bank-affiliated dealers, and have not fully offset decline in bank-affiliated dealer capital. A decline in the overall supply of market-making capital is consistent with the evidence reported by Friewald and Nagler (2016) that the relation between dealer inventory positions and risk-adjusted bond returns has strengthened in recent years.

In the segment of the market where electronically-facilitated trades are most likely to occur, we document a decrease in capital commitment relative to trading volume for both bank and non-bank dealers. This result is consistent with the interpretation that less capital is required in the portion of the market where electronic communications have reduced search costs.

It is possible that the most notable reductions in bond market liquidity do not manifest during normal trading, but emerge when the market is stressed. Further, it could be the case that

[6] Bond ETF information is available to academics from ICI.org. Madhavan (2016, pg. 104) notes that "*many regulatory schemes do not consider ETFs as an investment type, typically treating ETFs as equities even if the underlying exposure is to bonds. Examples include capital rules for insurers and broker-dealers and investment eligibility and diversification rules for insurers.*"

non-bank dealers reduce their commitment and rely on traditional bank-affiliated dealers to provide liquidity at difficult times. To shed light on these possibilities, we study days where individual bonds are stressed by large customer block trades as well as days characterized by market-wide stress, identified based on the credit market component of the Cleveland Federal Reserve Financial Stress Index. We find that results for both bond-level and market-wide stressful days mirror those for the overall sample. In particular, non-bank dealers increased block volume, intraday, overnight, and weekend capital commitment on stressful days in recent periods relative to pre-crisis periods, while bank-affiliated dealers have reduced their stressful day market commitment. Further, only for bank-affiliated dealers do we detect a reduction in capital commitment on stressful days as compared to control days within the same time period.

Collectively, the evidence indicates that the roles of corporate bond dealers have changed in recent years. Bank-affiliated dealers in particular are less inclined to play the role of a traditional market maker who commits capital to absorb customer order imbalances, moving instead toward more of a matching role. This shift is especially apparent in the most recent period, when banks became increasingly subject to the requirements of the Volcker Rule. At the same time, non-bank dealers have increased their market share and their willingness to commit capital, albeit from small initial pre-crisis levels. Overall, customer trade execution costs have not increased appreciably, but this outcome reflects in part a shift in trading toward the most liquid segments of the market.

The stark divergence in recent period outcomes for bank-affiliated versus non-bank dealers supports the reasoning that post-crisis regulations focused on banking have contributed to the empirically observed reductions in turnover, average trade size, block trading frequency and dealer capital commitment in the corporate bond market. It will be of interest to assess if capital commitment by non-bank dealers and/or the continued emergence of electronic quotation venues will in time fully offset the effects of decreased bank-affiliated dealer capital commitment.

This paper is organized as follows. We discuss related literature and post-crisis regulation in Section I. We describe the data, dealer sample construction, and provide aggregate market statistics in Section II. Section III presents trading cost estimates. Section IV describes how we measure dealer-level capital commitment and additional market quality variables. Section V presents the outcomes of multivariate regressions that assess the evolution of capital commitment and market quality over time, after allowing for changes in relevant control variables. In Section

VI we expand the analysis to consider capital commitment and market quality outcomes separately for bank-affiliated and non-bank dealers. Section VII presents bank and non-bank dealer outcomes on days that are particularly stressful. Finally, we summarize the results and present implications of the study in Section VIII.

I. The Related Literature and Post-crisis Regulation

A. Bond Market Liquidity Literature

While the literature on market making and liquidity is vast, the majority of researchers' attention has focused on stock markets. Schultz (2001) provides the first systematic evidence regarding corporate bond trading, showing that institutional trades in corporate bonds incurred transactions costs that were large relative to those observed in equity markets.[7]

The introduction of post trade transparency to the corporate bond market and the 2007-2009 financial crisis accelerated research focused on corporate bonds. The phased introduction of TRACE transaction reporting during the 2002 to 2005 period 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 trade execution costs paid by customers. Dick-Nielsen, Feldhutter, and Lando (2012) and Friewald, Jankowitsch and Subrahmanyam (2012) document that corporate bond liquidity was substantially degraded during the 2007-2009 financial crisis.

As the corporate bond market lacks pre-trade transparency, authors have developed measures of corporate bond liquidity that do not require quotation data. Feldhutter (2012) 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 and test a measure to capture "latent" liquidity in illiquid markets.

A number of recent papers examine dealer networks and dealer behavior. Di Maggio, Kermani, and Song (2016) study the collapse of a large dealer in 2008 and find that disruption to the dealer network led to increased transaction costs. O'Hara, Wang, and Zhou (2015) document

[7] Researchers have also studied closely related markets. Asquith, Au, and Covert (2013) examine the market for borrowing corporate bonds (which facilitates the ability to take short positions), reporting a reduction in borrowing costs over time. Das, Kalimipalli, and Nayak (2014) argue that the advent of CDS trading has made bond markets less efficient and has 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.

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 (2017) find that dealers' propensity to offset trades within the same day rather than commit capital for longer periods is highest for the most risky and illiquid bonds, indicating dealers actively mitigate inventory risk via increased search.

The literature has also demonstrated that liquidity is important because it affects the valuation of corporate bonds. Chen, Lesmond, and Wei (2007) and Lin, Wang, and Wu (2011) document that illiquid bonds have significantly higher yield spreads, and that improvements in bond liquidity leads to reduced yield spreads. Bao and Pan (2013) show that illiquidity contributes to the observed volatility of bond prices, while Cespa and Foucault (2014) show that a lack of liquidity can hinder efficient price discovery. Dick-Nielsen and Rossi (2015) study the removal of individual bonds from key indices, which is likely to generate customer selling pressure, documenting that transaction costs for these bonds more than doubled in the 2010 to 2013 period as compared to the pre-crisis period.

B. Post Crisis Regulatory Reforms

We consider in particular the possibility that post-crisis regulatory reforms focused on banks have affected dealers' willingness to supply liquidity to the corporate bond market. A number of working papers that share this broad objective have emerged since our paper was first circulated. Choi and Huh (2017) document the increased use in recent years of matching (facilitating) trades, as opposed to traditional market making by bond dealers. They show that bid-ask spreads on these matched trades are significantly lower than for traditional market making trades, and conclude that allowing for this endogenous shift leads to the conclusion that bid-ask spreads have increased in recent years for traditional market-making trades. Schultz (2017) documents that dealers in actively traded bonds have in recent years relied more frequently on prearranged trades that are quickly offset by opposite direction trades. Bao, O'Hara, and Zhou (2016) study individual bonds immediately following credit rating downgrades, when customers are likely to initiate sales, concluding that liquidity for these trades has decreased after the Volcker Rule (discussed further below) was implemented. However, Anderson and Stulz (2017) argue that the degradation of liquidity after bond downgrades is actually less pronounced in the recent data as compared to pre-crisis years.

Our study is distinguished from these by the fact that we provide comprehensive evidence for the U.S. corporate bond markets, both on an overall basis and on specific days when the market is likely to be stressed, that we present evidence focused directly on dealers' willingness to commit capital to bond trading, that we assess a number of additional measures of market quality, and most importantly that we assess outcomes for bank-affiliated and non-bank dealers separately.

B.1. The Dodd-Frank Act, the "Volcker Rule", and the Basel Accords

The Dodd-Frank act was signed into law on July 21, 2010. Several aspects of the Dodd Frank act focused specifically on banks. For example, the rule requires the Federal Reserve to conduct an annual stress test of bank holding companies with $50 billion or more in total consolidated assets.[8]

Perhaps the most relevant portion of the Dodd-Frank act for the corporate bond market was the "Volcker Rule", which was intended to prevent institutions with access to FDIC insurance or to the Federal Reserve's discount window from engaging in risky proprietary trading. The Volcker Rule was originally scheduled to take effect on July 21, 2012. However, implementation was delayed until an effective date of April 1, 2014. Large banks were required to be fully compliant by July 21, 2015, while making good faith efforts to comply during the implementation period subsequent to April 1, 2014. In fact, a number of banks announced closures of their proprietary trading operations in advance of the implementation of the Volcker rule, including J.P. Morgan and Goldman Sachs in September of 2010, Morgan Stanley in January of 2011, Bank of America in June 2011, Citigroup in January 2012, and RBC in April of 2014.[9]

The Volcker Rule was not intended to restrict market making activity, and specifically allows banks to conduct "riskless principal" trades that are "customer-driven." The rule also contains a market making exemption for trading desks that "routinely stand ready to purchase and sell financial instruments." However, Schultz (2017) observes that the Volcker Rule requires banks to report inventory turnover as well as the standard deviation of daily trading

[8] https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20160623a1.pdf.
[9] "JPMorgan shifting its proprietary trading desk," 9/27/2010, NY Times; "Goldman to close prop-trading unit," 9/4/2010, Wall Street Journal; "Morgan Stanley to spin off prop trading unit," 1/10/2011, Reuters; "Bank of America is shutting down Merrill's bond prop trading desk," 6/10/2011, Business Insider; "Citigroup exits proprietary trading, says most staff leave," 1/27/2012, Bloomberg; "RBC exits half it prop-trading strategies as Volker Rule looms," 12/3/2014, Bloomberg.

profits, with the implication that lower turnover or higher profit volatility may be deemed indicative of proprietary trading. The requirement to report inventory turnover could disincentive banks from taking positions in less-liquid bonds in particular. Duffie (2012) observes that market making is inherently a form of proprietary trading, and the Volcker Rule may have unintended consequences. He predicts that, under the Volcker Rule, "a bank that continues to offer substantial market making capacity to its clients would face a risk of regulatory sanction (and the attendant stigma) due to significant and unpredictable time variation in the proposed metrics for risk."

In addition to the Volcker rule, dealers affiliated with banks were affected by implementation of the Basel 2.5 and Basel III banking accords, which reduce allowable bank leverage and impose more restrictive definitions regarding banks' requisite capital holdings, in June 2012 and July 2013, respectively. A survey conducted in September 2015 by the Committee on the Global Financial Systems found that respondents considered the Basel 2.5 capital charges to have a significant impact on banks' corporate bond trading activities.[10] Basel III involved leverage ratio, liquidity coverage, and net stable funding ratio tests, each of which increase banks' capital costs[11,12]. The Basel accords impose higher capital costs for risky assets, which in turn may disincentive banks from making markets in riskier bonds in particular.

As this discussion demonstrates, it is not possible to define a discrete date when the effects of post-crisis regulatory initiatives became binding. As the closing of proprietary trading desks in advance of the formal effective date of the Volcker rule noted above illustrates, the effects of major new regulations can manifest themselves in advance of the formal compliance dates. We follow Bao, O'Hara, and Zhou (2016) in defining April 1, 2014 as the beginning of

[10] Committee on the Global Financial System, 2016, Fixed Income Market Liquidity, #55, p20.
[11] Committee on the Global Financial System, 2014, Market-making and Proprietary Trading: Industry Trends, Drivers and Policy Implications, #52, p.28.
[12] In addition, European banks with large corporate bond trading desks also face regulatory changes associated with the Basel Accords that potentially affect their capital commitments to U.S. trading desks. In February 2009, UBS announced that it is focusing on wealth management and other core businesses and making significant reductions in fixed income trading. In November of 2011, Credit-Suisse announced that it would accelerate previously announced plans to reduce their risk-weighted assets in fixed income by 50%. Barclays, as part of a strategic review in May of 2014 announced that that it is reducing its investment banking workforce by 25%. "Preparing UBS for the new market environment," 2/10/2009, UBS Investor Release. "Barclays strategic review," 2/12/2013, Barclays Investor Release. "Press release," 7/28/2011, Credit Suisse Media Release. "Deutsche Bank cuts prop trading, cautious about 2010," 2/4/2010, Reuters.

the "Volcker period", while recognizing that some effects might have been manifest in the market at earlier dates.

While the lack of a clear effective date precludes a simple difference-in-difference test, we are able to shed light on the question of whether post-crisis banking reforms have affected liquidity provision in the corporate bond market by examining results separately for dealers that are affiliated with a bank holding company and dealers that are not so affiliated. Bank-affiliated dealers are impacted by the Volcker Rule, stress tests, and the two Basel accords. In contrast, non-bank dealers are unlikely to be directly affected by these regulatory reforms.

II. Data and Sample Construction

In this section, we describe the enhanced TRACE data and the dealer samples we construct, and we report on aggregate corporate bond market statistics. Since the 2002 to 2005 TRACE phase-in period has been extensively examined by various studies that document reduced transaction costs subsequent to the introduction of transaction reporting, we omit these years and report on the January 2006 to October 2016 period.

A. Data Description

We rely on an enhanced version of the TRACE data provided by FINRA that includes trade data disseminated to the public as well as (144A bond) trades not so disseminated. The data includes a dealer identification number, indication of whether the dealer is (as of 2016) affiliated with a bank, and unmasked trade sizes. The database includes over 109,000 unique CUSIPs. However, the majority of these pertain to instruments other than corporate bonds, such as retail notes, foreign government bonds, U.S. agency debentures, pay-in-kind bonds, corporate strips, medium term notes, convertible and preferred securities, etc. We consider only the 24,648 CUSIPs identified by FISD as non-puttable U.S. Corporate Debentures and U.S. Corporate Bank Notes (bond type=CDEB or USBN) and with a reported maturity date.

The data includes 70.75 million trades completed between January 2006 and October 2016 for these CUSIPS. Table I reports the effects of additional data filters that we implement. We exclude all bonds with less than five trades during the eleven-year sample period, as well as bonds with a reported trade size that exceeds the bond's offer size, and bonds for which the TRACE implementation date is missing. We also exclude trades that are reported after the bond's amount outstanding is reported as zero, and trades with an execution date prior to January

2006. Finally, we exclude trades associated new issuances, including those indicated to be primary market transactions as well as secondary market transactions that occur immediately after the issuance.[13] With these filters imposed, the sample is comprised of 65.61 million transactions in 22,349 distinct CUSIPs.

B. Dealer Samples

We conduct a number of analyses that focus on capital commitment by individual dealers. The sample includes almost 2,700 dealers, about 2,100 of which engage in customer trades, but most of whom trade only sporadically. For tractability, we focus the dealer-level analysis on the more active dealers, defined in two ways. Each of these dealer samples excludes one relatively large dealer that, during 2014, began to report an immediately offsetting transaction for the large majority of its principal trades. Conversations with FINRA indicated that these transactions actually represented transfers of inventory to an off-shore subsidiary.[14]

First, we create a "Top 70%" sample. For each year, we select the largest dealers such that the dealers in combination have a seventy percent share of customer-dealer trading volume. The number of dealers that together comprise a 70% market share each year ranges between ten and twelve. Individual dealers may enter or depart the Top 70% sample across years, and a total of twenty unique dealers enter the Top 70% sample at some point. Second, we construct a "Constant Dealer" sample that consists of the thirty five dealers that (i) are active during all sample years, and (ii) were among the thirty most active dealers during at least one year. The "Top 70%" sample includes 28% of all trades, 68% of aggregate volume (including interdealer trading), and 71% of the customer-dealer volume. By comparison, the Constant Dealer sample includes 58% of all trades, 75% of aggregate volume, and 76% of customer-dealer volume.

The main advantage of studying the Constant Dealer sample is that any changes observed over time must reflect changes in the decisions of and outcomes to existing dealers, as opposed to the entry of new dealers or the exit of existing dealers. However, the Constant Dealer sample includes an increasing market share over time (from 69% in 2006 to 78% in 2016). The Top

[13] The intent is to avoid the possibility that results obtained here could be attributable to the growth in new bond issues and associated trades. If the offering day is on or before the 15th of the month we exclude the remainder of the issue month, otherwise we exclude the issue month and the following month.

[14] Since November 2015 FINRA has required dealers to specifically flag such offshore affiliate transactions. See http://www.finra.org/industry/notices/15-14. Since the affiliate flag was not available for the majority of our sample period we could not reliably identify which trades involved genuine capital commitment by this bank. Nevertheless, our key conclusions continue to hold when this bank is not excluded from the sample.

70% sample in contrast focuses on dealers with a nearly constant market share. As such, we focus on the Top 70% sample in our main tests of changing capital commitment over the sample period. However, when we consider outcomes for bank-affiliated and non-bank dealers we focus on the Constant Dealer sample, to ensure that outcomes reflect changes in the behavior of existing dealers as opposed to entry and exit of dealers.

C. Sub-Period Definitions

To understand how liquidity and the willingness of dealers to commit capital to the corporate bond market have changed over time, we consider five sub-periods. We designate the January 2006 to June 2007 interval as the "Pre-Crisis" period. During this period TRACE transaction reporting was in effect for all publically-issued bonds, and the financial crisis was not yet manifest. We define this period as the benchmark in our time-series regression analyses. We follow Friewald, Jankowitsch and Subrahmanyam (2012), Dick-Nielsen, Feldhutter and Lando (2012), Bao, O'Hara and Zhou (2016) and Friewald and Nagler (2016) in defining the July 2007 to April 2009 as the "Crisis" period. We designate the May 2009 to June 2010 interval as the "Post-Crisis" period. The Dodd-Frank act was signed into law on July 21, 2010. Consequently, we refer to the July 2010 to March 2014 as the "Regulation" period. Finally, following Bao, O'Hara and Zhou (2016) we designate the post April 2014 period as the "Volcker" period.

D. Aggregate Market Statistics

Table II reports aggregate market statistics for the 65.61 million trades that occurred between January 2006 and October 2016, and that pass the filters described on Table I. Trading volume was approximately three trillion dollars in 2006 and 2007, before declining to $2.3 trillion during the financial crisis year of 2008. Trading activity has surged since then, to over $3.7 trillion per year from 2010 to 2012, and between $4.2 trillion and $4.4 trillion per year from 2013 to 2016 (annualized). This increase in trading activity was accompanied by rapid growth in corporate bonds outstanding, from $3.3 trillion (8,050 issues) in 2006 to over $7.1 trillion (11,289 issues) in 2015, due to robust new issuance activity. However, the value and quantity of bonds outstanding dropped slightly during 2016. Trading activity relative to the amount of corporate bonds outstanding has generally trended downward, from 94% in 2006 to a financial crisis low point of 63% in 2008, before recovering to over 75% in 2009 and 2010, and since declining to 62% in 2015. Table II also reports on the volume of trading disseminated through TRACE and volume not so disseminated. The bonds whose trades were not reported through

TRACE after February 2005 are private 144A bonds, many of which are high yield. All corporate bond trade prices are publicly reported through TRACE after May 2014.

III. Trade Execution Costs

We estimate customer trade execution costs by means of indicator variable regressions, following Schultz (2001), Edwards, Harris and Piwowar (2006), and Bessembinder, Maxwell, and Venkataraman (2006). We report results for the Aggregate, Top 70%, and Constant Dealer samples, and for trade size categories, including small (less than $100,000), medium (between $100,000 and $1 million), large (between $1 million and $10 million) and block (greater than $10 million) trades. We also report results for investment grade and high yield bonds, and for issue size categories, defined by $500 million and $1 billion cutoffs. We also break out transaction costs estimates for "young" bonds, which are those that were issued within one year prior to the trade date. Finally, we report results for "click" bond trades, i.e. trades that are more likely to be completed through an electronic request for trading platform. Relying on the evidence in Hendershott and Madhavan (2015), these are trades of $5 million or less in young, investment grade, large issue size bonds.

The trading cost estimates are obtained by regressions of ΔPst, the percentage change in the trade price for a given bond from an observed trade at time '*s*' to the next observed trade at time '*t*', on $\Delta Q_{st} = Q_t - Q_s$, 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 the 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.[15] The analysis includes all customer-dealer trades. 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*.[16]

[15] 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. Estimates for subsets of bonds are identified by use of an indictor variable to identify the time t trade that meets the corresponding definitional criteria.

[16] 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&P 500 Index, the percentage change in the Barclays Capital U.S. Corporate Bond

Table III reports the resulting trading cost estimates. Focusing first on the Aggregate sample, it is noteworthy that on average (round trip) trade execution costs have been nearly constant from the beginning to the end of the sample, equal to 0.40% during the Pre-Crisis period and 0.42% during the Volcker period. Average trading execution costs increased to 0.65% during the financial crisis, remained elevated at 0.63% during the post-crisis period, declined to 0.47% during the Regulation period and, as noted, 0.42% during the Volcker period. Figure 1 plots average customer trade execution costs over the sample period.[17]

Average trade execution costs are notably lower for the Top 70% and constant dealer samples, which by construction emphasize the largest dealers in the market, as compared to the aggregate sample. For example, during the pre-crisis benchmark period (most recent Volcker period) average execution costs were 0.24% (0.25%) for customer trades executed against Top 70% dealers, compared to 0.40% (0.42%) for the aggregate sample. Assessing the reasons that trades with smaller dealers involve notably higher execution costs comprises an interesting question for future research.

Table III also reports execution costs based on trade size and bond characteristics. In general, execution costs for each trade size category displayed similar intertemporal patterns, increasing during the financial crisis and remaining elevated immediately thereafter, before declining in the most recent Volker period to levels close to those observed during the pre-crisis benchmark period. Consistent with prior studies, small trades pay the largest percentage execution costs in corporate bonds. Small trade execution costs approximate 0.61% during the pre-crisis period and the most recent Volcker period, and increased to 0.89% during the financial crisis. In contrast, trade execution costs for block trades averaged 0.16% during the first and last periods, and reached a maximum of 0.29% during the financial crisis.

Average trade execution costs were modestly greater for high yield than investment grade bonds in the initial, pre-crisis period (0.46% for high yield bonds vs. 0.36% for investment grade bonds). However, liquidity evolved differently for investment grade and high yield bonds thereafter. Transaction costs for investment grade bonds almost doubled during the financial

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.

[17] The slight uptick in average trade execution costs during the most recent period can be explained in part by the commensurate decline in average trades size, reflecting the fact that execution costs in corporate bonds are typically larger (in percentage terms) for smaller trades.

crisis to 0.71% (from 0.36% in the pre-crisis period), before declining in the most recent Volcker period to 0.38%. In contrast, the increase in transactions costs for high-yield bonds during the financial crisis was modest, to 0.50% from 0.46% pre-crisis. Notably, transaction costs for high yield bonds did not decrease in the immediate-post-crisis period, and remain moderately higher (0.51%) in the most recent Volcker period as compared to the pre-crisis period when they averaged 0.45%. This result is consistent with the evidence reported by Goldstein and Hotchkiss (2017).

The results on Table III show that trade execution costs are lower for "young" bonds, which is broadly consistent with the well-documented phenomenon that "on-the-run" treasury securities enjoy more liquid markets (Krishnamurthy (2001)). During the January 2006 to June 2007 benchmark period, the trading costs averaged 0.28% for young bonds vs. 0.46% for older bonds. Trade execution costs for young and old bonds evolved similarly during and after the financial crisis, and average execution costs for each group of bonds were modestly higher during the most recent Volcker period as compared to the benchmark period.

Finally, we consider average trade execution costs for clicking and calling trades as defined above. Clicking trades represent a small but growing (from 3% during the benchmark period to 10% during the Volcker period) share of the market. The results show that average execution costs are lower for clickable trades in both the January 2006 to June 2007 benchmark period (0.33% vs. 0.41% for other trades) and in the most recent Volcker period (0.30% vs. 0.44%). Since the 0.08% differential during the benchmark period is smaller than the 0.13% differential during the recent Volcker period, the results are consistent with the reasoning that the slight deterioration in execution costs for the overall sample is concentrated in trades that are more likely to occur through traditional telephone-based dealer trading. However, the increase in average execution costs for "non-clickable" trades, from 0.41% during the benchmark period to 0.44% during the Volcker period, is modest.

On balance, the results regarding average trade executions costs reported here do not support the notion that there has been a dramatic decline in corporate bond market liquidity in recent years. Customer trade execution costs rose during the Crisis period, but moderated thereafter, and for the full sample are only 0.02% higher during the most recent Volcker period as compared to the benchmark period. However, the increases in average execution costs are

larger for those trades most likely to have been executed through traditional telephone based dealer markets and for high yield bonds.[18]

Perhaps more important, execution costs pertain to trades that are successfully completed. As such, they cannot account for elapsed time or other difficulties in completing trades or for costs associated with trades that were desired but not completed. While databases exist to allow the assessment of time-to-completion and fill rates for institutional equity orders, to our knowledge no similar data exists for bond orders. In lieu of such data we study dealers' willingness to commit capital to market making, and also report on other aspects of market quality, overall and during stressed periods.

IV. Dealer-Level Measures of Market Quality

We construct several measures relevant to the assessment of liquidity and market quality, as described below, for both the Top 70% and Constant Dealer samples. Since most individual bonds trade only sporadically, we use a portfolio approach. Each bond is assigned to one of eight portfolios, six for public bonds and two for privately issued (144A) bonds. Public bonds are allocated to portfolios based on whether the bond is of small (less than $500 million), medium (between $500 million and $1 billion), or large issue size (greater than $1 billion), and whether the bond is rated investment grade or high yield. Private (144A) bonds are allocated to two portfolios based on whether the bond is rated investment grade or high yield.[19] We report herein on results that are aggregated across dealers, while the Internet Appendix [Tables IA.II & III] contains results that pertain to an average dealer portfolio.

a. Measuring Dealer Capital Commitment

The Federal Reserve Bank of New York publishes data on inventory held by primary bond dealers. However, until April 2013, the Federal Reserve reported an aggregate dealer inventory measure that included holdings in commercial paper and mortgage-backed securities

[18] These findings are consistent with two recent working papers that present coarser estimates of trading costs. Trebbi and Xiao (2016) examine U.S. data, Auilina and Suntheim (2016) examine U.K. data, each reporting that execution costs are not higher in recent years. In contrast, for a sample of bonds that are dropped from a corporate bond index, Dick-Nielsen and Rossi (2015) find that liquidity costs surrounding the index exclusion have increased after the financial crisis.

[19] Sample sizes for 144A bonds were too small to allow for assignment to issue size portfolios.

along with corporate bonds.[20] Further, the Federal Reserve inventory data is aggregated across bonds and dealers, thereby precluding any cross-sectional analysis. We therefore construct our own dealer-specific measures of corporate bond capital commitment. Our intent is to measure the extent to which dealers are willing to use their own capital to absorb customer order imbalances, as opposed to simply matching customers in an agency role. In the absence of initial inventory data for each dealer in each bond, we cannot construct a dealer's total inventory. Instead, we measure the extent to which dealers allow trading to flow through to changes in inventory.

A.1. Time Weighted Daily Capital Commitment

We measure, as of the time of each completed trade, the absolute value of the difference between the dealer's accumulated (within the portfolio) principal buy volume and the dealer's accumulated principal sell volume (including both trades with customers and with other dealers), to that point in the trading day (i.e. since midnight). This measure 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. That is, the measure captures the extent to which the dealer allows its overall inventory position to move away from the level at the beginning of the day. We then compute the average of this measure 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 midnight). We sum this measure across all dealer portfolios on a given day to obtain an aggregate (across dealers in the sample) measure of daily capital commitment. We report on both the total dollar capital commitment and the dollar figure scaled by trading volume for dealers in the sample.

A.2 Overnight Capital Commitment

We measure dealers' willingness to commit capital on an overnight basis by quantifying, for each dealer-portfolio day, the absolute value of the dealer's principal buy volume less principal sell volume. That is, the measure focuses on the extent to which the drift in the dealer's inventory position since the start of the day is carried as overnight inventory rather than being offset by opposite direction trades before the end of the day. We sum this measure across

[20] The data can be downloaded from the MarketAxess website, http://www.marketaxess.com/research/market-insights/dealer_net_positions.php. The disaggregated data made available after April 2013 indicates that mortgage backed securities account for over 50% of the dealers' holdings.

dealer portfolios for each day, reporting the resulting total dollar overnight capital and also overnight capital relative to total daily trading activity for the dealers in the sample. This ratio has the simple interpretation as the percentage of daily trading activity that is carried into overnight inventory.

A.3 Weekend Capital Commitment

Finally, we measure dealers' willingness to commit capital over multiple days by comparing accumulated weekly (beginning at midnight Friday night) dealer principal buy volume for each portfolio to the accumulated principal sell volume for the week. That is, the measure captures the magnitude of the drift in the dealer's inventory position since the start of the week that is carried as inventory over the following weekend. We also sum this measure across dealer portfolios, reporting both the resulting dollar total and the total relative to the week's trading activity of the dealers in the sample. The latter can be interpreted as the percentage of weekly trading activity that is carried as inventory over the following weekend.

A.4 Summary Statistics Regarding Dealer Capital Commitment

Table 4 reports summary statistics regarding dealer capital commitment, while Figure 2 displays the time series of overnight capital commitment for each dealer sample. The data on Table 4 show a clear pattern by which aggregate capital commitment for the dealers in the Top 70% sample declined during the financial crisis, largely rebounded during the post crisis period, before declining again during the regulatory period and declining further, to near-crisis levels, during the most recent Volcker period. The decline in capital commitment during the crisis was largely in line with the decline in trading activity as reported in Table II. In contrast, the decline in capital commitment during the most recent Volcker period occurred even as trading volumes increased, implying that dealers absorbed a smaller proportion of trading into inventory.

Top 70% dealers committed $1.38 billion in overnight capital on average for the full sample. Overnight capital commitment decreased from an average of $1.62 billion per night during the pre-crisis period to $1.17 billion per night during the financial crisis, before rebounding to $1.50 billion per night during the immediate post-crisis period. Overnight capital commitment declined to $1.39 billion during the Regulatory period, and to $1.31 billion per night during the most recent Volcker period. The decline in total overnight capital commitment during the financial crisis was only slightly more pronounced than the decline in trading activity,

as the proportion of trading carried into overnight inventory decreased only from 21.1% during the Pre-Crisis period to 20.5% during the financial crisis. In contrast, the decrease in overnight capital commitment in recent years occurred even as trading volumes increased, and the proportion of trading activity carried into overnight inventory declined to 16.2% during the Regulatory period and further to 13.8% during the Volcker period.

In general, the summary statistics for time-weighted daily capital and weekend capital commitment are consistent with those for overnight capital commitment. Daily capital commitment relative to volume decreased from 11.4% during the Pre-Crisis period to 8.5% during the Regulatory period and to 7.4% during the most recent Volcker period. Similarly, the proportion of weekly trading carried as inventory over the weekend declined from 10.4% during the Pre-Crisis period to 7.7% during the Regulatory period and 6.5% during the Volcker period.

Each measure of capital commitment indicates a notable decrease over time in the extent to which dealers allow their inventory to change as a consequence of trading, and decreased willingness to carry such changes overnight or over weekends. On balance, the results indicate that dealers were more likely to offset trades with opposite direction trades, thereby committing less of their own capital to absorb customer order imbalances, during the Volcker period as compared to the immediately preceding Regulatory period, and even, by most measures, relative to the financial crisis period.

b. Other Indicators of Market Quality Measured at the Dealer Level

B.1. Trading Activity and Trade Size

Overall trading activity is a commonly used proxy for market liquidity, with the obvious interpretation that larger volumes are indicative of a more liquid market, other things equal. In addition to trading activity relative to the amount outstanding (i.e. turnover), we consider the average trade size. The data reported on Table 4 verifies that corporate bond trading activity by the Top 70% sample relative to the amount outstanding has decreased over time, 7.12% in the Pre-Crisis period to 4.77% during the financial crisis. Monthly turnover partially rebounded to 5.56% during the immediate pre-crisis period, before falling to 4.67% during the Regulatory period and to 4.11% during the most recent Volcker period.

Average trade size for dealers in the Top 70% sample decreased from $2 million in the pre-crisis period to $1.32 million during the financial crisis. The average trade size increased to

$1.49 million in the post crisis period, before falling to $1.28 million during the Regulatory period and $1.21 million during the Volcker period. A decrease in trade sizes could reflect that customers desire to trade in smaller increments, or could be indicative that it is difficult to locate counterparties for larger trades that are desired.

B.2. Principal vs. Agent Trading

An obvious measure of dealers' willingness to commit capital to enhance liquidity is their completion of trades on a principal basis (i.e. where the dealer is the counterparty to the customer trade) rather than an agency basis (where the dealer arranges for a trade between two customers or with another dealer). TRACE reporting requires a dealer to designate a transaction as a principal trade if the dealer takes ownership of the bond, however briefly. By this standard, almost all dealer-intermediated trades are principal trades. We focus on a narrower definition of principal trades that excludes trades that are exactly offset by three or fewer opposite-direction trades by the same dealer, within one minute. Since the median bond trades only once every few months (see, for example, Edwards et al., 2007), it seems reasonable to infer that virtually all offsetting transactions that occur within one minute were in fact prearranged and that dealer capital was not meaningfully at risk.[21]

As Table IV shows, the percentage of principal trading in the Top 70% percent sample was 91.4% in the Pre-Crisis period, and perhaps surprisingly, increased slightly to 91.9% during the Crisis period, and then declined slightly to 91.6% of volume during the Regulatory period, before increasing notably to 94.9% of volume during the most recent Volcker period. In Section VI below, we assess further which dealers, bank-affiliated or non-bank, are responsible for the increase in principal trading observed in the recent sample.

V. Time-Series Regressions

The univariate means reported on Table IV indicate reductions in the most recent Volcker period relative to the Pre-Crisis period in dealers' capital commitment, as well as reductions in bond turnover and average trade size. We next report the results of time series regressions that include control variables, and that allow for formal statistical tests for equality of coefficients across time periods. Probability values are based on robust (Huber-White) standard errors.

[21] Other studies, including Zitzewitz (2011) and Ederington, Guan, and Yadav (2015), also use a one-minute window, and refer to these trades as "riskless principal" transactions.

We include in these regressions control variables for market conditions. In particular, we control for recent market-wide stock (S&P 500 index) and bond (the Barclays Capital U.S. Corporate Bond Index) returns, since Hameed, Kang, and Viswanathan (2010) and Comerton-Forde et al. (2010) show that lower returns reduce dealers' propensity to supply liquidity, via its impact on their market making profits. We control as well for changes in the CBOE stock market volatility index (VIX) and the 3-month LIBOR. We also include aggregate flows into or out of corporate bond mutual funds and ETFs, as a control for transaction demand on the part of corporate bond funds.[22] Finally, we include the percentage of total trading that occurs in trades of $100,000 or less, as a control for retail trading activity.

While the coefficients estimated on these control variables are not our main focus, it can be observed that dealer capital commitment in dollars is positively associated with recent stock market returns. Increases in VIX are associated with decreased capital commitment relative to trading volume, but perhaps surprisingly, with greater capital commitment in dollars. Increases in LIBOR are associated with decreased capital commitment relative to volume, as are increased gross flows to or from bond mutual funds and ETFs. Finally, increased retail trading is associated with smaller capital commitment.

The key variables in this specification are indicator variables for the Crisis (July 2007-April 2009), Post-crisis (May 2009-June 2010), Regulatory (July 2010-March 2014) and Volcker (April 2014-October 2016) sub-periods. The regression intercept pertains to the Pre-Crisis (January 2006-June 2007) benchmark period, and coefficient estimates on the period indicator variables measure changes in regression intercepts relative to the benchmark period. We report *p*-values for each indictor variable coefficient, and indicate by use of asterisks at the bottom of Table V whether formal statistical tests reject the hypothesis that coefficients on the indicator variables are equal across sub-periods.

a. Capital Commitment

In columns (1) to (6) of Table V, Panel A, we report results obtained when the dependent variable in the regression specification is alternative measures of dealer capital commitment. The first two columns pertain to time-weighted daily capital, the second pair pertain to overnight capital, and the third pair pertain to weekend capital, with even numbered columns measuring

[22] The variable is standardized by the prior month total net asset value. Data on fund flows is obtained from the Investment Company Institute.

capital commitment in dollars and odd numbered columns measuring capital commitment relative to trading volume.

When focusing on capital commitment in dollars (columns 2, 4, and 6), the results confirm an economically and statistically significant decline during the financial crisis as compared to the pre-crisis benchmark period. The decrease is $199 million in daily capital commitment, $330 million in overnight capital commitment, and $574 million in weekend capital commitment. However, when measured relative to trading activity, the results indicate no significant decrease in capital commitment during the financial crisis, after allowing for variation in control variables. In particular, the coefficient estimate on the crisis period indicator variable is statistically insignificant in each of columns 1, 3, and 5.

Coefficient estimates on the indicator variable for the post-crisis period indicate an increase in capital commitment in dollars as compared to the pre-crisis period, after allowing for variation in control variables. Point estimates indicate a $15 million increase in daily capital, $76 million in overnight capital, and $108 million in weekend capital. However, capital commitment relative to trading volume decreased by statistically significant amounts during the post-crisis period as compared to the benchmark period. Point estimates indicate a decrease of 1.6% in daily capital, 2.5% in overnight capital, and 1.7% in weekend capital.

For the Regulatory period, the results on Table V indicate decreased capital commitment relative to the pre-crisis benchmark, both in dollars and relative to trading volume. The decreases in measured dollar capital commitment during the Regulatory period are smaller (and the differentials are statistically significant) than those observed during the financial crisis. However, in light of increased volumes, capital commitment as a percentage of trading activity decreased significantly during the Regulatory period as compared to both the pre-crisis benchmark and crisis periods. The decline relative to the pre-crisis benchmark is 2.1% in daily capital relative to volume, 3.6% in overnight capital relative to volume, and 2.9% in weekend capital relative to volume.

Outcomes for the Volcker period are of particular interest due to the increased restrictions on bank trading activity specified by the Volcker Rule. The results on Table V indicate decreased capital commitment during the Volcker period after allowing for variation in control variables, both in dollar capital commitment and in capital commitment relative to trading activity. Notably, capital commitment relative to trading volume during the Volcker period is

not only lower than during the pre-crisis benchmark, but is also lower than during the crisis, post-crisis, and Regulatory periods. In fact, the only capital commitment outcomes during the Volcker period that are *not* statistically significant pertain to the comparison of daily and overnight dollar capital commitment during the Volcker period to the crisis period. That is, the results indicate that dealers' dollar capital commitment to corporate bond trading during the Volcker period is lower than any other subperiod except the financial crisis. Capital commitment relative to trading activity is significantly lower during the Volcker period as compared to any other period.

The decreases in dealer capital commitment during the Volcker period are economically substantial. Focusing on weekend capital commitment in dollars, the decrease during the Volcker period relative to the pre-crisis benchmark is $599 million, which is large relative to the full sample average of $3.25 billion, and also relative to the decline in the immediately preceding Regulatory period, which was $398 million. Weekend capital commitment relative to trading volume decreased by 4.1% during the Volcker period as compared to the pre-crisis benchmark, which is large relative to the full sample average of 8.4%. By comparison, weekend capital commitment relative to trading volume had decreased by 2.9% during the immediately preceding Regulatory period.

To summarize, the results reported on Table V indicate economically large and statistically significant decreases in dealer capital commitment during the Volcker period as compared to preceding periods, after allowing for changes in control variables. Capital commitment in dollars during the Volcker period is equal to or less than during the financial crisis. Capital commitment relative to trading volume is substantially lower during the Volcker period as compared to the financial crisis, and also as compared to the immediately preceding Regulatory period. These results are consistent with the reasoning that the Volker rule has reduced dealers' willingness to commit capital in support of market making in corporate bonds. However, they are also consistent with the reasoning that increased competition due to growth in electronic trading and in the holdings of corporate bond mutual funds and ETFs caused traditional dealers to reduce their capital investment. We provide more specific evidence on this issue in Section VI below, where we consider outcomes separately for bank-affiliated and non-bank dealers.

b. Other Market Quality Measures

We also report in Table V results obtained when the dependent variable is trading volume relative to the amount outstanding (i.e. turnover, column 7), natural logarithm of average trade size (column 8), and principal volume as a percentage of total volume (column 9). In general, the results indicate shifts in market quality during the financial crisis as compared to the pre-crisis benchmark that were accentuated rather than reversed in the periods subsequent to the financial crisis.

Results reported in column (7) of Table V show that monthly turnover was reduced by 1.9% during the financial crisis as compared to the pre-crisis benchmark. This decline is substantial relative to the full sample average turnover (for the Top 70% sample), which is 5%. Turnover continued to decline thereafter, and during the most recent Volcker period was 2.8% less than during the benchmark period, after allowing for changes in control variables. Results reported in column (8) of Table V show a similar pattern in average log trade size, which was 0.20 lower during the financial crisis and 0.30 less during the most recent Volcker periods, as compared to the pre-crisis benchmark.

A notable exception to the overall pattern is observed for principal volume as a percentage of total volume (column 9). Principal trading was not significantly different during the financial crisis period, the post-crisis period and the Regulatory periods, but increased by a statistically significant 3.4% during the most recent Volcker period, as compared to the pre-crisis period.

On balance, the results reported in Table V suggest a more difficult trading environment in the recent Volcker period as compared to the January 2006 to June 2007 benchmark period. Dealers' daily, overnight, and weekend capital commitment, trading volume relative to amount outstanding, and average trade size, have all declined. Deterioration of these measures during the financial crisis is not surprising or unanticipated. More noteworthy, these measures did not broadly recover, and many worsened, during the Regulatory period.

VI. Bank vs. Non-Bank Dealers

We next assess more specifically the possibility that the quality of the market for corporate bonds has been affected by post-crisis regulations focused on banks. To do so, we estimate results separately for dealers that are affiliated with banks and for dealers that are not

bank affiliated. As noted, the data provided to us includes only masked dealer identifications. However, FINRA identified for us the dealers contained in our constant-dealer sample that are affiliated with banks vs. those that are not so affiliated. A recent industry report identifies Cantor Fitzgerald & Co., Daiwa Capital Markets Americas, Jefferies & Company, and Nomura Securities International as examples of prominent non-bank dealers active in the U.S. corporate bond market.[23]

It should be noted that each dealer is designated as bank-affiliated or not by FINRA based on their 2016 status. Therefore, the designation of a dealer as bank-affiliated does not evolve through time. In particular, Goldman Sachs and Morgan Stanley, which became bank holding companies during 2008, would be identified for our purposes as bank-affiliated dealers throughout the sample.[24] This research design is appropriate because we are not primarily interested in assessing the effects of dealer shifts from non-bank to bank status in the midst of the financial crisis. Rather, our intent is to assess the effects of post-crisis banking regulations. This assessment depends on dealers' status as bank-affiliated (treated) or not bank-affiliated (non-treated) at the time the regulations become effective.

For this analysis, we shift to the Constant Dealer sample, so that the results for the bank-affiliated and non-bank samples reflect outcomes and choices of common sets of dealers, and do not reflect the entry or exit of participants. Within the Constant Dealer sample, ten dealers are non-bank, while twenty five are bank-affiliated. The twenty five dealers who were bank-affiliated post-crisis comprise the treatment sample that is subject to bank-related regulations such as the Volcker rule and the Basel III accords, while the ten non-bank dealers comprise the non-treated sample.

a. Summary statistics for bank and non-bank dealers

Table VI provides some sample statistics by sub-period for bank and non-bank dealers contained in the constant dealer sample. Panel A reports on market shares, average customer trade execution costs and other trading statistics, while Panel B reports on capital commitment measures.

[23] The report is available at http://www.oliverwyman.com/content/dam/oliver-wyman/global/en/files/archive/2012/Oliver_Wyman_The_Volcker_Rule_Restrictions_on_Proprietary_Trading.pdf.
[24] See http://www.nytimes.com/2008/09/22/business/22bank.html.

The data on Panel A of Table VI shows that non-bank dealers' share of overall trading activity is relatively small, but has increased substantially over time. During the pre-crisis period non-bank dealers participated in 4.4% of overall trading volume, as compared to 13.5% during the Volcker period. The non-bank dealer share of customer-to-dealer volume rose more sharply, from 2.4% during the pre-crisis period to 12.5% during the Volcker period. When stated relative to the quantity outstanding, non-bank turnover increased from 0.3% per month during the pre-crisis period to 0.6% during the Volcker period, while bank-affiliated dealer turnover decreased from 6.5% during the pre-crisis period to 4.0% during the Volcker period.

Average execution costs for trades executed by non-bank dealers were slightly greater (seven basis points) than for trades executed by bank-affiliated dealers during both the pre-crisis benchmark and the most recent Volcker period. The higher execution costs for non-bank trades are attributable in part to the fact that their trades were smaller on average. In particular, the average trade size for non-bank dealers during the pre-crisis period was $0.37 million, as compared to $1.25 million for bank-affiliated dealers. Average trade sizes decreased over time, to $0.31 million for non-bank dealers during the Volcker period, and more sharply (to $0.76 million) for bank-affiliated dealers during the Volcker period.

Finally, the data on Panel A of Table VI shows that the increase in principal trading during the Volcker period is mainly attributable to non-bank dealers. In particular, the proportion of non-bank dealers' overall trading completed on a principal basis rose from 76.2% during the pre-crisis period to 90.9% during the Volker period, while that for bank-affiliated dealers increased modestly from 92.4% to 93.6%.

Panel B of Table VI reports capital commitment measures for bank-affiliated and non-bank dealers contained in the Constant Dealer sample. Two main results are noteworthy. First, non-bank dealer capital commitment was much lower than that of bank-affiliated dealers during the pre-crisis benchmark period, for all measures of capital commitment. Focusing, for example, on overnight capital commitment, non-bank dealers' collectively carried an average of $50 million overnight during the pre-crisis benchmark, as compared to $1.66 billion for bank-affiliated dealers. When stated as a percentage of own daily trading volume (i.e. as the percentage of trading carried into overnight inventory) the divergence during the pre-crisis period was less stark, as non-bank dealers carried 14.8% overnight, as compared to 22.0% for bank-affiliated dealers.

Second, while both bank and non-bank reduced their capital commitment during the financial crisis, non-bank dealers have increased their capital commitment in recent years, while bank-affiliated dealers decreased their capital commitment, for all measures. Focusing again on overnight capital, non-bank dealers increased their capital commitment from $50 million during the benchmark period to $244 million during the most recent Volcker period.[25] In contrast, bank-affiliated dealers decreased their capital commitment from $1.66 billion during the pre-crisis period to $1.45 billion during the Volcker period. When stated relative to trading volume, non-bank dealers' overnight capital commitment grew modestly from 14.8% during the pre-crisis period to 15.6% during the Volcker period, while bank-affiliated overnight capital commitment declined markedly from 22.0% during the pre-crisis period to 14.8% during the most recent Volcker period. Results for daily and weekend capital commitment are broadly similar to those for overnight capital commitment.

b. Regression outcomes for bank and non-bank capital commitment

In Table VII, Panel A, we report the results of implementing regressions similar to those reported on Table V, except that we include indicator variables to allow for differing time-period-specific intercepts for bank-affiliated and non-bank dealers. These results are more informative than the comparison of summary statistics contained on Table VI because the regression analysis includes the control variables as previously employed for the results reported in Table V.

The coefficient on the bank indicator variable estimates the difference in the benchmark period intercept for bank-affiliated dealers as compared to non-bank dealers. For each sub-period subsequent to the benchmark we include the product of the sub-period indicator and both bank and non-bank indicators, the coefficient estimates on which reveal the change in the intercept estimate relative to the base period for bank and non-bank dealers, respectively. While Table VII includes estimated indicator variable coefficients for each sub-period, this discussion focuses mainly on the most recent Volker sub-period.

The empirical results for all six measures of capital commitment (columns 1 to 6) are quite consistent, indicating that the decline in capital commitment during the most recent Volcker period as compared to the pre-crisis benchmark is entirely attributable to bank-affiliated dealers. This result strongly supports the predictions of Duffie (2012) that the Volcker Rule

[25] Eight of the ten individual non-bank dealers increased their capital commitment.

would likely have unintended consequences in terms of bank-affiliated dealers ability and willingness to commit capital to enhance bond market liquidity.

The difference between indicator variable coefficient estimates obtained for bank-affiliated and non-bank dealers during the Volcker period is, in all cases, statistically significant at the .01 level. The change in capital commitment by bank-affiliated dealers during the Volcker period as compared to the benchmark period is negative and statistically significant at the .01 level for all six measures of capital commitment. In contrast, the change in capital commitment for non-bank dealers in the Volker period as compared to the pre-crisis period is positive for all six measures of capital commitment, and is statistically significant for all measures but one (weekend capital commitment relative to volume).[26]

For example, overnight capital commitment in dollars (column 4) by bank-affiliated dealers declined by $194 million during the most recent period as compared to the pre-crisis benchmark, after allowing for changes in control variables. By comparison, overnight capital commitment by non-bank dealers increased by $210 million from the pre-crisis benchmark to the Volcker period, after allowing for changes in control variables. When stated relative to trading activity (i.e. as the percentage of trading carried into overnight inventory) the decrease (column 3) for bank-affiliated dealers is 5.6%, while the increase for non-bank dealers is 2.4%. Results for the other measures of capital commitment are broadly similar to those for overnight capital.

It is also instructive to compare outcomes for the most recent Volcker period to the immediately preceding Regulatory period. Coefficient estimates on the Volcker period indicator are larger in absolute magnitude as compared to coefficient estimates on the Regulatory period indicator when the dependent variable is capital commitment in dollars (columns 2, 4, and 6), for both bank-and non-bank dealers. For example, the decrease in overnight capital commitment for bank affiliated dealers during the Regulatory period (as compared to the benchmark period) was $85 million, versus $194 million during the Volcker period. The implication is that bank-affiliated dealers sharply reduced their capital commitment after the Volcker rule became

[26] Increased competition for traditional dealers has emerged in the form of corporate bond ETFs, particularly for investment grade bond indices. In the Internet Appendix [Table IA.V] we report regression coefficients that correspond to those in Table VII Panel B, except that the subsamples are defined for investment grade and high yield bonds. In each of these subsamples we find, in line with the overall sample, that bank-affiliated dealers have reduced their capital commitment while non-bank dealers have increased capital commitments during the Regulatory and the Volcker periods, relative to the pre-crisis benchmark period. These results support that our central conclusions are robust to increased competition from bond ETFs.

effective. In contrast, the increase in overnight capital commitment for non-bank dealers during the Regulatory period (as compared to the benchmark period) was $152 million, compared to $210 million during the Volcker period. The implication is that, unlike bank-affiliated dealers, non-bank dealers continued to increase their overnight capital commitment after the Volcker rule became effective.[27]

c. Regression outcomes for other market quality measures for bank and non-bank dealers

In columns (7) to (9) of Table VII, Panel A, we report results for bank and non-bank dealers when the dependent variable is volume relative to amount outstanding (i.e. turnover), average trade size, and the percentage of total volume completed on a principal basis, respectively. The results indicate that the patterns observed in sample means reported on Table VI are also observed after allowing for changes in control variables, and that differences in outcomes for bank-affiliated vs. non-bank dealers during the Volker period are always statistically significant.

In particular, trading activity by non-bank dealers relative to the amount outstanding (column 7) increased by 0.3% during the Volcker period relative to the benchmark period, while trading activity by bank-affiliated dealers decreased by 2.5%, after allowing for changes in control variables. The average log trade size for bank-affiliated dealers (column 8) decreased significantly statistically significant $0.40 million relative to the benchmark period after allowing for changes in control variables, while the decrease for non-bank dealers was statistically insignificant. Finally, principal trading relative to total trading (column 9) increased by a statistically significant 15.5% for non-bank dealers during the most recent period as compared to the benchmark period, while the change for bank-affiliated dealers was 2.3%.

Each of the results described in the preceding paragraphs is consistent with the reasoning that bank-affiliated dealers have reduced the extent to which they commit capital to facilitate trading during the most recent years, while non-bank dealers have increased the extent to which they commit capital to facilitate trading. While the lack of clearly identifiable effective dates for regulations precludes definitive tests, the results support the reasoning that post-crisis regulations

[27] Note, though, that the increase in overnight capital commitment during the Volcker period vs. the preceding Regulatory period for non-bank dealers was less than proportionate to their increase in trading volume, as evidenced by a smaller coefficient estimate during the Volcker period in column (3).

that focus on banks, such as the Volcker Rule and the Basel Accords, have had the consequence of decreasing bank-affiliated dealers' willingness or ability to commit capital to facilitate trading in corporate bonds.

d. Clicking vs Calling Trades

Electronic limit order books, which allow for the submission of executable orders and online transactions, have come to dominate trading in equities and futures. In contrast, electronic platforms for corporate bonds, while growing rapidly, account for a minority of overall trading. A 2015 survey by Greenwich Associates reports that electronic venues accounted for 8% of investment-grade corporate bond trading in 2010, growing to 20% by 2015.[28] Further, most activity involves electronic requests for quotations, as opposed to direct executions. A 2013 Greenwich Associates industry survey concluded that "true corporate bond e-trading is a long way from becoming reality".[29]

Trades that occur through electronic platforms cannot be directly identified on TRACE, as each is reported by the broker-dealer involved without any specific flag. Hendershott and Madhavan (2015) study the largest electronic request for quotation platform, operated by MarketAxess, documenting that market participants are most likely to "click" rather than call a traditional dealer when conducting smaller trades in recently issued, large issue size and investment grade bonds. We next assess capital commitment and market quality for bank and non-bank dealers, for "clicking" trades, defined for our study as trades of $5 million or less in investment grade bonds that are within one year of issuance, with an issue size of at least $1 billion. Not all trades in this category are executed via electronic means, but we anticipate electronic platforms to be more prevalent for these trades.

Table VII Panel B presents the results of the time series regressions identical to those in Panel A, except that results pertain to the "Click" trade subsample. Clicking trades account for a small but increasing portion of overall trading, ranging (Table 3) from three percent during the benchmark period to ten percent during the most recent Volcker period. Corresponding results for "Call" trades subsample are reported in the Internet Appendix Table IA.IV. Not surprisingly, results for the call sample generally mirror those reported in Panel A of Table VIII for the full sample. We denote on Panel B of Table VIII coefficient estimates that differ significantly

[28] See Greenwich Associates, "The Continuing Corporate Bond Evolution", Q4 2015.
[29] Corporate Bond E-Trading: Same Game, New Playing Field, McKinsey& Company-Greenwich Associates, p. 5.

across the click and call samples (p-value < .05) with bold formatting. We focus this discussion mainly on coefficient estimates for the Volcker period, to assess the evolution of outcomes over time.

The results on Panel B of Table VIII show that both bank and non-bank dealers increased their dollar capital commitment (columns 2, 4, and 6) to click trades over time. However, as noted, the click sample share of overall trading has grown rapidly. Relative to trading volume (columns 1, 3, and 5), the coefficient estimates on capital commitment measure during the Volcker period (as well as during the immediately preceding regulatory period) are negative for both bank and non-bank dealers, and are not statistically different from each other.

These results support the interpretation that increased competition has reduced the demand for dealer intermediation services in the segment of the corporate bond market where electronic venues have reduced search costs the most. Both bank and non-bank dealers have responded by committing less capital to this segment of the market, relative to volume. In contrast, in the segments of the market where electronic venues have a less significant impact, non-bank dealers have increased their capital commitment to the overall market, even as bank-affiliated dealers withdraw.

VII. Stressful Day Analysis

The results reported in the preceding sections rely on the full sample of trading days. However, it is possible that the most notable changes in bond market liquidity emerge when the market is under unusual duress. To shed light on this possibility, we examine dealer trading behavior on days when it can be reasonably be inferred that the market is stressed. To ensure robustness, we consider both stressful days identified on a bond-specific basis and stressful days identified on a market-wide basis.

The bond-specific stress measure we consider is the occurrence of a block trade of $10 million or more. We focus in particular on the behavior of the individual dealers who complete block trades. The processing of a block transaction tends to dominate a dealer's trading for the day. We calculate that, for bank-affiliated dealers, a block transaction on average accounts for 92% of the dealers' total trading in the block direction (i.e. total daily buy trading if the block is a buy, and vice versa) for the day. The corresponding figure for non-bank dealers is 94%.

A dealer who executes a block trade on a principal basis commits significant capital to bond market making. However, the extent of capital commitment depends also on how long the position remains on the dealer's books, as opposed to being offloaded through opposite direction trades to other dealers or to customers. We compute time-weighted daily capital commitment and overnight capital commitment on the days that dealers in the Constant Dealer sample complete block trades, as previously described. We also compute weekly capital commitment for the dealer in the same manner as the previously described weekend capital commitment, except that we focus on a one-week period from the date of the block trade instead of Friday in particular. We then sum the dollar capital commitment measures across all dealers who completed block trades during the given day, and scale by the same dealers' total trading activity on the corresponding day or week.

We also rely on an indicator of market-wide stress. The Federal Reserve Bank of Cleveland constructs a Financial Stress Index. While this index has been discontinued due to a data error, we focus exclusively on its credit market component, which is a simple combination of five interest rate spreads (between UK and U.S. Treasury bills, AAA corporate bonds and U.S. Treasuries, commercial paper and Treasury bills, and 10 year U.S. Treasury notes vs. three month U.S. Treasury Bills) and the bid-ask spread in U.S. Treasury bills (Oet, Eiben, Bianco, Gramlich, and Ong, 2011).[30] We designate individual days as stressed if the change in this index is more than 1.96 standard deviations (computed separately by sub-period) above its sub-period mean.

Table VIII reports a number of summary statistics regarding the variables used in the stressful day analyses. It can be observed that the proportion of all trading that occurs in the form of blocks greater than $10 million has decreased for bank-affiliated dealers, but has increased for non-bank dealers, from the benchmark period through the Volcker period. Further, capital commitment on stressful days defined both on a bond-specific and a market-wide basis has decreased for bank-affiliated dealers and has increased for non-bank dealers over time.

[30]For general description see: https://www.clevelandfed.org/newsroom-and-events/publications/economic-commentary/2012-economic-commentaries/ec-201204-the-cleveland-financial-stress-index-a-tool-for-monitoring-financial-stability.aspx. Daily observations on the credit spread component are downloaded from https://fred.stlouisfed.org/series/CMRKTSD678FRBCLE. The metric was discontinued May 5, 2016, so this analysis ends at that date.

On Table IX we report results of regression specifications similar to those on Table VII, but focusing in particular on stressful days, to assess whether these changes are observed and are statistically significant after allowing for changes in control variables. Panel A of Table IX pertains to stressful days identified on a bond-specific basis, while Panel B pertains to stressful days identified based on market-wide conditions.

A. Portfolio Time Series Regressions for Bond-Specific Stressful Days

Coefficient estimates on the bank indicator variable pertain to the difference between bank and non-bank dealers during the pre-crisis benchmark period. Estimates reported on Panel A of Table IX confirm show that bank-affiliated dealers accommodated more block trading and committed more capital on bond-specific stressful days during the pre-crisis period, and that these differences are statistically significant.

Turning to coefficient estimates for the bank and non-bank indicator variables during the Volcker period, which estimate changes relative to the pre-crisis benchmark period that are not accounted for by outcomes to the control variables also included in the regression, it can be observed that non-bank dealers increased both the frequency of block trading and capital commitment relative to block trading volume on stressful days for all measures, while bank-affiliated dealers decreased block trading and capital commitment on stressful days, each as compared to the pre-crisis benchmark periods. The difference in coefficient estimates across bank-affiliated and non-bank dealers is statistically significant in every instance.

These coefficient estimates are economically large. Focusing on block volume as a percentage of total volume (column 1), the decrease for bank-affiliated dealers is 3.0%, while the increase for non-bank dealers is 3.0%, each after allowing for changes in control variables. By comparison, the full sample average of this variable is 15.1%. The increase in overnight capital commitment relative to block-day volume (column 3) is 9.3% for non-bank dealers who completed block trades, while the decrease for bank-affiliated dealers who completed block trades is 20.3%. Each of these changes from the benchmark period to the Volcker period is large relative to the full sample average of 35.7%.

Results are quite uniform across measures of capital commitment, indicating that not only did non-bank dealers increase their proportion of total volume accounted for by large block trades, they committed more capital relative to block volume during the most recent period as

compared to the benchmark period. In contrast, bank-affiliated dealers block trading volume and capital commitment relative to block volume declined.

C. Portfolio Time Series Regressions for Market-Wide Stressful Days

In Panel B of Table IX we report the results of time series regressions that focus on aggregate capital commitment across dealers in the Constant Dealer sample on days where market wide stress is indicated. We estimate identical time series regressions for control days, which are one to seven days prior to the identified stress days. The resulting coefficient estimates are suppressed to conserve space, but we indicate by use of bold type those stressful day coefficients that differ (p-value < .05) from the corresponding coefficient on control days. In each case where such a divergence is detected, the point estimates indicate lower capital commitment on stressful days as compared to same-period control days.

The empirical results in Panel B of Table IX are very consistent when focusing on daily time-weighted capital commitment, overnight capital commitment, or weekly capital commitment, and show that the following conclusions hold, after allowing for changes in control variables. First, bank-affiliated dealers committed much greater amounts of capital as compared to non-bank dealers on stressful days during the benchmark period. Overnight capital as a percentage of trading volumes, for example, was 8.2% higher for bank-affiliated dealers on stressful days during the benchmark period.

Second, while there was no significant change in non-bank dealers' stressful day capital commitment during the financial crisis, bank-affiliated dealers significantly reduced their stressful day capital commitment in dollars during the crisis. Further, bank-affiliated dealers' capital commitment on stressful days during the crisis decreased by more than on control days, and this difference is statistically significant exception for weekly capital commitment. Bank-affiliated dealers' reduction in capital commitment on stressful days during the financial crisis was partially explained by their reduced trading volume. For example, bank-affiliated dealers overnight capital relative to trading volume (column 3) declined by 1.5% during the financial crisis. While this coefficient does not differ significantly from zero, it does differ significantly from the 2.4% increase in the corresponding measure for non-bank dealers. That is, the results support the notion that bank-affiliated dealers withdrew market making capital on the stressful days that occurred during the financial crisis to a greater extent than did non-bank dealers.

Third, when comparing results for the most recent Volcker period to the benchmark period, non-bank dealers have significantly increased their capital commitment on stressful days, while bank-affiliated dealers have significantly decreased their capital commitment. For non-bank dealers, the increase in stressful day capital commitment (e.g. $226 million in overnight capital, column 4) is explained by a commensurate increase in stressful day trading activity as compared to the benchmark period, as the coefficient estimate on capital commitment relative to volume is not statistically significant for any of the three capital commitment measures.

For bank-affiliated dealers, however, we observe a decline in capital commitment on stressful days during the Volcker period as compared to the benchmark period, whether measured in dollars or relative to trading volume. For example, bank-affiliated dealers' overnight capital commitment on stressful days declined by $127 million (column 4), and by 12.2% (column 3) relative to trading volume, during the Volcker period.

Further, the decrease in bank-affiliated dealers' overnight capital commitment on stressful days during the Volcker period is significantly greater than their decrease on control days during the Volcker period. In contrast, non-bank dealers' capital commitment on stressful days during the Volcker period does not differ significantly from control days.[31]

In Section VI we report that non-bank dealers have increased their market share, their willingness to complete block trades, and their capital commitment in recent years, while bank affiliated dealers completed less block trades and reduced their capital commitment. In this section we show that the same general patterns hold on more stressful days. Further, the data show no tendency for non-bank dealers to exit the market on stressful days, either during the financial crisis or thereafter. To the extent the data show such a tendency, it is bank-affiliated dealers that exit under stress.

VIII. Conclusion

Concerns that liquidity in corporate bond markets is deteriorating are widespread. We conduct a comprehensive analysis of corporate bond trading over the 2006 to 2016 period, and

[31] For robustness, we study two additional measures of stressful days, and present the results in the Internet Appendix Tables IA.VI & VII. First, we focus on days in which customer trading volume in a particular bond is unusually high. Second, we construct a composite stress index, separately for high yield and investment grade bonds, by combining information from the Cleveland Fed Credit Stress Index with measures of bond market returns, the VIX equity volatility index, and returns to the Wilshire 5000 stock index. Each of these analyses confirms the conclusions reached here.

obtain a number of findings relevant in evaluating these concerns. We document that, despite a temporary increase during the financial crisis, customer trade execution costs are on average nearly unchanged from 2006 to 2016. Thus the evidence for customer trade execution costs, obtained over a relatively long time series, does not indicate systematic degradation of corporate bond liquidity in recent years.

However, execution costs for completed trades do not capture the difficulty that customers may have encountered in locating counterparties, or the costs associated with trades that were desired but not consummated. We conduct a broader analysis that may indicate some possible concerns regarding liquidity in the corporate bond markets. Measures of dealers' commitment of capital to absorb customer order imbalances, trading volume relative to amounts outstanding, average trade size, and frequency of large block trading were not only degraded during the financial crisis, but these measures in general did not revert to pre-crisis levels in the years after the financial crisis abated, and in many cases worsened during the most recent years.

Dealer capital commitment is potentially affected by post-crisis banking regulations such as the Volcker Rule. To assess this possibility, we measure capital commitment and market quality separately for bank-affiliated and non-bank dealers. The results indicate that, while non-bank dealers were relatively unimportant during the pre-crisis period, they have steadily increased their market share, the proportion of their volume attributable to block trades, and their levels of capital commitment in recent years, even while bank-affiliated dealers have reduced their willingness to accommodate block trades and to commit capital to absorb customer order imbalances. We find that results for both bond-level and market-wide stressful days mirror those for the overall sample.

Decreased dealer capital commitment could result from increasing competition, e.g. from electronic trading venues and from corporate bond ETFs and mutual funds. We document that both banks and non-bank dealers reduced capital commitment as a percentage of volume traded in the portion of the market where electronically-facilitated trades are most likely to occur. These results support that electronic venues have reduced search costs and the need for dealer intermediation services. However, electronically-facilitated trading still represents a relatively small share of the overall market, and in the broader market where electronic venues are less important the data shows that bank-affiliated dealers have reduced capital commitment while non-bank dealers have increased capital commitments. These results are supportive of the Duffie

(2012) prediction that bank-specific regulations enacted in the wake of the financial crisis, including the Volcker Rule and the Basel III accords, had important consequences for the ability of banks to provide liquidity to the corporate bond markets.

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Table I
Sample Construction

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 January 2006 to October 2016. The Aggregate Market sample that includes all dealers and trades includes 22,837 unique bonds and 68.2 million trades. We construct two subsamples of active dealers. The Top 70% sample includes the dealers that capture 70% of customer trading volume each year. To construct the Constant Dealer sample, we select dealers ranked in the top 30 by customer volume in any sample year then retain dealers that trade each year in the sample period.

Aggregate Market Sample	# Cusips	# Trades
Corporate bonds in TRACE and FISD	24,648	70,752,451
Exclude bonds having less than 5 trades over the sample period	23,433	70,749,867
Exclude bonds with a trade size > issue size	23,357	70,285,747
Exclude primary market transactions	23,341	69,513,725
Exclude trades reported after amount outstanding falls to zero	23,172	69,405,828
Exclude bonds with missing TRACE dissemination date	23,166	69,404,280
Exclude trades with pre-2006 execution date	22,837	68,180,930
Exclude trades after offering date (if offering day <= 15, exclude issue month, otherwise exclude issue month and following month)	22,349	65,611,097
Top 70% Sample		
% of aggregate trades	28%	
% of aggregate volume	68%	
% of customer volume	71%	
Constant Dealer Sample		
% of aggregate trades	58%	
% of aggregate volume	75%	
% of customer volume	76%	

Table II

Summary Statistics

This table provides descriptive statistics on the size of the corporate bond market between January 2006 and October 2016. All statistics are computed using the Aggregate Market sample described in Table I.

Year	Trading Volume (Billions)	Corporate Bond Outstanding Amount (Billions)	# of Corporate Bonds Outstanding	Trading Volume Relative to Amount Outstanding	TRACE Reported Volume (Billions)	Volume not Disseminated on TRACE (Billions)
2006	3,141	3,331	8,050	0.94	2,770	372
2007	2,956	3,577	8,069	0.83	2,542	414
2008	2,309	3,658	7,567	0.63	2,095	215
2009	3,297	4,327	8,259	0.76	2,928	369
2010	3,752	4,820	8,996	0.78	3,133	620
2011	3,722	5,171	9,371	0.72	3,070	652
2012	3,851	5,723	10,052	0.67	3,115	737
2013	4,217	6,199	10,721	0.68	3,364	853
2014	4,227	6,557	10,967	0.64	3,801	426
2015	4,402	7,147	11,289	0.62	4,402	1
2016 (10 Months)	3,723	6,726	10,291	0.55	3,723	0

Table III
Estimates of Transaction Costs on Customer Trades - 2006-2016

The table reports estimated trade execution costs paid by customers in customer-to-dealer principal trades for the Aggregate Market, Top 70%, and Constant Dealer samples described in Table 1. Transaction costs are estimated following the regression based model implemented by Bessembinder, Maxwell, and Venkataraman (2006). Small, medium, and large issue size are defined by $500 million and $1 billion cutoffs. 'Young' refers to bonds that have traded less than one year. 'Clicking' trades comprise of trades in young, investment grade, and large issue bonds that are less than or equal to $5 million. All other trades are categorized as 'calling' trades.

	January 2006 - June 2007	July 2007 - April 2009	May 2009 - June 2010	July 2010 - March 2014	April 2014 - Oct 2016
	Pre-Crisis	Crisis	Post-Crisis	Regulatory Phase-In	Volcker
Aggregate Market Sample	0.40%	0.65%	0.63%	0.47%	0.42%
Top 70% Sample	0.24%	0.45%	0.35%	0.26%	0.25%
Constant Dealer Sample	0.31%	0.56%	0.54%	0.43%	0.39%
By Trade Size - Aggregate Market Sample					
Transaction Cost (%): <=$100K	0.61%	0.89%	0.87%	0.69%	0.62%
% of Total Volume	*1%*	*2%*	*2%*	*2%*	*2%*
Transaction Cost (%): >$100K & <=$1M	0.25%	0.47%	0.42%	0.31%	0.29%
% of Total Volume	*7%*	*9%*	*9%*	*9%*	*10%*
Transaction Cost (%): >$1M & <=$10M	0.19%	0.33%	0.28%	0.21%	0.20%
% of Total Volume	*60%*	*60%*	*58%*	*61%*	*61%*
Transaction Cost (%): > $10M	0.16%	0.29%	0.23%	0.18%	0.16%
% of Total Volume	*32%*	*29%*	*31%*	*28%*	*27%*
By Bond Characteristics - Aggregate Market Sample					
Transaction Cost (%): Investment Grade	0.36%	0.71%	0.65%	0.45%	0.38%
% of Total Volume	*58%*	*64%*	*68%*	*63%*	*69%*
Transaction Cost (%): High Yield	0.46%	0.50%	0.56%	0.51%	0.51%
% of Total Volume	*42%*	*36%*	*32%*	*37%*	*31%*
Transaction Cost (%): Large Issue Size	0.36%	0.68%	0.57%	0.38%	0.33%
% of Total Volume	*37%*	*47%*	*49%*	*48%*	*52%*
Transaction Cost (%): Medium Issue Size	0.38%	0.64%	0.67%	0.48%	0.45%
% of Total Volume	*29%*	*29%*	*28%*	*32%*	*32%*
Transaction Cost (%): Small Issue Size	0.45%	0.59%	0.70%	0.64%	0.58%
% of Total Volume	*34%*	*24%*	*23%*	*20%*	*16%*
Transaction Cost (%): Young bonds	0.28%	0.55%	0.47%	0.36%	0.33%
% of Total Volume	*51%*	*53%*	*55%*	*59%*	*54%*
Transaction Cost (%): Old bonds	0.46%	0.70%	0.72%	0.56%	0.48%
% of Total Volume	*49%*	*47%*	*45%*	*41%*	*46%*
Transaction Cost (%): Clicking Trades #	0.33%	0.72%	0.49%	0.34%	0.30%
% of Total Volume	*3%*	*7%*	*8%*	*7%*	*10%*
Transaction Cost (%): Calling Trades	0.41%	0.64%	0.65%	0.49%	0.44%
% of Total Volume	*97%*	*93%*	*92%*	*93%*	*90%*

Table IV

Capital Commitment Summary Statistics

This table reports summary statistics of variables used in the capital commitment regressions reported in Table V. The capital commitment measures are aggregated at the daily and weekly level and all other variables are aggregated at the monthly level. Daily, weekly, and monthly averages are reported for five sub-periods and for the full January 2006 to October 2016 sample period. All variables are computed using the dealers in the Top 70% sample described in Table I. Variable definitions are provided in Appendix IA.I

	Jan. 2006 - Jun. 2007	Jul. 2007 - Apr. 2009	May 2009 - Jun. 2010	Jul. 2010 - Mar. 2014	Apr. 2014 - Oct. 2016	Jan. 2006 - Oct. 2016
	Pre-Crisis	Crisis	Post-Crisis	Regulatory Phase-In	Volcker	Full Sample
Time-Weighted Daily Capital / Volume (%)	11.4	10.6	9.3	8.5	7.4	9.1
Time-Weighted Daily Capital ($ Millions)	872.4	604.9	782.1	723.1	705.1	725.8
Overnight Capital / Volume (%)	21.1	20.5	17.8	16.2	13.8	17.2
Overnight Capital ($ Millions)	1,625.5	1,170.5	1,501.2	1,386.2	1,313.5	1,377.7
Weekend Capital / Volume (%)	10.4	10.7	8.7	7.7	6.5	8.4
Weekend Capital ($ Millions)	3,883.2	2,950.5	3,527.9	3,174.2	3,063.4	3,245.9
Dollar Volume / Amount Outstanding (%)	7.1	4.8	5.6	4.7	4.1	5.0
Average Trade Size ($ Thousands)	2,004.3	1,326.2	1,490.2	1,279.8	1,212.8	1,394.6
Principal Volume / Total Volume (%)	91.4	91.9	92.3	91.6	94.9	92.5

Table V

Time Series Regressions: Capital Commitment

This table reports time series regression results over the January 2006 to October 2016 period. Each regression includes four time period indicators; the benchmark period is the January 2006 to June 2007 pre-crisis period. The capital commitment measures are computed at the daily and weekly level and all other variables are computed at the monthly level. All dependent variables are computed using the dealers in the Top 70% sample described in Table I. All regressions report robust standard errors and include 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. Variable definitions are provided in Appendix I. Sample period (January 2006 to October 2016) averages of each dependent variable are shown above regression results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Time-Weighted Daily Capital / Volume (%)	Time-Weighted Daily Capital ($ Millions)	Overnight Capital / Volume (%)	Overnight Capital ($ Millions)	Weekend Capital / Volume (%)	Weekend Capital ($ Millions)	Dollar Volume / Amount Outstanding (%)	Ln Average Trade Size ($ Thousands)	Principal Volume / Tot. Volume (%)
Dependent Variable Average	9.1	725.8	17.2	1,377.7	8.4	3,245.9	5.0	7.2	92.5
Crisis	-0.2	-199.4***	0.2	-329.9***	0.2	-573.8***	-1.9***	-0.2***	0.0
	(0.470)	(0.000)	(0.719)	(0.000)	(0.783)	(0.000)	(0.000)	(0.000)	(0.949)
Post-Crisis	-1.6***	15.2	-2.5***	75.6*	-1.7**	108.3	-0.8**	0.1	0.5
	(0.000)	(0.436)	(0.000)	(0.054)	(0.011)	(0.536)	(0.033)	(0.340)	(0.430)
Regulatory Phase-In	-2.1***	-95.5***	-3.6***	-139.8***	-2.9***	-398.2***	-2.1***	-0.2***	-0.1
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.785)
Volcker	-3.5***	-127.8***	-6.4***	-238.5***	-4.1***	-598.7***	-2.8***	-0.3***	3.4***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Corp Bond Index Return (t - 1)	2.7	62.8	4.5	53.8	2.6	985.6	0.8	0.3	-8.2
	(0.313)	(0.659)	(0.374)	(0.844)	(0.620)	(0.437)	(0.735)	(0.553)	(0.111)
Stock Market Index Return (t - 1)	-4.8**	402.4***	-11.3***	742.2***	-8.4*	1,512.2	4.9**	1.2**	-1.1
	(0.030)	(0.001)	(0.007)	(0.003)	(0.080)	(0.183)	(0.043)	(0.043)	(0.802)
Chg. in VIX (t - 1)	-0.1*	8.1**	-0.2**	15.6**	-0.3	28.2	0.1*	0.0*	-0.1
	(0.053)	(0.028)	(0.046)	(0.034)	(0.119)	(0.437)	(0.089)	(0.085)	(0.320)
Chg. in 3-Month Libor (t - 1)	0.4	-190.2***	0.6	-377.1***	2.0	-501.3*	-1.8***	-0.3**	-1.9
	(0.566)	(0.000)	(0.589)	(0.000)	(0.124)	(0.075)	(0.004)	(0.021)	(0.227)
ABS (MF+ETF Flows (t-1) / Tot. Out. (t-2))	30.9*	-3,333.7***	65.7**	-6,481.4***	-1.2	-7,753.9	-33.7**	-4.3	6.6
	(0.088)	(0.006)	(0.037)	(0.001)	(0.971)	(0.340)	(0.049)	(0.136)	(0.850)
% Retail Volume	-41.8***	-4,190.2***	-80.0***	-7,802.0***	9.5	-22,167.7***	-26.8**	-17.4***	24.2
	(0.001)	(0.000)	(0.001)	(0.000)	(0.683)	(0.000)	(0.021)	(0.000)	(0.306)
Constant	11.8***	963.5***	22.0***	1,797.5***	10.3***	4,289.9***	7.8***	14.8***	90.9***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2,716	2,716	2,716	2,716	566	566	130	130	130
Adjusted R-squared	0.124	0.167	0.145	0.148	0.257	0.167	0.657	0.673	0.456
Test: Crisis = Post-Crisis	***	***	***	***	***	***	***	***	ns
Test: Crisis = Regulatory	***	***	***	***	***	*	ns	ns	ns
Test: Crisis = Volcker	***	***	***	***	***	ns	***	***	***
Test: Post-Crisis = Regulatory	*	***	*	***	*	***	***	***	ns
Test: Post-Crisis = Volcker	***	***	***	***	***	***	***	***	***
Test: Regulatory = Volcker	***	***	***	**	***	**	***	***	***

Table VI

Capital Commitment Summary Statistics: Bank vs. Non-Bank Dealers

This table reports summary statistics for bank and non-bank dealers in the Constant Dealer sample described in Table I. Panel A reports trading statistics for the bank and non-bank samples of dealers. Panel B reports daily and weekly averages over five sub-periods of capital commitment measures for bank and non-bank dealers. The capital commitment measures are computed at the daily and weekly level and all other variables are computed at the monthly level. Variable definitions are provided in Appendix I.

	Jan. 2006 - Jun. 2007	Jul. 2007 - Apr. 2009	May 2009 - Jun. 2010	Jul. 2010 - Mar. 2014	Apr. 2014 - Oct. 2016
	Pre-Crisis	Crisis	Post-Crisis	Regulatory Phase-In	Volcker
Panel A: Trading Statistics					
Non-Bank Market Share	4.4%	5.1%	7.0%	10.2%	13.5%
Non-Bank Market Share - Customer Volume	2.4%	3.3%	5.5%	9.2%	12.5%
Bank Sample					
Dollar Volume / Amount Outstanding (%)	6.5	4.5	5.3	4.7	4.0
Average Trade Size ($ Thousands)	1,258.3	880.9	798.2	817.4	761.3
Principal Volume / Total Volume (%)	92.0	90.0	91.0	91.3	93.6
Transaction Cost (%)	0.31%	0.56%	0.53%	0.40%	0.37%
Non-Bank Sample					
Dollar Volume / Amount Outstanding (%)	0.3	0.2	0.4	0.5	0.6
Average Trade Size ($ Thousands)	373.5	188.8	206.1	241.6	305.9
Principal Volume / Total Volume (%)	76.2	82.8	77.6	84.2	90.9
Transaction Cost (%)	0.37%	0.63%	0.61%	0.54%	0.44%
Panel B: Capital Commitment					
Bank Sample					
Time-Weighted Daily Capital / Volume (%)	11.8	11.0	9.6	9.0	7.9
Time-Weighted Daily Capital ($ Millions)	883.8	611.6	819.7	806.1	771.6
Overnight Capital / Volume (%)	22.0	21.1	18.4	17.2	14.8
Overnight Capital ($ Millions)	1,660.1	1,184.6	1,577.3	1,546.7	1,449.2
Weekend Capital / Volume (%)	11.0	11.3	9.2	8.2	7.5
Weekend Capital ($ Millions)	4,030.4	3,057.3	3,785.8	3,598.6	3,611.0
Non-Bank Sample					
Time-Weighted Daily Capital / Volume (%)	7.9	7.4	8.0	8.9	8.2
Time-Weighted Daily Capital ($ Millions)	27.0	21.3	52.7	89.9	127.8
Overnight Capital / Volume (%)	14.8	13.8	15.1	17.3	15.6
Overnight Capital ($ Millions)	50.5	39.4	99.6	174.8	244.3
Weekend Capital / Volume (%)	9.2	8.3	8.8	9.7	8.9
Weekend Capital ($ Millions)	153.4	116.0	283.2	482.7	681.5

Table VII

Time Series Regressions: Bank vs. Non-Bank Dealers

This table reports time series regression results over the January 2006 to October 2016 period for bank and non-bank affiliated dealers. Each regression includes four period indicators; the benchmark period is January 2006 to June 2007. The capital commitment measures are computed at the daily and weekly level and all other variables are computed at the monthly level. All dependent variables are computed using the Constant Dealer sample described in Table I. All regressions report robust standard errors and include market controls. Tests for statistical differences between changes (relative to the benchmark period) in bank dealer and non-bank dealer activity each period are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. Dependent variable sample period (January 2006 to October 2016) averages are shown above regression results. Panel A shows the results for all bonds and trades in the Constant Dealer sample. Panel B shows results for the sample of 'clicking' trades. 'Clicking' trades comprises of trades in young (age less than one year), investment grade, and large issue (issue size of at least $1 billion) that are less than or equal to $5 million. All other trades are categorized as 'calling' trades. Bold formatting indicates calling and clicking coefficients are statistically different at the 5% level.

Panel A: Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Time-Weighted Daily Capital / Volume (%)	Time-Weighted Daily Capital ($ Millions)	Overnight Capital / Volume (%)	Overnight Capital ($ Millions)	Weekend Capital / Volume (%)	Weekend Capital ($ Millions)	Dollar Volume / Amount Outstanding (%)	Ln Average Trade Size ($ Thousands)	Principal Volume / Total Volume (%)
Dependent Variable Average	8.9	425.9	16.9	812.2	9.1	1,996.2	2.6	6.1	87.7
Bank	3.8***	856.8***	7.2***	1,609.6***	1.9***	3,877.0***	6.2***	1.2***	15.8***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Crisis x Non-Bank	0.7**	21.1***	1.3**	38.5***	0.1	115.9**	0.0	-0.4***	7.9***
	(0.015)	(0.000)	(0.028)	(0.000)	(0.899)	(0.018)	(0.617)	(0.000)	(0.000)
Crisis x Bank	0.4	-245.4***	1.4***	-426.0***	1.2**	-819.8***	-1.9***	-0.2***	-0.7
	(0.117)	(0.000)	(0.005)	(0.000)	(0.020)	(0.000)	(0.000)	(0.001)	(0.227)
Post-Crisis x Non-Bank	1.4***	70.8***	2.7***	132.3***	0.7	277.0***	0.4***	-0.2***	2.1
	(0.000)	(0.000)	(0.000)	(0.000)	(0.203)	(0.000)	(0.007)	(0.001)	(0.270)
Post-Crisis x Bank	-0.9***	-19.0	-1.2**	0.4	-0.8	-97.4	-0.9***	-0.1*	-0.3
	(0.002)	(0.276)	(0.018)	(0.990)	(0.167)	(0.514)	(0.001)	(0.086)	(0.742)
Regulatory Phase-In x Non-Bank	2.3***	77.9***	5.0***	152.4***	1.5***	427.9***	0.2***	-0.2***	9.1***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.007)	(0.000)	(0.000)
Regulatory Phase-In x Bank	-1.4***	-62.6***	-2.3***	-85.4***	-1.9***	-333.2***	-1.8***	-0.2***	0.4
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.004)	(0.000)	(0.000)	(0.589)
Volcker x Non-Bank	1.1***	109.6***	2.4***	210.3***	0.2	584.1***	0.3***	-0.0	15.5***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.581)	(0.000)	(0.000)	(0.326)	(0.000)
Volcker x Bank	-3.0***	-103.5***	-5.6***	-194.4***	-3.1***	-363.4***	-2.5***	-0.4***	2.3***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
Observations	5,436	5,436	5,436	5,436	1,132	1,132	260	260	260
Adjusted R-squared	0.123	0.864	0.133	0.862	0.173	0.889	0.958	0.960	0.784
Test: Crisis x Non-Bank = Crisis x Bank	ns	***	ns	***	*	***	***	***	***
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	***	***	***	***	**	***	***	**	ns
Test: Regulatory x Non-Bank = Regulatory x Bank	***	***	***	***	***	***	***	ns	***
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***	***	***	***	***	***	***
Market Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Panel B: Clicking Trades									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Time-Weighted Daily Capital / Volume (%)	Time-Weighted Daily Capital ($ Millions)	Overnight Capital / Volume (%)	Overnight Capital ($ Millions)	Weekend Capital / Volume (%)	Weekend Capital ($ Millions)	Dollar Volume / Amount Outstanding (%)	Ln Average Trade Size ($ Thousands)	Principal Volume / Total Volume (%)
Dependent Variable Average	16.2	39.1	31.4	75.9	18.3	214.3	1.9	6.0	90.8
Bank	**0.7**	**45.8*** **	**0.7**	**87.2*** **	**-2.7** **	**223.4*** **	**3.0*** **	**0.6*** **	**5.5**
	(0.322)	(0.000)	(0.640)	(0.000)	(0.048)	(0.000)	(0.000)	(0.000)	(0.110)
Crisis x Non-Bank	**-7.5*** **	**-1.9*** **	**-14.3*** **	**-4.0*** **	**-10.2*** **	**-9.2**	-0.1**	**-0.9*** **	1.8
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.198)	(0.049)	(0.000)	(0.623)
Crisis x Bank	**-2.4*** **	**-1.6**	**-3.4*** **	**-0.0**	-0.5	**27.1***	**-0.5*** **	-0.3***	**-3.9*** **
	(0.000)	(0.227)	(0.000)	(0.988)	(0.628)	(0.055)	(0.006)	(0.000)	(0.000)
Post-Crisis x Non-Bank	**-5.4*** **	**4.4*** **	**-10.9*** **	**7.1*** **	**-8.4*** **	**1.2**	0.2	**-0.7*** **	-5.6
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.920)	(0.147)	(0.000)	(0.160)
Post-Crisis x Bank	**-7.0*** **	**17.1*** **	**-13.3*** **	33.7***	**-7.0*** **	89.1***	**-0.3**	-0.2***	**-9.7*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.157)	(0.001)	(0.000)
Regulatory Phase-In x Non-Bank	**-5.6*** **	**5.9*** **	**-10.5*** **	**11.1*** **	**-7.0*** **	**33.2*** **	0.2**	-0.4***	1.9
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.014)	(0.000)	(0.600)
Regulatory Phase-In x Bank	**-6.1*** **	**21.2*** **	**-11.3*** **	**42.1*** **	**-5.2*** **	**135.5*** **	**0.3***	-0.3***	**-6.6*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.086)	(0.000)	(0.000)
Volcker x Non-Bank	**-7.8*** **	**11.9*** **	**-14.4*** **	**23.5*** **	**-8.9*** **	**71.1*** **	0.3***	-0.1	**5.1**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.126)	(0.151)
Volcker x Bank	**-8.7*** **	**35.0*** **	**-16.3*** **	**68.1*** **	**-6.8*** **	**236.1*** **	**-0.0**	**-0.2*** **	**-1.1**
	(0.000)	(0.000)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.901)	(0.000)	(0.321)
Observations	5,426	5,426	5,426	5,426	1,132	1,132	260	260	260
Adjusted R-squared	0.198	0.788	0.188	0.775	0.214	0.781	0.925	0.857	0.171
Test: Crisis x Non-Bank = Crisis x Bank	***	ns	***	*	***	***	**	***	ns
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	*	***	ns	***	ns	***	**	***	ns
Test: Regulatory x Non-Bank = Regulatory x Bank	ns	***	ns	***	ns	***	ns	ns	**
Test: Volcker x Non-Bank = Volcker x Bank	ns	***	ns	***	ns	***	ns	ns	*
Market Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table VIII

Stressful Day Summary Statistics

This table reports summary statistics for the stressful day analysis for bank and non-bank affiliated dealers. The capital commitment measures are aggregated at the daily and weekly level. Daily and weekly averages are reported for five sub-periods. All variables are computed using the Constant Dealer sample described in Table I. Variable definitions are provided in Appendix I. Panel A reports statistics for bond-level stress based on the occurrence of large block trades (trade size of at least $10 million). Panel B reports statistics for days with market-wide stress based on the Federal Reserve Bank of Cleveland Stress Index. A description of the identification of "stressful days" can be found in Section VII of the paper.

Panel A: Bond-Level Stress - Block Trading					
	Jan. 2006 - Jun. 2007	Jul. 2007 - Apr. 2009	May 2009 - Jun. 2010	Jul. 2010 - Mar. 2014	Apr. 2014 - Oct. 2016
	Pre-Crisis	Crisis	Post-Crisis	Regulatory Phase-In	Volcker
Bank Sample					
Block Volume / Total Volume (%)	22.5	19.0	23.6	20.6	18.8
Time-Weighted Daily Capital / Volume (%)	30.8	23.3	25.9	24.0	20.8
Overnight Capital / Volume (%)	62.0	47.3	53.6	48.9	41.0
Weekly Capital / Volume (%)	42.9	33.5	35.4	31.4	25.9
Non-Bank Sample					
Block Volume / Total Volume (%)	7.8	8.2	10.1	10.7	10.1
Time-Weighted Daily Capital / Volume (%)	9.7	7.6	12.0	13.6	12.0
Overnight Capital / Volume (%)	14.0	9.9	19.5	27.1	22.6
Weekly Capital / Volume (%)	12.5	7.5	13.8	20.2	15.8
Panel B: Market-Wide Stress - Federal Reserve Bank of Cleveland Stress Index					
# Events	12	23	4	23	24
Bank Sample					
Time-Weighted Daily Capital / Volume (%)	12.0	9.8	10.0	8.5	6.8
Time-Weighted Daily Capital ($ Millions)	827.0	609.7	923.1	788.3	747.2
Overnight Capital / Volume (%)	22.3	19.0	19.8	16.3	12.6
Overnight Capital ($ Millions)	1,534.4	1,182.1	1,815.6	1,511.4	1,387.6
Weekend Capital / Volume (%)	21.9	18.8	18.2	16.1	13.0
Weekend Capital ($ Millions)	9,439.0	7,077.2	10,629.2	8,734.9	8,305.2
Non-Bank Sample					
Time-Weighted Daily Capital / Volume (%)	7.6	7.8	8.8	8.9	7.8
Time-Weighted Daily Capital ($ Millions)	22.4	20.9	60.0	95.2	130.3
Overnight Capital / Volume (%)	14.1	14.6	16.8	17.2	14.9
Overnight Capital ($ Millions)	40.4	38.8	116.1	183.9	246.3
Weekend Capital / Volume (%)	15.1	13.0	15.0	16.9	14.8
Weekend Capital ($ Millions)	299.1	227.0	677.8	1,088.8	1,431.1

Table IX
Time Series Regressions: Stressful Days

This table reports time series regression results over the January 2006 to October 2016 period for bank and non-bank affiliated dealers on stressful days. Each regression includes four period indicators; the benchmark period is January 2006 to June 2007. The capital commitment measures are computed at the daily and weekly level. All dependent variables are computed using the Constant Dealer sample described in Table I. All regressions report robust standard errors and include market controls. Tests for statistical differences between changes (relative to the benchmark period) in bank dealer and non-bank dealer activity each period are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. Dependent variable sample period (January 2006 to October 2016) averages are shown above regression results. Panel A reports statistics for bond-level stress based on the occurrence of large block trades (trade size of at least $10 million). Panel B reports statistics for days with market-wide stress based on the Federal Reserve Bank of Cleveland Credit Market Index. A description of the identification of "stressful days" can be found in Section VII of the paper. In Panel B, bold indicates coefficients are statistically different (at least 5%) from control regression.

Panel A: Bond-Level Stress - Block Trading

	(1)	(2)	(3)	(4)
	Block Volume / Total Volume (%)	Time-Weighted Daily Capital / Volume (%)	Overnight Capital / Volume (%)	Weekly Capital / Volume (%)
Dependent Variable Average	15.1	18.2	35.7	24.4
Bank	14.7***	21.1***	47.9***	30.4***
	(0.000)	(0.000)	(0.000)	(0.000)
Crisis x Non-Bank	1.4***	-1.4	-2.2	-3.2*
	(0.007)	(0.196)	(0.284)	(0.080)
Crisis x Bank	-2.5***	-6.8***	-12.7***	-7.7***
	(0.000)	(0.000)	(0.000)	(0.000)
Post-Crisis x Non-Bank	2.8***	4.3***	9.7***	5.1***
	(0.000)	(0.000)	(0.000)	(0.005)
Post-Crisis x Bank	1.5***	-2.9***	-4.2***	-3.7***
	(0.000)	(0.000)	(0.000)	(0.000)
Regulatory Phase-In x Non-Bank	3.7***	4.5***	14.7***	9.3***
	(0.000)	(0.000)	(0.000)	(0.000)
Regulatory Phase-In x Bank	-1.2***	-6.2***	-11.4***	-9.8***
	(0.000)	(0.000)	(0.000)	(0.000)
Volcker x Non-Bank	3.0***	2.4***	9.3***	3.9***
	(0.000)	(0.003)	(0.000)	(0.006)
Volcker x Bank	-3.0***	-9.8***	-20.3***	-16.3***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	5,430	5,190	5,190	5,190
Adjusted R-squared	0.590	0.442	0.504	0.362
Test: Crisis x Non-Bank = Crisis x Bank	***	***	***	**
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	**	***	***	***
Test: Regulatory x Non-Bank = Regulatory x Bank	***	***	***	***
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***	***
Market Controls	YES	YES	YES	YES

Panel B: Market-Wide Stress - Federal Reserve Bank of Cleveland Credit Market Index						
	(1)	(2)	(3)	(4)	(5)	(6)
	Time-Weighted Daily Capital / Volume (%)	Time-Weighted Daily Capital ($ Millions)	Overnight Capital / Volume (%)	Overnight Capital ($ Millions)	Weekend Capital / Volume (%)	Weekend Capital ($ Millions)
Dependent Variable Average	8.5	407.0	16.2	772.7	15.9	4,591.3
Bank	4.4***	804.6***	8.2***	1,494.0***	6.8***	9,139.8***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Crisis x Non-Bank	1.3	**-29.8**	2.4	**-69.6**	1.1	**-235.0**
	(0.184)	(0.311)	(0.239)	(0.234)	(0.346)	(0.412)
Crisis x Bank	-1.2	**-245.6*** **	-1.5	-420.3***	0.1	-2,524.7***
	(0.127)	(0.000)	(0.280)	(0.000)	(0.907)	(0.000)
Post-Crisis x Non-Bank	3.5*	47.1	7.5**	94.1	3.9**	846.1**
	(0.058)	(0.231)	(0.041)	(0.225)	(0.020)	(0.033)
Post-Crisis x Bank	0.4	105.6	2.3	299.5	0.2	1,657.6***
	(0.708)	(0.338)	(0.340)	(0.140)	(0.878)	(0.004)
Regulatory Phase-In x Non-Bank	2.0*	37.8	4.1*	62.1	**4.7*** **	429.0
	(0.057)	(0.287)	(0.062)	(0.377)	(0.001)	(0.279)
Regulatory Phase-In x Bank	-2.8***	-73.6	-5.0***	-104.3	-2.9**	-1,064.9
	(0.005)	(0.309)	(0.005)	(0.464)	(0.032)	(0.239)
Volcker x Non-Bank	-0.8	124.1***	-1.7	226.1***	0.2	1,078.3***
	(0.332)	(0.000)	(0.316)	(0.000)	(0.895)	(0.002)
Volcker x Bank	-6.3***	-63.5	**-12.2*** **	-126.7	-8.4***	-1,187.5*
	(0.000)	(0.272)	(0.000)	(0.249)	(0.000)	(0.066)
Observations	172	172	172	172	172	172
Adjusted R-squared	0.342	0.904	0.320	0.896	0.615	0.934
Test: Crisis x Non-Bank = Crisis x Bank	***	***	**	***	ns	***
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	ns	ns	ns	ns	**	ns
Test: Regulatory x Non-Bank = Regulatory x Bank	***	*	***	ns	***	**
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***	***	***	***
Market Controls	YES	YES	YES	YES	YES	YES

[#]Bold indicates coefficients are statistically different (at least 5%) from control regression

Internet Appendix (IA)

Table IA.I
Variable Definitions

Panel A: Dependent Variables	
Time-Weighted Daily Capital	'Daily Time-Weighted Capital' refers to aggregate daily unsigned, time-weighted changes in capital for each dealer in a portfolio. Capital commitment is measured 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. The measure is aggregated over each dealer-portfolio-day by 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). We sum this measure across all dealer portfolios on a given day to obtain an aggregate measure of daily capital commitment. This measure is reported both unscaled and scaled by volume across all dealers and bonds in the sample.
Overnight Capital	'Overnight capital' is aggregate volume 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. This measure is based on end-of-day capital for each dealer in a portfolio, where capital is accumulated throughout the day for each portfolio as the absolute value of the difference between the dealer's accumulated principal buy volume and the dealer's accumulated principal sell volume. We sum this measure across all dealer portfolios on a given day to obtain an aggregate measure of daily capital commitment. This measure is reported both unscaled and scaled by volume across all dealers and bonds in the sample.
Weekend Capital	'Weekend Capital' is aggregate volume completed on a principal basis that is not offset by the end of the trading week, i.e., that is absorbed as a change in weekend inventory. This measure is based on end-of-week capital for each dealer in a portfolio, where capital is accumulated throughout the week (beginning and ending at midnight Friday night) for each portfolio as the absolute value of the difference between the dealer's accumulated principal buy volume and the dealer's accumulated principal sell volume. We sum this measure across all dealer portfolios on a given week to obtain an aggregate measure of weekend capital commitment. This measure is reported both unscaled and scaled by volume across all dealers and bonds in the sample.
Dollar Volume / Amount Out.	Aggregate dollar volume scaled by total amount outstanding for each month.
Average Trade Size	Average dollar trade size over each month.
Principal Volume / Total Volume	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. Principal volume is aggregated then scaled by total volume each month.
Transaction Costs %	Transaction costs are estimated following the regression based model implemented by Bessembinder, Maxwell, and Venkataraman (2006). Estimation details are provided in Section III of the paper.
Block Volume / Total Volume	'Block' refers to a single large trade by a dealer of at least $10 million. Block volume is aggregated then scaled by total volume each month.
Panel B: Control Variables	
Corp Bond Index Return (t - 1)	The return to the Barclays Capital U.S. Corporate Bond Index in the previous month.
Stock Market Index Return (t - 1)	The return to the S&P 500 index in the previous month.
Chg. in VIX (t - 1)	The change in the CBOE stock market volatility index (VIX) in the previous month.
Chg. in 3-Month Libor (t - 1)	The change in 3-month LIBOR in the previous month.
ABS (MF+ETF Flows (t-1) / Tot. Out. (t-2))	The absolute value of the aggregate flows into or out of investment grade corporate bond mutual funds and ETFs scaled by the prior month total net asset value. The data is obtained from the Investment Company Institute (ICI).
% Retail Volume	The percentage of total volume that occurs in trades of less than $100,000. This measures is computed using the Aggregate Market sample described in Table I.

Table IA.II

Time Series Regressions: Capital Commitment Using Portfolio-Dealer Approach

This table reports time series regression results over the January 2006 to October 2016 period using a portfolio-dealer approach. Bonds are placed in eight portfolios based on investment grade and high yield, small, medium, and large issue size, and public and private (144A) status. Each regression includes four time period indicators; the benchmark period is the January 2006 to June 2007 pre-crisis period. The capital commitment measures are computed at the portfolio-dealer-day and portfolio-dealer-week level and all other variables are computed at the portfolio-dealer-month level. All dependent variables are computed using the dealers in the Top 70% sample described in Table I. All regressions include portfolio-dealer fixed effects and portfolio bond characteristics and market controls and report standard errors clustered at the portfolio-dealer level. 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. Variable definitions are provided in Appendix I. Sample period (January 2006 to October 2016) averages of each dependent variable are shown above regression results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Time-Weighted Daily Capital / Volume (%)	Time-Weighted Daily Capital ($ Millions)	Overnight Capital / Volume (%)	Overnight Capital ($ Millions)	Weekend Capital / Volume (%)	Weekend Capital ($ Millions)	Dollar Volume / Amount Outstanding (%)	Ln Average Trade Size ($ Thousands)	Principal Volume / Tot. Volume (%)
Dependent Variable Average	11.2	8.1	21.4	15.4	10.3	36.4	0.4	13.6	90.9
Crisis	0.2	-3.4***	1.3**	-6.0***	1.5***	-12.4***	-0.3***	-0.2***	-4.1***
	(0.472)	(0.000)	(0.048)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Post-Crisis	-1.9***	-0.9**	-3.2***	-1.4*	-1.5***	-4.3**	-0.2***	-0.2***	-1.7***
	(0.000)	(0.030)	(0.001)	(0.086)	(0.007)	(0.042)	(0.000)	(0.000)	(0.002)
Regulatory Phase-In	-3.1***	-1.4***	-5.4***	-2.2***	-3.0***	-7.1***	-0.3***	-0.4***	-2.5***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volcker	-4.2***	-1.6***	-7.9***	-3.0***	-4.2***	-8.5***	-0.3***	-0.4***	0.0
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.953)
Ln (Average Issue Size)	-2.0***	1.9***	-4.7***	3.4***	-3.6***	8.3***	0.1**	0.1	1.9
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.024)	(0.470)	(0.282)
Ln (Average Bond Age)	-0.2	0.1	-0.5	0.3*	1.8***	0.0	-0.1***	-0.3***	-2.2**
	(0.307)	(0.203)	(0.333)	(0.067)	(0.000)	(0.966)	(0.005)	(0.001)	(0.039)
Corp Bond Index Return (t - 1)	0.6	2.0**	2.4	3.0*	2.0	14.9*	0.2***	0.4***	-8.2
	(0.481)	(0.033)	(0.216)	(0.076)	(0.375)	(0.093)	(0.000)	(0.002)	(0.102)
Stock Market Index Return (t - 1)	-1.4	5.3***	-3.4	10.1***	-13.5***	25.6***	0.6***	1.4***	16.5***
	(0.258)	(0.000)	(0.163)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.009)
Chg. in VIX (t - 1)	-0.1***	0.1***	-0.2***	0.1***	-0.4***	0.3	0.0***	0.0***	0.1
	(0.002)	(0.009)	(0.004)	(0.006)	(0.000)	(0.166)	(0.000)	(0.000)	(0.462)
Chg. in 3-Month Libor (t - 1)	1.0***	-1.1***	2.3***	-2.2***	2.4***	-2.4	-0.0***	-0.2***	-1.8
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.231)	(0.000)	(0.000)	(0.111)
ABS (MF+ETF Flows (t-1) / Tot. Out. (t-2))	-11.7*	-0.7	-15.8	3.5	-6.8	-1.0	-1.4***	0.6	-44.1**
	(0.058)	(0.880)	(0.191)	(0.701)	(0.389)	(0.968)	(0.000)	(0.289)	(0.011)
% Retail Volume	-16.0	-45.3***	-16.5	-73.4**	16.2	-166.3	-0.2	-6.3***	-20.9
	(0.237)	(0.008)	(0.561)	(0.031)	(0.414)	(0.100)	(0.839)	(0.001)	(0.496)
Constant	42.4***	-15.8***	90.8***	-27.9***	55.1***	-65.1**	-0.9	14.7***	76.0***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.026)	(0.270)	(0.000)	(0.002)
Observations	242,124	242,124	242,124	242,124	50,497	50,497	11,606	11,606	11,600
Adjusted R-squared	0.155	0.265	0.147	0.222	0.143	0.251	0.739	0.767	0.583
Test: Crisis = Post-Crisis	***	***	***	***	***	***	***	ns	***
Test: Crisis = Regulatory	***	***	***	***	***	*	ns	***	***
Test: Crisis = Volcker	***	***	***	***	***	ns	***	***	***
Test: Post-Crisis = Regulatory	***	ns	***	ns	*	***	***	***	ns
Test: Post-Crisis = Volcker	***	*	***	ns	***	***	***	***	***
Test: Regulatory = Volcker	***	ns	***	ns	***	**	***	ns	***

Table IA.III

Time Series Regressions: Bank vs. Non-Bank Dealers Using Portfolio-Dealer Approach

This table reports time series regression results over the January 2006 to October 2016 period for bank and non-bank affiliated dealers using a portfolio-dealer approach. Bonds are placed in eight portfolios based on investment grade and high yield, small, medium, and large issue size, and public and private (144A) status. Each regression includes four period indicators; the benchmark period is January 2006 to June 2007. The capital commitment measures are computed at the portfolio-dealer-day and portfolio-dealer-week level and all other variables are computed at the portfolio-dealer-month level. All dependent variables are computed using the Constant Dealer sample described in Table I. All regressions include portfolio fixed effects and portfolio bond characteristics and market controls and report robust standard errors. Tests for statistical differences between changes (relative to the benchmark period) in bank dealer and non-bank dealer activity each period are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. Dependent variable sample period (January 2006 to October 2016) averages are shown above regression results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Time-Weighted Daily Capital / Volume (%)	Time-Weighted Daily Capital ($ Millions)	Overnight Capital / Volume (%)	Overnight Capital ($ Millions)	Weekend Capital / Volume (%)	Weekend Capital ($ Millions)	Dollar Volume / Amount Out. (%)	Ln Average Trade Size ($ Thousands)	Principal Volume / Total Volume (%)
Dependent Variable Average	10.9	3.1	21.7	5.9	15.5	14.4	0.1	13.5	85.7
Bank	4.2***	4.3***	8.1***	23.1***	-0.6	19.3***	0.2***	0.8***	3.6***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.154)	(0.000)	(0.000)	(0.000)	(0.000)
Crisis x Non-Bank	-1.9***	0.1***	-3.9***	-6.0***	-4.6***	0.2	-0.0***	0.1	1.9*
	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.411)	(0.005)	(0.274)	(0.093)
Crisis x Bank	-1.1***	-1.5***	-1.9***	-5.8***	-1.2***	-5.4***	-0.1***	-0.2***	-1.5**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.024)
Post-Crisis x Non-Bank	-0.4***	0.4***	-0.9***	-0.3	1.1***	-2.5***	-0.0***	-0.1**	-6.4***
	(0.003)	(0.000)	(0.001)	(0.872)	(0.006)	(0.000)	(0.002)	(0.023)	(0.000)
Post-Crisis x Bank	-2.3***	-0.5***	-4.5***	-3.2*	-0.6**	1.0***	0.0***	0.1**	-3.9***
	(0.000)	(0.000)	(0.000)	(0.072)	(0.020)	(0.005)	(0.000)	(0.044)	(0.000)
Regulatory Phase-In x Non-Bank	0.8***	0.9***	1.7***	0.9	-4.9***	4.3***	0.0*	0.3***	5.4***
	(0.000)	(0.000)	(0.000)	(0.540)	(0.000)	(0.000)	(0.069)	(0.000)	(0.000)
Regulatory Phase-In x Bank	-1.0***	-0.6***	-2.0***	-5.3***	-1.9***	-3.4***	-0.1***	-0.3***	5.6***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volcker x Non-Bank	0.3***	1.3***	0.4*	3.9***	-6.5***	6.3***	0.0***	0.2***	8.3***
	(0.001)	(0.000)	(0.057)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volcker x Bank	-1.5***	-0.9***	-3.0***	-8.7***	-2.9***	-3.7***	-0.1***	-0.3***	7.2***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	750,799	750,799	750,799	596,337	156,582	156,582	35,991	34,770	33,479
Adjusted R-squared	0.025	0.117	0.023	0.078	0.024	0.117	0.154	0.238	0.044
Test: Crisis x Non-Bank = Crisis x Bank	***	***	***	ns	***	***	***	***	***
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	***	***	***	*	***	***	***	***	**
Test: Regulatory x Non-Bank = Regulatory x Bank	***	***	***	***	***	***	***	***	ns
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***	***	***	***	***	***	ns
Market Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table IA.IV

Time Series Regressions: Calling Trades

This table reports time series regression results over the January 2006 to October 2016 period for bank and non-bank affiliated dealers for 'calling' trades. 'Clicking' trades comprises of trades in young (age less than one year), investment grade, and large issue (issue size of at least $1 billion) that are less than or equal to $5 million. All other trades are categorized as 'calling' trades. Each regression includes four period indicators; the benchmark period is January 2006 to June 2007. The capital commitment measures are computed at the daily and weekly level and all other variables are computed at the monthly level. All dependent variables are computed using the Constant Dealer sample described in Table I. All regressions report robust standard errors and include market controls. Tests for statistical differences between changes (relative to the benchmark period) in bank dealer and non-bank dealer activity each period are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. Dependent variable sample period (January 2006 to October 2016) averages are shown above regression results. Bold formatting indicates 'calling' and 'clicking' coefficients are statistically different at the 5% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Time-Weighted Daily Capital / Volume (%)	Time-Weighted Daily Capital ($ Millions)	Overnight Capital / Volume (%)	Overnight Capital ($ Millions)	Weekend Capital / Volume (%)	Weekend Capital ($ Millions)	Dollar Volume / Amount Out. (%)	Ln Average Trade Size ($ Thousands)	Principal Volume / Total Volume (%)
Dependent Variable Average	8.5	452.3	16.1	861.7	9.2	2234.2	2.9	6.2	88.0
Bank	**4.0*** **	**846.4*** **	**7.4*** **	**1,591.3*** **	**1.9*** **	**3,853.4*** **	**6.1*** **	**1.2*** **	**16.0*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Crisis x Non-Bank	**0.9*** **	**22.4*** **	**1.5** **	**40.9*** **	**0.3**	**117.7** **	0.1	**-0.4*** **	7.9***
	(0.005)	(0.000)	(0.011)	(0.000)	(0.627)	(0.014)	(0.501)	(0.000)	(0.000)
Crisis x Bank	**0.5***	**-245.9*** **	**1.6*** **	**-427.4*** **	1.3**	**-835.1*** **	**-1.9*** **	-0.1***	**-0.6**
	(0.063)	(0.000)	(0.002)	(0.000)	(0.012)	(0.000)	(0.000)	(0.004)	(0.301)
Post-Crisis x Non-Bank	**1.6*** **	**71.2*** **	**3.0*** **	**133.4*** **	**0.9**	**297.6*** **	0.3***	**-0.2*** **	2.2
	(0.000)	(0.000)	(0.000)	(0.000)	(0.124)	(0.000)	(0.006)	(0.002)	(0.246)
Post-Crisis x Bank	**-0.7** **	**-20.6**	**-0.8**	-1.7	**-0.6**	-98.4	**-1.0*** **	-0.1	**0.0**
	(0.020)	(0.235)	(0.132)	(0.960)	(0.298)	(0.508)	(0.000)	(0.169)	(0.980)
Regulatory Phase-In x Non-Bank	**2.6*** **	**77.4*** **	**5.6*** **	**151.7*** **	**1.7*** **	**421.3*** **	0.2***	-0.2***	9.2***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)
Regulatory Phase-In x Bank	**-1.3*** **	**-66.2*** **	**-2.1*** **	**-91.3*** **	**-1.9*** **	**-358.1*** **	**-1.9*** **	-0.2***	**0.6**
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)	(0.381)
Volcker x Non-Bank	**1.3*** **	**105.5*** **	**2.7*** **	**202.1*** **	**0.2**	**554.9*** **	0.3***	-0.1	**15.6*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.574)	(0.000)	(0.000)	(0.257)	(0.000)
Volcker x Bank	**-2.9*** **	**-112.1*** **	**-5.3*** **	**-208.3*** **	**-3.0*** **	**-435.4*** **	**-2.6*** **	**-0.4*** **	**2.4*** **
	(0.000)	(0.000)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.000)	(0.000)	(0.000)
Observations	5,436	5,436	5,436	5,436	1,132	1,132	260	260	260
Adjusted R-squared	0.120	0.862	0.132	0.860	0.171	0.890	0.956	0.959	0.791
Test: Crisis x Non-Bank = Crisis x Bank	ns	***	ns	***	*	***	***	***	***
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	***	***	***	***	**	***	***	***	ns
Test: Regulatory x Non-Bank = Regulatory x Bank	***	***	***	***	***	***	***	ns	***
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***	***	***	***	***	***	***
Market Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table IA.V
Time Series Regressions: Investment Grade vs. High Yield

This table reports time series regression results over the January 2006 to October 2016 period for bank and non-bank affiliated dealers and for investment grade and high yield bonds. Each regression includes four time period indicators; the benchmark period is January 2006 to June 2007. The capital commitment measures are computed at the daily and weekly level and all other variables are computed at the monthly level. All dependent variables are computed using the Constant Dealer sample described in Table I. All regressions report robust standard errors and include market controls. Bold formatting indicates investment grade and high yield coefficients are statistically different at the 5% level. Tests for statistical differences between changes (relative to the benchmark period) in bank dealer and non-bank dealer activity each period are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. Dependent variable sample period (January 2006 to October 2016) averages are shown above regression results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Time-Weighted Daily Capital / Volume (%)		Time-Weighted Daily Capital ($ Millions)		Overnight Capital / Volume (%)		Overnight Capital ($ Millions)		Weekend Capital / Volume (%)		Weekend Capital ($ Millions)		Dollar Volume / Amount Outstanding (%)		Average Trade Size ($ Thousands)		Principal Volume / Total Volume (%)	
Dependent Variable Average	9.4	8.2	295.3	130.8	18.0	15.5	561.8	250.7	9.5	8.5	1369.2	627.0	2.3	3.6	13.0	13.2	90.7	83.9
	IG	HY	IG	HY	IG	HY	IG	HY	IG	HY	IG	HY	IG	HY	IG	HY	IG	HY
Bank	**2.9*** **	**4.0*** **	**579.3*** **	**277.5*** **	**5.6*** **	**7.3*** **	**1,094.5*** **	**515.1*** **	**1.0** **	**2.4*** **	**2,601.4*** **	**1,275.6*** **	**5.3*** **	**8.4*** **	**1.1*** **	**1.4*** **	**8.1*** **	**21.5*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.043)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Crisis x Non-Bank	**-1.8*** **	**3.9*** **	**1.6**	**19.7*** **	**-3.4*** **	**7.3*** **	**2.7**	**36.1*** **	**-2.5*** **	**4.5*** **	**6.2**	**109.8*** **	**-0.1**	**0.4***	-0.5***	-0.4***	**1.6**	**10.6*** **
	(0.000)	(0.000)	(0.675)	(0.000)	(0.000)	(0.000)	(0.724)	(0.000)	(0.000)	(0.000)	(0.871)	(0.000)	(0.261)	(0.069)	(0.000)	(0.000)	(0.418)	(0.000)
Crisis x Bank	**0.1**	**1.2*** **	**-177.7*** **	**-67.5*** **	**0.9***	**2.5*** **	**-310.8*** **	**-114.8*** **	1.2**	1.5***	**-590.9*** **	**-228.9*** **	-1.8***	-1.9***	**-0.2*** **	**0.0**	-1.4**	0.3
	(0.733)	(0.000)	(0.000)	(0.000)	(0.073)	(0.000)	(0.000)	(0.000)	(0.041)	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.461)	(0.039)	(0.711)
Post-Crisis x Non-Bank	**0.2**	**2.2*** **	**27.1*** **	**43.5*** **	**0.7**	**4.0*** **	**50.1*** **	**82.0*** **	**-0.7**	**2.1*** **	**61.0**	**216.0*** **	**0.1**	**1.1*** **	-0.3***	-0.2***	-1.2	3.3
	(0.507)	(0.000)	(0.000)	(0.000)	(0.338)	(0.000)	(0.000)	(0.000)	(0.332)	(0.001)	(0.294)	(0.000)	(0.468)	(0.000)	(0.000)	(0.003)	(0.623)	(0.179)
Post-Crisis x Bank	**-1.6*** **	**0.5**	-3.1	-16.1**	**-2.6*** **	**1.7*** **	10.4	-10.2	**-1.5** **	**0.8**	-78.4	-19.1	-0.6**	-1.4***	**-0.2*** **	**0.1**	**-1.6***	**1.8**
	(0.000)	(0.116)	(0.814)	(0.011)	(0.000)	(0.009)	(0.687)	(0.405)	(0.010)	(0.257)	(0.486)	(0.737)	(0.011)	(0.004)	(0.002)	(0.433)	(0.077)	(0.171)
Regulatory Phase-In x Non-Ban	**0.7** **	**3.9*** **	37.4***	40.7***	**2.1*** **	**7.6*** **	76.1***	76.7***	**0.2**	**2.9*** **	209.3***	218.5***	**0.0**	**0.8*** **	-0.3***	-0.2***	**5.4*** **	**10.7*** **
	(0.026)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.730)	(0.000)	(0.000)	(0.000)	(0.610)	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)
Regulatory Phase-In x Bank	**-2.1*** **	**-0.3**	-32.6***	-29.9***	**-3.7*** **	**-0.2**	-48.3**	-36.7***	-2.4***	-1.1**	-202.7**	-130.5***	-1.6***	-2.0***	-0.3***	-0.2***	**-0.6**	**1.7** **
	(0.000)	(0.329)	(0.007)	(0.000)	(0.000)	(0.709)	(0.020)	(0.000)	(0.000)	(0.025)	(0.019)	(0.004)	(0.000)	(0.000)	(0.000)	(0.001)	(0.433)	(0.049)
Volcker x Non-Bank	**-0.7*** **	**2.9*** **	**64.5*** **	**45.5*** **	**-0.9***	**5.4*** **	**126.3*** **	**84.8*** **	**-1.4*** **	**1.8*** **	**343.7*** **	**240.4*** **	**0.2*** **	**0.8*** **	**-0.2*** **	**0.0**	**9.3*** **	**18.7*** **
	(0.006)	(0.000)	(0.000)	(0.000)	(0.084)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.003)	(0.541)	(0.000)	(0.000)
Volcker x Bank	**-4.0*** **	**-1.6*** **	-56.7***	-45.5***	**-7.5*** **	**-2.7*** **	**-120.6*** **	**-71.3*** **	**-3.8*** **	**-1.9*** **	-179.0**	-184.5***	**-2.1*** **	**-3.0*** **	**-0.3*** **	**-0.5*** **	**1.3** **	**3.3*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.042)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.032)	(0.000)
Observations	5,436	5,430	5,436	5,430	5,436	5,430	5,436	5,430	1,132	1,132	1,132	1,132	260	260	260	260	260	260
Adjusted R-squared	0.154	0.082	0.853	0.813	0.163	0.083	0.847	0.799	0.211	0.135	0.869	0.836	0.963	0.933	0.954	0.950	0.521	0.817
Test: Crisis x Non-Bank = Crisis x Bank	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	ns	***
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	***	***	**	***	***	***	*	***	ns	*	ns	***	***	***	**	***	ns	ns
Test: Regulatory x Non-Bank = Regulatory x Bank	***	***	***	***	***	***	***	***	***	***	***	***	***	***	ns	ns	***	***
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Market Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Bold indicates coefficients are statistically different (at least 5%) from HY regression

Table IA.VI

Stressful Day Summary Statistics for Alternate Stress Events

This table reports summary statistics for the stressful day analysis for bank and non-bank affiliated dealers. The capital commitment measures are aggregated at the daily and weekly level. Daily and weekly averages are reported for five sub-periods. All variables are computed using the Constant Dealer sample described in Table I. Variable definitions are provided in Appendix I. Panel A reports statistics for bond-level stress based on abnormal selling at the bond level. Panel B reports statistics for days with market-wide stress based on the Composite Stress Index. A description of the identification of "stressful days" can be found in Section VII of the paper.

Panel A: Bond-Level Stress - Abnormal Sell Volume					
	Jan. 2006 - Jun. 2007	Jul. 2007 - Apr. 2009	May 2009 - Jun. 2010	Jul. 2010 - Mar. 2014	Apr. 2014 - Oct. 2016
	Pre-Crisis	Crisis	Post-Crisis	Regulatory Phase-In	Volcker
Bank Sample					
Time-Weighted Daily Capital / Volume (%)	28.8	23.2	24.9	23.5	21.0
Overnight Capital / Volume (%)	61.6	49.2	53.7	50.4	43.9
Weekly Capital / Volume (%)	39.2	31.3	31.3	29.3	25.1
Non-Bank Sample					
Time-Weighted Daily Capital / Volume (%)	13.7	11.6	13.7	16.7	18.2
Overnight Capital / Volume (%)	26.3	22.1	26.6	36.5	37.3
Weekly Capital / Volume (%)	18.6	13.1	16.0	23.3	22.8
Panel B: Market-Wide Stress - Composite Stress Index					
# Events	20	17	15	76	36
Bank Sample					
Time-Weighted Daily Capital / Volume (%)	11.8	9.8	8.6	9.0	6.6
Overnight Capital / Volume (%)	21.4	18.9	16.5	17.2	12.4
Weekend Capital / Volume (%)	20.3	18.0	16.9	16.4	12.7
Non-Bank Sample					
Time-Weighted Daily Capital / Volume (%)	7.9	5.4	7.3	9.4	8.5
Overnight Capital / Volume (%)	14.9	9.8	13.8	18.3	16.7
Weekend Capital / Volume (%)	13.3	10.5	13.8	16.7	15.1

Table IA.VII
Time Series Regressions: Alternate Stressful Days

This table reports time series regression results over the January 2006 to October 2016 period for bank and non-bank affiliated dealers on stressful days. Each regression includes four period indicators; the benchmark period is January 2006 to June 2007. The capital commitment measures are computed at the daily and weekly level. All dependent variables are computed using the Constant Dealer sample described in Table I. All regressions report robust standard errors and include market controls. Tests for statistical differences between changes (relative to the benchmark period) in bank dealer and non-bank dealer activity each period are included below regression results. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% level, respectively. Dependent variable sample period (January 2006 to October 2016) averages are shown above regression results. Panel A reports statistics for bond-level stress based on abnormal selling at the bond level. Panel B reports statistics for days with market-wide stress based on the Composite Stress Index. A description of the identification of "stressful days" can be found in Section VII of the paper.

Panel A: Bond-Level Stress - Abnormal Sell Volume			
	(1)	(2)	(3)
	Time-Weighted Daily Capital / Volume (%)	Overnight Capital / Volume (%)	Weekly Capital / Volume (%)
Dependent Variable Average	20.2	42.6	25.9
Bank	15.1***	35.3***	20.6***
	(0.000)	(0.000)	(0.000)
Crisis x Non-Bank	0.1	0.5	-1.3
	(0.951)	(0.890)	(0.625)
Crisis x Bank	-3.8***	-8.5***	-4.3***
	(0.000)	(0.000)	(0.000)
Post-Crisis x Non-Bank	2.4	6.2*	2.0
	(0.115)	(0.053)	(0.457)
Post-Crisis x Bank	-1.5**	-1.9	-3.3***
	(0.041)	(0.193)	(0.009)
Regulatory Phase-In x Non-Bank	4.8***	14.2***	8.4***
	(0.000)	(0.000)	(0.000)
Regulatory Phase-In x Bank	-3.5***	-7.1***	-6.2***
	(0.000)	(0.000)	(0.000)
Volcker x Non-Bank	5.8***	13.9***	6.5***
	(0.000)	(0.000)	(0.001)
Volcker x Bank	-6.4***	-14.8***	-11.7***
	(0.000)	(0.000)	(0.000)
Observations	4,916	4,916	4,916
Adjusted R-squared	0.194	0.218	0.137
Test: Crisis x Non-Bank = Crisis x Bank	**	***	ns
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	***	***	**
Test: Regulatory x Non-Bank = Regulatory x Bank	***	***	***
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***
Market Controls	YES	YES	YES

Panel B: Market-Wide Stress - Composite Stress Index			
	(1)	(2)	(3)
	Time-Weighted Daily Capital / Volume (%)	Overnight Capital / Volume (%)	Weekend Capital / Volume (%)
Dependent Variable Average	8.6	16.5	15.7
Bank	3.9***	6.5***	7.0***
	(0.002)	(0.001)	(0.000)
Crisis x Non-Bank	-0.7	-1.5	-0.1
	(0.681)	(0.623)	(0.948)
Crisis x Bank	-0.2	1.1	0.4
	(0.923)	(0.739)	(0.779)
Post-Crisis x Non-Bank	0.3	0.5	1.0
	(0.845)	(0.871)	(0.490)
Post-Crisis x Bank	-2.3*	-3.3	-2.9**
	(0.067)	(0.131)	(0.012)
Regulatory Phase-In x Non-Bank	2.3*	4.9**	4.3***
	(0.083)	(0.046)	(0.000)
Regulatory Phase-In x Bank	-1.9	-2.7	-3.0***
	(0.230)	(0.229)	(0.008)
Volcker x Non-Bank	1.1	2.8	2.8**
	(0.383)	(0.238)	(0.011)
Volcker x Bank	-4.7***	-8.1***	-6.5***
	(0.002)	(0.000)	(0.000)
Observations	328	328	328
Adjusted R-squared	0.179	0.191	0.430
Test: Crisis x Non-Bank = Crisis x Bank	ns	ns	ns
Test: Post-Crisis x Non-Bank = Post-Crisis x Bank	*	*	***
Test: Regulatory x Non-Bank = Regulatory x Bank	***	***	***
Test: Volcker x Non-Bank = Volcker x Bank	***	***	***
Market Controls	YES	YES	YES