Bond Ownership Concentration*

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Abstract

Institutional ownership of corporate bonds is highly concentrated. The largest five bondholders hold at least 40.4% of the amount outstanding of the average bond issue, making the bond market more concentrated than equities. Consistent with information acquisition costs, I document that bond ownership concentration increases with credit risk, but mostly among high-yield bonds, as investment-grade bonds are information insensitive. Conditional on credit risk, bond concentration decreases with firm transparency, but mostly among high-yield firms. To address endogeneity concerns, I find similar results when considering TRACE dissemination of historical bond trades as an exogenous shock to information acquisition costs. Borrowers with a concentrated investor base suffer from a higher cost of borrowing even after controlling for liquidity and credit risk. One standard deviation increase in pre-issuance bond concentration is associated with a 6 to 13 basis point increase in yield spread, translating to an extra cost of $2.5 million to $5.2 million for the median bond issuance.

Keywords: Corporate Bonds, Ownership Concentration, Information Sensitivity
JEL Classification: G11, G12, G23

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1 Introduction

The corporate bond market is the primary source of external funding for US public companies. As of the end of 2021, the total amount outstanding in corporate bonds reached 10 trillion dollars demonstrating a threefold increase in the last two decades[1]. Despite rapid development, the corporate bond market remains opaque, illiquid, and predominantly populated with institutional investors. With the increasing prevalence of bond mutual funds in the post-GFC period, academics and regulators have been focusing on the heterogeneity of bond market clientele and its effect on funding fragility and the cost of borrowing[2]. At the same time, there is limited knowledge about the structure of institutional bond ownership in the cross-section of bonds and borrowers, which ultimately affects the illiquidity and cost of borrowing in this market.

In this paper, I study the widespread tendency of institutional investors to hold significant stakes in individual corporate bonds. An average corporate bond is owned by only a handful of investors with concentrated positions. For example, out of 4483 publicly traded corporate bonds of US public firms between 2000 and 2019, 73% had at least one investor who owned more than 10% of the issue, and 26% had at least one with more than 20% of the amount outstanding. On average, the largest five bondholders, defined on the ultimate parent (portfolio) level, own at least 40.4% (33.5%) of the amount outstanding, making the bond market significantly more concentrated than the equity market[3]. Moreover, there is substantial variation in bond concentration in the cross-section of bonds and issuers, with the interquartile range of 19.0% of the amount outstanding[4].

In the first part of my paper, I explore the properties of bond ownership concentration on bond and borrower levels. I document a convex relation between bond ownership concentration and credit risk. There is almost no variation in concentration across investment-grade borrowers, with a steep positive trend in the high-yield part of the spectrum. As a result, high-yield bonds demonstrate more concentrated ownership than investment-grade instruments. Moreover, I show that bond concentration decreases with borrower transparency, even after controlling for credit risk.

What are the fundamental reasons behind bond ownership concentration and the observed patterns? To answer this question, I consider three types of friction when investing

[1] www.sifma.org and Federal Reserve Board.

[2] See, for example, Massa, Yasuda, and Zhang (2013), Zhu (2021), Nanda, Wu, and Zhou (2019), Choi, Dasgupta, and Oh (2019), Bretscher, Schmid, Sen, and Sharma (2022). Erel and Inozemtsev (2022) survey the literature on the increasing role of nonbank lenders in debt financing.

[3] For comparison, the average stock ownership by the largest five investors, defined on the ultimate parent level, is 31.5% of the total market cap, conditional on total observed institutional ownership to be at least 50% of the total market cap.

[4] Here the sample of bonds is restricted to those with at least $50 million of the amount outstanding and the total observed ownership by insurance companies and mutual funds of at least 50% of the bond size. For the rest of the paper, the sample of bonds is restricted to those with observed ownership of at least 25% of the bond size. The average Top 5 ownership on the ultimate parent (portfolio) level for the bonds in the main sample is 30.2% (24.6%) of bond size.

in corporate bonds. The first friction is information acquisition cost (Van Nieuwerburgh and Veldkamp (2010), Dang, Gorton, and Holmström (2013), Dang, Gorton, and Holmström (2020)). The value of private information for deep-in-the-money debt securities is low relative to the cost of producing it, leading to dispersed bond ownership. As credit risk increases, private information becomes more valuable. With the fixed upside and potentially substantial downside, bond investors have strong incentives to conduct costly due diligence and collect private information about the risky borrower. Credit-risky securities become information-sensitive (Dang, Gorton, and Holmström (2013)). Investors acquire large stakes in such bonds to justify these costs (Van Nieuwerburgh and Veldkamp (2010)). In the cross-section, high-yield and opaque borrowers require costlier due diligence leading to higher bond ownership concentration.

The second friction is expected bankruptcy costs. Bond investors have a strong incentive to expand their position as a borrower approaches a state of financial distress. In the event of potential corporate restructuring, a large position increases the bargaining power of a bondholder, making a significant stake more valuable than many smaller stakes with the same face value. In contrast, holders of senior claims are well-protected and receive high recovery rates regardless of the restructuring outcome (Bolton and Scharfstein (1996), Hotchkiss and Mooradian (1997), Jiang, Li, and Wang (2012), Lim (2015), Ivashina, Iverson, and Smith (2016), Feldhütter, Hotchkiss, and Karakaş (2016)), Altman (2018), Altman, Hotchkiss, and Wang (2019)).

The third friction is the heterogeneity in regulatory treatment and investment mandate restrictions among the major players in the bond market. For instance, insurance companies are subject to risk-based capital regulation, making it exceptionally costly to participate in the high-yield market. The required capital charge for insurance companies increases exponentially with credit risk. For instance, life insurance companies — the major player in the corporate bond market — pay 1.3% of bond value for holding [BBB–, BBB+]-rated bonds. The capital charge sharply increases to 4.6% for holding [BB–, BB+]-rated bonds and goes as high as 30.0% for investing in [D, CC]-rated distressed bonds (Ellul, Jotikasthira, and Lundblad (2011), Nanda, Wu, and Zhou (2019), Murray and Nikolova (2022))[5]. Index mutual funds and ETFs are also predominantly oriented to investment-grade securities. As a result, fewer institutional investors are available for high credit-risky instruments, leading to higher bond ownership concentration.

These three frictions lead to two testable hypotheses – the bond concentration increases with credit risk in a non-linear manner and decreases with firm transparency. I test these predictions on a large sample of US public firms with at least one bond outstanding using bond ownership data of insurance companies and mutual funds during

[5]The regulation and corresponding risk-based required capital charges changed in 2021. See, for instance, https://www.spglobal.com/spdji/en/documents/commentary/market-commentary-potential-impacts-of-proposed-risk-based-capital-factors.pdf.

2000q4–2019q4. I consider several measures of bond concentration on both bond and issuer levels. These measures include the natural logarithm of the number of bondholders, Ln(Bondholders), the Herfindahl-Hirschman index, HHI, and the ownership by the largest one and five bondholders as the share of the amount outstanding — Top 1 and Top 5 (Figures 1 and 2 plot the distribution of main concentration measures).

Consistent with frictions, high-yield bonds demonstrate an increasing ownership concentration with almost no variation among investment-grade bonds. This relation persists even after controlling for a wide range of bond and issuer-specific characteristics. For instance, the average B-rated bond is held by 14.2% fewer institutional investors than BBB+ rated bonds, with the total ownership of the Top 5 being 2.6 percentage points of the amount outstanding higher. [D, CCC+]-rated distressed bonds possess 4.8 percentage points more concentrated ownership by the Top 5 and 35.7% fewer investors than BBB+ bonds[6]. At the same time, there is no consistent difference in concentration across investment-grade securities. Aside from credit risk, bond concentration decreases with bond size and increases with bond age. Consistent with information acquisition costs (Dang, Gorton, and Holmström (2013)), bonds with embedded options, such as callability and convertibility, demonstrate higher ownership concentration. To rule out issuer-specific endogeneity concerns, I confirm my findings in the panel regression with issuer times date fixed effects, exploiting the variation across bonds of the same firm.

Using borrower-level concentration measures, I further document the convex relation between bond ownership concentration and credit risk on the firm level. Again, there is little variation in concentration across investment-grade issuers, with a sharp positive trend for high-yield borrowers. For instance, the Top 5 bond ownership in [D, CCC+]-rated distressed borrowers is 13.3 percentage points of the amount outstanding higher than in BBB+ rated borrowers. The results are consistent among all four measures of bond concentration.

To test the information acquisition cost story as one of the reasons behind bond ownership concentration, I exploit various standard measures of firm-level information transparency, such as the size of firm assets, the analyst coverage, the number of previously issued bonds, and the number of news. All measures of information acquisition costs demonstrate a robust pattern: issuer-level bond-ownership concentration decreases with borrower transparency, even after controlling for credit risk and other firm-specific characteristics. To further pin down the role of information, I show that concentration-risk convexity varies with firm transparency. The relation between bond concentration

[6]The results should be treated as a lower bound of the actual difference in concentration. The main sample includes the corporate bonds with observed institutional ownership of at least 25% of bond size – a reasonable tradeoff between measurement error and sample selection. The difference in concentration between investment-grade and high-yield bonds increases further when restricting the sample to those bonds with observed institutional ownership of at least 50% of the bond size. See the Appendix for more details.

and credit risk is steeper for opaque high-yield borrowers than for similar-rated transparent borrowers. There is no such difference across investment-grade issuers, with the only exception being those with BBB and marginal BBB– ratings. Consistent with information acquisition costs, I show that transparency explains the variation in bond ownership concentration predominantly in the high-yield part of the spectrum.

The correlation between bond ownership concentration and various measures of information transparency is subject to endogeneity concerns. Institutional ownership and firm transparency are simultaneously determined and might be driven by some omitted factor. To address the endogeneity problem, I consider the public dissemination of corporate bond trades via TRACE as an exogenous shock to information acquisition costs. The staggered implementation of TRACE dissemination during 2002–2005 allows me to identify the causal effect of mandatory transparency on bond ownership concentration. Consistent with the information acquisition cost mechanism, the increased transparency of the corporate bond market did not affect the ownership concentration of investment-grade bonds and borrowers. Conversely, the concentration of high-yield bonds decreased by 4-7 percent following the new regulation depending on the measure. Notably, although the introduction of TRACE led to a significant decline in transaction costs for all the categories of bonds (Asquith, Covert, and Pathak (2013)), only high-yield bonds experienced a decrease in ownership concentration. Thus, transaction costs cannot serve as an explanation for bond ownership concentration.

In equilibrium, the costs associated with the frictions should be priced, and incumbent institutional investors should be compensated accordingly. As credit-risky borrowers require more due diligence, investors ask for additional compensation for their work beyond credit risk and liquidity considerations. The potential for costly restructuring should also be reflected in bond prices. Finally, the deteriorating participation of institutional investors further increases the borrowing cost. Thus, bond ownership concentration is a composite measure that reflects the entry barriers and holding costs for investors. Using a comprehensive dataset of bond issuances during 2001–2019, I explore the pricing implications of issuer-level bond concentration on the cost of borrowing in the primary corporate bond market.

In the cross-section of bond issuances, I show that pre-issuance issuer-level bond concentration explains offering yield spread even after controlling for a wide range of bond and issuer-specific characteristics, including well-known measures of information transparency, credit risk, and bond illiquidity. One standard deviation increase in pre-issuance bond concentration is associated with a 6 to 13 basis point increase in offering yield spread. To put these numbers in perspective, a back-of-the-envelope calculation of the economic magnitude suggests that present value interest losses range from 0.50% to 1.03% of par value[7]. For the median offering of $500 million, borrowers with concentrated

[7]Average duration of newly issued bonds in my sample is 8.01 years.

bond ownership overpay between $2.5 million and $5.2 million per one standard deviation change in concentration.

The effect of pre-issuance bond concentration is expected to be higher for credit-risky borrowers. In the cross-section, the borrowers become subject to all three types of frictions discussed above as credit risk increases. Consistently, I show that the effect of pre-issuance concentration on offering yield spread increases with credit risk, measured by issuer-level distance-to-default (Merton (1974), Bharath and Shumway (2008), Schwert (2018)). For instance, one standard deviation increase in Ln(Bondholders) is associated with a 27 basis point drop in the offering yield spread of distressed borrowers with distance-to-default close to zero — two times the average effect.

According to the asymmetric-information theory by Dang, Gorton, and Holmström (2013), debt instruments become information-sensitive during credit market turmoil. As macro-level credit spread increases, market participants become increasingly worried about the prospects of potential default, making them more cautious about new investments. Due diligence costs increase, making opaque and risky borrowers with a small investor base even more vulnerable. In line with this argument, high-yield issuers lose access to capital markets during recessions (Baker (2009), Erel, Julio, Kim, and Weisbach (2012)). Thus, the cost implications of pre-issuance concentration should be higher during periods of high turmoil. I test this prediction by interacting pre-issuance concentration with a macro-level credit spread. Consistent with increasing due diligence costs, concentration costs go up with macro-level credit spread. For instance, at the bottom of the Global Financial Crisis of 2008-2009, the abnormal yield spread of concentrated borrowers sky-rocketed to 48-68 basis points for average bond issuance in the sample - five times the average effect.

Notably, the results are robust to various specifications and control variables. Neither the secondary market liquidity of the issuer's seasoned bonds nor the liquidity of new bond issuance drives the results. The cost-implication of bond concentration is also robust to controlling for credit risk measured by issuance credit rating, stock return volatility, and issuer-level distance-to-default. Based on recent academic literature on the importance of the underwriter's reputation (Goldstein, Hotchkiss, and Pedersen (2019), Dick-Nielsen, Nielsen, and von Rüden (2021)), I also control for the underwriter's market power and the total number of lead underwriters. Finally, my main finding is robust to the inclusion of a wide range of issuer-specific characteristics, including the measures of information transparency, such as firm size, media coverage (Gao, Wang, Wang, Wu, and Dong (2020)), analyst coverage (Kelly and Ljungqvist (2012)), and the number of previously issued bonds.

In this paper, I restrict my attention to US public firms with at least one outstanding bond. As these firms are the most transparent in the economy, the sample selection effectively introduces a bias against finding any results. Thus, one should treat the mag-

nitude of economic effect as a lower bound of the actual cost of bond concentration. For instance, bond-issuing private firms presumably require more due diligence and possess a smaller investor base, leading to a higher cost of borrowing. Firms issuing corporate bonds for the first time are another group not covered in my sample. Bodnaruk and Rossi (2021) show that such firms heavily rely on a subset of shareholders who tend to invest in both equity and debt of their portfolio firms — habitual dual holders.

To the best of my knowledge, my work is the first comprehensive study of the properties of bond ownership concentration and the fundamental reasons behind this phenomenon. The empirical literature on bond concentration is scarce. IMF economists first drew attention to concentrated bond ownership of US mutual funds in the 2015 Global Financial Stability Report and raised concerns about funding fragility in the corporate bond market[8]. Consistently, Li and Yu (2022) document a positive correlation between bond ownership concentration and secondary market illiquidity. Although bonds with concentrated ownership are less liquid, institutional investors are more hesitant to sell them during massive outflows or periods of high turmoil. Faced with asset redemption, portfolio managers follow a pecking order and tend to sell the most liquid instruments first (Ma, Xiao, and Zeng (2022)). Thus, bonds with a concentrated position demonstrate better performance and lower secondary market volatility during recessions (Giannetti and Jotikasthira (2022), Li and Yu (2022)). None of these papers explore the fundamental reasons behind bond ownership concentration. My work makes the first attempt to explain the tendency of institutional bond investors to accumulate the position and document the pricing implications of bond concentration above and beyond bond illiquidity and credit risk.

My work further contributes to the growing literature on institutional ownership of corporate bonds and its pricing implications. The primary focus of the existing literature is the increasing role of mutual funds and overall investor composition and heterogeneity (Bretscher, Schmid, Sen, and Sharma (2022)). The volatile nature of mutual fund flows directly affects the cost of borrowing and the debt structure of borrowing firms whose bonds are predominantly owned by mutual funds (Massa, Yasuda, and Zhang (2013), Zhu (2021), Choi, Dasgupta, and Oh (2019)). Insurance company ownership also has price implications for corporate bonds. Risk-based capital regulation creates a fire-sale risk for bonds with marginal credit ratings (for instance, BBB– rating), affecting the overall demand and pricing of these bonds (Nanda, Wu, and Zhou (2019), Murray and Nikolova (2022)). A battery of papers further documents the price implications of changes in insurance company demand for bonds (Massa and Zhang (2021), Coppola (2021), Barbosa and Ozdagli (2021), Kubitza (2021)). My work emphasizes the importance of investor concentration for the cost of borrowing, even after considering the effect of

[8]See the report here: https://www.imf.org/en/Publications/GFSR/Issues/2016/12/31/Vulnerabilities-Legacies-and-Policy-Challenges

investor heterogeneity.

Most importantly, the results of this paper contribute to the growing empirical evidence in support of the asymmetric-information theory of debt pricing (Dang, Gorton, and Holmström (2013), Dang, Gorton, and Holmström (2020)). Benmelech and Bergman (2018) examine the corporate bond market and show that bond illiquidity increases with credit risk, with the relation being highly nonlinear and having a "hockey-stick" form. They conclude that the information sensitivity of a bond affects its illiquidity[9]. Although the bond ownership concentration is correlated with bond illiquidity (Li and Yu (2022)), it does not necessarily represent the same phenomenon. First, the bond ownership concentration is a composite measure that blends multiple frictions to form a unique measure of institutional demand or the lack of it. In the context of this paper, I treat pre-issuance bond concentration as a measure of the cost of investing in the underlying borrower's bonds. Second, the structure of institutional ownership depends on both the value of private information and the cost of collecting it. As the incentive to collect private information increases with the credit risk, the cost of collecting it also goes up. For instance, high-yield bonds have more covenant protection and typically possess more embedded options, which increase the cost of due diligence. In equilibrium, the cost of producing private information should be reflected in prices beyond the illiquidity premium. Although there is a theoretically justified correlation between bond liquidity and concentration, many other not borrower-specific factors affect liquidity, including market microstructure frictions and liquidity preferences of incumbent bondholders[10]. Consistently, I show that bond concentration explains the offering yield spread even after controlling for bond and issuer-level illiquidity. Moreover, this cost is not attributed to the initial underpricing (Cai, Helwege, and Warga (2007), Nikolova, Wang, and Wu (2020)). Instead, it is a long-term component of the bond price.

More generally, the nontrivial bond concentration levels that I document in this work raise several questions regarding the active role of high-yield bondholders and their engagement in the corporate governance of the borrowing firms (Shleifer and Vishny (1997)). The classical theories of external funding draw a sharp contrast between bank loans and arm's length debt (Gertner and Scharfstein (1991), Rajan (1992)). A typical assumption in these models is a relatively high bank loan concentration and dispersed corporate bond ownership structure. As a result of this presumed difference in ownership structure, bondholders have fewer incentives to monitor the borrower. On top of that, dispersed bondholders suffer from a coordination problem, creating frictions during debt restructuring of financially distressed borrowers.

My work questions the traditional assumption of dispersed bond ownership. To put

[9]For the comprehensive review of this literature, please, see Dang, Gorton, and Holmström (2020).

[10]One might think about the composition of various investor types – insurance companies and mutual funds – with the demand for liquidity being significantly larger for mutual fund investors.

the magnitude of bond concentration in perspective, consider a scenario of bond covenant violation. According to current legislation, a group of bondholders with total ownership of at least 25% of the amount outstanding has the right to accelerate the bond immediately (Kahan (2002), Kahan and Rock (2009)). Following my results, it takes the coordination of less than the five largest bondholders to impose legal actions against the borrower. Kahan and Rock (2009) provide examples of such bondholder activism among hedge fund investors. Feldhütter, Hotchkiss, and Karakaş (2016) consistently document the premium in high-yield bond prices attributed to the value of creditor control. This might be a fruitful direction for future research.

The paper is structured as follows: Section 2 describes the economics behind bond ownership concentration and the main hypotheses of the paper. Section 3 provides a detailed description of my dataset and the key variables of interest. Section 4 discusses the cross-sectional properties of bond ownership concentration. Section 5 provides evidence in support of information acquisition cost as one of the main economic reasons for bond ownership concentration, including the causal inference. Section 6 provides evidence of the adverse consequences of bond concentration on the cost of borrowing in the corporate bond market. Section 7 concludes with a discussion of the main findings and potential directions for future research.

2 The economics of bond ownership concentration

2.1 Reasons for bond ownership concentration

What are the fundamental reasons behind bond ownership concentration? To answer this question, I consider three types of frictions bond investors face when investing in corporate bonds — the information acquisition costs, the bankruptcy costs, and the investment mandate restrictions.

The first friction is information acquisition costs. Corporate bonds typically offer a fixed upside, at the same time being vulnerable to significant downside risk. Mismeasurement of the potential risk may lead to severe losses for bond investors[11]. Thus, bond investors have strong incentives to collect private information about the borrower and conduct costly due diligence. Such costs lead to a larger position to justify pre-investment losses associated with due diligence (Van Nieuwerburgh and Veldkamp (2010)). The demand for private information varies across debt instruments, with high credit-risk instruments incentivizing more due diligence. According to recent theoretical work by Dang, Gorton, and Holmström (2013), deep-in-the-money debt securities, such as the safest investment-grade bonds, are information-insensitive because the probability of default is negligible. Once the likelihood of default increases, private information becomes

[11]The handbook of fixed income securities by Fabozzi, Mann, and Fabozzi (2021).

more valuable, incentivizing bond investors to conduct costly due diligence. Moreover, high-yield instruments are typically more complicated as they contain more covenant protection and embedded options, such as callability and convertibility. As the cost of due diligence increases, the average position of participating institutional investors increases to justify the cost of information production. As a result, there is a potentially non-linear positive relation between bond ownership concentration and credit risk, with high credit-risky and opaque borrowers demonstrating more concentrated ownership.

The second friction is the bankruptcy costs. During the last five decades, the academic literature has provided numerous estimates, with the consensus being that bankruptcy is expensive for all the claim holders in the distressed firm[12]. A classic theoretical paper by Bolton and Scharfstein (1996) argues that credit-risky firms prefer concentrated debt ownership because it leads to more efficient restructuring and higher recovery rates. Ivashina, Iverson, and Smith (2016) empirically showed that a higher concentration of debt holders is indeed associated with faster restructuring and larger recovery rates in corporate bankruptcies. Thus, the increasing probability of default and related bankruptcy costs incentivize investors to accumulate debt positions in junior claims – a fulcrum position. In the event of a corporate restructuring, a large position increases the bargaining power of a bondholder, making a significant stake more valuable than many smaller stakes with the same face value. In contrast, holders of senior claims are well-protected and receive high recovery rates regardless of the restructuring outcome. Consistently, distressed debt investing has become widespread among vulture investors looking to obtain active control over the firm's decisions[13].

Bondholders can exercise control over a firm's decisions even outside the state of default. Embedded covenant protection effectively restricts the borrower's behavior, granting bondholders a certain amount of power. Violation of bond covenants without the explicit consent of a significant share of bondholders may trigger early bond acceleration. Kahan and Rock (2009) document various examples of bondholder activism whereby debtholders with concentrated positions actively engage with the borrowing firm to improve the value of debt claims. Consistently, Nini, Smith, and Sufi (2012) show that creditors restrict the risk-taking behavior of the borrower and enhance the governance and overall firm value following loan covenant violations. Thus, bondholders can accumulate their position and actively monitor the borrower even outside of financial distress.

The third friction affecting bond concentration is variation in regulation and investment mandate restrictions among major players in this market. Risk-based capital regulations of insurance companies — an important class of investors in the corporate bond

[12]A number of papers try to estimate direct and indirect costs of bankruptcy, among others Warner (1977), Cutler and Summers (1988), Weiss (1990), Shleifer and Vishny (1992), Weiss and Wruck (1998), Andrade and Kaplan (1998), Pulvino (1998), Hortaçsu, Matvos, Syverson, and Venkataraman (2013).

[13]See Hotchkiss and Mooradian (1997), Jiang, Li, and Wang (2012), Lim (2015), Feldhütter, Hotchkiss, and Karakaş (2016)), Altman (2018), Altman, Hotchkiss, and Wang (2019).

market — can make it prohibitively costly to invest in high credit-risk securities. Consequently, the share of insurance company holdings in any bond issue declines with its default risk (Ellul, Jotikasthira, and Lundblad (2011), Nanda, Wu, and Zhou (2019), Murray and Nikolova (2022)). Passive mutual funds and bond ETFs tend to follow investment-grade bond indexes, which also restricts the potential buyers for lower-rated issues. Active mutual and hedge funds are the most common acquirers of high-yield bonds. While the latter group can purchase any bond, investment-grade and high-yield, insurance companies and passive mutual funds mostly stick with investment-grade bonds. This asymmetry in institutional demand leads to fewer investors in the high-yield part of the spectrum, resulting in higher bond ownership concentration[14].

All three types of frictions suggest that bond concentration should increase with credit risk, with the relation being nonlinear. There should be little to no relation between bond concentration and credit rating for relatively safe investment-grade bonds. Once security passes the borderline BBB– rating, the concentration should increase with credit risk. This discussion leads me to the following hypothesis:

Hypothesis 1: There is a nonlinear relation between bond ownership concentration and credit risk. There is limited variation in concentration across relatively safe investment-grade bonds and borrowers, with a steep positive trend in the high-yield part of the spectrum.

Consistent with the information acquisition cost theory by Dang, Gorton, and Holmström (2013), small and opaque credit-risky borrowers are costly to analyze. Typically, there is limited analyst research and media coverage available for such firms. Fixed-income investors willing to invest in credit-risky bonds of opaque issuers must conduct due diligence in-house, increasing the investment cost. According to Van Nieuwerburgh and Veldkamp (2010), the information acquisition cost leads to a larger position to justify the cost. My second hypothesis:

Hypothesis 2: Conditional on credit risk, bond concentration decreases with borrower transparency.

2.2 Cost of borrowing and bond ownership concentration

The frictions create entry barriers for potential investors. When investing in credit-risky bonds, institutional investors bear information acquisition costs which vary with borrower transparency and credit risk. As investors become increasingly concerned about

[14]Taking it to the extreme, Altman and Benhenni (2019) estimate the total number of distressed debt investors operating in the US to be just over 200 in 2018.

the underlying value of the firm's assets, the information production and the cost of due diligence go up. As a result, the pool of informed investors shrinks, leading to more concentrated ownership. In equilibrium, those informed participating investors should be compensated for their efforts. The cost of due diligence is not necessarily a one-time up-front payment. In fact, holding credit-risky debt securities require continuous monitoring and examination of the borrower. Taken to the extreme, one can draw a parallel between a tight banking relationship and investment in high-yield corporate bonds. Similar to the banking relationship, high-yield bond investors should constantly monitor the borrower for potential deterioration in firm value (Fama (1985), Ongena and Smith (2000)). This monitoring introduces a period-by-period cost reducing the market value of the bond. In extreme cases, a small investor base may lead to imperfect competition and rent extraction by incumbent bondholders – similar to the hold-up problem in banking relationships (Sharpe (1990), Rajan (1992), Farinha and Santos (2002), Santos and Winton (2008)). Thus, the bond ownership concentration serves as a measure of information acquisition cost.

As an alternative, not necessarily mutually exclusive, investors become increasingly worried about the potential restructuring and bankruptcy costs as the borrower's credit quality deteriorates. To manage their expected losses, the bond investors actively accumulate the position to get more negotiation power and affect the outcome of the restructuring. Concentration is expected to be higher for those borrowers with higher bankruptcy costs. Thus, one can treat bond ownership concentration as a measure of the expected cost of restructuring.

Finally, investment mandate restrictions are tightly related to investors' incentives to produce private information. For instance, a financially constrained insurance company might be worried about the potential for the marginal BBB-rated borrower to become a fallen angel. As a result, a portfolio management team decides to examine the borrower and assess the risks better. More generally, heterogeneous regulatory treatment and investment mandate restrictions lead to a reduction in the pool of available investors raising the price and the cost of borrowing.

The bond ownership concentration is a composite measure that combines the cost of all three frictions discussed above. Whatever the exact mechanism, pre-issuance issuer-level bond concentration reflects the cost of attracting new investors. The discussion leads to the following hypothesis:

Hypothesis 3: Issuers with high bond ownership concentration (small investor base) have a higher cost of borrowing.

The expected cost of the frictions increases with credit risk. Thus, one can expect a more substantial pre-issuance concentration effect on the cost of borrowing for riskier bor-

rowers. During periods of high turmoil, market participants become increasingly worried about the prospects of potential default, making them more cautious about new investments. The due diligence cost increases. Consistently, high-yield issuers lose access to capital markets during recessions (Baker (2009), Erel, Julio, Kim, and Weisbach (2012)). As a result, information acquisition costs should be higher during periods of high credit spread.

3 Data

3.1 Sample construction

I compile my sample from several different sources. Mutual fund (MF) bond holdings and mutual fund characteristics are from Morningstar Direct and the CRSP Mutual Fund Database. Insurance company holdings and characteristics are from NAIC and obtained through the S&P Market Intelligence platform. Firm variables are from several sources: major accounting variables are from CRSP/COMPUSTAT, institutional stock ownership is from Thomson Reuters, and analyst coverage from Bloomberg. Bond characteristics, including time-invariant and credit rating data, are from Mergent FISD, returns and yields are from WRDS, the amount outstanding is from Thomson Reuters Eikon and Bloomberg, and underwriter information is from Thomson Reuters Eikon. Bond transactions are from Enhanced TRACE.

In this paper, I restrict my attention to two major types of bondholders: mutual funds and insurance companies. These two groups of institutional investors are likely to represent the bond market's marginal investor, with the total ownership coverage ranging from 40% in 2008 to 66% of the amount outstanding in 2020, according to the US federal flow of funds account (Figure B.8 in Appendix B). I construct granular bond ownership data of US mutual funds by merging CRSP with Morningstar on a share class level, following Pástor, Stambaugh, and Taylor (2017). If not specified otherwise, I consider bond holdings on the individual portfolio levels, that is, granular ownership by individual mutual funds and insurance companies (rather than a mutual fund family or NAIC group). The final sample of bond mutual fund and insurance company holdings ranges from 2000q4 to 2019q4.

The empirical analysis is conducted on the subsample of public firms headquartered in the US, with at least one outstanding bond covered in my holding sample. To minimize the measurement errors in concentration measures and avoid the influence of outliers, I consider only bonds and issuers with at least 25% coverage of the amount outstanding and at least $50 million in the amount outstanding. Doing so, I drop about 20% of bonds by par value outstanding[15]. The results of my paper are not affected by choice of

[15]See Appendix B for details.

particular filters. Some key results are duplicated with a 50% coverage filter in Appendix B. Following the literature, I drop financial issuers with SIC 6000-6999, utility issuers with SIC 4900-4949, and non-profit and government firms with SIC 8000s and 9000s. Descriptive statistics are provided in Table 1. All the variables are winsorized cross-sectionally at 1st and 99th percentiles, except for the Herfindahl index winsorized at 2.5th and 97.5th levels. Appendix A contains detailed information on sample construction.

Throughout my work, I consider several measures of bond ownership concentration: Ln(Bondholders), the Herfindahl–Hirschman index (HHI), the total bond holdings of the largest one and five bondholders as a share of the amount outstanding (Top 1 and Top 5). I define the Herfindahl–Hirschman index as:

$$HHI_{i,t} = \sum_{j=1}^{N} \left(\frac{Holding_{i,j,t}}{BondSize_{i,t}} \right)^2$$

where $HHI_{i,t}$ is the total amount outstanding of bond i at time t, $Holding_{i,j,t}$ is the total par value holding of investor j of bond i at time t, and N is the total number of observed insurance companies and mutual funds.

The bond concentration varies for three reasons. First, it varies due to changes in total holdings of major bondholders relative to others with smaller stakes – the primary interest of this paper. Second, concentration changes due to endogenous variation in observed bond ownership. The bond holdings data I rely on covers only insurance companies and mutual funds. As credit rating deteriorates, insurance company holdings decline, driving down the overall coverage of the data. For example, I observe the ownership of 55% of the amount outstanding for BBB-rated bonds on average and only 39% of the amount outstanding for B-rated bonds (see Figure B.4 in Appendix)[16]. Finally, bond concentration varies due to endogenous changes in the amount outstanding. It is common to redeem bonds prematurely, especially among high-yield borrowers, often not entirely and only to a certain extent. The decision to call the bond partially or entirely depends on firm-specific and macroeconomic conditions. It is crucial for the purposes of this paper to disentangle the first mechanism from the latter two.

Endogenous variation in bond ownership coverage creates measurement error in the concentration measures. Since the measurement error, proxied by overall coverage, is correlated with firm fundamentals, using bond concentration as a dependent variable leads to inconsistent OLS estimates because of the correlation between the error term and the explanatory variables. Adding the total observed ownership as additional control reduces the bias. However, bond concentration measures and ownership coverage are positively correlated with the functional form being non-linear (see Figure B.5 in the Appendix). I address this non-linearity by constructing 100 percentile-based binary variables rep-

[16] After filtering out bonds and borrowers with at least 25% of observed coverage.

resenting the corresponding data coverage buckets. All the specifications include data coverage fixed effects, effectively controlling for endogenous variation in data quality.

The unobserved part of bond ownership raises a concern about the measurement error in concentration measures. Depending on the concentration of the unobserved part of the institutional ownership, the true concentration might be higher or lower than the estimated one. The data coverage fixed effects do not resolve this issue. To rule out this concern, I duplicate all my analysis on the subsample of bonds with at least 50% of observed coverage. Although the sample restrictions improve all the main findings of this paper (please, see the results in Appendix B), it comes at a high cost of reducing the sample size. Thus, the 25% filter on observed bond ownership is a meaningful tradeoff.

4 The properties of bond concentration

In this section, I investigate the properties of bond ownership concentration. Following the discussion in section 2, bond concentration is expected to increase as credit rating deteriorates and to decline with firm transparency. In the first part of the section, I explore the determinants of bond ownership concentration in the cross-section of bonds. I further proceed with the analysis of issuer-level capital structure. A typical public firm has a complicated debt structure consisting of multiple bonds of different seniority and ratings. Senior debt claims have higher credit ratings and frequently remain deep in the money in a state of financial distress. Subordinated claims, on the opposite, become the target for distressed debt investors willing to gain more power in the restructuring process (Hotchkiss and Mooradian (1997), Jiang, Li, and Wang (2012), Lim (2015), Ivashina, Iverson, and Smith (2016)), leading to more concentrated ownership. Aside from restructuring consideration, the junior claims are difficult to analyze, increasing the information acquisition cost. I test these hypotheses on a bond level with issuer-times-date fixed effects, effectively controlling for all the firm-specific variation. Finally, I test my hypotheses on the issuer level, exploiting various measures for information acquisition costs.

4.1 Concentration measures

I consider several measures of bond concentration on both bond and issuer levels. These measures include the natural logarithm of the number of bondholders, the Herfindahl-Hirschman index (HHI), and the ownership by the largest one and five bondholders as a share of the amount outstanding – Top 1 and Top 5. Figures 1 and 2 plot the distribution of the main concentration measures.

During my sample period, ranging from 2000q4 to 2019q4, the corporate bond market experienced a major transformation. Before 2002, there was limited information on

historical bond trades as the trade details were available only to direct participants of the deal. In 2002, SEC introduced a new regulation requiring all FINRA institutions to report corporate bond transactions for public viewing via TRACE, making the secondary market more transparent and accessible. According to the literature, the introduction of TRACE led to a significant decrease in transaction costs (Bessembinder, Maxwell, and Venkataraman (2006), Edwards, Harris, and Piwowar (2007), Goldstein, Hotchkiss, and Sirri (2007), Asquith, Covert, and Pathak (2013), Brugler, Comerton-Forde, and Martin (2022)). As will be shown later in the paper, TRACE reduced the cost of collecting and analyzing historical risk-return properties of corporate bonds and led to the entrance of new uninformed outside investors, diluting the shares of incumbent bondholders.

Figure 3 shows the evolution of the average bond ownership concentration separately for investment-grade and high-yield borrowers. Consistent with the informational role of TRACE, bond ownership concentration showed a massive decline during the first decade of the 21st century. The average Top 5 ownership of investment-grade bonds dropped from the height of 23% of the amount outstanding to about 19% by 2008. During the same period, the concentration of high-yield bonds dropped from almost 27% in 2001 to 24% in 2008. The negative trend continued in the post-GFC period with the increased competition among corporate bond mutual funds.

4.2 Univariate analysis

To test Hypothesis 1 about the non-linear relation between bond concentration and credit risk, I start with a univariate analysis by plotting various bond-level concentration measures against credit rating (see Figure 4). Credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The figure is constructed by controlling for date, industry, and bond ownership coverage fixed effects. Consistent with Hypothesis 1, there is little to no variation in bond concentration across investment-grade ratings, with a steep upward-slopping trend in the high-yield area. The same pattern is observed across all four measures of bond ownership concentration. For instance, the Top 5 ownership for investment-grade bonds is in the range of 20%-23% of the amount outstanding, while for the distressed bonds of below CCC+ rating, the concentration goes up all the way to 31%, with non-rated bonds showing an even higher concentration of 33% of the amount outstanding.

Figure 5 reports similar results on borrower-level concentration measures. The total ownership by the largest five bondholders stays the same across investment-grade credit ratings, ranging from 10% to 13% of the total amount outstanding in the issuer's bonds. The relation becomes positive and upward-sloping for the marginal BBB-rated borrowers. Issuers with BBB– rating possess more concentrated bond ownership reaching 15.7% of the amount outstanding. The concentration keeps growing with credit risk, reaching

30.9% for [D, CCC+]-rated distressed borrowers. Consistent with information acquisition costs, non-rated bonds demonstrate an enormous concentration of 26.7% – comparable with B-rated borrowers. Typically, the risk profile of non-rated borrowers corresponds to the average high-yield borrowers or better. However, the costly due diligence of such borrowers, along with credit risk, elevates the ownership concentration[17].

It is important to emphasize that the concentration numbers severely underestimate the true magnitude of concentration as I observe only 47% of the amount outstanding on the issuer level, on average[18]. The critical idea of the analysis is the examination of the relative rather than the absolute magnitude of concentration. Preliminary results indicate a significant concentration variation in the cross-section of bonds and borrowers.

4.3 The cross-section of bonds

The structure of institutional bond ownership varies cross-sectionally and over time, with various bond and issuer characteristics affecting credit risk and ownership concentration. To test hypotheses 1 and 2, I proceed with the following multinomial regression, controlling for a wide range of bond and issuer characteristics:

$$Concentration_{i,f,t} = \alpha_t + \beta_1 CreditRating_{i,t} + \theta X^{bond}_{i,t} + \gamma X^{firm}_{f,t} + \epsilon_{i,f,t} \quad (1)$$

where the dependent variable is one of the four bond concentration measures: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. Credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. Due to few observations available, I pool extreme ratings together and form two buckets: [AA–, AAA] and [D, CCC+]. Preliminary univariate analysis shows that concentration starts increasing from BBB rating onward. Thus, I treat BBB+ bonds as a base case in pairwise comparison with other groups and exclude the corresponding binary variable from the regression. Bond characteristics $X^{bond}_{i,t}$ include $Ln(BondSize)$, $Ln(BondSize)^2$, dispersion of credit ratings across three major credit rating agencies Sd(Rating), number of ratings, covenant index following Billett, King, and Mauer (2007), D(Covenant Index Missing), $Ln(1 + BondAge)$, $Ln(1 + BondMaturityLeft)$, binary variables D(Callable), D(Convertible), D(Global issue), D(144A), and total bond ownership by mutual fund investors to address the heterogeneity of investor base (Massa, Yasuda, and Zhang (2013), Zhu (2021), Nanda, Wu, and Zhou (2019), Choi, Dasgupta, and Oh (2019)). I also control for a wide range of firm-specific characteristics: Ln(Assets), Ln(Age), R&D,

[17]Figure B.7 in Appendix reports the binscatter plots of issuer-level bond concentration against various measures of credit risk: Altman's Z-score (Altman (1968); Altman, Hotchkiss, and Wang (2019)), Distance-to-default (Merton (1974); Bharath and Shumway (2008); Schwert (2018)), 5-year issuer-level CDS spread, and stock return volatility.

[18]Please, see Figure B.4 in the Appendix.

D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, institutional stock ownership and mutual fund bond ownership on issuer level. All specifications include date, SIC2 industry, and bond ownership coverage fixed effects.

The empirical setting allows me to consider static bond-specific characteristics such as covenant protection and bond convertibility. An issuer may have a set of bonds with different levels of covenant protection depending on the participants' risk appetite and relative negotiation power when issuing bonds. The ex-ante prediction for covenant-concentration relation is not clear. Higher covenant protection serves bondholder interests better, leading to a lower probability of restructuring and, as a result, lower incentives in accumulating a concentrated position. On the other hand, a rich set of covenants complicates the valuation of the bond, increasing the cost of due diligence. The latter would lead to higher bond ownership concentration. It is an empirical question, which of the two forces dominates in the investment process. Following Billett, King, and Mauer (2007), I construct the index of covenant protection by aggregating the information on 15 major bond covenants: dividend restrictions, share repurchase restrictions, funded debt restrictions, subordinate debt restrictions, senior debt restrictions, secured debt restrictions, total leverage, sale and leaseback, stock issue restrictions, rating and net worth restrictions, cross-default provisions, poison put, asset sale clause, investment policy restrictions, and merger restrictions. The covenant index is calculated as the share of all active covenants.

Table 2 reports the regression results of Equation (1). Consistent with Hypothesis 1, bond ownership concentration increases as credit rating deteriorates, with the relation being highly non-linear. The evidence is robust across various concentration measures. The credit ratings, ranging from BBB to [AA–, AAA], demonstrate no consistent differences in ownership concentration across the measures. The concentration begins to grow at a borderline BBB– rating. Starting with a B rating, bond ownership concentration is higher across all measures relative to BBB+ bonds. In column (1), the logarithm of the number of bondholders for a high-yield B rating is 0.153 lower than in BBB+, translating to 14.2% fewer bondholders relative to the average number of bondholders of 80.3 in BBB+ bonds. The group of distressed bonds, ranging from D to CCC+, has 0.442 fewer bondholders – 35.7% lower than BBB+ bonds. Finally, the group of non-rated bonds possesses even more concentrated ownership, with the logarithm of the number of bondholders being 0.541 lower than the BBB+ bonds – 41.8% lower than the average of the BBB+ bond. The results are consistent across different measures of bond ownership concentration.

Notably, the main results should be treated as a lower bound of the actual difference in concentration between investment-grade and high-yield bonds. The difference

in concentration becomes more prominent after restricting the sample to those bonds with observed ownership of at least 50% of the bond size, as documented in Table B.2 of the Appendix section. For instance, after the sample restriction, the difference in the logarithm of the number of bondholders between BBB+ and B-rated bonds increases from 0.153 to 0.273, with the latter corresponding to a 23.9% difference in the number of bondholders. Controlling for mutual fund ownership further reduces the difference in concentration, as shown in Panel B of Table B.2, reporting the results without controlling for investor heterogeneity. The results are also robust to controlling for bond liquidity and transaction costs, including the first two principal components of various measures, as shown in the Panel D of the same Table B.2 in the Appendix.

The evidence of high ownership concentration in non-rated corporate bonds is consistent with the costly due diligence of these instruments. Typically, non-rated debt is treated as high-yield and has a comparable credit risk profile. However, in the absence of an official credit rating, bond investors conduct the fundamental analysis in-house, leading to a larger position. Two other measures of information acquisition costs are a dispersion of credit ratings across three major credit rating agencies, Sd(Rating), and the number of ratings. Disagreement in a credit rating is significant only for one out of four measures of concentration – number of bondholders – with the economic effect being 1.6% per one standard deviation change in disagreement. The number of ratings is marginally significant only in one of the specifications. I also include embedded options – binary variables D(Callable) and D(Convertible) – as measures of instrument complexity. Pricing of embedded options is challenging and requires special skills from the credit analyst team, leading to higher ownership concentration. Indeed, callable bonds have 4.0% fewer bondholders, everything else equal. Finally, convertible bonds demonstrate high bond ownership concentration with a 34.6% smaller investor base, according to specification (1). More concentrated ownership of convertible securities is also consistent with the bankruptcy cost story, with distressed debt investors accumulating the position in those securities, allowing them to acquire control over the borrowing firm.

The bond concentration varies across other dimensions, such as bond size. Large bonds possess lower bond ownership concentration. One standard deviation increase in bond size is associated with a 2.8 times increase in the number of bondholders. Concentration increases with bond age and maturity, with the economic effect being 7.0% and 10.1% change in the number of bondholders per one standard deviation change in the corresponding characteristic. Importantly, concentration decreases with the covenant index – increasing covenant protection by one standard deviation is associated with a 4.5% increase in the number of holders.

4.4 Firm debt structure

Bond credit ratings vary over time due to endogenous issuer-specific reasons unobserved to econometricians. These same drivers can affect the structure and concentration of institutional bond ownership. One possible way of dealing with the endogeneity concern is to consider the cross-sectional heterogeneity of bonds within the same issuer. An average issuer has 4.2 bonds outstanding in my sample, allowing me to analyze the within-issuer variation of bond concentration. Within a given issuer, bonds vary both in seniority and credit rating. Senior bonds are typically safer, having higher credit ratings and recovery rates in restructuring. In contrast, junior bonds are riskier and more likely to become a fulcrum investment for distressed debt investors (Hotchkiss and Mooradian (1997), Jiang, Li, and Wang (2012), Lim (2015), Altman (2018), and Feldhütter, Hotchkiss, and Karakaş (2016)).

To control for issuer-specific variation, I run the following regression with issuer-times-date fixed effects:

$$Concentration_{i,f,t} = \alpha_{f,t} + \beta_1 CreditRating_{i,t} + \theta X_{i,t}^{bond} + \epsilon_{i,f,t} \tag{2}$$

where the dependent variable is one of the four bond concentration measures: natural logarithm of the number of bondholders, HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. $X_{i,t}^{bond}$ include the same set of variables as in Equation (1). Following the discussion in section 2, riskier securities are expected to have higher bond concentration. To test this idea, I include the same credit rating binary variables. The base BBB+ rating is dropped from the regression.

The results are reported in Table 3. Consistent with Hypothesis 1, the riskier bonds possess a higher bond concentration within the issuer's debt structure. In specification (1), bonds with B and [D, CCC+] ratings demonstrate -0.319 and -0.451 lower Ln(Bondholders) than BBB+ bonds correspondingly, translating to 27.3% and 36.3% fewer bondholders. Other measures of concentration provide similar results. In specification (3), I consider the ownership of the largest bondholder as a measure of concentration. The largest investor holds 1.8% of the amount outstanding more in BB– bonds relative to BBB+ bonds, significant at the 5% level. Top1 ownership in remaining [B–, B+] and [D, CCC+] categories ranges from 2.5% to 3.2% higher relative to BBB+ bonds depending on a particular rating, statistically significant at least at 5% level. Surprisingly, according to some of the specifications, the concentration of [A–, AAA] bonds is slightly higher than BBB+ bonds. One possible explanation for such a phenomenon is "reaching-for-yield," leading to lower demand for the safest corporate bonds in a low-interest environment (see, e.g., Becker and Ivashina (2015); Choi and Kronlund (2018)). I also repeat the analysis restricting my sample only to those bonds with at least 50% of observed coverage. The evidence of elevated concentration across the safest investment-grade bonds is less

prevalent for more accurate measurement of concentration (see Table B.3 in Appendix).

Consistent with the previous analysis, larger bond issues have a more extensive investor base leading to smaller ownership concentration. Bond age is positively and significantly correlated with bond concentration, with the recent bond issues enjoying more dispersed ownership. The time to maturity is another vital driver, and long bonds are treated as riskier, leading to higher bond ownership concentration. Consistent with the costly due diligence and bankruptcy cost stories, convertible bonds possess more concentrated ownership – the largest bondholder owns 2.7% of the amount outstanding more, everything else equal – 41.5% of standard deviation.

4.5 Firm-level concentration

In the previous sections, I showed a substantial variation in bond ownership concentration in the cross-section of corporate bonds, including the bonds of the same issuer. The natural question is whether there is a considerable variation in the firm-level concentration. The firm-level analysis allows me to compare the ownership structure of corporate bonds between opaque and transparent firms and further establish the connection with the cost of borrowing in this market.

I proceed with the analysis of firm-level determinants of bond ownership concentration. Table 4 reports the estimation results of the following equation:

$$Top5_{f,t} = \alpha_t + \beta_1 InfoAsym_{f,t} + \beta_2 CreditRating_{f,t} + \gamma X_{f,t} + \epsilon_{f,t} \tag{3}$$

where $Top5_{f,t}$ is the ownership by the largest five bondholders as a share of the amount outstanding[19], and the variables of interest are grouped in two buckets: $InfoAsym_{f,t}$ and $CreditRating_{f,t}$. $InfoAsym_{f,t}$ includes firm size Ln(Assets), analyst coverage Ln(Analyst Coverage), the number of previously issued bonds Ln(Prev. Issued Bonds), the number of firm-specific news in press Ln(Number of News), and D(NotRated) – a binary variable reflecting the absence of borrower-level S&P credit rating. $CreditRating_{f,t}$ is a set of binary variables corresponding to issuer-level S&P credit rating. Firm controls $X_{f,t}$ include $Ln(Age)$, R&D, D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, Institutional stock ownership and Mutual fund bond ownership on issuer level. All the specifications include industry, date, and bond ownership coverage fixed effects.

Consistent with the previous results, borrower-level bond ownership concentration follows the same pattern – the convex relation with credit rating. There is a slight variation in the Top 5 ownership across investment-grade [BBB, AAA]-rated bonds. In the cross-

[19]Other measures of firm-level concentration lead to similar results. The results are reported in Panel D of Table B.4 in the Appendix section.

section, concentration begins increasing with BBB– rating onward. In specification (1), the largest five bondholders hold 2.8% of the amount outstanding more in borrowers with BBB– rating than in BBB+ borrowers. Moving down the credit spectrum, the difference between concentration levels keeps growing. [BB–, BB+]-rated borrowers demonstrate more concentrated ownership by [3.8%, 4.9%] of the amount outstanding than BBB+ borrowers – [22.4%, 28.8%] relative to the average Top 5 ownership of BBB+ of 17% of the amount outstanding. The concentration of [B–, B+]-rated borrowers is more than 5% of the amount outstanding higher, with the difference reaching 8.3% for B– borrowers. Finally, highly speculative borrowers with credit ratings from D to CCC+ show the largest bond ownership concentration, with 13.3% above the base case BBB+ – an enormous 78.2% difference. Along with credit rating, institutional investors care about other risk metrics. For example, one standard deviation increase in cash flow volatility is associated with a 4.0% standard-deviation increase in bond concentration even after controlling for credit rating. Stock return volatility demonstrates the effect of similar economic magnitude[20].

Borrower reputation and transparency play a massive role in corporate borrowings. The borrower's size is an apparent measure of trustworthiness most industry experts rely on[21]. Small firms are typically less transparent and require costlier due diligence. Specification (1) shows that one standard deviation increase in borrower size is associated with an enormous 23.4% of amount outstanding decrease in bond concentration.

I consider several other measures for information acquisition costs along with firm size. In specification (2), one standard deviation increase in equity analyst coverage is associated with a 7.0% standard-deviation decrease in the ownership of the largest five bondholders, even after controlling for borrower size and credit risk[22]. A borrower's reputation in capital markets is reflected in the history of past borrowings. When a borrower has multiple outstanding bonds, fixed-income investors usually exploit the relative pricing of these instruments in their decisions, which significantly reduces the cost of due diligence. Therefore, I consider the number of previously issued bonds as another measure of information acquisition costs. According to specification (3), one standard deviation increase in previously issued bonds is associated with a 0.99% standard deviation decrease in the ownership of the largest five bondholders – 9.9% standard deviation.

The downside risk is the major threat for corporate bond investors, especially in the high-yield part of the spectrum. Investors must monitor borrower-specific news and media reports to avoid massive losses in their positions. Companies with enormous media coverage are easier to track, reducing the cost of due diligence. Using Ravenpack data, I construct a measure of media coverage, reflecting the number of borrower-related articles

[20] Both not reported.

[21] Fabozzi, Mann, and Fabozzi (2021)

[22] The inclusion of both firm size and analyst coverage in the same specification allows me to treat the analyst coverage variable as the *residual analyst coverage* following Hong, Lim, and Stein (2000).

published in the press. In specification (4), one standard deviation increase in the number of news is associated with a 6.1% standard deviation decrease in bond concentration after controlling for borrower size. Finally, I compare borrowers without credit ratings with the base case BBB+ borrowers in all the above specifications. All other things being equal, non-rated borrowers demonstrate 6.8% larger ownership by the Top 5 bondholders – comparable with B-rated borrowers.

The results are robust to various alternative specifications and subsamples, reported in Table B.4 of the Appendix section. First, consistent with the bond-level concentration results, the concentration-rating relation's convexity is steeper for the subsample of firms with the observed bond ownership of at least 50% of the firm's bond outstanding, documented in Panel A of the table. Panel B reports the result without controlling for investor heterogeneity. The results are also robust for specifications with firm-fixed effects and for using all four measures of firm-level bond concentration, as reported in Panels C and D, respectively.

In summary, my analysis reveals the main drivers of bond ownership concentration on bond and issuer levels. In the cross-section, as a borrowing firm's credit quality deteriorates, bondholders tend to accumulate bond positions, even more so in opaque firms. Bond ownership concentration-credit risk relation demonstrates the same convexity within a borrower's debt structure. Bond concentration increases more in convertible instruments, allowing the claim holder to exchange bonds for equity in a distressed firm. The observed patterns are consistent with the frictions considered above.

5 The role of information transparency

Following my earlier discussion in Section 2, one of the major frictions explaining the increasing bond ownership concentration for high-yield borrowers is information acquisition costs. In the cross-section, as credit risk increases, bond investors' incentives to collect private information about the borrower increase along with the value of this information. Information production costs also increase, leading to the acquisition of larger stakes. In this section, I will make an attempt to disentangle the information production channel from the rest of the two frictions – bankruptcy costs and information mandate restrictions.

5.1 The role of transparency in the cross-section

One way of showing the importance of information channel is to compare the functional form of concentration-rating relation between opaque and transparent borrowers. If information acquisition cost is an essential driver of concentration, then one would expect to see a steeper relationship for opaque high-yield borrowers than for transparent ones.

To test that, I run the following modification of Equation (3):

$$\begin{aligned} Top5_{f,t} = \alpha_t + \beta_1 D(Transparent)_{f,t} + \beta_2 CreditRating_{f,t} + \\ + \beta_3 CreditRating_{f,t} * D(Transparent)_{f,t} + \gamma X_{f,t} + \epsilon_{f,t} \end{aligned} \tag{4}$$

where the binary variable $D(Transparent)_{f,t}$ is defined as the above-median borrower by corresponding information transparency measure across all issuers with the same credit rating at each moment in time. As earlier, I consider several measures of information transparency: firm size measured by Ln(Assets), Ln(Analyst coverage), Ln(Previously issued bonds), and Ln(Number of firm news in press).

The results are presented in Table 5. According to the results, opaque firms demonstrate similar convex relation between bond concentration and credit risk with the lack of variation across investment-grade borrowers. Interaction coefficients D(XXX rating)* D(Transparent) vary over credit ratings. Consistent with the worthlessness of private information for investment-grade borrowers, there is no statistical difference in concentration between transparent and opaque investment-grade borrowers. The pattern changes once the credit rating reaches BBB and BBB– ratings. Three out of four transparency indicators show that concentration is lower for transparent marginally BBB– -rated borrowers, with the economically large effect of 4.3% of the amount outstanding, according to specification (2). Moreover, bond ownership concentration is lower across all the ratings in the high-yield part of the spectrum. Thus, the convexity varies in the cross-section, with the concentration-risk relation being steeper for opaque borrowers. The results are widely consistent with the demand for private information and the high cost of collecting it when investing in credit-risky borrowers. Interestingly, the coefficient on D(BBB– rating)*D(Transparent) is the largest, suggesting the importance of investment mandate restrictions in acquiring private information.

From the previous analysis, it is clear that information transparency is valuable for investors of high-yield bonds. I further test this hypothesis by exploiting my continuous measures of information transparency and running the following regression:

$$\begin{aligned} Top5_{f,t} = \alpha_t + \beta_1 InfoAsym_{f,t} + \beta_2 D(IGrating)_{f,t} + \\ + \beta_3 InfoAsym_{f,t} * D(IGrating)_{f,t} + \gamma X_{f,t} + \epsilon_{f,t} \end{aligned} \tag{5}$$

where $InfoAsym_{f,t}$ includes firm size measured by Ln(Assets), Ln(Analyst coverage), Ln(Previously issued bonds), and Ln(Number of firm news in press).

Table 6 reports the estimation results. Consistent with the information production story, information acquisition costs predominantly matter for investing in bonds of high-yield borrowers. The results of all four specifications suggest that information transparency is significantly less valuable for investing in corporate bonds of investment-grade borrowers. For instance, according to specification (2), one standard deviation increase in

firm transparency translates to a 9.9% reduction in the bond concentration of high-yield borrowers and only a 2.2% reduction in the concentration of investment-grade issuers.

5.2 Causal inference

In the previous section, I explore the cross-sectional properties of bond ownership concentration. The results suggest that bond concentration comoves with the measures of information acquisition costs. Although I try to control for various firm characteristics, including the firm fixed effects[23], my analysis is subject to endogeneity concerns – both bond ownership structure and borrower information opaqueness are simultaneously determined. For instance, some third variable, unobserved to the econometrician, might affect both bond concentration and the cost of information acquisition. To address the endogeneity concerns, I consider the dissemination of corporate bond trades by FINRA as an exogenous shock to information acquisition costs. During 2002-2005, the Trade Reporting and Compliance Engine (TRACE) – a regulator-based platform – disseminated all the eligible corporate bond trades reported to FINRA since 2002, making OTC bond market more transparent and reducing the transaction costs (Bessembinder, Maxwell, and Venkataraman (2006), Edwards, Harris, and Piwowar (2007), Goldstein, Hotchkiss, and Sirri (2007), Asquith, Covert, and Pathak (2013), Brugler, Comerton-Forde, and Martin (2022)).

5.2.1 TRACE dissemination

Before the introduction of TRACE, there was limited information on historical bond trades as the trade details were available only to direct participants of the deal. In 2002, SEC introduced a new regulation requiring all FINRA institutions to report corporate bond transactions to make the secondary bond market more transparent and accessible. Although FINRA started to collect all the bond trades in 2002, the public dissemination of this information was conducted in four steps from 2002 to 2005. Simultaneously with the introduction of TRACE on July 1, 2002, FINRA launched Phase 1, disseminating all the trades of investment-grade TRACE-eligible bonds with an initial size of $1 billion or greater[24]. Phase 2, covering all the investment-grade TRACE-eligible bonds of at least $100 million initial-size par value or greater and rated A– or higher, was implemented on March 3, 2003[25]. After more than two years into the program, FINRA decided to disseminate the remaining set of bonds in two steps, Phase 3A and Phase 3B, implemented on October 1, 2004, and February 7, 2005, respectively. The main difference between the

[23] Specification with firm fixed effects is reported in Table B.4 of Appendix B.

[24] On July 1, 2002, FINRA also disseminated the data on 50 non-investment grade bonds under the Fixed Income Pricing System (FIPS).

[25] On April 14, 2003, FINRA disseminated 120 investment-grade TRACE-eligible bonds rated BBB as a part of the controlled experiment studied in Goldstein, Hotchkiss, and Sirri (2007).

two phases was the eligibility of transactions for delayed dissemination. For instance, Phase 3B covered transactions greater than $1 million on thinly traded high-yield bonds (Asquith, Covert, and Pathak (2013)).

Following the dissemination of TRACE, all the market participants were allowed to obtain the data on the historical bond trades at a relatively low cost, which used to be available only to the most active participants. The historical data on corporate bond transactions is valuable to investors for several reasons:

- It allows investors to assess the trading and liquidity risk of the security — which includes transaction costs, price dispersion, and overall liquidity — more accurately. As high-yield bonds are rarely traded, the dissemination of high-yield bond trades is more valuable to investors.

- Access to the historical bond prices allows investors to examine price sensitivity to fundamental shocks. Better assessment of liquidity risk, among other things, provides a better understanding of how the bond price could react to fundamental shocks, including scenario analysis (simulations) based on historical pricing data. Due to the higher probability of adverse price movements, high-yield bonds benefit more from mandatory transparency in secondary markets.

- Bond investors often price bonds using a set of comparables. With complete transparency on secondary markets, bond investors can come up more easily with the estimate of a "fair price" given the fundamentals and specifics of the bond contract. It is more rewarding for high-yield investors, as it is more challenging to come up with a good comparable group for credit-risky bonds (heterogeneity in idiosyncratic risk and contract characteristics).

- Finally, with historical bond trades, bond investors can analyze the dynamics of the particular borrower's seasoned bonds - risk/return properties. For instance, is bond price volatile? If yes, how is it related to fundamentals? Etc.

In summary, although the dissemination of TRACE offers limited information about firm fundamentals per se, it provides valuable information for investors on how to realize the profit from having an information advantage about the fundamentals. Thus, I hypothesize that public dissemination of TRACE reduces the cost of collecting and analyzing historical risk-return properties of corporate bonds, leading to the entrance of new uninformed investors and diluting the shares of incumbent bondholders. As a result, the number of bondholders increases, and bond ownership concentration decreases following the introduction of TRACE. More importantly, the effect of mandatory market transparency should vary in the cross-section of corporate bonds and borrowers, with a substantial impact on high-yield and limited to no effect on investment-grade bonds and borrowers. I test these predictions by exploiting the staggered nature of TRACE implementation.

To explore the consequences of bond trade dissemination, I construct a sample of corporate bonds whose secondary market trading information became publicly available in Phase 2 and Phases 3A and 3B. That is, I restrict my sample to those bonds that changed the treatment status (Asquith, Covert, and Pathak (2013))[26]. The staggered implementation of TRACE allows me to estimate the causal effect of dissemination on each of the Phases by using yet-to-be-treated and already-treated bonds as a control group. Phases 3A/B, treated in October 2004, serve as a control group for Phase 2 bonds, treated in March 2003, and vice versa[27]. As the difference between Phases 3A and 3B is subtle (being more on transaction level rather than bond level), and given a short 4-month difference in dates of implementation, I pull all the Phases 3A and 3B bonds together and consider the 2004q4-2005q1 range as treatment period (from now on, Phase 3 bonds).

Following the official FINRA rules[28], I define Phase 2 bonds as those non-144A bonds with an initial size of at least $100 million and a credit rating of A– and higher as of the end of 2002. The treatment date for Phase 2 bonds is 2003q1. Due to sample limitations, for Phase 3, I restrict my attention to those non-144A bonds with credit ratings ranging from BBB+ to B– and an initial size of at least $100 million as of 2004q3. I make sure the Phase 3 bonds are not treated as a part of Phase 1 or Phase 2. Phase 3 bonds are further divided into two groups – BBB bonds with credit ratings [BBB–, BBB+] and high-yield bonds with ratings [B–, BB+]. The final sample includes 349 bonds from 100 borrowers disseminated in Phase 2. Phase 3 sample includes 441 BBB bonds from 132 borrowers and 102 HY bonds from 61 borrowing firms. The time range is restricted to 2002q1-2006q1. Table 1, Panel D, provides the descriptive statistics for treated bonds.

To study the effect of TRACE dissemination on bond ownership concentration, I estimate the following stacked difference-in-difference specification on the bond level:

$$\begin{aligned} Concentration_{p,i,t,c} = \alpha_{p,t} + \alpha_{p,i} + \alpha_c + \beta_1\, Treated\_Ph2_{2,i,t} * Post_{2,i,t} + \\ + \beta_2 Treated\_Ph3\_BBB_{3,i,t} * Post_{3,i,t} + \beta_3 Treated\_Ph3\_HY_{3,i,t} * Post_{3,i,t} + \\ + \gamma X_{i,t} + \epsilon_{p,i,t,c} \end{aligned} \tag{6}$$

where $Concentration_{p,i,t,c}$ is one of the four concentration measures for bond i from phase p at time t with bond ownership data coverage from percentile c – natural logarithm of the number of bondholders, HHI index, and the ownership by the largest one and five bond-

[26] I do not consider Phase 1 bonds in my work for two reasons. First, there are very few eligible investment-grade bonds with an initial size of at least $1 billion in my sample. Second, as I am primarily interested in high-yield bonds and their reaction to dissemination, large investment-grade bonds do not serve as a good control group for high-yield securities.

[27] I check and make sure that none of the Phases 3A/B bonds were disseminated earlier as a part of the FINRA120 program. I do not consider FINRA120 bonds separately, as there are very few of them in my sample.

[28] Please, see Asquith, Covert, and Pathak (2013) for more details.

holders as a share of the amount outstanding. Concentration measures vary with the bond ownership coverage in a non-linear way, so it is necessary to control for observed bond ownership data coverage using a set of percentile-based fixed effects α_c. Following the stacked difference-in-differences regression methodology (Gormley and Matsa (2011)), the model includes cohort times quarter fixed effects $\alpha_{p,t}$ and cohort times bond fixed effects $\alpha_{p,i}$. $Treated\_Ph2_{2,i,t}$ reflects the [A–, AAA]-rated Phase 2 bonds, $Treated\_Ph3\_BBB_{3,i,t}$ stands for [BBB–, BBB+]-rated Phase 3 bonds, and $Treated\_Ph3\_HY_{3,i,t}$ for [B–, BB+]-rated Phase 3 bonds. For each event, I consider the last two quarters before and six quarters after the treatment, estimating the effect every two quarters relative to the last two quarters before treatment. The set of control variables $X_{i,t}$ includes the natural logarithm of bond size, the square of the natural logarithm of bond size, the natural logarithm of bond age, and the natural logarithm of maturity left. Table 7 reports the difference-in-differences effects on bond-level concentration. Panel A reports the estimates for the natural logarithm of the number of bondholders. According to the results, there is no change in the number of bondholders of investment-grade bonds following Phase 2 dissemination. The remaining three measures of concentration show similar results – there is no effect of mandatory transparency on the concentration of [A–, AAA]-rated investment-grade bonds. The empirical evidence is consistent with the information acquisition cost theory by Dang, Gorton, and Holmström (2013), where deep-in-the-money corporate bonds are information-insensitive, and bond investors have little incentives to conduct costly due diligence, including the analysis of historical bond returns.

The evidence on [BBB–, BBB+]-rated bonds, disseminated in Phase 3, is mixed. The number of bondholders in [BBB–, BBB+]-rated bonds dropped by 1.5% following four quarters after the event and 1.8% after six quarters, significant at least at the 5% level. HHI and Top5 measures show a small 0.64% increase in concentration during the first four quarters, and Top1 demonstrates a decline of 3.8% following six quarters after the treatment.

Finally, high-yield [B–, BB+]-rated bonds in Phase 3 demonstrate a 4.0%-increase in the total number of bondholders compared to Phase 2 bonds six quarters following the shock. The effect on the HHI index, documented in Panel B, shows similar results, with the HHI index dropping by 0.00155, which is a 6.4% decrease relative to the pre-treatment values. A similar result holds for the Top1 measure, with the overall position of the largest bondholders in [B–, BB+]-rated bonds declining by 4.1% four quarters following the shock and 7.0% after six quarters, both significant at 1% level. There is no statistically significant effect on Top5 concentration for high-yield bonds[29]. Overall, the results are consistent with the findings of Brugler, Comerton-Forde, and Martin (2022),

[29]Although there is no significant effect relative to the pre-treatment period, the comparison relative to the period [t, t+1] — the treatment quarters for high-yield bonds — leads to a similar effect as for the Top 1 measure, that is, a decrease in Top 5 ownership by 66 bps by the end of [t+4, t+5].

documenting the decline in the ownership concentration of initial allocation in bond issuance following the introduction of TRACE.

One potential concern of the above analysis is the choice of the control group for each TRACE dissemination phase. To establish the causal effect on high-yield bonds, I compare these bonds with [A–, AAA]-rated bonds from Phase 2. The sharp difference in institutional ownership structure and other characteristics in the pre-treatment period can violate the parallel trend assumption, allowing for a significant difference in the dynamics of bond concentration even in the absence of treatment. To check for the possible presence of pre-trends, I run the same difference-in-difference regression by allowing the effect to vary over time. Figures 6-8 report the effect on all four measures of bond concentration for all the bonds in the sample. The graphs show no apparent violation of the parallel trend assumption in the pre-treatment period for all the measures and bond subsamples. The decline in the concentration of [B–, BB+]-rated bonds starts following the end of the treatment period and continues during the next four quarters after the event, reflecting the idea that market participants keep learning about the disseminated bonds[30].

In summary, disseminating secondary market bond transactions via TRACE increased the average number of bondholders and reduced the overall concentration. Consistent with the information acquisition theory by Dang, Gorton, and Holmström (2013), there is no effect on investment-grade borrowers and bonds. In contrast, the dissemination of historical trades reduced bond ownership concentration for [B–, BB+]-rated bonds, decreasing the concentration by 4.0% to 7.0% relative to pre-treatment levels following six quarters after the shock. The results suggest that bond investors care about information transparency of high-yield bonds and borrowers more than they do about investment-grade securities.

5.2.2 Alternative explanation – transaction costs

The existing academic literature shows that TRACE dissemination had a strong negative effect on transaction costs for the entire corporate bond market (Bessembinder, Maxwell, and Venkataraman (2006), Edwards, Harris, and Piwowar (2007), Goldstein, Hotchkiss, and Sirri (2007), Asquith, Covert, and Pathak (2013)). Bessembinder, Maxwell, and Venkataraman (2006) document a 50% drop in transaction costs of corporate bonds disseminated over Phase 1 in July 2002. Goldstein, Hotchkiss, and Sirri (2007) further report the sharp decline in the transaction costs of 120 BBB-rated bonds disseminated in March 2003 as a part of the controlled experiment conducted with FINRA. Finally, the recent

[30] Another related concern is the downward trend in macro-level credit spread around the TRACE dissemination period, which might have contributed to the reduction in the concentration of high-yield bonds relative to investment-grade bonds. Although it is true that the credit spread of BBB-rated bonds has been decreasing all the way until the first quarter of 2005 - the final quarter of high-yield bond dissemination, the effective yield of high-yield bonds was stable in 2004-2005. See Figure B.9 in the Appendix.

study by Asquith, Covert, and Pathak (2013) considers all four TRACE dissemination phases and shows that the high-yield bonds disseminated in Phase 3B experienced the largest decrease in transaction costs by 22.9%. For comparison, according to the study, the transaction costs of Phase 2 bonds declines by 17.7% following the dissemination.

One may argue that the transaction cost and its cross-sectional variation is the main driver behind bond ownership concentration. Thus, the decline in bond ownership concentration following the TRACE dissemination results from a sharp reduction in transaction costs for treated securities. There is some truth to this statement. According to information theories, the demand for information and the high cost of acquiring it are the reasons behind entry barriers for outside investors, leading to high transaction costs, illiquidity (Kyle (1985)), and ownership concentration. Consistently in a recent study, Li and Yu (2022) document a positive correlation between bond ownership concentration and secondary market liquidity. Thus, it is not surprising to expect that public dissemination of historical bond trades reduced both transaction costs and decreased bond ownership concentration[31]. The obvious question that should be raised is whether the reduction of bond concentration results from the decline in transaction costs or is a direct effect of better information transparency.

There are at least two arguments in favor of the view that transaction costs alone cannot (fully) explain the bond ownership concentration. That is, there is a direct effect of information transparency on bond concentration. First, the existing literature documents the drop in transaction costs for all the corporate bonds following the TRACE dissemination. Still, only the concentration measures of high-yield bonds react to improved information transparency. Second, the negative relation between borrower-level bond ownership concentration and firm transparency holds even after controlling for various measures of transaction costs associated with trading the firm's bonds[32].

6 Cost of borrowing

In the previous section, I explored the basic properties of bond ownership concentration. Institutional investors tend to accumulate large positions in bonds issued by credit-risky and opaque borrowers. The frictions – information acquisition costs, bankruptcy costs, and investment mandate restrictions – ultimately lead to a situation when a few bondholders own most of the issuer's outstanding bonds. In equilibrium, each of these three frictions should be priced as they directly affect the institutional demand for corporate bonds. Thus, one can consider the issuer-level bond ownership concentration as a composite measure reflecting the severity of these frictions for the borrower.

[31]The evidence on bond liquidity and trading activity is mixed. See, for instance, Asquith, Covert, and Pathak (2013).

[32]Not reported. Results are available upon request.

In this section, I examine and test the pricing implications of the borrower-level bond ownership concentration. Specifically, I compare the initial pricing of new bonds for borrowers with concentrated and dispersed pre-issuance structures of bond ownership on the large set of 2,548 bond issuances during the 2001-2019 period. I also study the cost implications in the cross-section of borrowers, comparing high and low-credit-risky borrowers. Next, I explore how borrowing costs fluctuate with the credit cycle. Following the discussion in Section 2, increasing macro-level credit spread is associated with a higher probability of default, making potential investors more cautious in their investment decisions and raising the cost of due diligence.

6.1 Baseline specification

To study the initial pricing of corporate bonds, I run the following regression with offering yield spread as a dependent variable:

$$YieldSpread_{j,t} = \alpha_t + \beta_1 \, Concentration^{firm}_{i,t-1} + \theta X^{bond}_{j,t} + \gamma X^{firm}_{i,t-1} + \epsilon_{i,j,t} \tag{7}$$

where $YieldSpread_{j,t}$ is the difference between offering yield and maturity-matched Treasury yield for issuance j at time t, $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing seasoned bonds outstanding one quarter before the new issuance, $X^{bond}_{j,t}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing), Sd(Rating), Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Depending on credit rating, the bond issuance process may take as long as three months (Tresnowski and Nowak (2004)). To isolate the possible reallocation of debt claims during the bond issuance process, I take all firm-level characteristics as of one quarter before the bond issuance. Bond-level characteristics are as of the moment of issuance.

Pre-issuance issuer-specific characteristics $X^{firm}_{i,t-1}$ include several groups of variables. The first group is firm fundamentals which include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, and Capex. The second control variable group includes stock-specific variables – Annual Stock Returns, Sd(Stock Returns), and Institutional Investor Stock Holdings. The third group of control variables consists of measures describing the dynamics of the issuer's seasoned bonds – Annual Bond Returns, Sd(Bond Returns), the liquidity of seasoned bonds measured by Amihud measure (Amihud (2002))[33]. Recent academic literature documents the

[33]For the list of variables, see, for example, Goldstein, Hotchkiss, and Pedersen (2019), Ma, Stice, and Williams (2019), Manconi, Neretina, and Renneboog (2018), Gao, Wang, Wang, Wu, and Dong (2020), Bodnaruk and Rossi (2021), Zhu (2021), Brugler, Comerton-Forde, and Martin (2022).

pricing implications of the clientele effect, so I also control for the composition of ownership structure, measured as a share of issuer's bonds owned by mutual funds - Mutual Fund Bond Ownership (Choi, Dasgupta, and Oh (2019), Nanda, Wu, and Zhou (2019)). To construct issuer-level bond liquidity, I first construct a quarterly Amihud measure for every seasoned bond of the issuer in the following way (Amihud (2002)):

$$Amihud_{i,t} = \frac{1}{N-1} \sum_{t=2}^{N} \frac{\left| \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \right|}{Q_{i,t}}$$

where $P_{i,t}$ and $P_{i,t-1}$ are the prices of two sequential intraday trades, $Q_{i,t}$ is volume of trade t in millions, and N is the number of intraday trades. The quarterly measure is the equally-weighted average daily Amihud measure. Issuer-level bond illiquidity is a value-weighted average of individual bond illiquidity, with the bond size used as weights.

Although including bond credit rating fixed effects is a standard practice in academic literature, the granular nature of credit ratings allows for significant heterogeneity of credit risk across firms with the same credit rating. Moreover, credit ratings are known to be sluggish and to react with a lag to the deteriorating credit quality (Altman and Rijken (2004), Altman, Hotchkiss, and Wang (2019)). To better control for the credit risk, I include the issuer's Distance-to-Default measure, estimated following Bharath and Shumway (2008) and Schwert (2018).

The existing literature documents the importance of information transparency in pricing the cross-section of corporate bonds. For instance, Gao, Wang, Wang, Wu, and Dong (2020) show that higher media coverage reduces borrowing costs in the corporate bond market. To rule out the effect of well-known measures of information transparency on offering yield, I include the following variables used earlier in the paper: Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). Finally, all specifications have borrower SIC2 industry, borrower-level bond ownership coverage percentile-based fixed effects, and year fixed effects. As discussed earlier, concentration measure positively correlates with the quality of bond ownership data. To eliminate quality-related endogenous variation in concentration, I include percentile-based bond ownership coverage fixed effects in all specifications[34]. Standard errors are double-clustered on issuer and calendar year levels.

Table 8 reports the estimation results of Equation (7). Four measures of pre-issuance borrower-level concentration include Ln(Bondholders), HHI index, Top1, and Top5. One standard deviation increase in the number of incumbent bondholders is associated with a 12.9 basis point increase in the cost of borrowing or 9.8% relative to an unconditional standard deviation with a t-stat of –4.95. The economic effects for HHI, Top 1, and

[34]The results are robust to using the relative concentration measures, constructed as a share of the total observed bond ownership instead of the amount outstanding.

Top 5 are 8.2, 6.3, and 9.0 basis points, correspondingly. All four measures of bond concentration are significant at the 1% level. To put these numbers in perspective, a back-of-the-envelope calculation of the economic effect suggests that the present value of interest losses ranges from 0.50% to 1.03% of par value[35]. For the median offering of $500 million, borrowers with concentrated bond ownership overpay from $2.5 million and $5.2 million per one standard deviation change in concentration.

6.2 Gross spread and underpricing

In the previous subsection, I established the negative price implications of pre-issuance bond concentration on new bond issuance. However, the total cost of borrowing also depends on the cost of issuance, or underwriting fees, also known as *gross spread*. It is possible that lower issuance cost compensates for the negative effect of concentration on the cost of borrowing for these borrowers. For instance, it might be easier and cheaper for the underwriter syndicate to allocate to a small pool of investors leading to lower fees charged. To test this idea, I estimate the following baseline regression:

$$GrossSpread_{j,t} = \alpha_t + \beta_1 Concentration^{firm}_{i,t-1} + \theta X^{bond}_{j,t} + \gamma X^{firm}_{i,t-1} + \epsilon_{i,j,t} \tag{8}$$

where $GrossSpread_{j,t}$ is the fee borrowers pay to the underwriting syndicate as a share of par value, $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance. The remaining control variables are the same as before. The Panel A of Table 9 reports the estimation results. All four specifications show no effect of concentration on underwriting fees.

The academic literature provides a number of evidence suggesting the severe underpricing of new bond issuances (Cai, Helwege, and Warga (2007), Nikolova, Wang, and Wu (2020)). The underpricing is measured as the percentage difference between the offering price and the first trading price on secondary markets. There are several reasons for underpricing to exist and be positive, especially for high-yield bond issuances. Information production is one of them (Benveniste and Spindt (1989)). Institutional investors receive a price discount for conducting the costly due diligence and sharing their price expectations with the underwriting syndicate. Notably, the underpricing at offering is a one-time compensation for information production. On the other hand, the cost of due diligence might take a period-by-period form, requiring the lender's attention to monitor the risky borrower at each point in time. To test whether the cost of pre-issuance concentration

[35] Average duration of newly issued bonds in my sample is 8.01 years.

takes the long-term discount in bonds prices, I run the following baseline regression:

$$Underpricing_{j,t} = \alpha_t + \beta_1 Concentration^{firm}_{i,t-1} + \theta X^{bond}_{j,t} + \gamma X^{firm}_{i,t-1} + \epsilon_{i,j,t} \tag{9}$$

where $Underpricing_{j,t}$ is the percentage price difference between the price on the first day of trading and the offering price, constructed following Nikolova, Wang, and Wu (2020), $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance. The remaining control variables are the same as before. Panel B of Table 9 reports the estimation results. All four specifications show no effect of concentration on bond underpricing. Thus, the cost of the frictions considered in this paper has a long-term adverse effect on bond prices and does not reflect the information production at the issuance.

6.3 Credit risk

The frictions discussed earlier are more pronounced for riskier securities and borrowers. For instance, AA borrowers would not suffer from any of those frictions; thus, one should expect no effect of bond ownership concentration on the borrowing cost for such borrowers. Conversely, investors of B-rated bonds take the downside risk seriously (Dang, Gorton, and Holmström (2013)) and would require higher compensation for their efforts. Thereby, the effect of concentration on an offering price should be higher for riskier borrowers.

To test this hypothesis, I interact concentration measures with the continuous measure of credit risk – Distance-to-Default – and estimate the following regression:

$$\begin{aligned} YieldSpread_{j,t} = \alpha_t + \beta_1 Concentration^{firm}_{i,t-1} + \beta_2 DtD^{firm}_{i,t-1} + \\ + \beta_3 Concentration^{firm}_{i,t-1} * DtD^{firm}_{i,t-1} + \theta X^{bond}_{j,t} + \gamma X^{firm}_{i,t-1} + \epsilon_{i,j,t} \end{aligned} \tag{10}$$

where $YieldSpread_{j,t}$ is the difference between offering yield and maturity-matched Treasury yield for issuance j at time t, $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance, $DtD^{firm}_{i,t-1}$ is an issuer's Distance-to-Default measure, estimated following Bharath and Shumway (2008) and Schwert (2018). The remaining control variables are the same as before. Table 10 reports the estimation results.

In all four specifications, the interaction term between concentration and distance-to-default is statistically significant and suggests that concentration's effect on yield spread decreases with distance-to-default as borrowers become safer. To better understand the pricing implications for various borrowers, I estimate the marginal effect of concentration on the yield spread for 0th, 25th, 50th, and 75th percentile borrowers by distance-to-default measure. Roughly, 0th percentile borrowers are financially distressed and close (or

at) bankruptcy. The 25th percentile (DtD = 6.02) corresponds to BB-rated borrowers, the 50th percentile (DtD = 8.95) matches BBB-rated borrowers, and finally, the 75th percentile (DtD = 12.01) is similar to A+ rated borrowers. The price of the Top 5 ownership concentration decreases with distance-to-default DtD, being 21 bps for the 0th percentile, 11 bps for the 25th, and 7 bps for the 50th percentile, all significant at the 1% level. There is no effect of the Top 5 on 75th percentile borrowers, suggesting that information acquisition cost is negligible for the safest category of borrowers.

6.4 Credit cycle

As macro conditions deteriorate, market participants become increasingly worried about the prospects of potential default, making them more cautious about new investments. Investor incentives to conduct costly due diligence increase leading to higher information acquisition costs and making opaque and risky borrowers with a small investor base even more vulnerable. Consistently, high-yield issuers lose access to capital markets during recessions (Baker (2009), Erel, Julio, Kim, and Weisbach (2012)). Thus, the price implications of information acquisition costs should be higher during periods of high turmoil. To test the idea, I proceed by interacting pre-issuance borrower-level concentration with macro-level credit spread to estimate the cost of concentration over the credit cycle:

$$\begin{aligned} YieldSpread_{j,t} = \alpha_t + \beta_1 Concentration^{firm}_{i,t-1} + \beta_2 CreditSpread_t + \\ +\beta_3 Concentration^{firm}_{i,t-1} * CreditSpread_t + \theta X^{bond}_{j,t} + \gamma X^{firm}_{i,t-1} + \epsilon_{i,j,t} \end{aligned} \tag{11}$$

where all the variables are as above, except for $CreditSpread_t$, defined as Moody's seasoned Baa corporate bond yield relative to yield on 10-Year Treasury constant maturity.

Table 11 provides the estimation results. For all four concentration measures, the interaction term is statistically significant, suggesting that the cost of concentration increases during bad times. To better understand the effect of information acquisition cost on bond prices, I estimate the marginal effect of concentration at various points in time – at the median macro-level credit spread and the bottom of the Global Financial Crisis of 2008-2009, 2.56% and 6.10% correspondingly. Consistent with the previous results, the cost of concentration ranges from 5.8 to 9.7 basis points for ordinary times. However, the magnitude sky-rockets at the bottom of GFC, reaching enormous 48-68 basis points of abnormal yield spread for average bond issuance in the sample. Overall, macroeconomic conditions play an essential role in borrowing costs in the cross-section of borrowers. Borrowers with a smaller investor base tend to suffer more during periods of high cost of external funding.

Bond ownership concentration, as a measure of the information acquisition cost, should be priced in both benign and turmoil periods. One potential concern of the analysis above is that the effect could be driven exclusively by turmoil periods. To rule

out this possibility, I estimate the baseline Equation (7) on the subsamples of benign and turmoil periods of the credit cycle. The benign period is defined as the one with a Credit Spread being lower than the median of 2.56%, and the turmoil period is the opposite – above or equal to 2.56%. As above, the credit spread is measured as Moody's seasoned Baa corporate bond yield relative to yield on 10-Year Treasury constant maturity. The results are shown in Table 12.

The estimation results show a significant effect of pre-issuance bond concentration on both periods – benign and turmoil. Consistent with the increased cost of information acquisition and bankruptcy during periods of high turmoil, the effect is higher during periods of the credit crunch.

6.5 Robustness check – 1: Bond liquidity

Along with credit risk, the corporate bond prices also incorporate an illiquidity premium (Bao, Pan, and Wang (2011)). When a bond is thinly traded, investors require additional compensation for holding such bonds. The phenomenon of bond concentration is related to the illiquidity of corporate bonds. When market-entry costs are high, and only a handful of investors own the entire issue, the trading activity deteriorates, driving the illiquidity premium up. Consistently, Li and Yu (2022) document the positive correlation between ownership concentration and secondary market illiquidity for corporate bonds. Thus, pre-issuance bond concentration may capture the component of expected secondary market liquidity of new issuance.

To rule out this possibility, I construct four measures of bond liquidity using the Enhanced TRACE dataset. The first measure is Turnover, calculated as the total par volume traded in a given quarter over the par value of the amount outstanding. A higher turnover value is interpreted as higher liquidity. The second measure is Bid/Ask spread, with higher values corresponding to lower liquidity. The third measure is the Amihud illiquidity measure (Amihud) – the average absolute return between consecutive transactions normalized by trade size (Amihud (2002)). Amihud measure can be interpreted as a measure of price movement per unit of trade, so a higher Amihud measure means lower liquidity. Finally, the fourth measure is the imputed round trip cost (IRC) which measures the average percentage change in price over all imputed roundtrip trades within a trading day (Feldhütter (2012), Anderson and Stulz (2017)). Next, I measure the expected liquidity of new bond issuance using the realized bond liquidity during the first three-quarters of trading (Goldstein, Hotchkiss, and Pedersen (2019)). Importantly, I still control for the issuer-level equally-weighted pre-issuance liquidity of existing seasoned bonds, measured by the Amihud measure defined earlier.

Table 13 reports the estimation results of (7) after controlling for realized liquidity. In all specifications, regardless of the liquidity measure I use, pre-issuance issue-level

concentration is a significant and positive driver of the yield spread at issuance. Surprisingly, compared with the baseline result from Table 8, the regression coefficient does not change after controlling for illiquidity. For instance, controlling for the Amihud measure in specification 2, the economic effect of the Top 5 ownership is still about 9 bps per one standard deviation change.

6.6 Robustness check – 2: Alternative specifications and subsamples

In security issuance, an underwriter is the crucial financial intermediary between issuers and investors. An investment bank or, more generally, a syndicate of investment banks facilitates the transaction by providing various services from due diligence and roadshows to supporting the secondary market liquidity of newly issued bonds. Recent academic literature emphasizes the importance of interdealer trading relationships in an opaque OTC environment affecting both the allocation and cost of transactions (Di Maggio, Kermani, and Song (2017), Nikolova, Wang, and Wu (2020), Flanagan, Kedia, and Zhou (2019)). Underwriter centrality, the ability to reach a vast pool of investors, affects the initial allocation and secondary market liquidity of new bonds (Goldstein, Hotchkiss, and Pedersen (2019)). When the underwriter has limited access to the pool of potential investors, initial allocation might be biased towards incumbent bondholders, affecting the issuance price. Put differently, search costs for potential investors translate into higher rent extraction by incumbent bondholders. Thus, the significant effect of bond concentration might be driven by those issuers with a small syndicate of less-known investment banks.

To rule out this possibility, I collect the names of lead underwriters for all the bond issuances in my sample from the TR Eikon data vendor. I construct two issue-level measures of the syndicate's access to the pool of investors. The first measure is simply the number of lead underwriters in the syndicate. Typically, each lead underwriter gets a significant stake in new issuance and allocates it among its investors. A higher number of lead underwriters potentially increase the coverage of bond investors in the market. The median bond issuance has four underwriters in my data. The second variable measures the market power of the underwriter syndicate in allocating bonds for a given rating bucket. For each individual underwriter each year, I calculate a par value share of new bonds the underwriter allocates in a given credit rating bucket. For instance, if Goldman Sachs allocates 50% of the par value of all the bonds in the [BB–, BB+] bucket in a given year, then the market power of the underwriter is 50% for a given category of ratings in a given year. Then, the issue-level market power of the whole syndicate is calculated as the arithmetic sum of all the market powers of individual lead underwriters in the syndicate. The average market power of the issue-level syndicate is 0.39, suggesting that the team

is responsible for allocating 39% of all newly issued bonds in a given credit rating bucket.

Specification (1) of Table 14 reports Equation (7) regression results after controlling for underwriter-specific characteristics. The measure of the underwriter's access to investors is insignificant in explaining the yield spread at issuance. My primary interest, however, is the effect of concentration on bond pricing – the effect is robust to controlling for the market power of the underwriter's syndicate.

The periods of high turmoil are also characterized by increased volatility in liquidity supply for major bond investors, such as mutual funds. The asset redemption-driven fire-sales of borrower's seasoned bonds might affect the cost of borrowing in the market. To rule out this possibility, I construct two measures of issuer-level liquidity constraints of incumbent bondholders by value-weighting mutual fund and insurance company liquidity constraints using the size of the position in borrower's seasoned bonds. The results are reported in column (2) of Table 14. The effect of bond concentration on yield spread is robust to the liquidity constraints of incumbent bondholders. Finally, I run the analysis on subperiods, 2001-2012 and 2013-2019. As I showed earlier in Figure 3, the bond concentration decreased dramatically during the first decade of the 21st century. The earlier part of the sample may drive my results. I reject this hypothesis in columns (3) and (4) of Table 14 – the bond concentration is priced in both subperiods with pretty similar costs in both periods.

To summarize, I show that pre-issuance issuer-level concentration is priced in the cross-section of bond issuances.

Conclusion

In this paper, I document the widespread tendency of institutional investors to hold significant stakes in individual corporate bonds. A typical corporate bond is owned by only a handful of investors with concentrated positions. On average, the largest five bondholders own at least 40.4% of the outstanding amount, making the bond market significantly more concentrated than the equity market. There is substantial heterogeneity in concentration among borrowers. I provide several reasons behind this phenomenon. Consistent with Dang, Gorton, and Holmström (2013) theory, institutional investors have the incentives to collect costly private information about high credit-risky borrowers, especially when it comes to opaque firms. The high cost of information acquisition translates into a high ownership concentration. I also discuss bankruptcy cost channel and investor mandate restrictions as fundamental frictions behind concentration. Empirically, I show that bond ownership concentration is relatively flat across investment-grade borrowers and grows exponentially in the high-yield part of the spectrum.

In the second part of my work, I discuss the adverse implications of bond ownership concentration on borrowing costs. In equilibrium, the costs associated with the

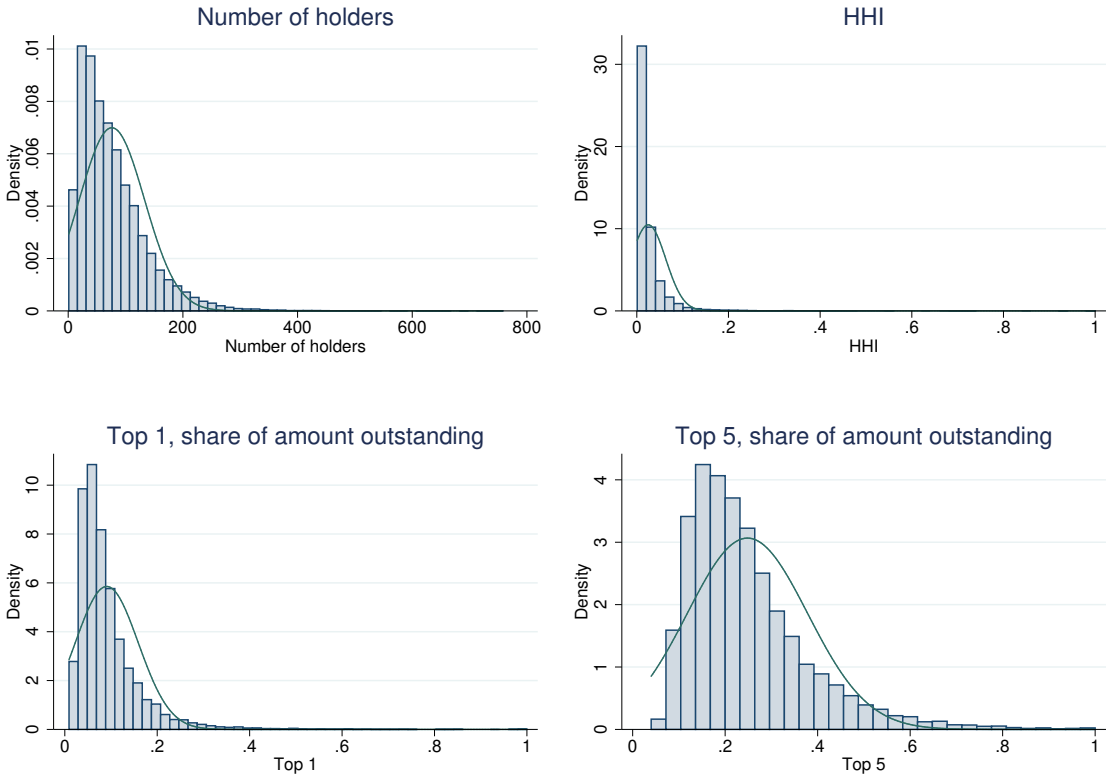
frictions should be priced, and incumbent institutional investors should be compensated accordingly. As credit-risky borrowers require more due diligence, investors ask for additional compensation for their work beyond credit risk and liquidity considerations. The potential for costly restructuring should also be reflected in bond prices. Finally, the deteriorating participation of institutional investors further increases the borrowing cost. Bond ownership concentration is a composite measure that reflects these frictions and entry barriers for investors. Using a comprehensive dataset of bond issuances during 2001-2019, I show that pre-issuance issuer-level bond concentration explains offering yield spread even after controlling for a wide range of bond and issuer-specific characteristics, including well-known measures of information transparency, credit risk, and bond illiquidity. One standard deviation increase in pre-issuance bond concentration is associated with a 6 to 13 basis point increase in yield spread, translating to an abnormal cost of $2.5 million to $5.2 million. Consistent with the information-sensitivity theory of Dang, Gorton, and Holmström (2013) and bankruptcy costs, the effect of issuer concentration on offering yield spread is more pronounced for credit-risky borrowers. I further show that it escalates during periods of high turmoil.

My paper emphasizes the importance of bond ownership structure on the cost of external funding. It is in the best interests of issuers to have a vast diversified pool of lenders competing for the allocation of new bond issuances. Creditworthiness and policy of corporate transparency decrease bond ownership concentration and increase the pool of investors willing to lend.

Bond ownership concentration has a wide range of implications. Classical theory papers such as Gertner and Scharfstein (1991) draw a sharp contrast between bank loans and arm's length debt, assuming a dispersed nature of corporate bond ownership. According to their model, in comparison to bank loans, coordination problem among bondholders creates investment inefficiencies for financially distressed borrowers. In light of my findings, the coordination problem might not be as severe as presumed in the literature, as it takes a handful of the largest bondholders to get a majority of the voting power. More importantly, nontrivial stakes of bond investors create incentives for monitoring and active engagement in the firm's management. The higher cost of borrowing for borrowers with concentrated bond ownership provides evidence supporting the existence of holding costs for investors. Future academic research may want to reconsider some of the predictions of classical financial models about forms of corporate borrowings and the role of bondholders in corporate governance.

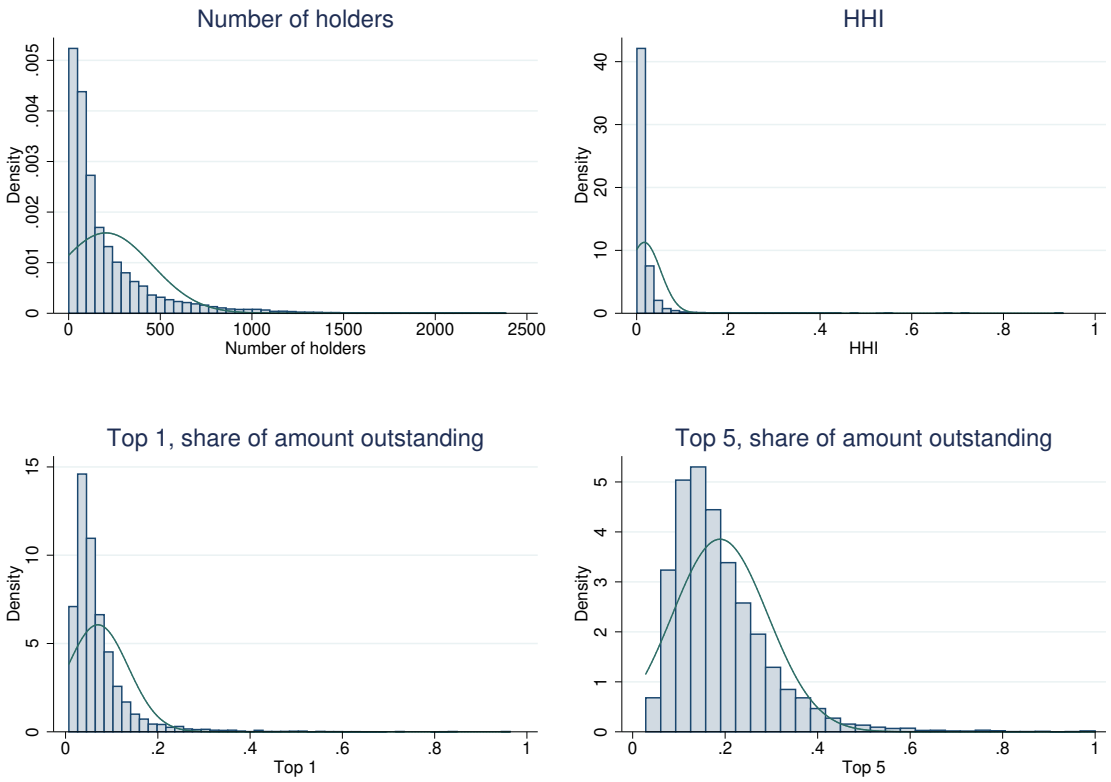
Figures

Figure 1: Distribution of bond-level concentration measures, 25% filter on observed ownership



The figure shows the distribution of concentration measures on the bond level, namely the number of institutional portfolio-level bondholders, the Herfindahl–Hirschman index (HHI), the holding of the largest one and five investors as a share of the amount outstanding (Top 1 and Top 5). Institutional investors include all US mutual funds and insurance companies. Institutional ownership is measured on the individual portfolio level. Only bonds with observed institutional ownership of at least 25% of the amount outstanding are included in the sample. The sample consists of bonds with at least $50 million in par value outstanding.

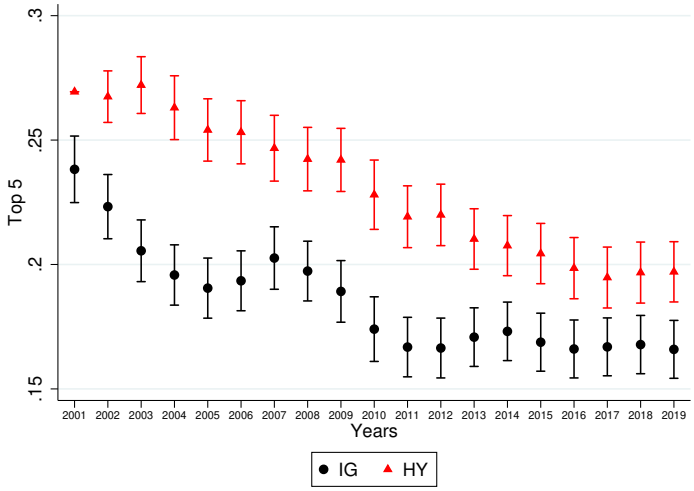
Figure 2: Distribution of firm-level concentration measures, 25% filter on observed ownership



The figure shows the distribution of concentration measures on the firm level, namely the number of institutional portfolio-level bondholders, the Herfindahl–Hirschman index (HHI), the holding of the largest one and five investors as a share of the amount outstanding (Top 1 and Top 5). Firm-level measures are constructed by considering the total investor's position in all the observed bonds of the borrower. Institutional investors include all US mutual funds and insurance companies. Institutional ownership is measured on the individual portfolio level. Only borrowers with observed institutional ownership of at least 25% of the amount outstanding are included in the sample. The sample consists of borrowers with at least $50 million par value in the bond amount outstanding.

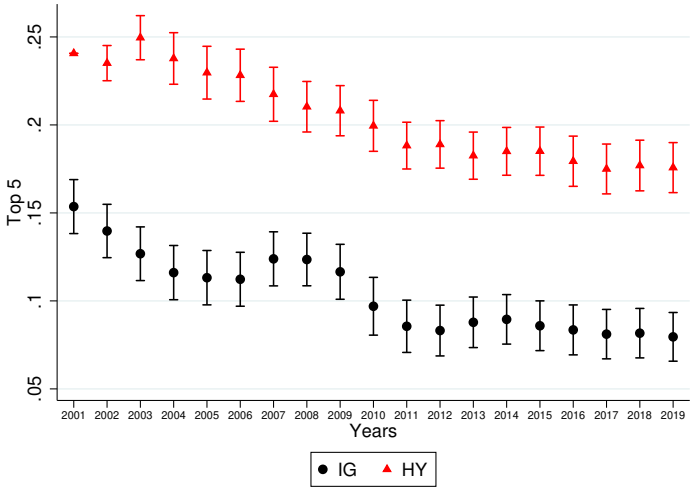
Figure 3: Evolution of bond ownership concentration over time

Figure 3a: Bond level



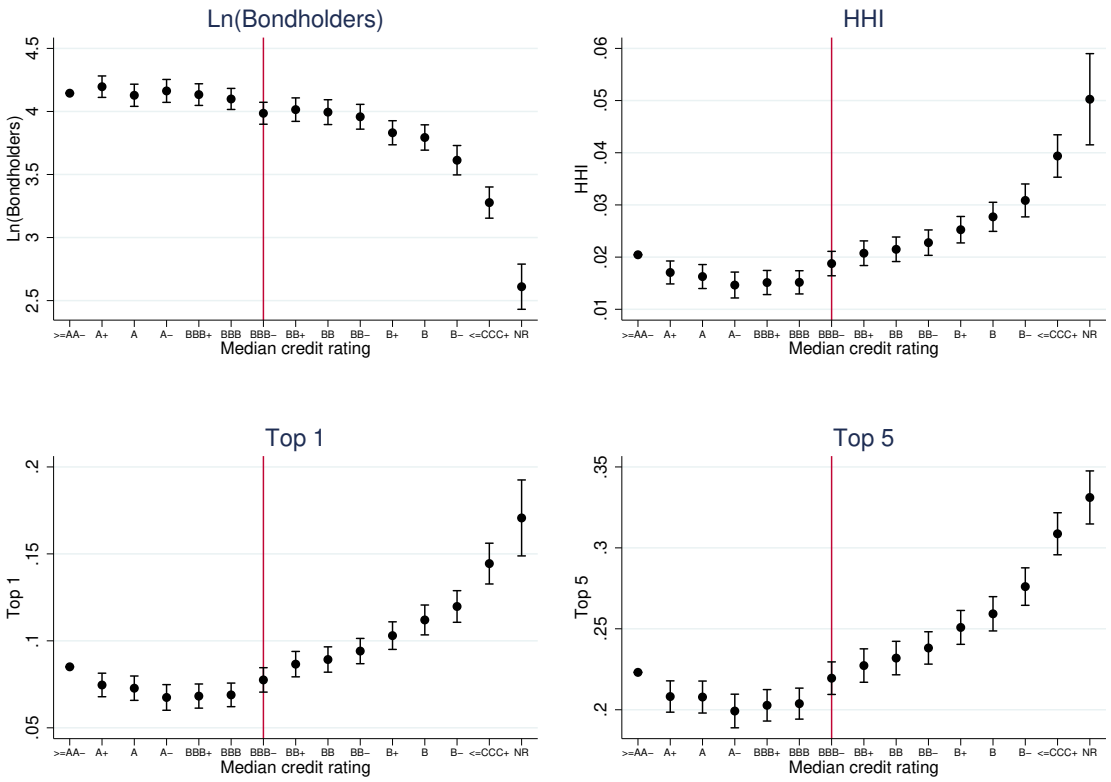
The figure shows the dynamics of average Top 5 ownership as a share of the amount outstanding on a bond level over time. The circle dots correspond to investment-grade bonds (IG), and the triangle dots describe the concentration of high-yield bonds (HY). The graph is constructed by running a bond-level panel regression with year, industry, and bond ownership coverage fixed effects. The standard errors are double-clustered by bond and date. The scaling is chosen to match the average of the Top 5 for high-yield bonds in 2001. The sample is restricted to bonds with at least $50 million par value in the amount outstanding and observed bond ownership of at least 25% of the bond size.

Figure 3b: Firm level



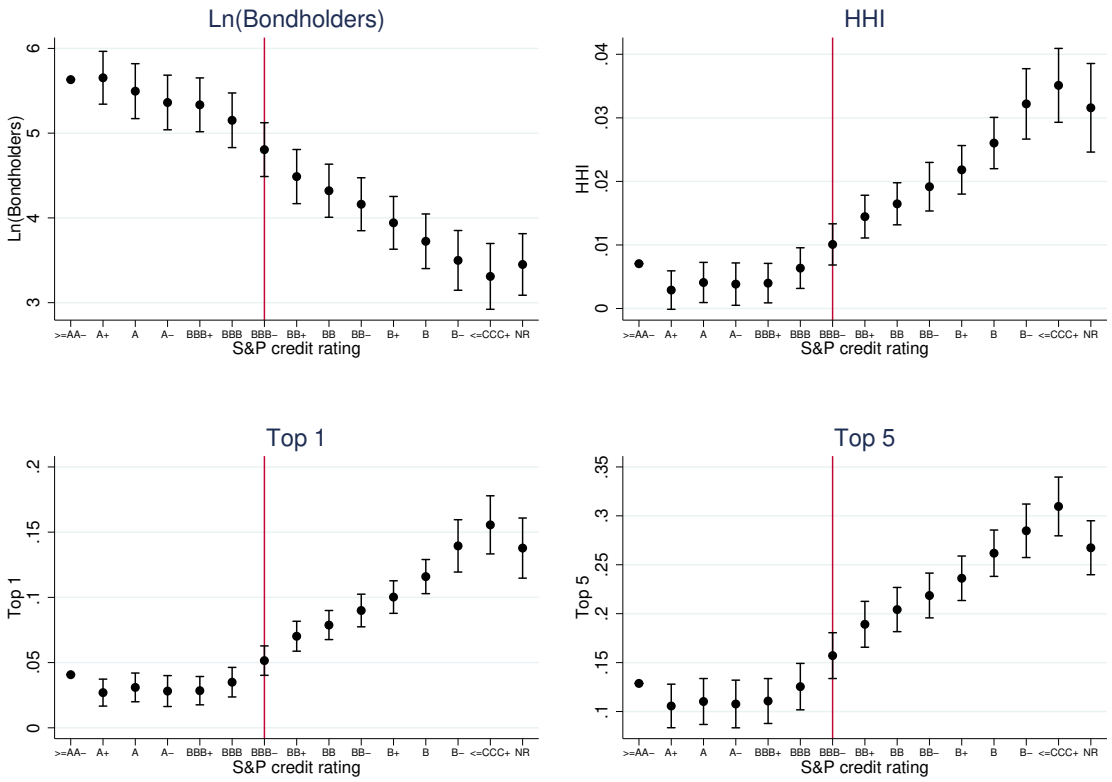
The figure shows the dynamics of average Top 5 ownership as a share of the amount outstanding on the firm level over time. The circle dots correspond to investment-grade firms (IG), and the triangle dots describe the concentration of high-yield borrowers (HY). The graph is constructed by running a firm-level panel regression with year, industry, and bond ownership coverage fixed effects. The standard errors are double-clustered by borrower and date. The scaling is chosen to match the average of the Top 5 for high-yield borrowers in 2001. The sample is restricted to firms with at least $50 million par value in the bond amount outstanding and observed bond ownership of at least 25% of the bond size.

Figure 4: Bond ownership concentration over credit rating, bond level



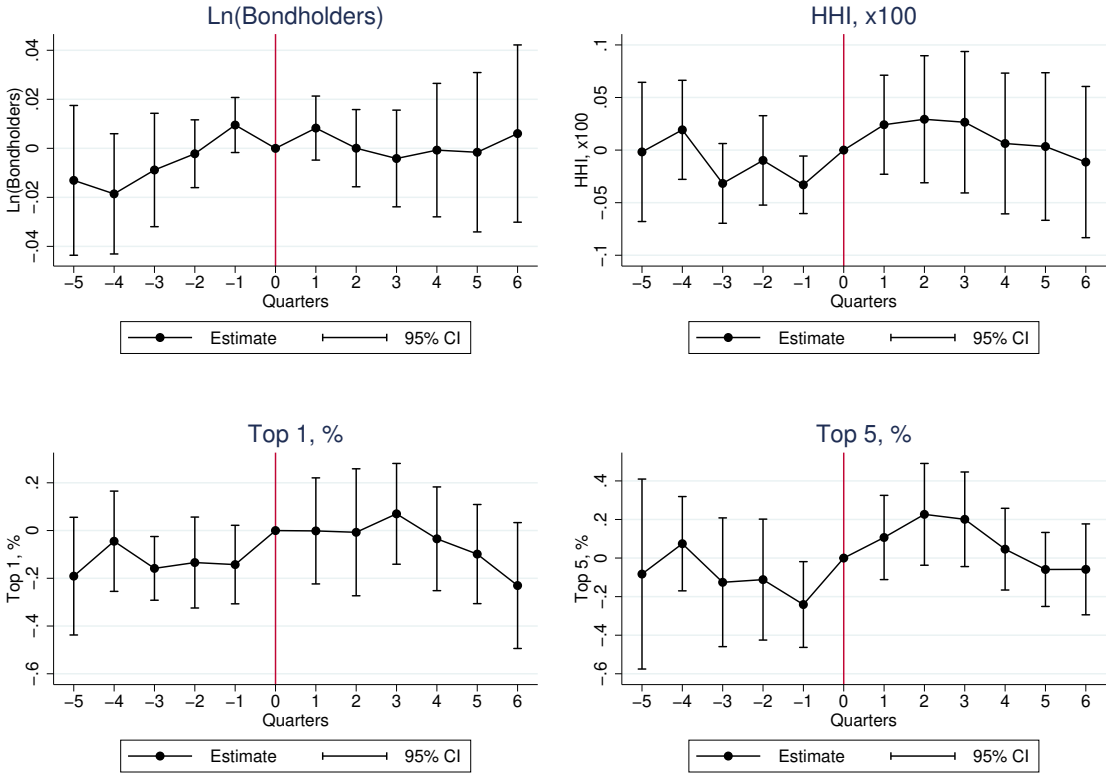
The figures show the relation between concentration and credit rating after controlling for date, industry, and bond ownership coverage fixed effects. Credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The scale is chosen to match the average concentration of the safest category of bonds (with a credit rating of at least AA– and better). The sample is restricted to bonds with at least $50 million par value in the bond amount outstanding and observed bond ownership of at least 25% of the bond size. Standard errors are double clustered on bond and date levels.

Figure 5: Bond ownership concentration over S&P credit rating, firm level



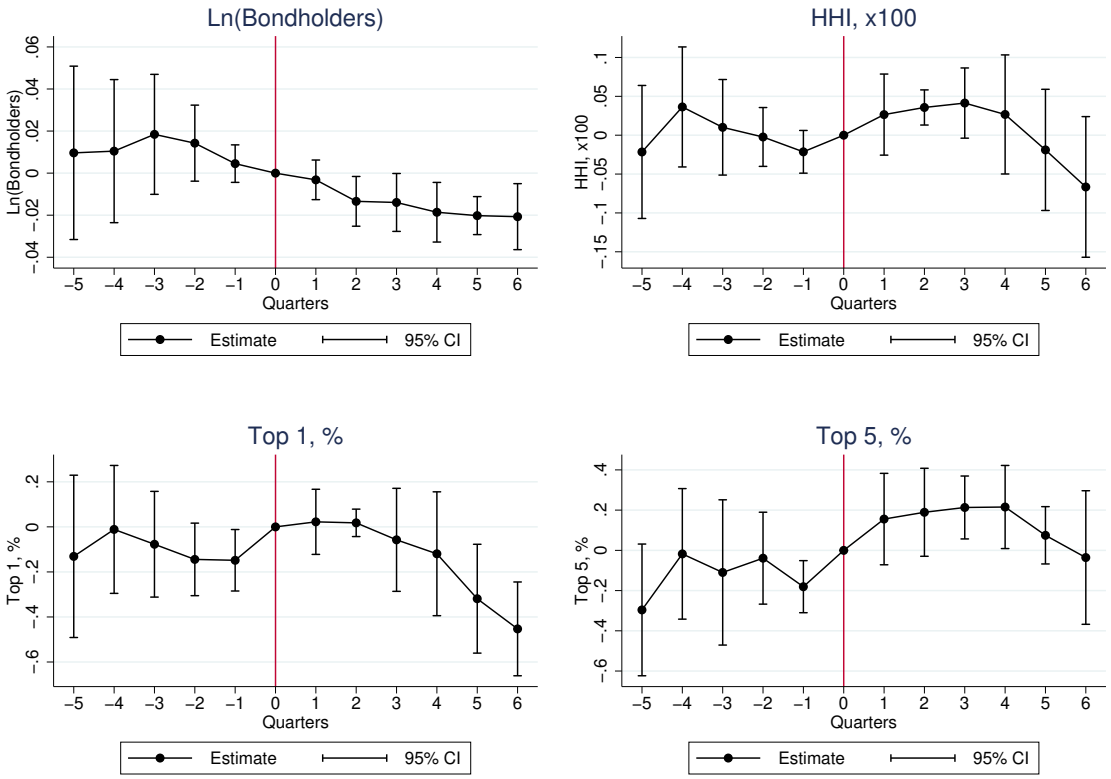
The figures show the relation between firm-level concentration and S&P credit rating after controlling for date, industry, and bond ownership coverage fixed effects. The scale is chosen to match the average concentration of the safest category of borrowers (with a credit rating of at least AA– and better). The sample is restricted to borrowers with at least $50 million par value in the bond amount outstanding and observed bond ownership of at least 25% of the bond size. Standard errors are double clustered on firm and date levels.

Figure 6: The effect of TRACE dissemination on bond ownership concentration,
Phase-2 bonds with rating [A–, AAA]



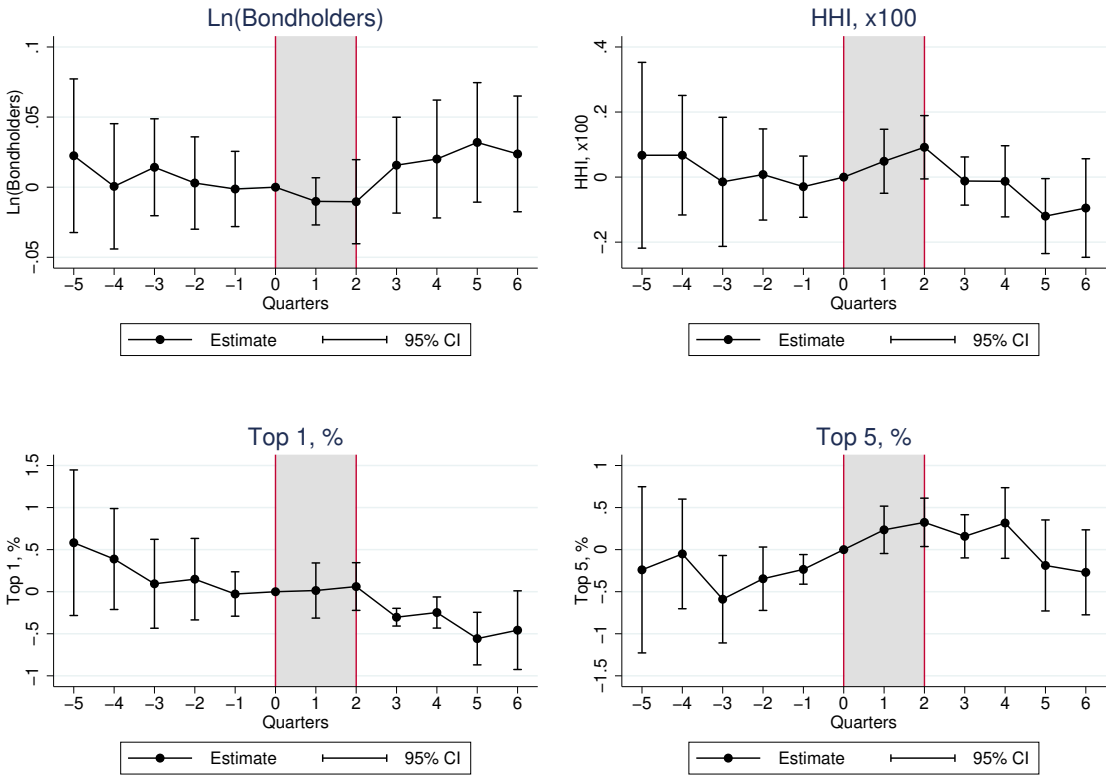
The figures show the effect of TRACE dissemination on various measures of bond concentration for corporate bonds disseminated in Phase 2 with the pre-treatment credit rating of [A–, AAA+]. The treatment happens in 2003q1, and the red vertical line corresponds to the last quarter before the treatment. The graphs are constructed by estimating the Equation (6) of stacked difference-in-differences analysis. The dependent variable is one of the four bond ownership concentration measures – the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The sample covers all the corporate bonds treated in Phase 2 and Phase 3 and ranges from 2002q1 to 2006q1. Only the subsample of eventually treated bonds is considered. The sample is further restricted to bonds with at least $50 million in outstanding amounts and an initial size of at least $100 million. The causal effect of each Phase is estimated relative to bonds either already treated or yet to be treated in the future. Bonds treated in Phase 3 serve as a control group for bonds treated in Phase 2, and vice versa. The set of control variables $X_{i,t}$ includes the natural logarithm of bond size, the square of the natural logarithm of bond size, the natural logarithm of bond age, and the natural logarithm of maturity left. All the bond-level specifications include the phase times date, phase times bond, and bond ownership coverage-based percentile fixed effects. The standard errors are double-clustered on phase times credit rating and date levels.

Figure 7: The effect of TRACE dissemination on bond ownership concentration,
Phase-3 bonds with rating [BBB–, BBB+]



The figures show the effect of TRACE dissemination on various measures of bond concentration for corporate bonds disseminated in Phase 3 with the pre-treatment credit rating of [BBB–, BBB+]. The treatment happens in 2004q4, so the red vertical line corresponds to the last quarter before the treatment. The graphs are constructed by estimating the Equation (6) of stacked difference-in-differences analysis. The dependent variable is one of the four bond ownership concentration measures – the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The sample covers all the corporate bonds treated in Phase 2 and Phase 3 and ranges from 2002q1 to 2006q1. Only the subsample of eventually treated bonds is considered. The sample is further restricted to bonds with at least \$50 million in outstanding amounts and an initial size of at least \$100 million. The causal effect of each Phase is estimated relative to bonds either already treated or yet to be treated in the future. Bonds treated in Phase 3 serve as a control group for bonds treated in Phase 2, and vice versa. The set of control variables $X_{i,t}$ includes the natural logarithm of bond size, the square of the natural logarithm of bond size, the natural logarithm of bond age, and the natural logarithm of maturity left. All the bond-level specifications include the phase times date, phase times bond, and bond ownership coverage-based percentile fixed effects. The standard errors are double-clustered on phase times credit rating and date levels.

Figure 8: The effect of TRACE dissemination on bond ownership concentration, Phase-3 bonds with rating [B–, BB+]



The figures show the effect of TRACE dissemination on various measures of bond concentration for corporate bonds disseminated in Phase 3 with the pre-treatment credit rating of [B–, BB+]. The gray area bounded by red vertical lines corresponds to the treatment period of high-yield bonds, as historical trades of high-yield bonds were disseminated in two quarters, 2004q4 and 2005q1. The graphs are constructed by estimating the Equation (6) of stacked difference-in-differences analysis. The dependent variable is one of the four bond ownership concentration measures – the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The sample covers all the corporate bonds treated in Phase 2 and Phase 3 and ranges from 2002q1 to 2006q1. Only the subsample of eventually treated bonds is considered. The sample is further restricted to bonds with at least $50 million in outstanding amounts and an initial size of at least $100 million. The causal effect of each Phase is estimated relative to bonds either already treated or yet to be treated in the future. Bonds treated in Phase 3 serve as a control group for bonds treated in Phase 2, and vice versa. The set of control variables $X_{i,t}$ includes the natural logarithm of bond size, the square of the natural logarithm of bond size, the natural logarithm of bond age, and the natural logarithm of maturity left. All the bond-level specifications include the phase times date, phase times bond, and bond ownership coverage-based percentile fixed effects. The standard errors are double-clustered on phase times credit rating and date levels.

Tables

Table 1: Descriptive Statistics

Panel A reports the descriptive statistics of the main variables on the firm level. Panel B shows statistics on the bond level. Panel C provides statistics on bond issuance level. Panel D reports the averages of the main characteristics of bonds disseminated via TRACE. All measures are winsorized cross-sectionally on the 1st and 99th percentile levels, except for the bond-level Herfindahl index, which is winsorized on the 2.5th and 97.5th levels. The data sample ranges from 2000q4 to 2019q4.

Panel A: Issuer-level characteristics								
	Mean	Std.	5th pctile	25th pctile	50th pctile	75th pctile	95th pctile	N
Ln(Bondholders)	4.745	1.183	2.833	3.932	4.754	5.620	6.625	29794
HHI	0.014	0.017	0.002	0.005	0.009	0.017	0.046	29794
Top 1	0.067	0.059	0.018	0.033	0.051	0.080	0.168	29794
Top 5	0.186	0.100	0.070	0.117	0.164	0.233	0.375	29794
Total observed bond ownership	0.479	0.144	0.283	0.370	0.455	0.566	0.764	29794
Ln(Assets)	8.682	1.347	6.630	7.746	8.550	9.574	11.075	29794
Ln(Analyst coverage)	2.550	0.635	1.386	2.197	2.639	3.045	3.434	29794
Ln(Previously issued bonds)	2.121	0.901	0.693	1.386	2.079	2.708	3.761	29794
Ln(Number of firm news in press)	3.384	0.614	2.303	3.045	3.466	3.829	4.263	29555
Ln(Age)	4.635	0.638	3.367	4.234	4.771	5.170	5.380	29794
R&D	0.005	0.012	0.000	0.000	0.000	0.006	0.026	29794
D(missing R&D)	0.561	0.496	0.000	0.000	1.000	1.000	1.000	29794
Cash Flow Volatility	0.011	0.019	0.002	0.005	0.007	0.012	0.030	29794
Tangibility	0.301	0.235	0.035	0.115	0.225	0.446	0.795	29794
Cash/Assets	0.103	0.118	0.005	0.027	0.062	0.134	0.341	29794
Leverage	0.347	0.190	0.113	0.219	0.313	0.438	0.684	29794
Debt Maturity	0.896	0.150	0.596	0.857	0.959	0.994	1.000	29794
Sd(Stock Returns)	0.351	0.176	0.166	0.234	0.308	0.415	0.680	29794
Tobin's Q	1.858	1.031	0.969	1.234	1.563	2.123	3.720	29794
Sales	0.247	0.177	0.065	0.130	0.204	0.305	0.593	29794
Sales Growth	0.084	0.238	-0.210	-0.017	0.052	0.139	0.475	29794
Dividends	0.004	0.007	0.000	0.000	0.002	0.006	0.015	29794
Capex	0.013	0.015	0.002	0.005	0.009	0.016	0.040	29794
ROA	0.011	0.033	-0.021	0.004	0.013	0.022	0.042	29794
Annual Stock Returns	0.149	0.454	-0.432	-0.091	0.115	0.323	0.805	29794
Mutual fund bond ownership	0.164	0.130	0.006	0.053	0.134	0.258	0.397	29794
Institutional stock ownership	0.778	0.181	0.387	0.693	0.815	0.907	1.000	29794
S&P credit rating	9.865	3.141	5.000	8.000	10.000	12.000	15.000	28133
D(IG rating)	0.561	0.496	0.000	0.000	1.000	1.000	1.000	29794
D(Not rated)	0.056	0.229	0.000	0.000	0.000	0.000	1.000	29794

Panel B: Bond-level characteristics								
	Mean	Std.	5th pctile	25th pctile	50th pctile	75th pctile	95th pctile	N
Ln(Bondholders)	4.091	0.796	2.708	3.584	4.190	4.663	5.247	123309
HHI	0.024	0.028	0.004	0.008	0.014	0.027	0.077	123309
Top 1	0.089	0.065	0.028	0.048	0.071	0.108	0.210	123309
Top 5	0.246	0.130	0.099	0.154	0.216	0.301	0.500	123309
Total observed bond ownership	0.498	0.166	0.277	0.365	0.470	0.604	0.815	123309
$Ln(BondSize)$	6.002	0.783	4.605	5.521	5.991	6.551	7.313	123309
$Ln(BondSize)^2$	36.641	9.456	21.208	30.487	35.898	42.917	53.483	123309
Sd(Rating	0.474	0.499	0.000	0.000	0.577	0.707	1.414	123309
Number of ratings	2.495	0.624	2.000	2.000	3.000	3.000	3.000	123309
Covenant index	0.214	0.114	0.000	0.133	0.200	0.267	0.467	123309
D(Covenant Index Missing)	0.059	0.235	0.000	0.000	0.000	0.000	1.000	123309
D(Callable)	0.845	0.362	0.000	1.000	1.000	1.000	1.000	123309
D(Convertible)	0.020	0.139	0.000	0.000	0.000	0.000	0.000	123309
D(Global issue)	0.369	0.483	0.000	0.000	0.000	1.000	1.000	123309
D(144A)	0.048	0.213	0.000	0.000	0.000	0.000	0.000	123309
Ln(1+Bond Age)	2.621	1.068	0.693	1.946	2.773	3.401	4.220	123309
Ln(1+Bond Maturity Left)	3.337	0.868	1.792	2.833	3.367	3.871	4.700	123309
Mutual fund bond ownership	0.118	0.117	0.000	0.026	0.082	0.179	0.358	123309
Credit rating	8.534	3.022	4.000	6.000	9.000	10.000	14.000	121790
Yield to maturity	0.044	0.025	0.014	0.029	0.042	0.056	0.078	106153

Panel C: Bond issuance level characteristics								
	Mean	Std.	5th pctile	25th pctile	50th pctile	75th pctile	95th pctile	N
Yield Spread, %	1.811	1.318	0.600	0.930	1.400	2.175	4.625	2548
Gross Spread, bps	62.799	30.927	25.000	45.000	65.000	65.000	112.500	2180
Underpricing, bps	34.922	45.793	-2.986	7.316	21.330	46.760	122.442	2244
L1.Ln(Bondholders), stand.	6.263	0.999	4.388	5.666	6.388	7.008	7.649	2548
L1.HHI, stand.	0.943	1.000	0.222	0.371	0.636	1.122	2.648	2548
L1.Top1, stand.	1.396	1.000	0.482	0.768	1.137	1.703	3.202	2548
L1.Top5, stand.	1.985	0.998	0.878	1.248	1.755	2.462	3.858	2548
L1.Distance-to-Default	9.190	4.426	2.640	6.021	8.946	12.009	16.986	2548
Underwriter Reputation	0.399	0.165	0.150	0.286	0.390	0.501	0.699	2124
MF Liquidity Shocks	0.002	0.005	-0.005	0.000	0.001	0.003	0.007	2537
IC Liquidity Shocks	0.000	0.005	-0.009	-0.002	0.001	0.003	0.008	2537
Turnover	0.661	0.363	0.164	0.397	0.616	0.896	1.269	2253
Amihud	0.006	0.006	0.001	0.003	0.005	0.008	0.017	2246
IRC	0.004	0.005	0.001	0.002	0.003	0.005	0.010	2202
BidAsk Spread	0.003	0.003	0.001	0.002	0.003	0.004	0.007	2157

Panel D: Means of various characteristics of corporate bonds disseminated via TRACE					
	Size, $ mln., Mean	Maturity left, q, Mean	Age, q, Mean	Number of bonds	Number of borrowers
Phase 2, [A–, AAA]	245.3	47.7	23.5	349	100
Phase 3, [BBB–, BBB+]	308.5	42.5	22.3	441	132
Phase 3, [B–, BB+]	292.0	33.6	14.5	102	61

Table 2: Determinants of bond ownership concentration, bond-level analysis

This table presents the results of panel regression analysis from Equation (1) that relates bond ownership concentration to a range of covariates capturing the bond's credit rating and other characteristics. The dependent variable is one of the four bond concentration measures: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. All specifications include the date, SIC2 industry, and bond ownership coverage percentile fixed effects along with a range of firm fundamentals: Ln(Assets), Ln(Age), R&D, D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, institutional stock ownership and mutual fund bond ownership on issuer level. Bond characteristics $X_{i,t}^{bond}$ include $Ln(BondSize)$, $Ln(BondSize)^2$, dispersion of credit ratings across three major credit rating agencies Sd(Rating), number of ratings, covenant index following Billett, King, and Mauer (2007), D(Covenant Index Missing), Ln(1+Bond Age), Ln(1+Bond Maturity Left), binary variables D(Callable), D(Convertible), D(Global issue), D(144A), and total bond ownership by mutual fund investors to address the heterogeneity of investor base. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 25% of observed bond ownership. Standard errors are double-clustered on bond and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 2—*Continued*

	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Credit rating				
D([AA–, AAA] rating)	0.006	0.001	0.006*	0.003
	(0.30)	(0.56)	(1.79)	(0.77)
D(A+ rating)	0.063***	-0.000	0.001	-0.004
	(3.34)	(-0.37)	(0.65)	(-1.13)
D(A rating)	0.077***	-0.000	0.001	-0.004
	(5.27)	(-0.28)	(0.52)	(-1.56)
D(A– rating)	0.032**	0.000	0.001	-0.004
	(2.50)	(0.20)	(0.32)	(-1.52)
D(BBB rating)	-0.014	0.000	0.000	0.001
	(-1.30)	(0.34)	(0.17)	(0.35)
D(BBB– rating)	-0.049***	0.001*	0.002	0.006**
	(-3.26)	(1.68)	(0.83)	(2.14)
D(BB+ rating)	0.019	0.001	0.003	0.007*
	(0.78)	(1.33)	(1.13)	(1.80)
D(BB rating)	0.029	0.001	0.001	0.006*
	(1.09)	(0.56)	(0.32)	(1.74)
D(BB– rating)	0.010	0.001	0.005	0.013***
	(0.37)	(1.06)	(1.47)	(3.23)
D(B+ rating)	-0.066**	0.002	0.007*	0.018***
	(-2.15)	(1.39)	(1.90)	(4.09)
D(B rating)	-0.153***	0.003**	0.012***	0.026***
	(-4.24)	(2.15)	(2.75)	(5.09)
D(B– rating)	-0.228***	0.005**	0.017***	0.036***
	(-5.49)	(2.63)	(3.42)	(6.61)
D([D, CCC+] rating)	-0.442***	0.007***	0.022***	0.048***
	(-9.22)	(3.18)	(3.56)	(6.97)
D(Not rated)	-0.541***	0.012**	0.036***	0.036***
	(-5.88)	(2.45)	(3.11)	(3.52)
Controls				
$Ln(BondSize)$	1.335***	-0.097***	-0.200***	-0.323***
	(16.67)	(-17.48)	(-15.95)	(-21.82)
$Ln(BondSize)^2$	-0.042***	0.007***	0.013***	0.021***
	(-6.74)	(15.79)	(13.60)	(17.76)
$Ln(Age)$	-0.068***	0.001***	0.003***	0.007***
	(-11.86)	(4.22)	(5.62)	(8.28)
$Ln(Maturityleft)$	-0.123***	0.001***	0.003***	0.010***
	(-20.43)	(5.27)	(4.70)	(10.79)
D(Global issue)	0.024**	0.001	0.001	-0.001
	(2.19)	(1.16)	(0.49)	(-0.73)
D(144A)	0.074***	-0.001	-0.004	-0.004
	(2.93)	(-0.92)	(-1.09)	(-0.95)

Table 2—*Continued*

	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Covenants Index	0.389***	-0.005**	-0.016**	-0.028***
	(6.31)	(-2.28)	(-2.39)	(-3.07)
D(Covenants missing)	0.090***	-0.001	-0.005	-0.011***
	(3.58)	(-0.72)	(-1.50)	(-2.79)
Sd(Rating)	-0.026***	-0.000	-0.000	0.000
	(-3.49)	(-0.56)	(-0.18)	(0.34)
Number of Ratings	0.014*	0.000	0.001	0.001
	(1.73)	(0.86)	(1.07)	(0.95)
D(Callable)	-0.041**	0.002**	0.010***	0.005
	(-2.40)	(2.23)	(3.63)	(1.44)
D(Convertible)	-0.425***	0.008***	0.023***	0.037***
	(-7.01)	(2.74)	(3.10)	(5.00)
MF ownership	0.258***	0.024***	0.076***	0.074***
	(2.77)	(4.67)	(5.18)	(4.67)
Observations	123,309	123,309	123,309	123,309
R-squared	0.824	0.683	0.545	0.810

Table 3: Determinants of bond concentration on bond level, variation across bonds of the same borrower

This table presents the results of panel regression analysis from Equation (2) that relates bond ownership concentration to a range of covariates capturing the bond's credit rating and other characteristics. All specifications include firm times date, and coverage percentile fixed effects. The dependent variable is one of the four bond concentration measures: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. All specifications include the bond ownership coverage percentile fixed effects. Bond characteristics $X_{i,t}^{bond}$ include $Ln(BondSize)$, $Ln(BondSize)^2$, dispersion of credit ratings across three major credit rating agencies Sd(Rating), number of ratings, covenant index following Billett, King, and Mauer (2007), D(Covenant Index Missing), Ln(1+Bond Age), Ln(1+Bond Maturity Left), binary variables D(Callable), D(Convertible), D(Global issue), D(144A), and total bond ownership by mutual fund investors to address the heterogeneity of investor base. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 3—*Continued*

	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Credit rating				
D([AA–, AAA] rating)	-0.066	0.005**	0.011*	0.013
	(-0.93)	(2.51)	(1.86)	(1.56)
D(A+ rating)	-0.105**	0.004**	0.011**	0.017**
	(-2.53)	(2.51)	(2.05)	(2.53)
D(A rating)	-0.020	0.003**	0.012***	0.013**
	(-0.71)	(2.61)	(3.97)	(2.21)
D(A– rating)	0.004	0.001	0.010**	0.004
	(0.17)	(1.50)	(2.40)	(0.77)
D(BBB rating)	0.048	-0.000	0.000	-0.002
	(1.04)	(-0.24)	(0.09)	(-0.34)
D(BBB– rating)	0.025	0.001	0.004	0.004
	(0.38)	(0.22)	(0.58)	(0.42)
D(BB+ rating)	-0.011	0.005	0.017*	0.012
	(-0.16)	(1.30)	(1.73)	(1.13)
D(BB rating)	0.051	0.002	0.013	0.007
	(0.66)	(0.79)	(1.60)	(0.63)
D(BB– rating)	0.015	0.004	0.018**	0.020*
	(0.16)	(1.35)	(2.26)	(1.74)
D(B+ rating)	-0.171	0.006*	0.025**	0.034***
	(-1.56)	(1.84)	(2.60)	(2.73)
D(B rating)	-0.319***	0.009**	0.032***	0.041***
	(-3.11)	(2.28)	(3.06)	(3.22)
D(B– rating)	-0.299***	0.006*	0.026**	0.039***
	(-2.76)	(1.69)	(2.38)	(3.00)
D([D, CCC+] rating)	-0.451***	0.007*	0.029***	0.049***
	(-4.41)	(1.93)	(2.67)	(3.76)
D(Not rated)	-0.531*	0.015	0.037	0.038
	(-1.82)	(1.02)	(1.05)	(1.09)
Controls				
$Log(BondSize)$	1.123***	-0.094***	-0.185***	-0.315***
	(11.45)	(-12.79)	(-10.85)	(-14.18)
$Log(BondSize)^2$	-0.025***	0.007***	0.012***	0.020***
	(-3.22)	(11.50)	(9.11)	(11.46)
$Log(Age)$	-0.057***	0.000	0.002*	0.006***
	(-6.79)	(1.40)	(1.91)	(4.42)
$Log(Maturityleft)$	-0.131***	0.001***	0.003***	0.010***
	(-16.53)	(4.34)	(3.91)	(9.74)
D(Global issue)	0.051***	0.001	0.001	0.001
	(3.06)	(1.26)	(0.46)	(0.39)
D(144a)	-0.022	0.001	0.001	0.001
	(-0.65)	(0.35)	(0.19)	(0.15)

Table 3—*Continued*

	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Covenants Index	0.109	-0.004	-0.011	-0.025
	(1.56)	(-0.93)	(-0.89)	(-1.58)
D(Covenants missing)	0.088***	-0.002	-0.007	-0.014**
	(2.71)	(-0.87)	(-1.22)	(-2.32)
Sd(Rating)	-0.028	0.000	0.002	0.001
	(-1.30)	(0.18)	(0.66)	(0.25)
Number of Ratings	0.017	-0.000	0.001	-0.000
	(1.15)	(-0.34)	(0.32)	(-0.03)
D(Callable)	0.000	0.001	0.006	0.001
	(0.01)	(0.44)	(1.64)	(0.33)
D(Convertible)	-0.433***	0.009**	0.027***	0.053***
	(-4.65)	(2.37)	(2.93)	(3.96)
MF ownership	0.199**	0.027***	0.082***	0.086***
	(2.01)	(4.81)	(5.52)	(5.33)
Observations	112,483	112,483	112,483	112,483
R-squared	0.877	0.767	0.647	0.858

Table 4: Determinants of bond concentration on borrower level, Top 5

This table presents the results of panel regression analysis from Equation (3) that relates firm-level bond ownership concentration to a range of covariates capturing the firm's credit rating, information transparency, and other characteristics. The dependent variable is the ownership by the largest five bondholders as a share of the amount outstanding. The list of measures for information transparency includes firm size measured by Ln(Assets), Ln(Analyst coverage), Ln(Previously issued bonds), Ln(Number of firm news in press), and D(Not rated) – a binary variable reflecting the absence of borrower-level S&P credit rating D(Not Rated). $CreditRating_{i,t}$ is a set of binary variables corresponding to issuer-level S&P credit ratings. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. Firm controls $X_{f,t}^{firm}$ include Ln(Age), R&D, D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, Institutional stock ownership and Mutual fund bond ownership on issuer level. All the specifications include industry, date, and bond ownership coverage fixed effects. The sample is restricted to those borrowers with at least $50 million in bond amount outstanding, and at least 25% of observed bond ownership. Standard errors are double-clustered on firm and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 4—*Continued*

	(1)	(2)	(3)	(4)
Information Acquisition Costs				
Ln(Analyst Coverage)		-0.011***		
		(-2.81)		
Ln(Prev. Issued Bonds)			-0.011***	
			(-3.16)	
Ln(Number of News)				-0.010***
				(-3.89)
Ln(Assets)	-0.027***	-0.024***	-0.022***	-0.025***
	(-12.55)	(-10.07)	(-7.94)	(-10.99)
Credit rating				
D([AA–, AAA] rating)	0.040***	0.038***	0.036***	0.040***
	(3.45)	(3.28)	(3.18)	(3.38)
D(A+ rating)	0.005	0.004	0.002	0.004
	(0.65)	(0.63)	(0.35)	(0.58)
D(A rating)	0.012*	0.012*	0.011*	0.012*
	(1.95)	(1.96)	(1.81)	(1.95)
D(A– rating)	0.001	0.002	0.001	0.001
	(0.25)	(0.26)	(0.16)	(0.10)
D(BBB rating)	0.010*	0.009*	0.010*	0.009*
	(1.83)	(1.69)	(1.95)	(1.75)
D(BBB– rating)	0.028***	0.026***	0.027***	0.028***
	(4.48)	(4.31)	(4.36)	(4.43)
D(BB+ rating)	0.038***	0.037***	0.037***	0.038***
	(4.77)	(4.61)	(4.73)	(4.72)
D(BB rating)	0.042***	0.040***	0.042***	0.041***
	(4.91)	(4.70)	(4.99)	(4.84)
D(BB– rating)	0.049***	0.046***	0.050***	0.048***
	(5.18)	(4.92)	(5.30)	(5.04)
D(B+ rating)	0.052***	0.050***	0.053***	0.051***
	(4.75)	(4.50)	(4.85)	(4.57)
D(B rating)	0.066***	0.063***	0.067***	0.065***
	(5.57)	(5.26)	(5.73)	(5.46)
D(B– rating)	0.083***	0.079***	0.085***	0.083***
	(6.31)	(6.01)	(6.41)	(6.21)
D([D, CCC+] rating)	0.133***	0.127***	0.134***	0.133***
	(7.75)	(7.35)	(7.67)	(7.66)
D(Not rated)	0.068***	0.066***	0.070***	0.068***
	(5.39)	(5.22)	(5.60)	(5.36)
Observations	29,794	29,794	29,794	29,555
R-squared	0.635	0.637	0.639	0.637

Table 5: Variation of concentration-risk convexity with information transparency, Top 5

This table presents the results of panel regression analysis from Equation (4) that relates firm-level bond ownership concentration to a range of covariates capturing the firm's credit rating, information transparency, and other characteristics. The dependent variable is the ownership by the largest five bondholders as a share of the amount outstanding. The binary variable $D(Transparent)_{i,t}$ corresponds to the top 50% of borrowers by corresponding information transparency measure across all firms with the same credit rating at each point in time. The measures of information transparency include firm size measured by Ln(Assets), Ln(Analyst coverage), Ln(Previously issued bonds), and Ln(Number of firm news in press). $CreditRating_{i,t}$ is a set of binary variables corresponding to issuer-level S&P credit ratings. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. Firm controls $X_{f,t}^{firm}$ include Ln(Age), R&D, D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, Institutional stock ownership and Mutual fund bond ownership on issuer level. All the specifications include industry, date, issuer credit rating, and bond ownership coverage fixed effects. The sample is restricted to those borrowers with at least $50 million in bond amount outstanding, and at least 25% observed bond ownership. Standard errors are double-clustered on firm and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 5—*Continued*

	(1) Ln(Assets)	(2) Ln(Analyst Coverage)	(3) Ln(Prev. Issued Bonds)	(4) Ln(Number of News)
Credit rating				
D([AA–, AAA] rating)	0.034*	0.047***	0.048**	0.023
	(1.76)	(2.73)	(2.35)	(1.38)
D(A+ rating)	0.001	0.001	0.004	-0.005
	(0.06)	(0.07)	(0.35)	(-0.49)
D(A rating)	0.010	0.018**	0.007	0.009
	(1.06)	(2.13)	(0.77)	(1.22)
D(A– rating)	0.007	0.006	0.002	0.001
	(0.69)	(0.73)	(0.20)	(0.06)
D(BBB rating)	0.019**	0.019**	0.020**	0.012
	(2.38)	(2.42)	(2.42)	(1.64)
D(BBB– rating)	0.046***	0.052***	0.036***	0.037***
	(5.15)	(5.89)	(4.02)	(4.59)
D(BB+ rating)	0.052***	0.058***	0.046***	0.045***
	(5.21)	(5.77)	(4.05)	(4.70)
D(BB rating)	0.055***	0.059***	0.048***	0.045***
	(5.08)	(5.54)	(4.18)	(4.62)
D(BB– rating)	0.063***	0.064***	0.051***	0.051***
	(5.42)	(5.60)	(4.39)	(4.79)
D(B+ rating)	0.065***	0.065***	0.063***	0.053***
	(5.10)	(5.32)	(4.99)	(4.49)
D(B rating)	0.076***	0.077***	0.079***	0.067***
	(5.76)	(6.17)	(5.68)	(5.46)
D(B– rating)	0.097***	0.104***	0.092***	0.085***
	(6.27)	(6.56)	(6.17)	(5.91)
D([D, CCC+] rating)	0.173***	0.152***	0.162***	0.136***
	(7.12)	(7.83)	(6.59)	(6.32)
D(Not rated)	0.083***	0.079***	0.090***	0.074***
	(4.79)	(4.50)	(6.11)	(4.55)
D([AA–, AAA] rating) * D(Transparent)	0.012	-0.015	-0.024	0.025
	(0.54)	(-0.84)	(-1.19)	(1.55)
D(A+ rating) * D(Transparent)	0.008	0.008	-0.003	0.017
	(0.65)	(0.68)	(-0.29)	(1.63)
D(A rating) * D(Transparent)	0.004	-0.011	0.006	0.006
	(0.40)	(-1.01)	(0.52)	(0.87)
D(A– rating) * D(Transparent)	-0.011	-0.009	-0.002	0.002
	(-0.93)	(-0.84)	(-0.14)	(0.22)
D(BBB rating) * D(Transparent)	-0.018*	-0.017*	-0.019**	-0.003
	(-1.94)	(-1.93)	(-2.05)	(-0.48)
D(BBB– rating) * D(Transparent)	-0.034***	-0.043***	-0.012	-0.016**
	(-3.37)	(-3.99)	(-1.17)	(-2.08)
D(BB+ rating) * D(Transparent)	-0.025**	-0.035***	-0.010	-0.010
	(-2.21)	(-3.60)	(-0.96)	(-1.40)

Table 5—*Continued*

	(1) Ln(Assets)	(2) Ln(Analyst Coverage)	(3) Ln(Prev. Issued Bonds)	(4) Ln(Number of News)
D(BB rating) * D(Transparent)	-0.021*	-0.029***	-0.005	-0.004
	(-1.93)	(-3.09)	(-0.48)	(-0.64)
D(BB– rating) * D(Transparent)	-0.022**	-0.025**	0.004	-0.002
	(-2.09)	(-2.61)	(0.39)	(-0.22)
D(B+ rating) * D(Transparent)	-0.019	-0.022**	-0.012	-0.000
	(-1.63)	(-2.04)	(-1.20)	(-0.03)
D(B rating) * D(Transparent)	-0.012	-0.018*	-0.014	0.002
	(-1.02)	(-1.68)	(-1.31)	(0.18)
D(B– rating) * D(Transparent)	-0.019	-0.035***	-0.008	0.000
	(-1.26)	(-2.75)	(-0.54)	(0.01)
D([D, CCC+] rating) * D(Transparent)	-0.069***	-0.036*	-0.043*	-0.001
	(-2.67)	(-1.80)	(-1.75)	(-0.05)
D(Not rated) * D(Transparent)	-0.023	-0.016	-0.022	-0.008
	(-1.35)	(-0.98)	(-1.61)	(-0.62)
Observations	29,794	29,794	29,794	29,555
R-squared	0.639	0.640	0.641	0.637

Table 6: The role of information transparency in the cross-section of borrowers, Top 5

This table presents the results of panel regression analysis from Equation (5) that relates firm-level bond ownership concentration to a range of covariates capturing the firm's credit rating, information transparency, and other characteristics. The dependent variable is the ownership by the largest five bondholders as a share of the amount outstanding. The list of measures for information transparency includes firm size measured by Ln(Assets), Ln(Analyst coverage), Ln(Previously issued bonds), and Ln(Number of firm news in press). $CreditRating_{i,t}$ is a set of binary variables corresponding to firm-level S&P credit ratings. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. D(IG rating) is the binary variable reflecting the investment-grade status of the firm. Firm controls $X_{f,t}^{firm}$ include Ln(Age), R&D, D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, Institutional stock ownership and Mutual fund bond ownership on issuer level. All the specifications include industry, date, issuer credit rating, and bond ownership coverage fixed effects. The sample is restricted to those borrowers with at least $50 million in bond amount outstanding, and at least 25% observed bond ownership. Standard errors are double-clustered on firm and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Panel A: Estimation results				
	(1)	(2)	(3)	(4)
Ln(Assets)	-0.032***	-0.024***	-0.022***	-0.025***
	(-12.03)	(-10.11)	(-7.86)	(-11.03)
Ln(Assets)*D(IG rating	0.010***			
	(2.83)			
Ln(Analyst Coverage)		-0.016***		
		(-3.63)		
Ln(Analyst Coverage)*D(IG rating)		0.012**		
		(2.06)		
Ln(Prev. Issued Bonds)			-0.017***	
			(-4.40)	
Ln(Prev. Issued Bonds)*D(IG rating)			0.008*	
			(1.97)	
Ln(Number of News)				-0.013***
				(-4.37)
Ln(Number of News)*D(IG rating)				0.007
				(1.60)
Observations	29,794	29,794	29,794	29,555
R-squared	0.638	0.638	0.640	0.637
Panel B: Post-estimation tests				
InfCost+InfCost*(IG rating)	-0.022***	-0.003	-0.009*	-0.006
	(-7.15)	(-0.63)	(-1.98)	(-1.51)

Table 7: The effect of corporate bond data dissemination via TRACE on bond ownership concentration, bond level

The table reports the results of the stacked difference-in-differences analysis from Equation (6) that relates bond-level bond ownership concentration to the TRACE dissemination status and other covariates. The dependent variable is one of the four bond ownership concentration measures – the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The sample covers all the corporate bonds treated in Phase 2 and Phases 3A/3B and ranges from 2002q1 to 2006q1. Three groups of bonds are considered, defined by credit rating buckets, namely [A–, AAA], [BBB–, BBB+], and [B–, BB+] or high-yield (HY) bonds. Only the subsample of eventually treated bonds is considered. The sample is further restricted to those bonds with at least \$50 million in the amount outstanding and an initial size of at least \$100 million. The causal effect of each Phase is estimated relative to bonds either already treated or yet to be treated in the future. Bonds treated in Phase 3 serve as a control group for bonds treated in Phase 2, and vice versa. Panel A reports the results for the natural logarithm of the number of bondholders. Panel B documents the results for the HHI index (multiplied by 100). Panels C and D report the results for the ownership by the largest one and five bondholders as a share of the amount outstanding, respectively (in percentages). The average pre-treatment concentration is reported for every bucket of bonds and concentration measures without correction for observed coverage. The set of control variables $X_{i,t}$ includes the natural logarithm of bond size, the square of the natural logarithm of bond size, the natural logarithm of bond age, and the natural logarithm of maturity left. All the bond-level specifications include the phase times date, phase times bond, and bond ownership coverage-based percentile fixed effects. The standard errors are double-clustered on phase times credit rating and date levels. t-statistics are reported below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 7—*Continued*

Ln(Bondholders)				
	Pre-treatment,	Diff-in-diff effect		
	mean	[t, t+1]	[t+2, t+3]	[t+4, t+5]
[A–, AAA], Phase 2	3.470	-0.001	-0.008	-0.005
		(-0.12)	(-0.66)	(-0.30)
[BBB–, BBB+], Phase 3	3.656	-0.008*	-0.015**	-0.018***
		(-1.82)	(-2.66)	(-5.15)
[B–, BB+], Phase 3	3.473	-0.005	0.026	0.040**
		(-0.57)	(1.50)	(2.49)
Observations		12,661	12,661	12,661
R-squared		0.980	0.980	0.980
HHI, x100				
	Pre-treatment,	Diff-in-diff effect		
	mean	[t, t+1]	[t+2, t+3]	[t+4, t+5]
[A–, AAA], Phase 2	3.009	0.051	0.040	0.021
		(1.72)	(0.97)	(0.49)
[BBB–, BBB+], Phase 3	3.559	0.027*	0.023	-0.062
		(1.77)	(0.58)	(-1.14)
[B–, BB+], Phase 3	2.428	0.060	-0.042	-0.155**
		(1.33)	(-0.57)	(-2.38)
Observations		12,661	12,661	12,661
R-squared		0.975	0.975	0.975

Table 7—*Continued*

Top1, %				
	Pre-treatment,	Diff-in-diff effect		
	mean	[t, t+1]	[t+2, t+3]	[t+4, t+5]
[A–, AAA], Phase 2	10.848	0.093	0.105	-0.075
		(0.58)	(0.81)	(-0.53)
[BBB–, BBB+], Phase 3	11.244	0.035	-0.095	-0.425**
		(1.01)	(-0.62)	(-2.83)
[B–, BB+], Phase 3	10.687	-0.048	-0.438***	-0.750***
		(-0.29)	(-3.24)	(-3.96)
Observations		12,661	12,661	12,661
R-squared		0.953	0.953	0.953
Top5, %				
	Pre-treatment,	Diff-in-diff effect		
	mean	[t, t+1]	[t+2, t+3]	[t+4, t+5]
[A–, AAA], Phase 2	29.391	0.318*	0.270	0.098
		(1.79)	(1.42)	(0.55)
[BBB–, BBB+], Phase 3	32.635	0.211**	0.220*	-0.007
		(2.43)	(2.04)	(-0.04)
[B–, BB+], Phase 3	25.551	0.319	0.194	-0.337
		(1.70)	(0.88)	(-1.21)
Observations		12,661	12,661	12,661
R-squared		0.982	0.982	0.982

Table 8: Offering yield spread and issuer-level pre-issuance bond concentration, baseline regression

This table presents the results of cross-sectional regression analysis from Equation (7) that relates offering yield spread to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating and other characteristics. The dependent variable is the difference between offering yield and maturity-matched Treasury yield. $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The concentration measures are standardized. $X^{bond}_{j,t}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing), Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X^{firm}_{i,t-1}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). All specifications include bond issuance credit rating, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding, and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively. The full version of this table is reported in Appendix B.

	(1)	(2)	(3)	(4)
L1.Ln(Bondholders), stand.	-0.129***			
	(-4.95)			
L1.HHI, stand.		0.082***		
		(3.89)		
L1.Top1, stand.			0.063***	
			(3.37)	
L1.Top5, stand.				0.090***
				(4.22)
Observations	2,548	2,548	2,548	2,548
R-squared	0.843	0.843	0.842	0.842

Table 9: Gross spread, underpricing, and issuer-level pre-issuance bond concentration

This table presents the results of cross-sectional regression analysis from Equations (8) and (9) that relates offering gross spread and initial underpricing to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating and other characteristics. In Panel A, the dependent variable is $GrossSpread_{j,t}$ - the fee borrowers pay to the underwriting syndicate as a share of par value. In Panel B, the dependent variable is $Underpricing_{j,t}$ - the percentage difference between the price on the first day of trading and the offering price, constructed following Nikolova, Wang, and Wu (2020). $Concentration_{i,t-1}^{firm}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The concentration measures are standardized. $X_{j,t}^{bond}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing) Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X_{i,t-1}^{firm}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). All specifications include the bond issue credit rating, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 9—*Continued*

Panel A: Gross Spread, bps				
	(1)	(2)	(3)	(4)
L1.Ln(Bondholders), stand.	0.975			
	(0.85)			
L1.HHI, stand.		-1.337		
		(-0.72)		
L1.Top1, stand.			-0.715	
			(-0.47)	
L1.Top5, stand.				-2.745
				(-1.45)
Observations	2,173	2,173	2,173	2,173
R-squared	0.710	0.711	0.710	0.712
Panel B: Underpricing, bps				
	(1)	(2)	(3)	(4)
L1.Ln(Bondholders), stand.	-3.576			
	(-1.48)			
L1.HHI, stand.		0.273		
		(0.18)		
L1.Top1, stand.			-1.551	
			(-1.30)	
L1.Top5, stand.				0.346
				(0.24)
Observations	2,241	2,241	2,241	2,241
R-squared	0.370	0.369	0.370	0.369

Table 10: Offering yield spread and issuer-level bond concentration, over credit risk

This table presents the results of cross-sectional regression analysis from Equation (10) that relates offering yield spread to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating and other characteristics. The dependent variable is the difference between offering yield and maturity-matched Treasury yield. $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The concentration measures are standardized. $X^{bond}_{j,t}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing) Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X^{firm}_{i,t-1}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). $DtD^{firm}_{i,t-1}$ is an issuer's Distance-to-Default measure, estimated following Bharath and Shumway (2008) and Schwert (2018). All specifications include bond issuance credit rating, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. Panel A reports the estimation results, and Panel B documents the post-estimation tests for various values of the Distance-to-Default measure. The sample is restricted to those bonds with at least $50 million in the amount outstanding, and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 10—*Continued*

Panel A: Estimation results				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
L1.Conc.	-0.272***	0.148***	0.123***	0.209***
	(-5.44)	(3.56)	(3.67)	(4.31)
L1.DtD	-0.090**	0.023**	0.027**	0.046***
	(-2.34)	(2.79)	(2.64)	(3.42)
L1.Conc.*L1.DtD	0.016**	-0.010**	-0.010**	-0.016**
	(2.72)	(-2.20)	(-2.20)	(-2.84)
Observations	2,548	2,548	2,548	2,548
R-squared	0.844	0.843	0.843	0.844

Panel B: Post-estimation tests				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
The magnitude of L1.Concentration + L1.Concentration*L1.DtD				
At DtD=0	-0.272***	0.148***	0.123***	0.209***
	(-5.44)	(3.56)	(3.67)	(4.31)
At 25th pctl. (DtD=6.02)	-0.172***	0.086***	0.065***	0.114***
	(-6.49)	(3.75)	(3.08)	(5.14)
At 50th pctl. (DtD=8.95)	-0.124***	0.056**	0.036	0.068***
	(-4.40)	(2.45)	(1.44)	(3.43)
At 75th pctl. (DtD=12.01)	-0.074*	0.024	0.006	0.020
	(-1.86)	(0.80)	(0.17)	(0.68)

Table 11: Offering yield spread and issuer-level bond concentration, over credit cycle

This table presents the results of cross-sectional regression analysis from Equation (11) that relates offering yield spread to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating and other characteristics. The dependent variable is the difference between offering yield and maturity-matched Treasury yield. $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. $X^{bond}_{j,t}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing) Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X^{firm}_{i,t-1}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). All specifications include bond issuance credit rating, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. Panel A reports the estimation results, and Panel B documents the post-estimation tests for various values of macro-level credit spread. The sample is restricted to those bonds with at least $50 million in the amount outstanding, and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 11—*Continued*

Panel A: Estimation results				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
L1.Conc.	0.328***	-0.244**	-0.336**	-0.240***
	(3.72)	(-2.87)	(-2.75)	(-3.02)
L1.Conc.* Credit Spread	-0.166***	0.119***	0.154***	0.120***
	(-6.19)	(3.60)	(3.26)	(4.16)
Credit Spread	1.728***	0.593***	0.509***	0.466***
	(13.31)	(7.53)	(4.76)	(4.30)
Observations	2,548	2,548	2,548	2,548
R-squared	0.891	0.889	0.890	0.890
Panel B: Post-estimation tests				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
The magnitude of L1.Concentration + L1.Concentration*Credit Spread				
At median (Credit Spread = 2.56%)	-0.097**	0.060***	0.058***	0.067***
	(-2.53)	(3.05)	(3.47)	(3.31)
At GFC (Credit Spread = 6.10%)	-0.683***	0.479***	0.603***	0.492***
	(-7.52)	(4.00)	(3.59)	(4.87)

Table 12: Offering yield spread and issuer-level bond concentration, benign and turmoil subperiods of credit cycle

This table presents the results of cross-sectional regression analysis from Equation (7) that relates offering yield spread to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating and other characteristics. The analysis is conducted on the subsamples of benign and turmoil periods of the credit cycle. The benign period is defined as the one with the macro-level credit spread being lower than the median of 2.56%, and the turmoil period is the opposite – higher or equal to 2.56%. The credit spread is measured as Moody's seasoned Baa corporate bond yield relative to yield on 10-Year Treasury constant maturity. The dependent variable is the difference between offering yield and maturity-matched Treasury yield. $Concentration_{i,t-1}^{firm}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The concentration measures are standardized. $X_{j,t}^{bond}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing) Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X_{i,t-1}^{firm}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). All specifications include the bond issue, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	(1) Benign	(2) Turmoil	(3) Benign	(4) Turmoil	(5) Benign	(6) Turmoil	(7) Benign	(8) Turmoil
L1.Ln(Bondholders), stand.	-0.100***	-0.101						
	(-3.40)	(-1.43)						
L1.HHI, stand.			0.063**	0.092**				
			(2.80)	(2.43)				
L1.Top1, stand.					0.050**	0.092**		
					(2.42)	(2.82)		
L1.Top5, stand.							0.051*	0.085*
							(2.14)	(2.02)
Observations	1,341	1,195	1,341	1,195	1,341	1,195	1,341	1,195
R-squared	0.898	0.854	0.898	0.855	0.898	0.855	0.897	0.854

Table 13: Robustness check-1: Offering yield spread and issuer-level bond concentration, bond liquidity

This table presents the results of cross-sectional regression analysis from Equation (7) that relates offering yield spread to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating, illiquidity, and other characteristics. The dependent variable is the difference between offering yield and maturity-matched Treasury yield. $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance - the ownership by the largest five bondholders as a share of the amount outstanding. The concentration measures are standardized. There are four measures of bond-level illiquidity. The first measure is Turnover, calculated as a total par volume traded in a given quarter over the par value of the amount outstanding. A higher turnover value is interpreted as higher liquidity. The second measure is Bid/Ask Spread, with higher values corresponding to lower liquidity. The third measure is the Amihud illiquidity measure (Amihud) – the average absolute return difference between consecutive transactions normalized by trade size (Amihud (2002)). Amihud measure can be interpreted as a measure of price movement per unit of trade, so a higher Amihud measure means lower liquidity. Finally, the fourth measure is the imputed round trip cost (IRC) which measures the average percentage change in price over all imputed roundtrip trades within a trading day (Feldhütter (2012), Anderson and Stulz (2017)). $X^{bond}_{j,t}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing) Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X^{firm}_{i,t-1}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). All specifications include the bond issue, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 13—*Continued*

	(1)	(2)	(3)	(4)
L1.Top5, stand.	0.093***	0.097***	0.089***	0.094***
	(4.18)	(5.18)	(3.95)	(3.96)
Turnover	0.047			
	(0.66)			
F1.Turnover	0.117*			
	(1.82)			
F2.Turnover	-0.019			
	(-0.28)			
Amihud		21.230***		
		(3.58)		
F1.Amihud		8.544***		
		(3.05)		
F2.Amihud		1.589		
		(0.40)		
IRC			7.757	
			(1.27)	
F1.IRC			13.727**	
			(2.35)	
F2.IRC			-8.866	
			(-1.06)	
Bid/Ask Spread				21.095
				(1.54)
F1.Bid/Ask Spread				37.129***
				(4.03)
F2.Bid/Ask Spread				0.567
				(0.04)
Observations	2,170	2,156	2,106	2,132
R-squared	0.791	0.807	0.798	0.804

Table 14: Robustness check-2: Offering yield spread and issuer-level bond concentration, alternative specifications and subsamples

This table presents the results of cross-sectional regression analysis from Equation (7) that relates offering yield spread to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating, illiquidity, and other characteristics. The dependent variable is the difference between offering yield and maturity-matched Treasury yield. $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance - the ownership by the largest five bondholders as a share of the amount outstanding. The concentration measures are standardized. Underwriter Reputation is the total share of bonds allocated by all the lead underwriters of the syndicate in the given credit rating in a given calendar year (specification (1)). I construct two measures of issuer-level liquidity constraints of incumbent bondholders by value-weighting mutual fund and insurance company liquidity constraints using the size of the position in borrower's seasoned bonds (specification (2)). Specification (3) and (4) provides the results for the two subperiods: 2001-2012 and 2013-2019. $X^{bond}_{j,t}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing) Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X^{firm}_{i,t-1}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). All specifications include the bond issue, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	(1) Underwriter	(2) Flows	(3) 2001-2012	(4) 2013-2019
L1.Top5, stand.	0.087***	0.076***	0.075**	0.080**
	(4.19)	(3.44)	(2.77)	(3.21)
MF Liquidity Shocks		-6.074**		
		(-2.23)		
IC Liquidity Shocks		-34.609**		
		(-2.21)		
Underwriter Reputation	0.084			
	(0.77)			
Observations	2,119	2,537	1,054	1,483
R-squared	0.794	0.854	0.850	0.899

A Appendix

A.1 Data Construction

A.1.1 Preparing Morningstar Holdings

Some mutual fund-level bond ownership holdings have missing ISIN and CUSIP information and nonmissing maturity and coupon information. I recover holdings of these bonds using 1) bond positions with known CUSIP and ISIN; 2) matching with Mergent FISD. Bonds are matched precisely by maturity, 2-decile coupon information, 144A status, and fuzzy merged by issuer name conditional on precisely matched previous variables.

A.1.2 Bond filters

The sample of corporate bonds is constructed as follows. I start with all the bonds in FISD (version of May, 2021), and keep those with non-missing coupon and maturity. I drop bonds denominated in foreign currencies (defined by FOREIGN_CURRENCY). I keep US-domiciled bonds (defined by COUNTRY_DOMICILE). I keep bonds with the first letter of BOND_TYPE being "C". Following the literature, I drop financial issuers with SIC 6000-6999, utility issuers with SIC 4900-4949, and non-profit and government firms with SIC 8000s and 9000s. I drop all the bonds with the maximum total ownership of mutual funds and insurance companies not exceeding 10% of the amount outstanding. I drop those bond observations with more than 100% ownership. I further drop Yankee bonds (YANKEE), Canadian bonds (CANADIAN), private placement (PRIVATE_PLACEMENT), MTNs (MTN), corporate MTNs (CMTN), CPIKs (CPIK), CPASes (CPAS), asset-backed bonds (ASSET_BACKED), unit deals (UNIT_DEAL), and perpetuals (PERPETUAL). I keep only bonds with fixed coupons (COUPON_TYPE). I further drop those bond observations with less than $50 million in amount outstanding. I drop bonds with more than 30-year maturity. I drop bonds with missing security levels (SECURITY_LEVEL). I keep bonds with observed bond ownership of at least 25% of the amount outstanding.

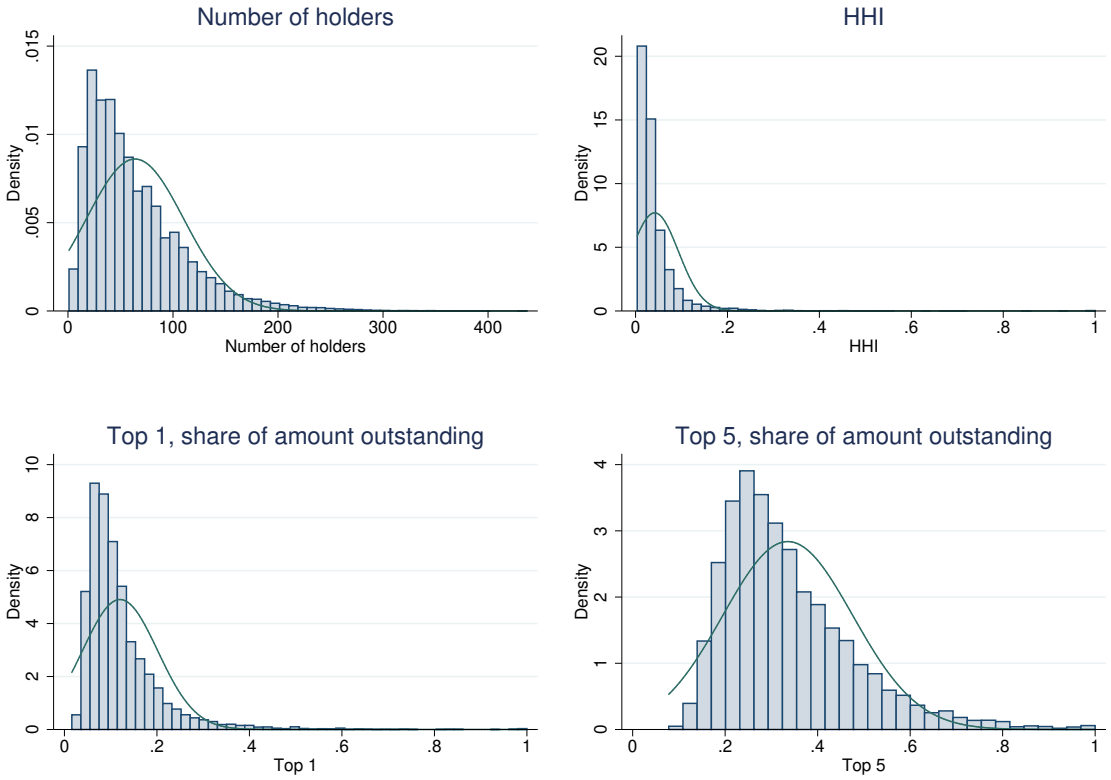
A.1.3 Creating dynamic bond-firm mapping

- From WRDS mapping, map bond_cusip*quarter to permco and map permco*quarter to gvkey.
- Use bond_cusip-to-ticker from TRACE and map to gvkey
- Using CAPITALIQ map, map bond_cusip*quarter to companyid and then to gvkey.
- Priorities for gvkey: WRDS, TRACE and then CAPITALIQ.

- Replace missing gvkey if past and future gvkeys are the same
- For all bonds with the same issuer_id and quarter fill the gap with already identified gvkey if there are no more than one gvkey for all bonds found.
- For all bonds with the same cusip6 and quarter fill the gap with already identified gvkey if there are no more than one gvkey for all bonds found.
- Expanding for pre-TRACE period: 2000q4-2002q3:
  - Using cusip6 and MERGENT FISD, identify the issuer's gvkey. Use it for bonds with age_q no more than 10 quarters and missing gvkey (identified earlier).
  - For bonds with still missing gvkey in 2000q4-2002q3 period, carrybackward gvkey from 2002q4.

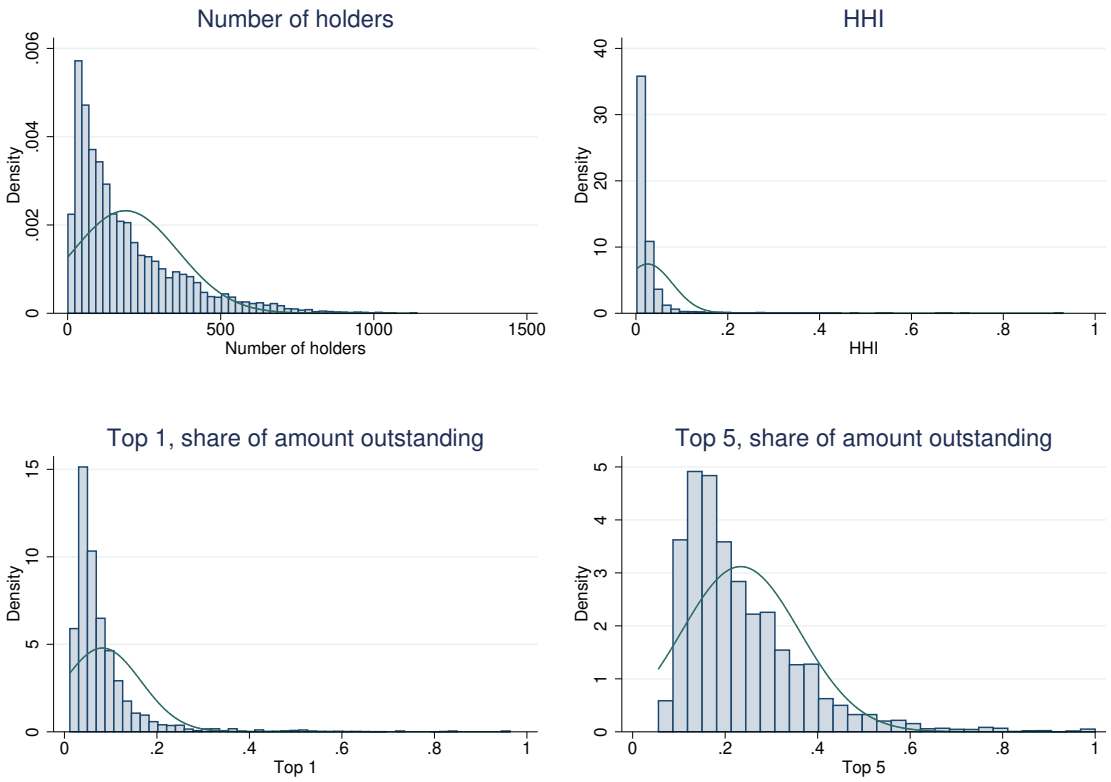
B Additional results

Figure B.1: Distribution of bond-level concentration measures, 50% filter on observed ownership



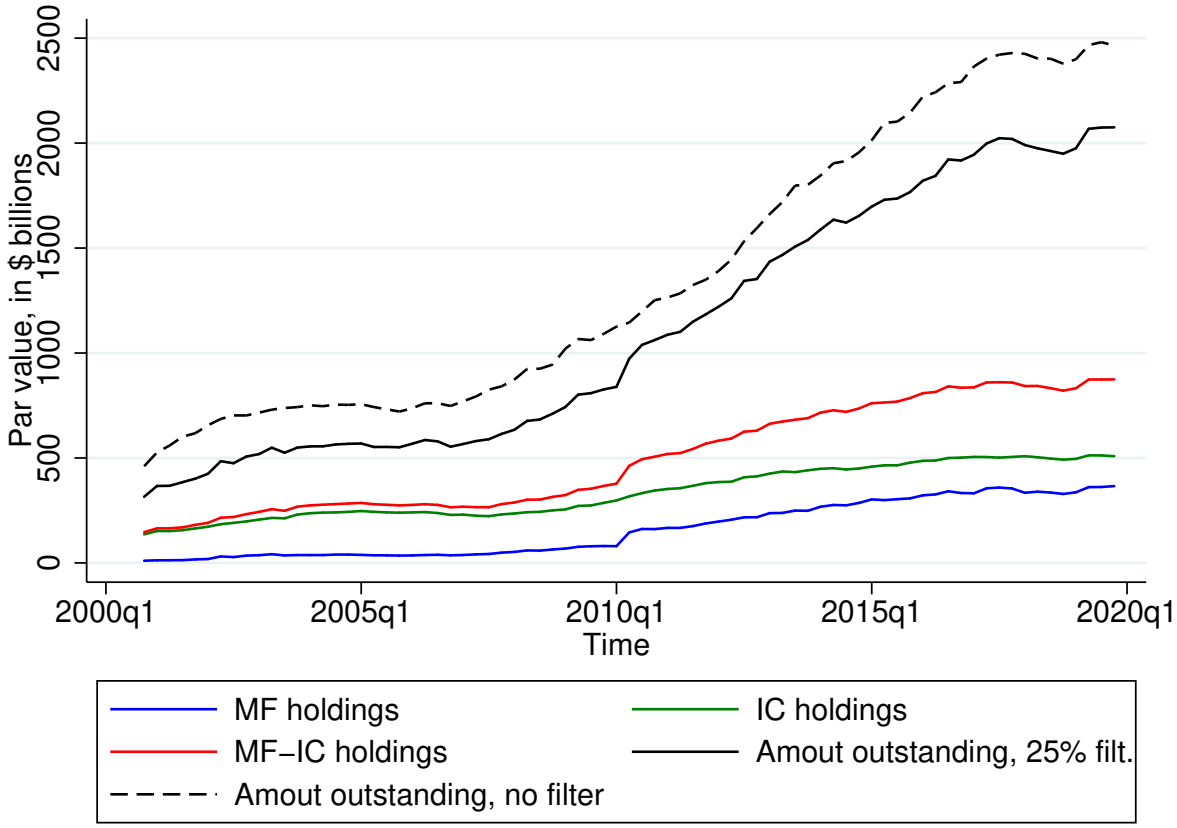
The figure shows the distribution of concentration measures on the bond level, namely the number of institutional portfolio-level bondholders, the Herfindahl–Hirschman index (HHI), the holding of the largest one and five investors as a share of the amount outstanding (Top 1 and Top 5). Institutional investors include all US mutual funds and insurance companies. Institutional ownership is measured on the individual portfolio level. Only bonds with observed institutional ownership of at least 50% of the amount outstanding are included in the sample. The sample consists of bonds with at least $50 million in par value outstanding.

Figure B.2: Distribution of firm-level concentration measures, 50% filter on observed ownership



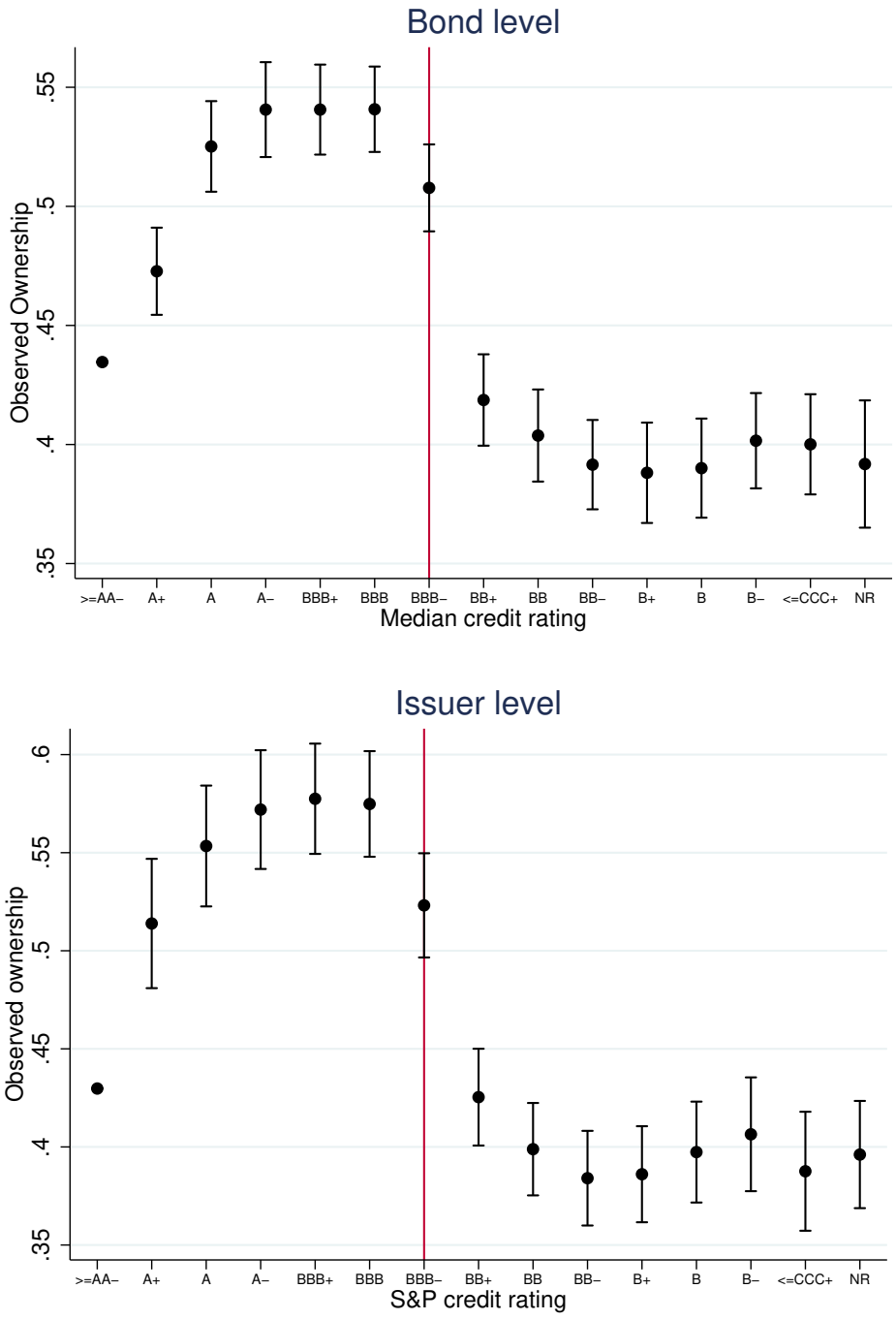
The figure shows the distribution of concentration measures on the firm level, namely the number of institutional portfolio-level bondholders, the Herfindahl–Hirschman index (HHI), the holding of the largest one and five investors as a share of the amount outstanding (Top 1 and Top 5). Firm-level measures are constructed by considering the total investor's position in all the observed bonds of the firm. Institutional investors include all US mutual funds and insurance companies. Institutional ownership is measured on the individual portfolio level. Only borrowers with observed institutional ownership of at least 50% of the amount outstanding are included in the sample. The sample consists of borrowers with at least $50 million par value in the bond amount outstanding.

Figure B.3: Total observed bond ownership



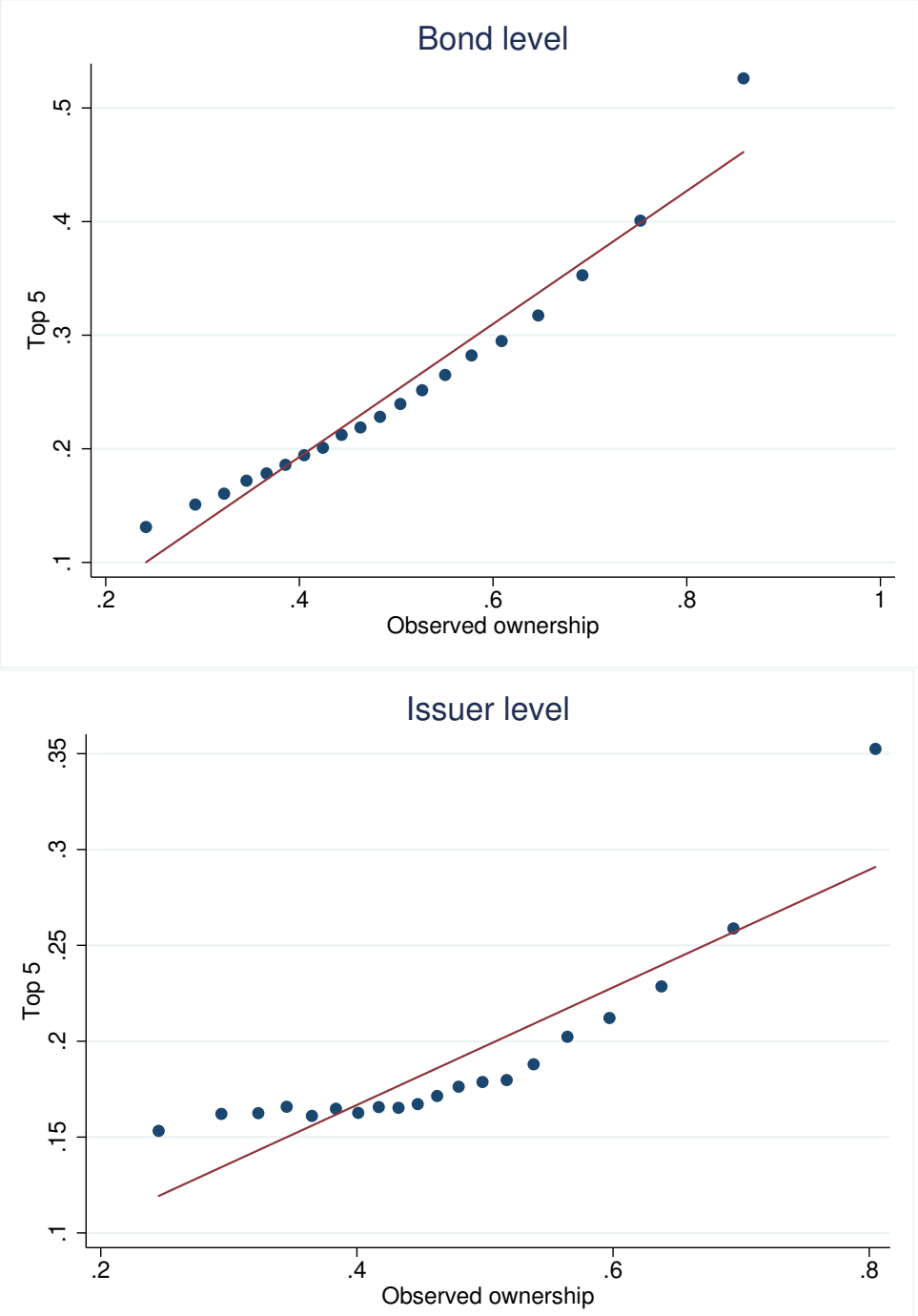
The figure shows the dynamics of total observed bond ownership in my sample before and after restricting the sample for bonds with at least 25% observed ownership. Blue and green lines show the total corporate bond holdings of US mutual funds and US insurance companies. Red line shows the total MF-IC ownership of corporate bonds in the sample. The black line reflects the total amount outstanding of bonds in the sample after applying a 25% filter, and the black dashed line shows the total amount outstanding before applying the 25% filter. The sample of bonds is restricted to those bonds held by mutual funds and insurance companies on top of other filters applied in the paper.

Figure B.4: Observed bond ownership data as a share of amount outstanding, over credit ratings



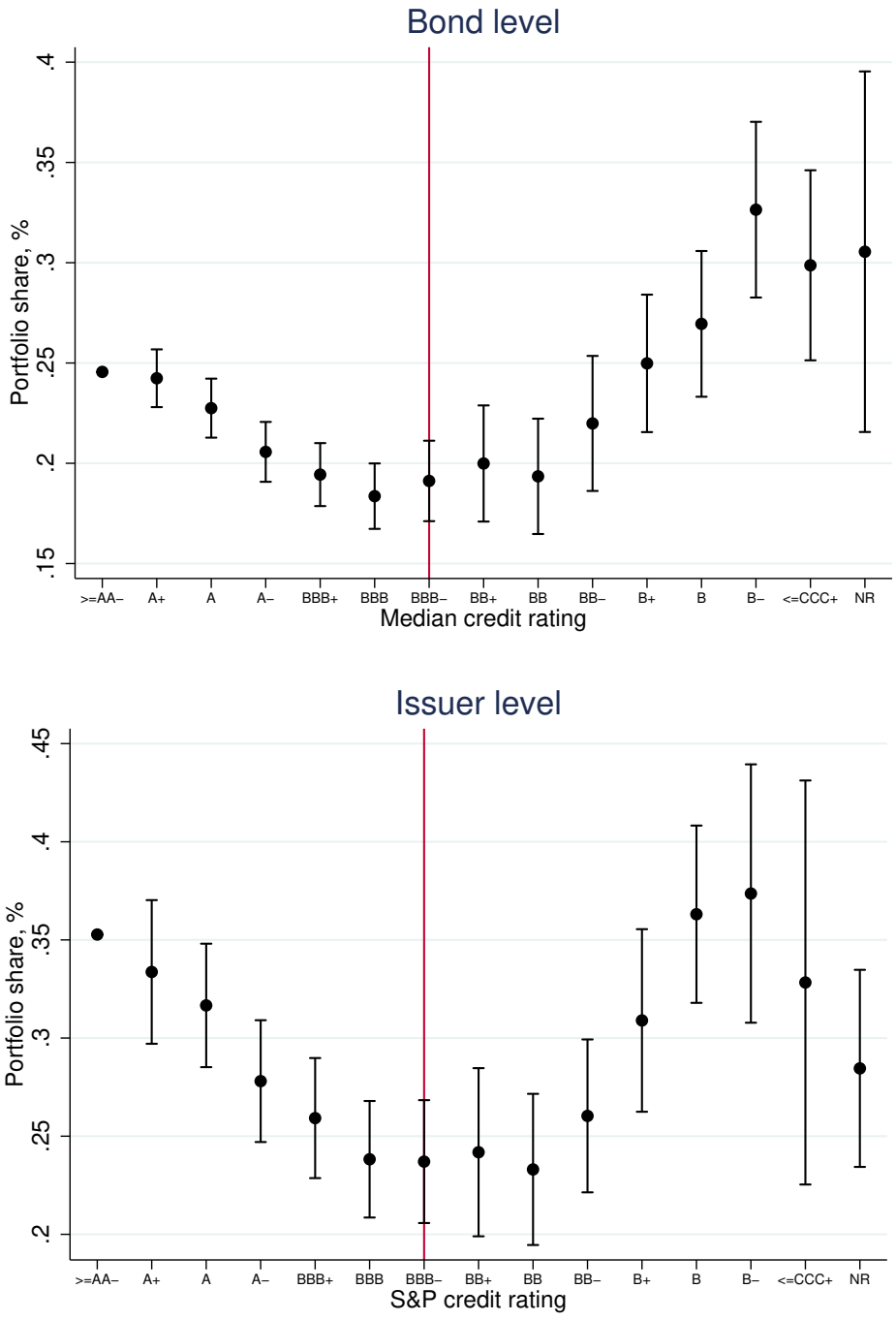
The figures show the average observed bond ownership across credit ratings on bond (top) and firm levels (bottom). Graphs are constructed after filtering out all the bonds with less than 25% of observed coverage as a share of the amount outstanding.

Figure B.5: Relation between bond concentration and observed coverage of bond ownership



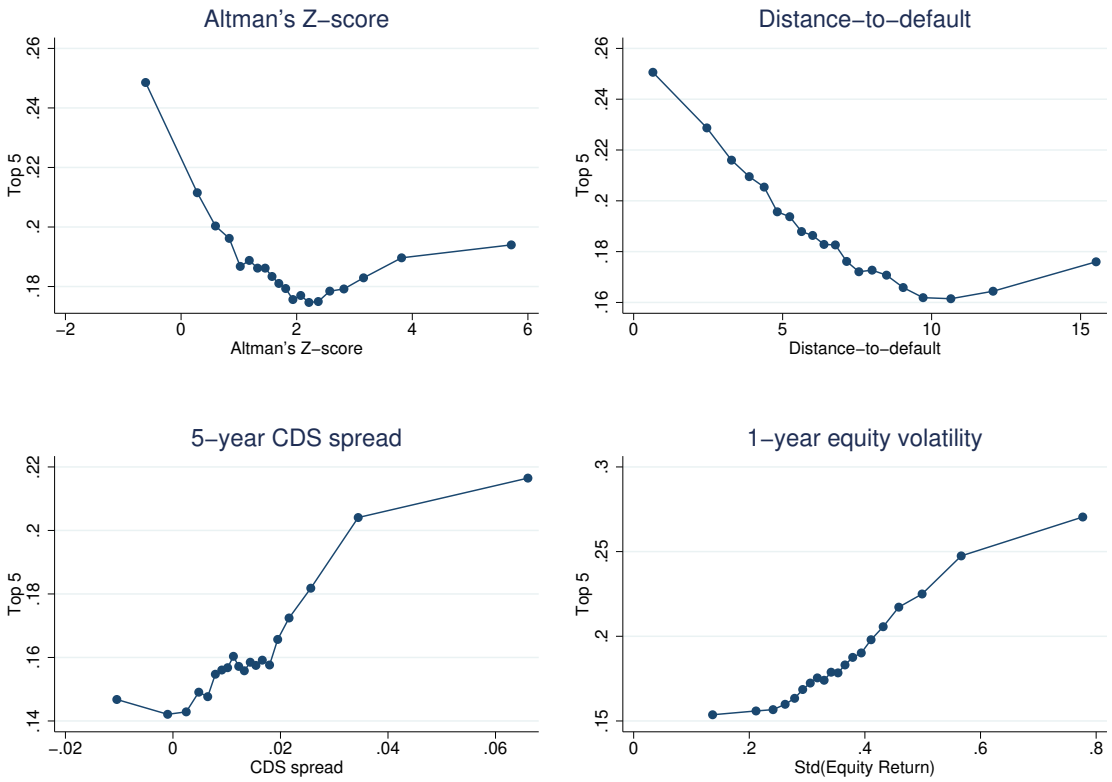
The figure shows the relation between bond concentration and observed coverage of bond ownership, both on bond and issuer levels. Graphs are constructed after filtering out all the bonds with less than 25% of observed coverage as a share of the amount outstanding.

Figure B.6: Average portfolio weight of incumbent bondholders, over credit ratings



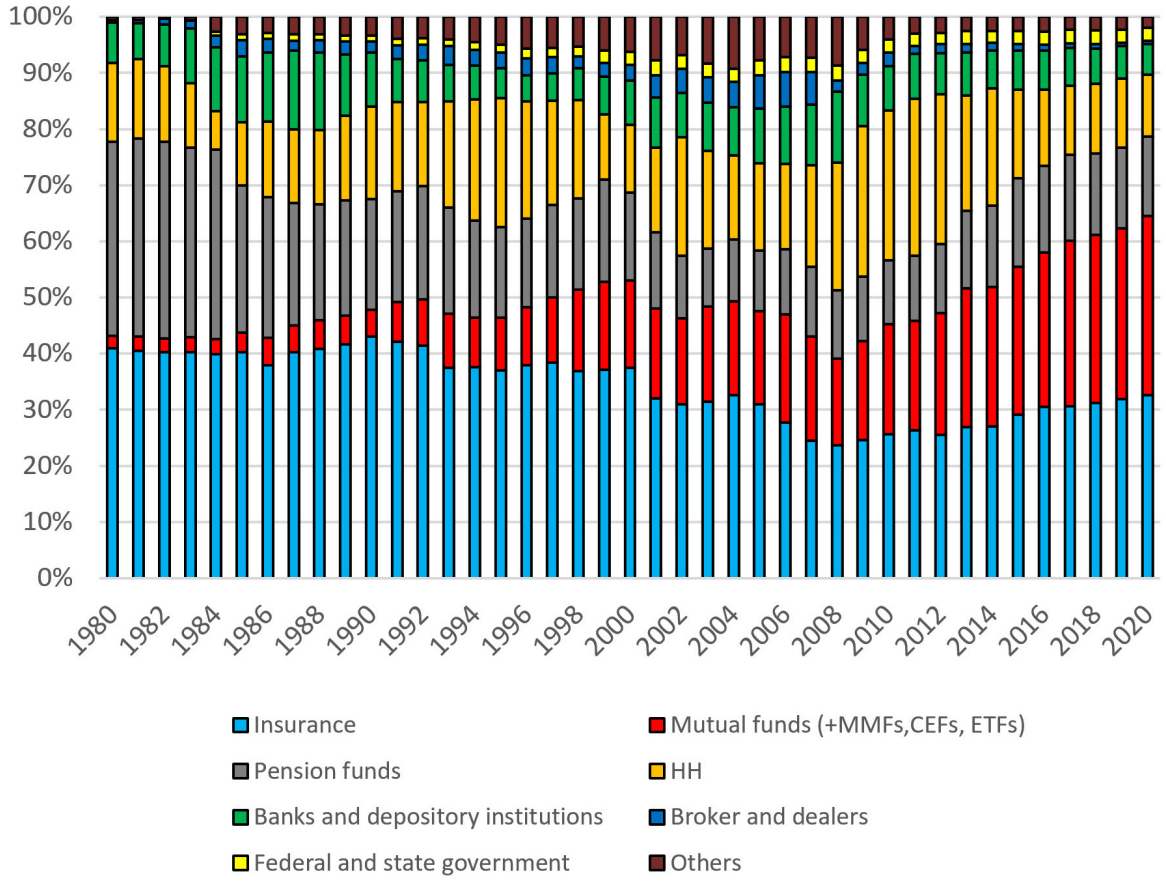
The figures show the average portfolio weight of bondholders holding a security across credit ratings on bond (top) and firm levels (bottom). Graphs are constructed after filtering out all the bonds with less than 25% of observed coverage as a share of the amount outstanding.

Figure B.7: Relation between bond concentration and various measures of credit risk, firm level



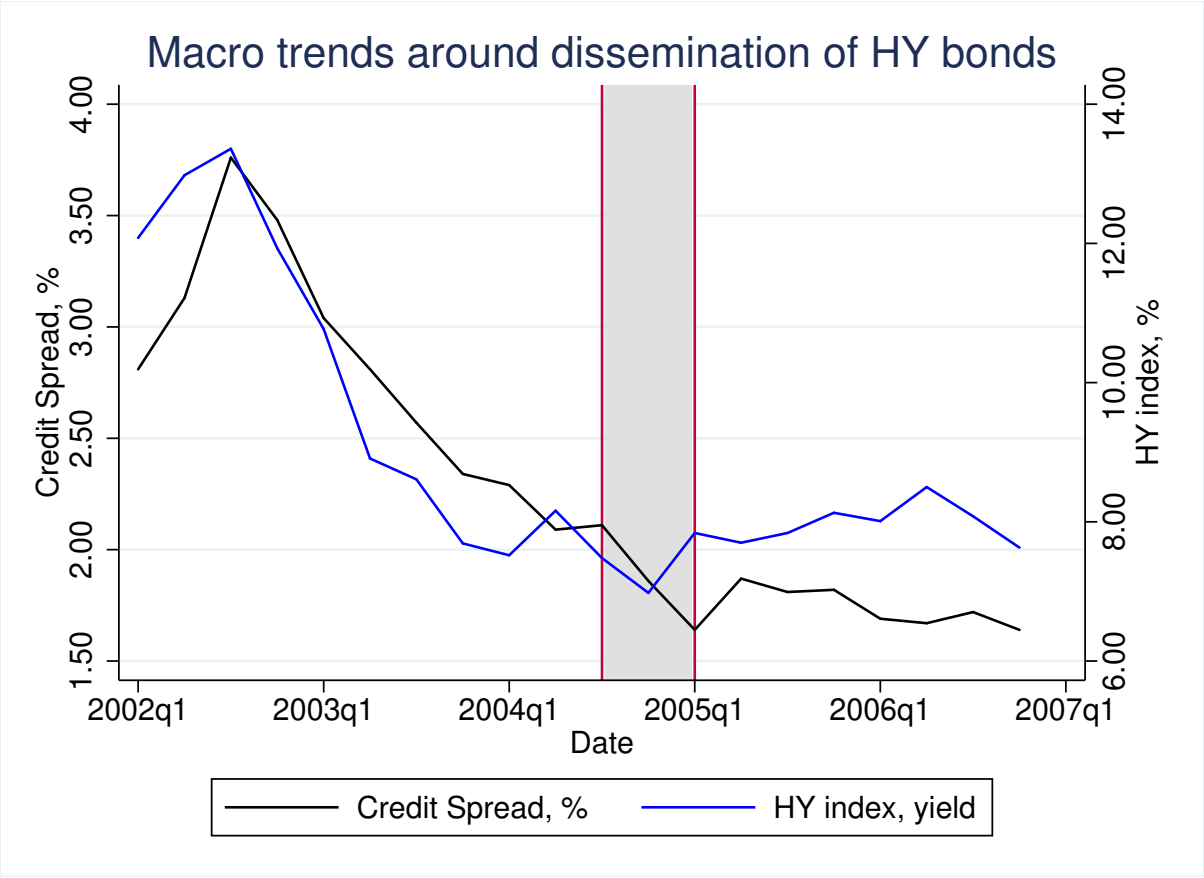
The figure shows the binscatter plots of the relation between bond concentration and various measures of firm-level credit risk – Altman's Z-score, Distance-to-default, 5-year CDS spread, and equity volatility. Graphs are constructed after filtering out all the bonds and borrowers with less than 25% of observed coverage as a share of the amount outstanding. The sample consists of bonds with at least $50 million in the amount outstanding. All the graphs are constructed after controlling for date, industry, and bond ownership coverage fixed effects.

Figure B.8: Ownership structure of corporate bonds, by investor types



The figure shows the ownership structure of corporate bonds by investor types over time. The figure is constructed based on the data from the US federal flows of funds account, FRS.

Figure B.9: Credit cycle during TRACE dissemination



The figure shows the dynamics of macro-level credit spread, calculated as the difference between Moody's seasoned Baa corporate bond and 10-Year Treasury constant maturity, and the effective yield of the ICE BofA US High Yield Index (both obtained from https://fred.stlouisfed.org/ website) during the TRACE dissemination.

Table B.1: The position of the largest five bondholders as a share of the amount outstanding over credit rating, across different filters by observed ownership coverage

This table presents the descriptive statistics of total ownership of the largest five bondholders across credit ratings. Each block applies the corresponding filter by observed ownership coverage. The first column, with the observed coverage of at least 25% of amount outstanding, is the main sample of this paper. The sample consists of bonds with at least $50 million in the amount outstanding. The documented ownership is on the individual portfolio level.

	Coverage ≥25%		Coverage ≥40%		Coverage ≥50%		Coverage ≥60%		Coverage ≥70%	
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
≥ AA-	0.22	8461	0.29	4171	0.35	2376	0.44	1098	0.54	546
A+	0.23	9306	0.28	5598	0.32	3554	0.38	1962	0.43	962
A	0.26	20106	0.29	14694	0.33	10326	0.38	6357	0.45	3359
A-	0.25	12921	0.30	9302	0.33	6973	0.38	4751	0.44	2643
BBB+	0.26	21392	0.30	15971	0.34	11919	0.39	7516	0.45	4273
BBB	0.26	32366	0.30	25316	0.33	18516	0.38	11725	0.43	6407
BBB-	0.26	16439	0.30	12098	0.34	7891	0.40	4591	0.47	2309
BB+	0.21	6943	0.25	3819	0.30	1629	0.38	478	0.46	184
BB	0.21	7217	0.24	3524	0.30	1319	0.42	339	0.61	85
BB-	0.20	7375	0.24	3145	0.31	933	0.43	186	0.50	54
B+	0.21	5545	0.26	2161	0.33	693	0.45	170	0.54	58
B	0.23	4250	0.29	1659	0.38	586	0.49	201	0.64	69
B-	0.25	3155	0.31	1320	0.40	500	0.50	190	0.60	54
≤CCC+	0.28	2238	0.36	930	0.44	399	0.53	163	0.62	48
Not Rated	0.30	1991	0.42	662	0.52	332	0.66	151	0.77	97
Total	0.25	159705	0.29	104370	0.34	67946	0.39	39878	0.45	21148

Table B.2: Determinants of bond ownership concentration, bond-level analysis, robustness check

This table presents the results of panel regression analysis from Equation (1) that relates bond ownership concentration to a range of covariates capturing the bond's credit rating and other characteristics. The dependent variable is one of the four bond concentration measures: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. In Panel A, the sample is restricted to bonds with the observed bond ownership of at least 50% of the bond size. In Panel B, the specifications are estimated without controlling for investor heterogeneity, measured by ownership of mutual-fund investors as a share of the bond size on both bond and firm levels. Panel C reports the estimation results without firm-level controls. In Panel D, all the specifications include the bond-level controls of liquidity and transactions costs measured by the first two principal components of the following measures: the number of trades, the number of trading days, the Amihud measure (Amihud (2002)), the dollar amount traded as a share of bond size or turnover, the imputed roundtrip cost IRC (Feldhütter (2012)), and BidAsk spread. All specifications include the date, SIC2 industry, and bond ownership coverage percentile fixed effects. A list of firm fundamentals includes Ln(Assets), Ln(Age), R&D, D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, institutional stock ownership and mutual fund bond ownership on issuer level. Bond characteristics $X_{i,t}^{bond}$ include $Ln(BondSize)$, $Ln(BondSize)^2$, dispersion of credit ratings across three major credit rating agencies Sd(Rating), number of ratings, covenant index following Billett, King, and Mauer (2007), D(Covenant Index Missing), Ln(1+Bond Age), Ln(1+Bond Maturity Left), binary variables D(Callable), D(Convertible), D(Global issue), D(144A), and total bond ownership by mutual fund investors to address the heterogeneity of investor base. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 25% of observed bond ownership. Standard errors are double-clustered on bond and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table B.2—*Continued*

Panel A: 50% ownership filter				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Credit rating				
D([AA–, AAA] rating)	0.040	-0.001	0.004	-0.009
	(1.16)	(-0.44)	(0.46)	(-0.98)
D(A+ rating)	0.082***	-0.002	0.001	-0.010
	(2.99)	(-1.04)	(0.15)	(-1.60)
D(A rating)	0.102***	-0.002**	-0.002	-0.013***
	(5.24)	(-2.02)	(-0.79)	(-2.83)
D(A– rating)	0.056***	-0.001	0.000	-0.008*
	(3.22)	(-0.62)	(0.04)	(-1.89)
D(BBB rating)	-0.030**	0.001	0.002	0.003
	(-2.09)	(0.97)	(0.90)	(0.85)
D(BBB– rating)	-0.067***	0.003**	0.005	0.009**
	(-3.35)	(2.22)	(1.54)	(2.01)
D(BB+ rating)	-0.056	0.006**	0.013*	0.020***
	(-1.21)	(2.48)	(1.96)	(2.77)
D(BB rating)	-0.037	0.006**	0.015*	0.025***
	(-0.58)	(2.12)	(1.78)	(2.88)
D(BB– rating)	-0.046	0.010**	0.022**	0.036***
	(-0.89)	(2.31)	(2.22)	(3.85)
D(B+ rating)	-0.172***	0.016***	0.044***	0.064***
	(-2.85)	(4.07)	(4.09)	(5.47)
D(B rating)	-0.273***	0.019***	0.044***	0.077***
	(-4.01)	(3.77)	(3.19)	(5.21)
D(B– rating)	-0.327***	0.021***	0.054***	0.084***
	(-3.97)	(3.70)	(3.87)	(6.36)
D([D, CCC+] rating)	-0.478***	0.020***	0.041**	0.089***
	(-4.93)	(3.04)	(2.40)	(5.19)
D(Not rated)	-0.817***	0.033**	0.092***	0.082***
	(-3.51)	(2.52)	(2.90)	(2.72)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Observations	53,747	53,747	53,747	53,747
R-squared	0.816	0.668	0.516	0.760

Table B.2—*Continued*

Panel B: Without controlling for investor heterogeneity				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Credit rating				
D([AA–, AAA] rating)	0.008	0.000	0.005	0.002
	(0.39)	(0.30)	(1.52)	(0.58)
D(A+ rating)	0.065***	-0.001	-0.001	-0.006*
	(3.44)	(-1.14)	(-0.29)	(-1.68)
D(A rating)	0.080***	-0.001	-0.002	-0.007**
	(5.56)	(-1.45)	(-0.78)	(-2.44)
D(A– rating)	0.033**	-0.000	-0.001	-0.005**
	(2.56)	(-0.50)	(-0.49)	(-2.05)
D(BBB rating)	-0.016	0.001	0.002	0.003
	(-1.47)	(1.52)	(1.52)	(1.18)
D(BBB– rating)	-0.056***	0.004***	0.010***	0.014***
	(-3.73)	(5.14)	(4.95)	(4.90)
D(BB+ rating)	0.007	0.006***	0.019***	0.021***
	(0.32)	(7.14)	(7.36)	(6.40)
D(BB rating)	0.016	0.006***	0.019***	0.023***
	(0.69)	(7.09)	(7.16)	(6.85)
D(BB– rating)	-0.005	0.008***	0.026***	0.032***
	(-0.19)	(7.23)	(8.79)	(8.90)
D(B+ rating)	-0.083***	0.010***	0.032***	0.041***
	(-3.19)	(8.70)	(9.56)	(9.81)
D(B rating)	-0.172***	0.012***	0.040***	0.051***
	(-5.52)	(8.45)	(9.81)	(10.81)
D(B– rating)	-0.248***	0.015***	0.048***	0.064***
	(-6.88)	(8.46)	(10.55)	(12.56)
D([D, CCC+] rating)	-0.461***	0.017***	0.054***	0.077***
	(-10.60)	(7.72)	(8.83)	(11.57)
D(Not rated)	-0.563***	0.019***	0.058***	0.056***
	(-6.21)	(3.99)	(5.13)	(5.51)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Observations	123,309	123,309	123,309	123,309
R-squared	0.823	0.676	0.531	0.807

Table B.2—*Continued*

Panel C: Without firm-level controls				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Credit rating				
D([AA–, AAA] rating)	-0.046**	0.004***	0.017***	0.020***
	(-2.09)	(4.36)	(5.02)	(4.96)
D(A+ rating)	0.041**	0.002**	0.007***	0.005
	(2.12)	(2.16)	(3.30)	(1.48)
D(A rating)	0.067***	0.001	0.004*	0.000
	(4.61)	(1.04)	(1.86)	(0.13)
D(A– rating)	0.031**	0.000	0.001	-0.003
	(2.46)	(0.46)	(0.63)	(-1.03)
D(BBB rating)	-0.004	-0.001	-0.002	-0.003
	(-0.40)	(-1.44)	(-1.45)	(-1.46)
D(BBB– rating)	-0.045***	0.000	-0.000	0.002
	(-3.06)	(0.54)	(-0.16)	(0.53)
D(BB+ rating)	0.025	0.000	0.002	0.001
	(1.11)	(0.47)	(0.54)	(0.31)
D(BB rating)	0.030	-0.000	-0.001	0.001
	(1.17)	(-0.35)	(-0.23)	(0.19)
D(BB– rating)	0.010	0.000	0.003	0.006
	(0.39)	(0.16)	(0.93)	(1.52)
D(B+ rating)	-0.075***	0.001	0.006*	0.011**
	(-2.81)	(0.78)	(1.67)	(2.60)
D(B rating)	-0.167***	0.003*	0.011***	0.018***
	(-5.26)	(1.83)	(2.71)	(3.89)
D(B– rating)	-0.259***	0.005***	0.017***	0.028***
	(-7.01)	(2.67)	(3.67)	(5.77)
D([D, CCC+] rating)	-0.500***	0.009***	0.026***	0.045***
	(-10.87)	(3.71)	(4.08)	(6.51)
D(Not rated)	-0.580***	0.013**	0.039***	0.033***
	(-6.32)	(2.58)	(3.32)	(3.19)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	No
Observations	123,309	123,309	123,309	123,309
R-squared	0.821	0.675	0.534	0.805

Table B.2—*Continued*

Panel D: After controlling for bond liquidity and transaction costs				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Credit rating				
D([AA–, AAA] rating)	-0.008	0.001	0.005*	0.006*
	(-0.40)	(0.86)	(1.92)	(1.68)
D(A+ rating)	0.059***	0.000	0.001	-0.002
	(3.32)	(0.14)	(0.74)	(-0.80)
D(A rating)	0.069***	0.000	0.001	-0.002
	(5.06)	(0.35)	(0.58)	(-0.98)
D(A– rating)	0.030**	-0.000	-0.001	-0.004**
	(2.62)	(-0.35)	(-0.71)	(-2.17)
D(BBB rating)	-0.021**	0.000	-0.000	0.001
	(-2.06)	(0.59)	(-0.28)	(0.28)
D(BBB– rating)	-0.069***	0.001	0.001	0.005*
	(-4.74)	(1.07)	(0.34)	(1.88)
D(BB+ rating)	-0.045**	0.001	0.003	0.008**
	(-2.08)	(0.69)	(1.23)	(2.04)
D(BB rating)	-0.032	-0.000	0.001	0.009**
	(-1.38)	(-0.35)	(0.42)	(2.41)
D(BB– rating)	-0.048*	0.001	0.005*	0.015***
	(-1.97)	(0.57)	(1.82)	(3.86)
D(B+ rating)	-0.134***	0.001	0.007**	0.020***
	(-4.62)	(0.71)	(2.08)	(4.50)
D(B rating)	-0.202***	0.002*	0.011***	0.027***
	(-6.66)	(1.95)	(3.07)	(5.31)
D(B– rating)	-0.316***	0.004***	0.018***	0.038***
	(-8.26)	(2.95)	(3.92)	(7.01)
D([D, CCC+] rating)	-0.477***	0.005***	0.020***	0.047***
	(-11.88)	(2.91)	(3.65)	(7.12)
D(Not rated)	-0.365	0.015	0.035	0.031
	(-1.40)	(1.20)	(0.99)	(0.97)
Liquidity (PC1)	0.047***	-0.000***	-0.002***	-0.003***
	(14.79)	(-3.73)	(-4.71)	(-6.20)
Liquidity (PC2)	0.013***	0.000**	0.001*	0.000
	(4.28)	(2.26)	(1.75)	(0.56)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Observations	92,499	92,499	92,499	92,499
R-squared	0.813	0.607	0.457	0.743

Table B.3: Determinants of bond concentration on bond level, variation across bonds of the same borrower, 50% ownership filter

This table presents the results of panel regression analysis from Equation (2) that relates bond ownership concentration to a range of covariates capturing the bond's credit rating and other characteristics. All specifications include firm times date and coverage percentile fixed effects. The dependent variable is one of the four bond concentration measures: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. All specifications include the bond ownership coverage percentile fixed effects. Bond characteristics $X_{i,t}^{bond}$ include $Ln(BondSize)$, $Ln(BondSize)^2$, dispersion of credit ratings across three major credit rating agencies Sd(Rating), number of ratings, covenant index following Billett, King, and Mauer (2007), D(Covenant Index Missing), Ln(1+Bond Age), Ln(1+Bond Maturity Left), binary variables D(Callable), D(Convertible), D(Global issue), D(144A), and total bond ownership by mutual fund investors to address the heterogeneity of investor base. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding and at least 50% of observed bond ownership. Standard errors are double-clustered on firm and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table B.3—*Continued*

	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Credit rating				
D([AA–, AAA] rating)	-0.045	0.005	0.014	0.007
	(-0.54)	(1.47)	(0.87)	(0.55)
D(A+ rating)	-0.106*	0.006	0.018	0.012
	(-1.68)	(1.29)	(1.04)	(0.70)
D(A rating)	-0.047	0.008**	0.031***	0.019
	(-0.79)	(2.01)	(2.75)	(1.35)
D(A– rating)	-0.025	0.006*	0.030***	0.013
	(-0.62)	(1.91)	(3.46)	(1.37)
D(BBB rating)	0.039	0.001	0.006	0.003
	(0.53)	(0.17)	(1.04)	(0.25)
D(BBB– rating)	0.010	0.000	0.010	0.004
	(0.11)	(0.00)	(0.70)	(0.24)
D(BB+ rating)	-0.083	0.017	0.050*	0.039*
	(-0.78)	(1.30)	(1.68)	(1.74)
D(BB rating)	0.268	0.002	0.014	0.017
	(1.52)	(0.29)	(0.61)	(0.74)
D(BB– rating)	0.106	0.003	0.020	0.037
	(0.48)	(0.34)	(0.76)	(1.15)
D(B+ rating)	-0.345*	0.022*	0.055*	0.104**
	(-1.72)	(1.94)	(1.87)	(2.58)
D(B rating)	-0.505**	0.026*	0.033	0.121***
	(-2.37)	(1.94)	(0.96)	(2.89)
D(B– rating)	-0.610***	0.042**	0.085*	0.146***
	(-3.03)	(2.57)	(1.99)	(3.49)
D([D, CCC+] rating)	-0.533**	0.016	0.039	0.118***
	(-2.57)	(0.91)	(0.80)	(3.02)
D(Not rated)	-0.620	0.036	0.084	0.049
	(-1.08)	(1.08)	(1.06)	(0.65)
Controls				
$Log(BondSize)$	1.104***	-0.136***	-0.261***	-0.432***
	(6.05)	(-10.59)	(-8.50)	(-10.31)
$Log(BondSize)^2$	-0.024	0.010***	0.018***	0.029***
	(-1.52)	(9.20)	(7.15)	(8.03)
$Log(Age)$	-0.051***	0.000	-0.001	0.005**
	(-4.18)	(0.65)	(-0.37)	(2.26)
$Log(Maturityleft)$	-0.142***	0.002***	0.004**	0.015***
	(-15.83)	(4.16)	(2.15)	(7.52)
D(Global issue)	0.078***	0.001	0.001	-0.000
	(2.82)	(0.73)	(0.16)	(-0.02)
D(144a)	-0.188***	0.005	0.007	0.016
	(-2.90)	(0.94)	(0.57)	(0.91)

Table B.3—*Continued*

	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Covenants Index	0.048	-0.007	-0.013	-0.051
	(0.37)	(-0.62)	(-0.43)	(-1.33)
D(Covenants missing)	0.102*	-0.006	-0.013	-0.027*
	(1.71)	(-0.95)	(-0.89)	(-1.88)
Sd(Rating)	-0.050	0.001	0.002	0.005
	(-1.39)	(0.62)	(0.41)	(0.68)
Number of Ratings	0.045	-0.001	0.001	-0.005
	(1.66)	(-0.99)	(0.17)	(-0.91)
D(Callable)	-0.009	0.002	0.010*	0.006
	(-0.35)	(1.02)	(1.95)	(1.00)
D(Convertible)	-0.168	0.017	0.018	0.075
	(-0.69)	(1.01)	(0.47)	(1.62)
MF ownership	0.441***	0.019**	0.043	0.032
	(2.85)	(2.04)	(1.45)	(1.13)
Observations	47,654	47,654	47,654	47,654
R-squared	0.876	0.763	0.630	0.829

Table B.4: Determinants of bond concentration on borrower level, robustness check

This table presents the results of panel regression analysis from Equation (3) that relates firm-level bond ownership concentration to a range of covariates capturing the firm's credit rating, information transparency, and other characteristics. The dependent variable is one of the four bond concentration measures: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The list of measures for information transparency includes firm size measured by Ln(Assets), Ln(Analyst coverage), Ln(Number of previously issued bonds), Ln(Number of firm news in press), and D(Not rated) – a binary variable reflecting the absence of borrower-level S&P credit rating D(Not Rated). In Panel A, the sample is restricted to firms with the observed bond ownership of at least 50% of the firm's bond outstanding. In Panel B, the specifications are estimated without controlling for investor heterogeneity, measured by ownership of mutual-fund investors as a share of the bond size on firm level. Panel C reports the estimation results with firm fixed effects. Panel D reports the estimation results of specification (2) with analyst coverage for all four measures of firm-level bond ownership concentration. $CreditRating_{i,t}$ is a set of binary variables corresponding to issuer-level S&P credit ratings. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. Firm controls $X_{f,t}^{firm}$ include Ln(Age), R&D, D(missing R&D), Cash Flow Volatility, Tangibility, Cash/Assets, Leverage, Debt Maturity, Sd(Stock Returns), Tobin's Q, Sales, Sales Growth, Dividends, Capex, ROA, Annual Stock Returns, Institutional stock ownership and Mutual fund bond ownership on issuer level. All the specifications include industry, date, and bond ownership coverage fixed effects. The sample is restricted to those borrowers with at least $50 million in bond amount outstanding, and at least 25% of observed bond ownership if not specified otherwise. Standard errors are double-clustered on firm and quarter levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table B.4—*Continued*

Panel A: 50% ownership filter				
	(1) Top5	(2) Top5	(3) Top5	(4) Top5
Information Acquisition Costs				
Ln(Analyst Coverage)		-0.012		
		(-1.64)		
Ln(Prev. Issued Bonds)			-0.009	
			(-1.23)	
Ln(Number of News)				-0.013***
				(-2.67)
Ln(Assets)	-0.025***	-0.022***	-0.021***	-0.022***
	(-5.17)	(-4.03)	(-3.56)	(-4.05)
Credit rating				
D([AA–, AAA] rating)	0.048	0.046	0.044	0.049
	(1.38)	(1.32)	(1.31)	(1.39)
D(A+ rating)	-0.009	-0.010	-0.011	-0.011
	(-0.87)	(-0.89)	(-1.02)	(-1.01)
D(A rating)	0.001	0.002	0.001	0.001
	(0.19)	(0.22)	(0.09)	(0.10)
D(A– rating)	-0.011	-0.011	-0.011	-0.013
	(-1.41)	(-1.40)	(-1.39)	(-1.63)
D(BBB rating)	0.012**	0.011*	0.012**	0.011*
	(2.02)	(1.80)	(2.05)	(1.81)
D(BBB– rating)	0.038***	0.037***	0.038***	0.038***
	(4.53)	(4.44)	(4.43)	(4.48)
D(BB+ rating)	0.077***	0.075***	0.076***	0.075***
	(4.76)	(4.63)	(4.76)	(4.70)
D(BB rating)	0.090***	0.087***	0.090***	0.088***
	(5.52)	(5.36)	(5.54)	(5.44)
D(BB– rating)	0.142***	0.137***	0.143***	0.139***
	(6.64)	(6.36)	(6.67)	(6.62)
D(B+ rating)	0.135***	0.132***	0.137***	0.138***
	(6.02)	(5.90)	(6.14)	(6.17)
D(B rating)	0.142***	0.138***	0.144***	0.141***
	(5.83)	(5.58)	(5.91)	(5.82)
D(B– rating)	0.127***	0.120***	0.129***	0.125***
	(4.30)	(4.10)	(4.32)	(4.21)
D([D, CCC+] rating)	0.322***	0.314***	0.323***	0.324***
	(6.96)	(6.66)	(7.04)	(6.94)
D(Not rated)	0.138***	0.136***	0.141***	0.140***
	(4.37)	(4.31)	(4.46)	(4.44)
Observations	11,360	11,360	11,360	11,317
R-squared	0.655	0.656	0.656	0.657

Table B.4—*Continued*

Panel B: Without controlling for investor heterogeneity				
	(1) Top5	(2) Top5	(3) Top5	(4) Top5
Information Acquisition Costs				
Ln(Analyst Coverage)		-0.010**		
		(-2.40)		
Ln(Prev. Issued Bonds)			-0.013***	
			(-3.46)	
Ln(Number of News)				-0.008***
				(-3.09)
Ln(Assets)	-0.026***	-0.024***	-0.021***	-0.024***
	(-11.34)	(-9.28)	(-6.96)	(-10.06)
Credit rating				
D([AA–, AAA] rating)	0.042***	0.041***	0.037***	0.042***
	(3.34)	(3.20)	(3.07)	(3.28)
D(A+ rating)	0.003	0.003	0.001	0.003
	(0.47)	(0.45)	(0.14)	(0.41)
D(A rating)	0.009	0.009	0.008	0.009
	(1.48)	(1.47)	(1.35)	(1.48)
D(A– rating)	-0.000	-0.000	-0.001	-0.001
	(-0.08)	(-0.08)	(-0.17)	(-0.20)
D(BBB rating)	0.013**	0.013**	0.014**	0.013**
	(2.51)	(2.40)	(2.64)	(2.47)
D(BBB– rating)	0.040***	0.038***	0.039***	0.040***
	(6.25)	(6.17)	(6.03)	(6.23)
D(BB+ rating)	0.065***	0.065***	0.064***	0.066***
	(9.28)	(9.21)	(9.21)	(9.30)
D(BB rating)	0.076***	0.074***	0.075***	0.076***
	(10.71)	(10.60)	(10.79)	(10.70)
D(BB– rating)	0.089***	0.087***	0.089***	0.089***
	(10.80)	(10.69)	(10.98)	(10.71)
D(B+ rating)	0.097***	0.095***	0.097***	0.097***
	(10.96)	(10.77)	(11.11)	(10.78)
D(B rating)	0.116***	0.114***	0.116***	0.116***
	(11.99)	(11.67)	(12.18)	(11.87)
D(B– rating)	0.135***	0.132***	0.136***	0.136***
	(11.62)	(11.42)	(11.70)	(11.48)
D([D, CCC+] rating)	0.186***	0.181***	0.185***	0.187***
	(11.37)	(11.02)	(11.19)	(11.29)
D(Not rated)	0.110***	0.108***	0.112***	0.111***
	(9.76)	(9.58)	(10.01)	(9.72)
Observations	29,794	29,794	29,794	29,555
R-squared	0.616	0.617	0.621	0.617

Table B.4—*Continued*

Panel C: With firm fixed effects				
	(1) Top5	(2) Top5	(3) Top5	(4) Top5
Information Acquisition Costs				
Ln(Analyst Coverage)		-0.010**		
		(-2.36)		
Ln(Prev. Issued Bonds)			-0.038***	
			(-6.21)	
Ln(Number of News)				-0.007***
				(-3.88)
Ln(Assets)	-0.042***	-0.040***	-0.032***	-0.040***
	(-10.81)	(-10.35)	(-7.94)	(-10.33)
Credit rating				
D([AA–, AAA] rating)	-0.010	-0.009	-0.012	-0.010
	(-0.98)	(-0.96)	(-1.06)	(-0.99)
D(A+ rating)	-0.020***	-0.020***	-0.022***	-0.020***
	(-2.78)	(-2.75)	(-2.91)	(-2.85)
D(A rating)	-0.010	-0.010	-0.011*	-0.010
	(-1.52)	(-1.50)	(-1.75)	(-1.56)
D(A– rating)	-0.007	-0.007	-0.007	-0.007
	(-1.28)	(-1.27)	(-1.36)	(-1.40)
D(BBB rating)	0.009**	0.009**	0.009**	0.009**
	(2.06)	(2.06)	(2.27)	(2.11)
D(BBB– rating)	0.021***	0.020***	0.022***	0.021***
	(3.56)	(3.50)	(3.94)	(3.64)
D(BB+ rating)	0.034***	0.034***	0.036***	0.035***
	(4.17)	(4.16)	(4.30)	(4.25)
D(BB rating)	0.046***	0.045***	0.046***	0.046***
	(5.10)	(5.08)	(5.10)	(5.19)
D(BB– rating)	0.061***	0.060***	0.061***	0.061***
	(6.04)	(6.01)	(6.07)	(6.12)
D(B+ rating)	0.063***	0.062***	0.063***	0.063***
	(5.71)	(5.66)	(5.75)	(5.79)
D(B rating)	0.073***	0.072***	0.073***	0.074***
	(6.24)	(6.18)	(6.28)	(6.30)
D(B– rating)	0.092***	0.091***	0.095***	0.094***
	(6.64)	(6.63)	(6.72)	(6.72)
D([D, CCC+] rating)	0.140***	0.138***	0.145***	0.141***
	(7.46)	(7.38)	(7.90)	(7.55)
D(Not rated)	0.065***	0.065***	0.065***	0.066***
	(3.82)	(3.82)	(3.75)	(3.87)
Observations	29,733	29,733	29,733	29,496
R-squared	0.830	0.830	0.834	0.830

Table B.4—*Continued*

Panel D: All four measures of firm-level concentration				
	(1) Ln(Bondholders)	(2) HHI	(3) Top1	(4) Top5
Information Acquisition Costs				
Ln(Analyst Coverage)	0.082**	-0.002***	-0.008***	-0.011***
	(2.06)	(-2.95)	(-3.00)	(-2.81)
Ln(Assets)	0.517***	-0.002***	-0.009***	-0.024***
	(18.46)	(-5.63)	(-6.42)	(-10.07)
Credit rating				
D([AA–, AAA] rating)	-0.365**	0.005***	0.016***	0.038***
	(-2.46)	(2.95)	(2.93)	(3.28)
D(A+ rating)	0.021	0.000	0.003	0.004
	(0.31)	(0.27)	(0.68)	(0.63)
D(A rating)	-0.045	0.002**	0.010***	0.012*
	(-0.70)	(2.37)	(3.03)	(1.96)
D(A– rating)	-0.048	0.001	0.003	0.002
	(-1.01)	(0.86)	(1.04)	(0.26)
D(BBB rating)	-0.059	0.001*	0.003	0.009*
	(-1.33)	(1.79)	(1.01)	(1.69)
D(BBB– rating)	-0.271***	0.003**	0.008**	0.026***
	(-5.15)	(2.60)	(2.45)	(4.31)
D(BB+ rating)	-0.356***	0.003*	0.010*	0.037***
	(-4.85)	(1.82)	(1.80)	(4.61)
D(BB rating)	-0.364***	0.003*	0.010	0.040***
	(-4.47)	(1.78)	(1.63)	(4.70)
D(BB– rating)	-0.418***	0.004*	0.013*	0.046***
	(-4.42)	(1.89)	(1.98)	(4.92)
D(B+ rating)	-0.472***	0.004*	0.015*	0.050***
	(-4.21)	(1.76)	(1.85)	(4.50)
D(B rating)	-0.566***	0.005**	0.018**	0.063***
	(-4.54)	(2.00)	(2.09)	(5.26)
D(B– rating)	-0.720***	0.010***	0.035***	0.079***
	(-4.75)	(3.02)	(2.92)	(6.01)
D([D, CCC+] rating)	-1.236***	0.016***	0.070***	0.127***
	(-5.85)	(3.78)	(4.46)	(7.35)
D(Not rated)	-0.769***	0.011***	0.040***	0.066***
	(-5.33)	(3.63)	(3.65)	(5.22)
Observations	29,794	29,794	29,794	29,794
R-squared	0.741	0.498	0.461	0.637

Table B.5: Offering yield spread and issuer-level pre-issuance bond concentration, baseline regression

This table presents the results of cross-sectional regression analysis from Equation (7) that relates offering yield spread to pre-issuance issuer-level bond ownership concentration and a range of covariates capturing the bond's credit rating and other characteristics. The dependent variable is the difference between offering yield and maturity-matched Treasury yield. $Concentration^{firm}_{i,t-1}$ is a borrower-level pre-issuance bond concentration measured on the set of existing bonds outstanding one quarter before the new issuance: the natural logarithm of the number of bondholders, the HHI index, and the ownership by the largest one and five bondholders as a share of the amount outstanding. The concentration measures are standardized. $X^{bond}_{j,t}$ include a wide range of issuance-specific characteristics, shown to be important explanatory variables in the literature, such as Ln(Bond Size), Ln(Maturity), D(Rule 144A), D(Global Issue), D(Callable), Covenant index, D(Covenant index missing), Sd(Rating), the Number of Ratings, Ln(Number of Lead Underwriters), and credit rating fixed effects. Pre-issuance issuer-specific characteristics $X^{firm}_{i,t-1}$ include Ln(Assets), Ln(Age), Leverage, Tobin's Q, Tangibility, ROA, Sales Growth, Cash Flow Volatility, Cash/Assets, Capex, Annual Stock returns, Sd(stock returns), Institutional investor stock holdings, Annual Bond Returns, Sd(Bond Returns), issuer's secondary market bond liquidity measured by Amihud's measure, Mutual fund bond ownership, Distance-to-Default (Bharath and Shumway (2008)), Ln(Analyst Coverage), Ln(Prev. Issued Bonds), and Ln(Number of News). All specifications include bond issuance credit rating, year, SIC2 industry, and bond ownership coverage percentile fixed effects. Bond-level credit rating is defined as a median across three major credit rating agencies – Moody's, S&P, and Fitch. The extreme ratings are pooled together to form two buckets: [AA–, AAA] and [D, CCC+]. The sample is restricted to those bonds with at least $50 million in the amount outstanding, and at least 25% of observed bond ownership. Standard errors are double-clustered on issuer and year levels. t-statistics are reported in parentheses below the point estimates. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table B.5—*Continued*

	(1)	(2)	(3)	(4)
L1.Ln(Bondholders), stand.	-0.129***			
	(-4.95)			
L1.HHI, stand.		0.082***		
		(3.89)		
L1.Top1, stand.			0.063***	
			(3.37)	
L1.Top5, stand.				0.090***
				(4.22)
Log(Bond Size)	0.060	0.053	0.051	0.053
	(1.56)	(1.43)	(1.37)	(1.40)
Log(Maturity)	0.278***	0.277***	0.278***	0.277***
	(7.57)	(7.63)	(7.61)	(7.57)
D(Rule 144a)	0.054	0.062	0.065	0.063
	(0.86)	(0.99)	(1.05)	(1.00)
D(Global)	-0.032	-0.028	-0.024	-0.028
	(-0.83)	(-0.72)	(-0.60)	(-0.71)
Covenants Index	0.146	0.127	0.107	0.135
	(0.58)	(0.50)	(0.43)	(0.53)
D(Covenants Index Miss.)	0.124	0.120	0.120	0.119
	(1.40)	(1.41)	(1.42)	(1.39)
Sd(Rating)	0.196***	0.204***	0.203***	0.201***
	(8.96)	(9.49)	(9.63)	(9.11)
Number of Ratings	-0.065**	-0.060**	-0.060**	-0.061**
	(-2.47)	(-2.29)	(-2.33)	(-2.31)
D(Redeemable)	0.095	0.088	0.076	0.085
	(0.58)	(0.55)	(0.48)	(0.53)
Log(Num. Lead Underwriters)	0.029	0.029	0.027	0.029
	(0.69)	(0.68)	(0.64)	(0.70)
L1.Bond Returns, Year	-2.212**	-2.224**	-2.217**	-2.233**
	(-2.53)	(-2.49)	(-2.46)	(-2.50)
L1.Sd(Bond Returns)	5.334	4.939	5.195	5.201
	(1.31)	(1.24)	(1.30)	(1.29)
L1.Amihud	12.107***	11.658***	11.520***	11.813***
	(6.50)	(5.95)	(5.89)	(6.06)
L1.MF Bond Ownership	0.641*	0.381	0.399	0.452
	(1.82)	(1.15)	(1.22)	(1.30)
L1.Stock Returns, Year	-0.181**	-0.170**	-0.175**	-0.172**
	(-2.65)	(-2.44)	(-2.43)	(-2.50)

Table B.5—*Continued*

	(1)	(2)	(3)	(4)
L1.Institutional Stock Ownership	-0.251	-0.236	-0.241	-0.234
	(-1.49)	(-1.39)	(-1.40)	(-1.38)
L1.Sd(Stock Returns)	2.489***	2.530***	2.513***	2.519***
	(9.11)	(9.11)	(8.73)	(9.05)
L1.Log(Assets)	-0.005	-0.047	-0.046	-0.038
	(-0.11)	(-1.16)	(-1.13)	(-0.90)
L1.Log(Age)	0.042	0.051	0.051	0.048
	(1.17)	(1.35)	(1.34)	(1.32)
L1.Leverage	0.334*	0.248	0.220	0.269
	(1.86)	(1.51)	(1.36)	(1.63)
L1.Tobin's Q	-0.074**	-0.078**	-0.076**	-0.077***
	(-2.76)	(-2.91)	(-2.82)	(-2.94)
L1.Tangibility	0.254	0.278	0.278	0.264
	(1.59)	(1.67)	(1.65)	(1.58)
L1.ROA	-2.520**	-2.562**	-2.565**	-2.585**
	(-2.61)	(-2.64)	(-2.64)	(-2.65)
L1.Sales growth	-0.097	-0.099	-0.101	-0.102
	(-0.96)	(-0.97)	(-1.01)	(-1.01)
L1.Cash Flow Volatility	3.341	3.215	3.259	3.234
	(1.69)	(1.63)	(1.64)	(1.66)
L1.Cash/Assets	0.146	0.093	0.096	0.121
	(0.93)	(0.59)	(0.60)	(0.76)
L1.Capex	-1.557	-1.400	-1.371	-1.511
	(-0.74)	(-0.62)	(-0.59)	(-0.68)
L1.Distance-to-Default	0.013	0.014*	0.013	0.013
	(1.72)	(1.75)	(1.63)	(1.72)
L1.Log(Number of News)	0.036	0.047	0.042	0.045
	(0.68)	(0.85)	(0.80)	(0.83)
L1.Low(Prev. Issued Bonds)	-0.038	-0.067	-0.071*	-0.060
	(-1.00)	(-1.72)	(-1.75)	(-1.57)
L1.Log(Analyst Coverage)	-0.196**	-0.203**	-0.204**	-0.208**
	(-2.41)	(-2.32)	(-2.35)	(-2.43)
Observations	2,548	2,548	2,548	2,548
R-squared	0.843	0.843	0.842	0.842

C Variable Definitions

Variable	Description
Firm-level accounting variables	
Ln(Assets)	Natural logarithm of total assets = Ln(atq)
Ln(Analyst coverage)	Ln(1+number of equity analysts from Bloomberg)
Ln(Previously issued bonds)	Ln(Previously issued bonds by the same borrower)
Ln(Number of firm news in press)	Ln(Number of firm news in press)
Ln(Age)	The natural logarithm of the number of quarters the firm has been listed on CRSP
R&D	Research and Development expenses (XRD) normalized by firm assets (AT) = xrdq/ atq. Firm-years for which this variable is missing are assigned a value of zero.
Missing R&D	Indicator variable set to one if R&D is missing, 0 – otherwise
Cash Flow Volatility	Standard deviation of operating income in 3-year rolling window, normalized by firm assets
Tangibility	Share of tangible assets = PPE/Assets
Cash/Assets	Cash/Assets = cheq/ atq
Leverage	Book leverage = LT Debt+Current/total Assets = (dlttq+ dlcq)/atq
Debt Maturity	Share of LT debt = LT Debt/(LT+ST Debt) = dlttq/(dlttq+ dlcq)
Sd(Stock return)	Standard deviation of daily stock returns, calculated on 252 –day rolling window
Tobin's Q	Total Assets- Book Equity+MV Equity/Total Assets = (atq-ceqq+ cshoq*prccq)/atq
Sales	Sales/Assets = saleq/ atq
Sales Growth	Change in quarterly sales compared to previous year
Dividends	Total Dividends/Assets = (dvy-L1.dvy+ dvpq)/L1.atq. Variable dvy is transformed only for 2-4 fiscal quarters to reflect quarterly values
Capex	Capital expenditures normalized by firm assets
ROA	Income/Assets = niq/ atq
Annual Stock Returns	Stock return during last 4q
S&P credit rating	S&P long-term credit rating, firm level.
D(Not Rated)	Indicator variable set to one if firm does not have S&P credit rating assigned, zero – otherwise.
Headquarters	Headquarters location country = loc variable from COMPUSTAT

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