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Liquidity Risk and Corporate Bond Yield Spread: Evidence from China*

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Abstract

This paper investigates the contribution of liquidity risk to Chinese corporate bond spreads. We calculate corporate bond spreads based on the full treasury yield curve and establish a set of liquidity measures of the Chinese corporate bonds. Our empirical study shows that liquidity premium accounts for a relatively smaller portion of corporate bond spread in China, although the market liquidity is low and corporate bond issuers are strictly pre-screened. These findings are interesting, as the developed markets have better liquidity and less pre-issuance restriction, and liquidity premium still explains a relatively larger portion of corporate bond spread. Besides, we also explore the determinants of Chinese corporate bond liquidity and default premiums.

JEL classification: C23 G12

Keywords: Yield spread, Liquidity risk, Default risk

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1. Introduction

Over the last four decades, the Chinese bond market has swiftly grown from scratch to roughly $13 trillion in total outstanding amount. At the same time, foreign institutional investors have shown a lively interest in the Chinese bond

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market, because hundreds of onshore Chinese bonds have been added to the Bloomberg Barclays Global Aggregate Index since April 1st, 2019. Hundreds of billions of capital will flow into the third-largest fixed income market in the world. However, this nascent but soaring bond market, particularly the corporate bond market, has not drawn equally increasing attention from the global finance scholars. Our research studies the Chinese corporate bonds, namely the bonds issued by Chinese public companies and traded in Shanghai and Shenzhen Exchanges, and adds to the limited literature by investigating the contribution of liquidity and default risk to corporate bond spread and their determinants.

Our study is essential, considering the tremendous differences between the Chinese corporate bond market and its counterpart in developed economies. In China, corporate bonds are generally issued by financially secure firms according to the *corporate bond issuance rules* published by the China Securities Regulatory Commission (hereafter CSRC) in 2007, whereas there is no comparable restriction in developed markets. Notably, the CSRC stipulates that only corporate bonds rated above investment grade can be publicly issued. On top of this, like other emerging markets, the Chinese capital market is still in its very early stage and underdeveloped in many aspects.[1]

For instance, the Chinese bond markets are more illiquid. The mean and the median of *Price Dispersion* (a measure of transaction costs that is based on the dispersion of traded prices around the market "consensus valuation.") are 1.53 and 0.50, respectively. This implies that transaction costs in Chinese bond market is very high. These are around twice as big as the corresponding number for US corporate bond market, around 0.50 and 0.29, respectively, reported by (Jankowitsch et al., 2011). The median *Bond zero trade* (the percentage of days during a year where a bond is not traded) is 88%, which means that in 88% of the time during a year 50% of the corporate bonds do not trade. In contrast, this index of the U.S. corporate bond market is around 60% , see (Dick-Nielsen et al.,

[1]The Chinese corporate bond market is even far less fully-fledged, and the first corporate bond issued by Chinese listed firm was floated in the second half of 2007.

2012). Given the larger magnitude of illiquidity of the Chinese corporate bond market, the very first question our study attempts to explore is whether bond liquidity is priced in after controlling for credit risk. We consider various proxies to measure bond liquidity and then generate a compound liquidity index by a principal component analysis approach. Our empirical work finds that liquidity risk is well priced and that this conclusion is both statistically and quantitatively significant. Specifically, we find that Chinese corporate bond spreads increase by $24 - 35$ bps for one standard deviation in our liquidity index.

If market participants well perceive liquidity risk, the next question is how much the default and liquidity risk respectively account for the corporate yield spread. Disentangling the contribution of liquidity and default risk premiums, however, is nontrivial, because neither liquidity nor its risk is readily and precisely measured. We follow Dick-Nielsen et al. (2012) and Schwert (2017) to decompose corporate bond spreads into two components, default and liquidity premiums. We find that default risk explains around 78.25% of the average corporate bond spread over the period 2009 to 2016. This result interestingly implies that the Chinese bond market participants ignore the *no corporate bond default* history, which is brilliant and rational.[2] Surprisingly, we find that the role of liquidity is not as important as one might infer from the literature on transaction costs in corporate bond markets and that the default premium absolutely dominates the Chinese corporate bond spreads. This conclusion seems to contradict with the first impression of fundamental facts of Chinese corporate bond markets mentioned above, especially the high ratings and low liquidity, as, intuitively, the liquidity spread depends on the expected cost of trading and the expected trading intensity, or the need to sell the bond. The explanation we intend to offer here is that the typical investor in the Chinese corporate bond market is a buy-and-hold style, like commercial banks, so the trading intensity is low, whereas the liquidity discount is not so substantial. Moreover, Figure

[2]Actually, there is even no default case for bonds issued by Chinese publicly listed companies in our sample period.

1 shows that around 58% of total outstanding amount of bonds were held by commercial banks as of August 2017 in the Chinese bond market, according to China Central Depository & Clearing Co., Ltd. Therefore, the contribution of liquidity risk to corporate bond spread is not very large. The increasing weight of liquidity in the total bond pricing also justifies our conjecture, as the reform measures in the Chinese bond markets, such as introducing more foreign investors and including bonds as collateral for central bank liquidity injection, adequately diversify the background of participants and give them trading incentives.

Finally, we examine the determinants of corporate bond spread and its liquidity and default related components. Our results show that total spread, default spread, and liquidity spread are all larger for the bonds with worse credit ratings. These findings indicate that Chinese bond ratings are informative as Livingston et al. (2018) discovered. Besides, we also have the following interesting empirical results: Higher ROA leads to lower yield spread and liquidity spread; The state-ownership of issuers reduces liquidity spread; The 10-year treasury yield is also an important determinant of borrowing costs. All the above conclusions are robust under various model specifications. In general, these results are largely consistent with our transaction-based decomposition approach, which successfully separates default and liquidity components of the yield spread.

Our work provides important policy implications: if Chinese policymakers intended to reduce the borrowing costs in bond markets, reducing transaction costs or improve liquidity would not be a sufficient remedy, as the default premium dominates the bond pricing. Instead, the policies that can significantly lower the default risk premium could be attractive, for instance, improving the legal framework to deal with corporate bankruptcy and default. Besides, from the macro-prudential perspective, default risk is more crucial than liquidity risk in containing the potential bond market crisis. Finally, our study also suggests that the effort of the Chinese government to reform bond markets during past years does not go in vain, as more liquidity factor gets considered when corporate bond get pricing.

This paper also contributes to the existing literature in several ways. First, we add the Chinese case to the research on the effect of liquidity risk on the corporate bond spread. The liquidity and default risk could influence corporate bond yield spreads very differently in emerging markets, and at least this is true to the Chinese bond market. Our evidence implies that liquidity risk is priced in the Chinese corporate bond market, which supports Elton et al. (2001); Dick-Nielsen et al. (2012); Longstaff et al. (2005); Huang and Huang (2012). However, liquidity risk only explains for a small proportion of corporate bond spreads, whereas Elton et al. (2001) and others report that default risk accounts for only a small percentage of corporate bond spread for US corporate bonds. Moreover, our study also enriches the study on the determinants of corporate yield spreads. To our best knowledge, this paper is among the first to explore how much the liquidity and default risk is linked to corporate bond pricing in Chinese markets by using the transaction-based yield spread decomposition approach. Finally, our paper also relates to the study on Chinese state-ownership and financing costs, which echoes the theory of Morellec et al. (2015) that firms with higher bargaining power prefer to raise debt by issuing bonds. The extant literature has brought forth several vital determinants of borrowing costs in emerging markets such as global stewards, political connections, corporate social responsibility (González-Rozada and Yeyati, 2008; Schweizer et al., 2017; Gong et al., 2018) from various aspects. We supplement this stream of literature with the impact of state-ownership, a fundamental and popular dimension for the Chinese market study.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the data sources and data filtering procedures. Section 4 outlines the empirical design and introduces the liquidity proxies. Section 5 presents the main results and discusses robustness. Section 6 describes the spread decomposition results. Finally, Section 7 concludes.

2. Related literature

This paper pertains to the study of corporate bond pricing, especially in the context of emerging markets such as China. There is a large body of literature on bond pricing, which begins with the seminal work Merton (1974) introducing the option pricing approach to corporate bond valuation. More generalization work follows thereafter, including but not limited to Leland (1994); Duffie and Singleton (1999); Duffie and Lando (2001); Collin-Dufresne et al. (2001); Chen et al. (2007). However, the literature much closer to our research ideas is as follows: Elton et al. (2001) show that state taxes explain a substantial portion of U.S. corporate bond risk premium; Based on structural models, Delianedis and Geske (2001) evidence that credit risk is not primarily explained by default but mainly attributable to taxes, jumps, liquidity, and market risk factors; Huang and Huang (2012) also uses structural bond pricing models to demonstrate that credit risk accounts for only a small portion of observed yield spreads when the models are required to be consistent with historical default rates and losses;Collin-Dufresne et al. (2001) suggests a large unexplained fraction of yield spread changes are driven primarily by factors other than credit risk. Consequently, some researchers start to explore the liquidity as a potential explanation for the credit spread puzzle, see (Perraudin and Taylor, 2003; Driessen, 2005; Longstaff et al., 2005; Chen et al., 2007; Acharya et al., 2013; Bongaerts et al., 2017).

Unfortunately, almost all the relevant literature above focuses on developed markets, whereas the study on emerging markets is quite rare. Meanwhile, significant disparities arise between emerging markets and developed markets in various dimensions, such as institutional settings, information environments, capital market regulations. Thereby the conclusions based on developed markets may not well represent the emerging cases. Moreover, even restricted to developed markets themselves, there is still no consensus on whether illiquidity can adequately explain corporate bond pricing. For example, Lin et al. (2011), and Acharya et al. (2013) find that liquidity is priced in corporate bonds returns, whereas Culp et al. (2018) claims that the explanatory power of bond market illiquidity to bond pricing is somewhat limited. Therefore, our study can undoubtedly contribute to the existing literature.

In methodology, our study is consistent with the recent work by Schwert (2017), in which the author uses three distinct approaches to decompose municipal bond spreads and concludes that default risk accounts for 74% to 84% of the average American municipal bond spread over the period from 1998 to 2015. Nevertheless, we employ only one in our work instead of three approaches because of data availability. Also, Dick-Nielsen et al. (2012) have made some efforts to decompose the impact of liquidity on the corporate bond spreads by using the U.S. transaction data, which concludes that the contribution of illiquidity to corporate bond spread increases dramatically with the onset of the sub-prime crisis.

There are also papers on corporate bonds in the Chinese and other emerging markets, though not from the asset pricing perspectives. Fan et al. (2015) suggest that foreign investors may diversify their asset portfolios by including Chinese bonds so that they could benefit from Chinese bond markets. Lin and Milhaupt (2017) evidence that state centricity has ineradicably shaped the developmental trajectory and operation of China's corporate bond market from a network perspective. Livingston et al. (2018) find that Chinese bond ratings contain information content, although the vast majority of Chinese bonds are AA rated or better. González-Rozada and Yeyati (2008) finds that the evolution of global factors primarily drives the time variability of emerging market bond spreads. Zinna (2014) also shows that global risks are the drivers for the difference in sovereign and corporate bond spreads in emerging economies. Dittmar and Yuan (2008) concludes that sovereign securities are conducive to promoting a vibrant corporate market in emerging economies. Ratha et al. (2018) document that governing law has a reliable power to explain bond spread differences among emerging countries. Bazzana et al. (2018) finds that Russian bondholders use covenant protection to compensate for different creditor protections when the firm has Eurobonds in its debt portfolio. Our work extends this line of research by investigating corporate bond pricing from the default risk and liquidity perspective.

Finally, our study also relates to the literature on public debt financing, as we discuss the role of Chinese state-ownership in Chinese corporate bond pricing. Morellec et al. (2015) document that bargaining power is a critical factor that affects the choice between issuing bonds and borrowing bank loans. They find that firms with higher bargaining power incline to raise debt by issuing bonds. Schweizer et al. (2017) shows that political connections can effectively reduce the offering yields of bonds issued by privately owned enterprises in China. Gong et al. (2018) suggest that firms with high CSR disclosure quality are associated with lower costs of corporate bonds in China. We supplement this strand of literature by exploring the relationship between corporate bond spread and the state-ownership.

3. Data description

Our data sample covers all fixed-coupon corporate bonds issued by the public companies listed in Shenzhen and Shanghai Exchanges by the end of 2016. We obtain static and trading information such as coupon rate, payment frequency, issuance size, open price, close price, time to maturity, and trading records from WIND information Co. Ltd, one of the leading financial data providers in China. We also collect Chinese treasury bond information from the same source. The accounting information of corporate bond issuers comes from China Stock Market & Accounting Research Database (CSMAR), which offers access to Chinas most extensive collection of historical corporate finance data. The WRDS (Wharton Research Data Services), a comprehensive web-based data management system, selects CSMAR as their only China data provider since 2004. Moreover, we collect relevant Chinese macro data from the World Bank.

Our data filtering procedure is as follows. (1) eliminate bonds issued by financial companies, (2) exclude bonds with time to maturity less than one month, and (3) drop bonds with missing variables. After this routine, we have

870 bond-year observations [3] (427 bonds) left during the period 2009-2016. When conducting liquidity pricing analysis, the sample includes fewer than 870 bond-year observations as one or more liquidity proxies are unavailable for some bonds.[4]

To precisely estimate the yield spreads between corporate bonds and central government bonds, we need to fit the forward rate curve of Chinese central government bonds first. To this end, we take daily transaction records of Chinese central government bonds satisfying the following standards: (1) there are at least 20 bond transactions; (2) the time-to-maturity of these bonds spans at least 10 years but no more than 30 years (allowing for the maximum time to maturity of corporate bonds in our sample is strictly less than 30 years); (3) we exclude bonds with the time to maturity of less than one month; (4) we only consider central government bonds traded in stock exchanges, where our corporate bond sample also belongs.

4. Empirical Methodology

4.1. Corporate bond spread calculation

In order to compute the corporate yield spread of a specific bond, we deduct its actual yield by the counterfactual *risk-free* one that is generated from the same cash flow schedule and central government bond yield curve. Most of previous literature controls for duration of time to maturity, but we follow the matching procedure in Ang et al. (2016). Therefore, the yield spread of corporate bond i at time t, YS_{it}, is defined as below.

$$YS_{it} = y_{it}^{CB} - y_{it}^{TB} \tag{1}$$

where y_{it}^{CB} is the actual yield calculated based on the cash flow schedule and the transaction price of bond i at time t and y_{it}^{TB} is the yield of matching bond

[3]We aggregate daily bond data to yearly data before conducting empirical analysis.
[4]The exact number of observations is reported in estimation result tables.

whose cash flow schedule is totally the same with the corporate bond i but discounted with the central government bond yield curve.

This procedure obviously requires computing the yield curve of Chinese central government bonds to obtain y_{it}^{TB} first. According to Svensson (1994), we fit the following forward rate (f) curve:[5]

$$\begin{aligned} f(m, \boldsymbol{\beta}) \quad = \quad & \beta_0 + \beta_1 \exp\left(-\frac{m}{\tau_1}\right) + \beta_2 \left[\frac{m}{\tau_1} \exp\left(-\frac{m}{\tau_1}\right)\right] \\ & + \beta_3 \left[\frac{m}{\tau_2} \exp\left(-\frac{m}{\tau_2}\right)\right] \end{aligned} \tag{2}$$

for each transaction date, where m refers to the time to occurrence (in years) of the cash flow for each bond. The vector $\{\beta_0, \beta_1, \beta_2, \beta_3, \tau_1, \tau_2\}$ is the model parameter vector to be estimated. Using the parameterized forward curve, we derive the corresponding zero-coupon treasury bond yield curve, $s(m, t)$, at each transaction date t over different maturities m according to $s(m, t) = \frac{1}{m} \int_0^m f(x, \boldsymbol{\beta}) dx$.

To find the matching treasury bond yield for corporate bond i at time t, y_{it}^{TB}, we hold corporate bond i's characteristics fixed, that is, coupon rate, coupon payment frequency, and maturity date, at the time of trade and then discount each remaining cash flow of bond i using the corresponding risk-free rates $s(m, t)$ and sum them up to calculate the counterfactual risk-free price P_{it}^{TB} as below.

$$P_{it}^{TB} = \sum_{m=1}^{T} C_i^{CB} e^{-ms(m,t)} + 100 e^{-Ts(T,t)} \tag{3}$$

in which T denotes the total number of remaining coupon payments and C_i^{CB} stands for the coupon payment each time. With the the counterfactual risk-free price P_{it}^{TB} in hands, we solve for the corresponding yield, y_{it}^{TB} in a classic way. Equation (3) effectively prices bond i at time t as a Chinese treasury bond because it uses that series of discount rates (see Duffie and Singleton, 1999; Ang

[5]The Svensson (1994) model produces smaller fitting errors than the Nelson and Siegel (1987) procedure by adding one more term in the parameterized foward curve.

et al., 2016), and is therefore more accurate than just matching on duration or maturity because it controls for all the cash flow effects unique to each corporate bond.

Finally, we compute bond yield spreads YS_{it} in Equation (1) at the daily frequency and winsorize at the top 99% and the bottom 1% levels, and then aggregate to the yearly frequency. In our final sample, there are 596 bond-year observations (274 of 870 bond-year observations dropped due to missing values of liquidity metrics) from January 2009 to December 2016.

4.2. Liquidity proxies construction

The liquidity spread on a corporate bond is unobservable, so we have to estimate it using several empirical proxies for liquidity. Following Dick-Nielsen et al. (2012); Helwege et al. (2014), and Schwert (2017), we consider the following 10 candidate proxies at the very beginning:

(1) Amihud Measure: We define the Amihud measure as

$$Amihud_{it} = \frac{1}{N_t}\sum_{j=1}^{N_t}\frac{|r_j|}{Q_j} = \frac{1}{N_t}\sum_{j=1}^{N_t}\frac{|\frac{P_j - P_{j-1}}{P_j}|}{Q_j} \tag{4}$$

where N_t is the number of trading days in year t, P_j is the dirty close price of the bond at trading date j, and Q_j is the trading volume on at trading date j.

(2) Amihud Risk: The standard deviation of Amihud Measure.

(3) Roll Measure: Roll (1984) shows that successive asset returns will have negative autocorrelation when there is a bid-ask spread in the market for the asset. We define the Roll measure as

$$Roll_{it} = 2\sqrt{-Cov(\Delta P_j, \Delta P_{j-1})} \tag{5}$$

where P_j is the dirty close price of the bond at trading date j and the measure is set to zero when the covariance between consecutive price movements is positive. We compute the Roll measure for each year, since there are no data on daily transactions.

(4) Turnover: Turnover is the ratio of yearly trading volume to the bond's amount outstanding.

(5) Issuer Zero Trade: Issuer zero trade is the proportion of days in year during which none of the issuer's bonds trade.

(6) Bond Zero Trade: Bond zero trade is the proportion of days in a year during which a bond has no trade.

(7) Trade Interval: Trade interval is the yearly average number of days since the previous trading day.

(8) High-Low Spread: High-low spread is the yearly average of the difference between bond daily high price and daily low price.

(9) Price Dispersion Measure: following Jankowitsch et al. (2011), the yearly price dispersion measure is defined as

$$Dispersion_{it} = \sqrt{\frac{1}{\sum_{k=1}^{N_t} Q_k} \sum_{k=1}^{N_t} (P_k - M_y)^2 Q_k} \tag{6}$$

where N_t is the number of transaction dates during a year, P_k is the clean close price on each transaction date, Q_k is the total trading volume on each transaction date, and M_y is the yearly average clean close price. This is an alternative measure of transaction costs that is based on the dispersion of close prices around the market "consensus valuation", which is similar to the imputed round-trip cost (Feldhütter, 2012).[6]

(10) CHL Spread: Following Abdi and Ranaldo (2017), we estimate the bid-ask spreads for bond i during day t and day $t+1$ from daily close, high, and low prices as $s_{it} = \sqrt{\max\{4(c_{it} - \eta_{it})(c_{it} - \eta_{it+1}), 0\}}$, where η is the mid-range defined as the average of daily high and low log-prices, c stands for the daily log clean close price, and s refers to the two-day estimates of bid-ask

[6]Due to data unavailability, we do not include the imputed round-trip cost in our set of liquidity metrics.

spreads. Then we estimate the yearly CHL Spread as

$$CHL\ Spread_{it} = \frac{1}{N_t} \sum_{k=1}^{N_t} s_{it} \tag{7}$$

4.2.1. Correlation analysis of liquidity proxies

We use the Pearson correlation to conduct a preliminary analysis of liquidity proxies and corporate yield spread and present the results in Table 1. The correlations between the first three liquidity metrics and *Yield Spread* are very small and insignificant. However, the correlations between all other liquidity metrics and *Yield Spread* are all statistically significant and show the expected signs. For instance, the correlation between *Price Dispersion* and *Yield Spread* is 0.29 with statistical significance at the 1% level. This suggests that *Price Dispersion* has a positive effect on corporate bond yield spread. Namely, higher transaction activity (higher *Price Dispersion*) correlates with higher corporate bond yield spreads. This is consistent with the spirit of Jankowitsch et al. (2011) in which the liquidity discount is increasing in transaction costs. Most of the liquidity metrics are also relevant to corporate bond spreads. Since there are no significant correlations between *Amihud Measure*,*Amihud Risk*, *Roll Measure* and *Yield Spread*, we do not incorporate these liquidity proxies into our analysis.

4.2.2. Principal components analysis of liquidity proxies

In the main empirical study, we reduce the dimension of liquidity variables, so we abstract the principal factors of liquidity proxies first. Table 2 summarizes the statistics of selected liquidity proxies and shows the results of principal components analysis on the liquidity proxies. Panel A of Table 2 shows that the mean and the median of *Price Dispersion* (a measure of transaction costs that is based on the dispersion of traded prices around the market "consensus valuation.") are 1.53 and 0.50, respectively. This implies that transaction costs in Chinese bond market is very high. These are strikingly higher than the corresponding number for US corporate bond market, around 0.50 and 0.29, respectively, reported by Jankowitsch et al. (2011). This suggests that the liquidity of the Chinese corporate market is worse than that of the US corporate bond market. The mean and median of the yearly average number of days since the previous trading day (*Trade Interval*) are 8 and 4.28 days, respectively. This suggests that the average and median interval between trade dates are respectively 8 and 4.28 days, and therefore, the corporate bond market trade is quite thin. Overall, the summary statistics for the liquidity variables are consistent with the low liquidity of corporate bond markets throughout the world, and at the same time, the liquidity of the Chinese corporate bond market is even lower.

Next, we conduct a principal component analysis of liquidity proxies and present results in Panel B of Table 2. Our purpose is to investigate if most of the relevant information in various liquidity metrics can be captured by a few common factors so that we can reduce the dimension of liquidity measures in the regression part.[7] The first principal component explains 37% variation in the liquidity variables and is close to its counterpart from the US corporate bond market, which is 39% reported by Dick-Nielsen et al. (2012). The second principal component explains 20% (the same as what Dick-Nielsen et al. (2012) reported), and the dominant liquidity proxy is bid-ask spread estimate (*CHL Spread*), and the third principal component explains 14% and the dominant liquidity proxy is *Turnover*. The last four principal components explain less than 30% and do not have clear interpretations. We employ the principal component loadings on the first and second principal components and label them as $Z(\lambda_1)$ and $Z(\lambda_2)$ respectively. Note that we normalize all the liquidity measures, including individual ones and their principal components, in the regression analysis for the convenience of result interpretation. Namely, we calculate the liquidity measure for each bond i and year t, L_{it}^k where $k = 1, \cdots, 7$, is the index for our seven liquidity measures, and then define $\tilde{L}_{it}^k = (L_{it}^k - \mu^k)/\sigma^k$,

[7] For Convenience, we rearrange the signs of the normalized liquidity metrics if necessary in the principal components analysis and regressions based on individual liquidity metrics so that the large values of the liquidity metrics mean the higher illiquidity (the expected effect on corporate bond yield spread is positive.

where μ^k and σ^k are the mean and standard deviation of L^k across bonds and years and receive our liquidity measure for each bond and year as the score with loadings from principal components analysis.

4.3. Bond and Issuer Characteristics

Table 3 reports the summary of bond and issuer characteristics. Panel A presents the descriptive statistics of the sample. The mean and median bond durations are 2.42 and 2.11 years, which suggests that short time and midterm bonds prevail in the Chinese corporate bond market. The amount issued is 100 million Chinese yuan (about 14.4 million US dollars) for a typical bond. The mean and median coupon rates are 5.69% and 5.60%. The mean yield difference between a corporate bond and its corresponding risk-free bond is 2.01%, and its median is 1.86%. The mean and median ROAs are 3.38% and 3.02% with a standard deviation of 4.49%, which suggests that a typical bond issuer has an excellent accounting performance. The mean and median of Profit Margin, 11.57% and 8.29%, also support this pattern. The substantial quality of Chinese corporate bond issuers results from the strict examination and approval of CSRC.[8] Besides, the growth opportunity for a typical bond issuer is 8%, which is consistent with the excellency of company quality.

Panel B of Table 3 collects the latest rating information of our sample bonds. 43% of the bonds enjoy the latest AAA ratings, 28% falls into the category of AA+, 25% are in AA, and the bonds with rating A or below is less than 2%. Overall, the corporate bonds in the secondary market have super latest credit ratings.

[8]For instance, in Article 18 of *Measures for the Issue and Trading of Corporate Bonds* issued by China Securities Regulatory Commission in 2015 states that "the average distributable profits of the company for each of the three years immediately preceding the application is sufficient to pay for one year's interest on its outstanding corporate bonds. The initial bond credit rating must be AAA." It suggests that firms meeting qualifications as bond issuers must have excellent performance.

5. Liquidity Premia

5.1. Benchmark regression

We follow the empirical design of Dick-Nielsen et al. (2012) and Schwert (2017), see Equation (8), to capture the conditional relation between yield spreads and the liquidity variable λ_{it} for each bond year observation:[9]

$$Yield\ Spread_{it} = \alpha + \beta_t^{\lambda}\lambda_{it} + \theta Rating_{it} + \sum \gamma Controls + \varepsilon_{it} \tag{8}$$

where $Yield\ Spread$ is the yearly bond spread, *Rating* stands for the bond rating dummies for each rating category present in the data (AAA, AA+, AA, AA-, A, CC) in year t, and ε_{it} is the error term. We use the most recent rating on the bond to control for credit risk. As mentioned in Schwert (2017), controlling ratings can mitigate omitted variable bias that would otherwise be present if there exists any correlation between liquidity and creditworthiness. However, unlike Schwert (2017), we also add more control variables such as the ratio of operating income to sales (*Profit Margin*), ratio of debt to assets (*Leverage*), corporate growth opportunity (*Growth*) defined as the growth rate of sales, firm size (log of total assets), return on assets (ROA), bond duration (*Duration*), bond age (*Bond Age*), and log of issue amount (*Issue Size*).[10] The reason is that people may question about the accuracy of Chinese bond ratings. We hope more bond and issuer characteristic variables can deal with the missing information caused by inefficient bond ratings.

Hence, a detailed version of our benchmark regression is given by Equation (9):

$$\begin{aligned} Yield\ Spread_{it} \quad &= \quad \alpha + \beta Z_{it}(\lambda_1) + \gamma Z_{it}(\lambda_2) + \theta_1 Ratings_{it} + \theta_2 Bond\ Age_{it} \\ &\quad +\theta_3 Issue\ Size_i + \theta_4 Duration_{it} + \theta_5 Coupon_{it} \end{aligned}$$

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[9] Since all investors in China are levied at the same tax rate, 20%, for their gains from corporate bond investment, tax effect is the same for all corporate bonds if any. Therefore, we do not incorporate it into our analysis.

[10] We use issue-specific accounting variables with one year lag throughout this paper.

$$+\theta_6 ROA_{it-1} + \theta_7 Leverage_{it-1} + \theta_8 Growth_{it-1}$$
$$+\theta_9 Firm\ Size_{it-1} + \theta_{10} Profit\ Margin_{it-1}$$
$$+Industry\ FEs + Year\ FEs + \varepsilon_{it} \quad (9)$$

where i denotes bond, t denotes year, $Z_{it}(\lambda_1)$ represents the first principal component score of liquidity metric, and $Z_{it}(\lambda_2)$ stands for the second one. β and γ are therefore the estimators of our most interest to study the conditional correlation between corporate bond spread and liquidity. Considering that each issuer can potentially have more than one outstanding bond, we calculate two-way cluster robust standard errors proposed by Petersen (2009) in order to correct for time-series effects and heteroscedasticity in the residuals. Besides, year and industry fixed effects are also controlled.

5.2. Liquidity premium

The results of our benchmark estimation are present in Table 4. Column (1) shows that the credit rating dummies explain 34% of the variation in corporate bond spreads and that high credit ratings imply low yield spreads. Column (2) shows that the liquidity factor $Z(\lambda_1)$ has significant power for explaining corporate bond spreads, as the R^2 increases from 34% to 41%. The positive coefficient on $Z(\lambda_1)$ is highly significant and implies that worse liquidity causes larger corporate bond spreads. Column (3) adds the second principal component score $Z(\lambda_2)$ to the explanatory variables. However, not only does the coefficient on this new variable carry no significance, but also adds minimal explanatory power to the regression. Consequently, we exclude the second principal component score $Z(\lambda_2)$ in the later analysis and focus on the liquidity measure $Z(\lambda_1)$, which is also in line with Dick-Nielsen et al. (2012) and Schwert (2017). Column (4) shows that the coefficient on $Z(\lambda_1)$ is still highly significant, despite the bond and issuer characteristics. Column (5) indicates that the coefficient on $Z(\lambda_1)$ is still significant after controlling for year fixed effects. Column (6) suggests that controlling for industry fixed effects does not change the significance of the coefficient on $Z(\lambda_1)$.[11] In both Columns (5) and (6), bond and issuer characteristic control variables, if significant, carry the expected signs. For instance, the coefficient of ROA is negative and significant at the 1%, suggesting that better accounting performance implies smaller bond yield spreads. The coefficient of *Profit Margin* is also negative and significant at the 1%, indicating that the bonds issued by firms with stronger profitability enjoy lower corporate bond spreads.

The contribution of liquidity to corporate bond spread is also quantitatively significant, as one standard deviation increase in $Z(\lambda_1)$ leads to an increase in the yield spread by around 20bps, see Columns (5) and (6). The year fixed effect in Column (5) leads the coefficient on $Z(\lambda_1)$ to decline by 26%. The interpretation is that 26% of the yield spread effects on liquidity are due to the changes in transaction costs and trading activity at the aggregate level, as the remaining loadings are due to cross-sectional differences among bonds. Nevertheless, the industry fixed effect does not matter that much in our sample period.

5.3. Robustness tests

5.3.1. Sub-sample analysis

Allowing for the first year of our sample coinciding with the 2008-2009 financial crisis, and the observations in that year being small (only 21 observations), we remove the observations in that year and conduct the same empirical exercises as in Table 4.

We present the results of this sub-sample in Table 5. The findings here is similar to what we have in Table 4. Column (1) shows that the credit rating dummies explain 33% of the variation in corporate bond spreads and that high credit ratings imply low yield spreads. Column (2) shows that the liquidity fac-

[11] We do not control for the nature of ownership here. In the untabulated results, we also add state-owned enterprise dummy (*SOE* into the regressions reported in Columns (5) and (6) to control for the variation in ownership, and the coefficient on $Z(\lambda_1)$ is also positive and significant at the 1% level with the same quantitative magnitude.

tor $Z(\lambda_1)$ has significant power for explaining corporate bond spreads. Column (3) shows that the addition of $Z(\lambda_2)$ only adds minimal explanatory power to the regression as before, although it assumes marginal significance. The last three columns show that incorporating more control variables and fixed effects does not change the significance of the coefficient on $Z(\lambda_1)$. Overall, The subsample analysis suggests that our findings remain consistent, and the estimated impacts of liquidity on the corporate bond spread is slightly larger.[12]

5.3.2. Individual liquidity proxies

The results of our benchmark regression could be sensitive to the choice of liquidity measures, so it is necessary to check the excises with individual liquidity proxies instead of their first principal component. Therefore, we estimate the model in Equation (9) again with the principal components being replaced by the individual liquidity measures. Note that each bond year observation may have different liquidity metrics available. Table 6 reports the results of the same sample, whose observations have all liquidity metrics available. Throughout all liquidity metrics, only *CHL spread* and *Turnover* are not significant, and all the others are similar to the benchmark case with slightly smaller estimators. In Table 7, the industry and year fixed effects are controlled. Most of our findings remain similar.[13]

Next, we investigate the same question with different samples due to the liquidity metrics availability, and demonstrate the results in Tables 8 (without fixed effects) and Table 9 (with fixed effects). These two excises still deliver similar messages, except that more coefficients become insignificant when fixed effects are controlled in Table 9. We may say that using individual liquidity

[12] The observations in 2010 is also small (29 observations), and we also do the same exercise by removing observations in both 2009 and 2010. This further reduced subsample delivers very similar results, and we do not report the results for brevity.

[13] The coefficient on normalized turnover (*Turnover*) assumes inconsistent signs and significance levels for different regressions in Tables 6 and 9, therefore this coefficient is not robust. However, this one dimensional result does not affect our results on liquidity pricing, because, according to our construction, the main liquidity measure $Z(\lambda_1)$ captures multiple dimensions of liquidity. Moreover, the remaining individual liquidity measures give the expected signs in all specifications.

metrics fail to capture the liquidity risk as well as first principal components cross-sectionally, because the fixed effect takes away the liquidity variation at aggregate level.

5.3.3. Simultaneous equation model test

As pointed out by Chen et al. (2007), liquidity measure could contain information about the credit quality of a bond, and thus may affect the yield through the credit risk channel. This potential channel would make it difficult to interpret the results presented in Table 4 purely in terms of liquidity costs. Under the assumption that much of the liquidity costs are due to adverse selection under asymmetric information, for a typical corporate bond, one would hypothesize that asymmetric information on its credit quality is the main reason for adverse selection costs. Intuitively, one may expect that bonds with lower credit quality should have a more severe adverse selection problem, ceteris paribus. Thus, higher liquidity costs could mean lower credit quality, which could lead, in turn, to higher yield spreads. On top of this, Campbell and Taksler (2003) document that credit ratings may contemporaneously incorporate observed issuer-level accounting characteristics. Rating agencies may also absorb market information through the observed yield spread as well as macroeconomic information when assigning a credit rating.

To overcome or mitigate all potential problems above, we follow the spirit of Chen et al. (2007) to employ a simultaneous equation model with three equations that represent each of the potentially endogenous variables. The system of equations is as follows.

$$
\begin{aligned}
Yield\ Spread_{it} \quad = \quad & \alpha + \beta Z_{it}(\lambda_1) + \gamma Credit\ Rating_{it} + \theta_1 Duration_{it} + \\
& + \theta_2 Coupon_{it} + \theta_3 ROA_{it-1} + \theta_4 Leverage_{it-1} \\
& + \theta_5 Growth_{it-1} + \theta_6 Firm\ Size_{it-1} \\
& + \theta_6 Profit\ Margin_{it-1} + \varepsilon_{it} \qquad (10)
\end{aligned}
$$

$$\begin{aligned} Z_{it}(\lambda_1) &= \alpha + \beta Credit\ Rating_{it} + \gamma Yield\ Spread_{it} + \theta_1 Duration_{it} + \\ &+ \theta_2 Bond\ Age_{it} + \theta_3 Issue\ Size_i + \varepsilon_{it} \end{aligned} \quad (11)$$

$$\begin{aligned} Credit\ Rating_{it} &= \alpha + \beta Yield\ Spread_{it} + \theta_1 Bond\ Age_{it} \\ &+ \theta_2 ROA_{it-1} + \theta_3 Leverage_{it-1} + \theta_4 Growth_{it-1} \\ &+ \theta_5 Firm\ Size_{it-1} + \theta_6 Profit\ Margin_{it} + \varepsilon_{it} \end{aligned} \quad (12)$$

Here *Credit Rating* equals 1 for the bonds below A, 2 for A, A+, or AA-, 3 for AA, 4 for AA+, and 5 for AAA. The parameters of the simultaneous equation model are estimated using the three-stage least squares method and the estimation results are in Table 10. As the table demonstrates, the potential endogeneity bias does not affect the relation between liquidity and the yield spread. Column (1) shows that the coefficient on $Z(\lambda_1)$ remains positive and significant at the 1% level. Moreover, the simultaneous equation model yields even larger coefficient, 51, which is much greater than that of reported in Table 4, 34.3.

5.3.4. Endogeneity Tests

We repeat the Durbin-Wu-Hausman test for the liquidity measure $Z(\lambda_1)$ and each individual liquidity proxy. If these tests pass, the liquidity variable can be regarded as exogenous. According to Dick-Nielsen et al. (2012), we use *Bond Age* as an instrument, and therefore take it out of the benchmark regressions. Table 11 shows the R^2 for the first stage regressions and the χ^2 tests for endogeneity. All the R^2 are very high, which implies that the control variables including the instrument can explain a large portion of the variation in the liquidity measures. Seven out of the eight χ^2 tests are insignificant at a 10% level so that we can claim endogeneity is not a major concern for our model.

6. Yield spread decomposition and determinants

6.1. Corporate bond spread decomposition

Inspired by Schwert (2017), we decompose the corporate bond spread into liquidity and default related components. In this process, the 1st percentile of the selected liquidity index, λ_{1p}, serves as the benchmark of best liquid corporate bond. The liquidity spread is then defined as below:

$$Liquidity\ Spread_{it} = \beta_t^{\lambda}(\lambda_{it} - \lambda_{1p}) \tag{13}$$

Where β_t^{λ} is the coefficient of liquidity variable in Equation (9). With the liquidity spread in hand, we calculate the default spread as the remaining portion of the yield spread

$$Default\ Spread_{it} = Yield\ Spread_{it} - Liquidity\ Spread_{it} \tag{14}$$

6.2. Descriptive statistics for the yield spread decomposition

Table 12 summarizes the corporate bond spread decomposition result. The first two rows are daily data results, whereas the last four rows are annual data results. For our sample period from 2009 to 2016, the mean corporate bond yield is 5.27%, which corresponds to a risk-free yield of 2.94%.[14] The typical corporate bond has a corporate bond spread of 2.01%, broken down to a default spread of 157.29 bps and a liquidity spread of 41.76 bps.[15] The default risk accounts for 78.25% (157.29/201) and liquidity accounts for 20.78% (41.76/201) of the corporate bond yield spread. By contrast, most of the research (e.g. Collin-Dufresne et al., 2001; Elton et al., 2001; Huang and Huang, 2012) on US bond market documents that the default risk can only explain a small fraction (between 20% and 30%) of yield spreads for the high grade debt. Longstaff et al.

[14]There is a little bit difference between the difference between means of *Market Yield* and *Implicit Yield* and mean of *Yield Spread* due to different levels of observations.

[15]There are some extreme values reported for the default spread. These outliers result from the estimation procedure and can be mitigated by winsorization.

(2005) report that default risk accounts for about 50% of the credit spread in the credit default swap (CDS) market. As aforementioned, the Chinese bond market is much more illiquid than developed bond markets, like the US bond market. For example, the mean or median of the price dispersion measure is twice as big as its US bond market counterpart. However, the liquidity premium accounts for a fraction of spreads of about 20% or higher (e.g. Driessen, 2005; Perraudin and Taylor, 2004) in the US bond market, similar in magnitude to what we found in the Chinese bond market.

Figure 2 plots the dynamics of total, default, and liquidity spreads. Chinese corporate bond spreads are steady from 2009 to 2014, and decline a little from 2014 to 2016. The dynamics of default spreads assemble that of total spreads, which is consistent with our finding that default risk accounts for most of the corporate bond spread. There are some extreme values for the default spread in 2009 and 2010. These outliers might result from the poor estimation due to the few observations in these two years (which are 21 and 29, respectively), and the problem can be fixed by removing the observations in these two years or winsorizing. We also plot the dynamics of the median total, default, and liquidity spreads, which are presented in Figure 3 and illustrate a similar pattern. Figure 4 plots the dynamics of mean and median liquidity spreads. The difference between the two series is small, and thus the distribution of liquidity spreads is not skewed.

Moreover, liquidity spreads increase substantially from 2014 to 2016. Figure 5 may help us to interpret the potential driving forces behind this dynamics, as it shows the dynamics of mean and median liquidity measure $Z(\lambda_1)$. These measures were declining from 2009 to 2016, and there is a sharp decrease in 2016, suggesting that the increase in liquidity spreads in 2015 and 2016 is mainly caused by the change in β_t^{λ}. This finding implies an increasing weight towards liquidity in Chinese corporate bonds pricing. In a word, Chinese corporate bond investors put more weight on liquidity, as the market liquidity keeps improving at the same time. The series of reform by Chinese bond market regulators may play an important role here, and the structure of corporate bond market participants are more diversified and have more incentives to trade.

6.3. Determinants of Chinese corporate bond spreads

Finally, we try to analyze the determinants of Chinese corporate bond spread and its liquidity and default-related components, that is to run the regression of corporate bond spread, liquidity premium, and default premium respectively on bond ratings, bond and issuer characteristics, and other variables such as state-ownership dummy (*SOE*), inflation rate (*Inflation*), 10-year Treasury bond yield (*TB_Yield*), and M2 growth rate (*M2*).

Table 13 reports the regressions of three spreads on bond and issuer characteristics, as well as the nature of ownership of issuers. According to Column (1), we can see that corporate bond yield spreads are larger for bonds with worse credit ratings, bonds with higher coupon rates, issuers with a lower return on assets, worse profitability, larger firm size, and private ownership. In sum, both bond credit ratings and the creditworthiness of issuers, reflected by balance sheet strength, are important determinants of borrowing costs. Besides, state-owned issuers typically enjoy lower borrowing costs.

Columns (2) and (3) repeat the same regression with liquidity and default spreads as dependent variables. Since these two dependent variables sum to the total corporate bond spread, their model coefficient estimators also sum to the corresponding ones in Column (1). We are particularly interested in the determinants of liquidity premium. Issuers with strong accounting performance also have smaller liquidity spreads. State ownership also lowers liquidity spreads. Somewhat surprisingly, firm size is positively associated with liquidity spreads, but this result is not robust to the industry and year fixed effects, as shown in Table 14. Liquidity spreads are also exposed to credit ratings, but the significance disappears after controlling for industry and year fixed effects. These peculiar findings may be attributed to the portfolio choice of different bond market investors. We conjecture that the market participants with stronger trading incentives, like mutual funds, tend to hold the bonds of better and smaller issuers, and they also consider state-ownership as a plus when allocating their funds.

For a robustness test, we redo all above the estimations by controlling industry and year fixed effects. Table 14 presents the results. Regarding the determinants of total corporate spreads, we obtain the results similar to those in Table 13. For instance, Column (1) shows that corporate bond yield spreads are smaller for bonds with better credit ratings, bonds with lower coupon rates, issuers with a higher return on assets, stronger profitability, and state-owned ownership. Nevertheless, all the coefficients get quantitatively smaller estimators, which is also true to the default and liquidity premium estimation. Column (2) shows that liquidity spreads are no longer exposed to credit ratings and issuer size, whereas the accounting performance of issuers is still negatively associated with liquidity spreads. Column (3) indicates that the determinants of default spreads are also largely consistent with those reported in Column (3) of Table 13.

Since macroeconomic factors might also be crucial determinants of corporate bond spreads, we incorporate yearly inflation rate (*Inflation*), yearly change of M2 growth rate (*M2*), and ten-year treasury yield (*TB_Yield*) into the previous regressions and present them in Table 15.[16] Columns (1) and (3) show that the only crucial macroeconomic factor is the ten-year central government yield, which has a positive effect on both total and default spreads.

7. Conclusion

This paper investigates the Chinese corporate bond spread, and particularly its liquidity risk component. We build a composite measure of liquidity, derived from a principal components analysis of seven liquidity proxies, to study the contribution of liquidity premium to corporate bond spreads. The corporate bond spread here is estimated based on the full information of Chinese central

[16] Due to lower variation in the three macroeconomic factors, controlling for year fixed effects results in multicollinearity problem so that the coefficients on the three newly added variables cannot be identified. Therefore, like Schwert (2017), we do not control for industry and year fixed effects in this series of empirical exercises.

government bond yield curves. Our empirical research shows that liquidity risk imposes a significant effect on corporate bond pricing though its contribution is much smaller than its US counterparts. Default risk plays an outsized role in the pricing of corporate bonds, responsible for 78% of the average corporate bond spread over the sample period from 2009 to 2016. This finding is surprising because the Chinese corporate bond market is much less liquid according to various liquidity measures, and the quality of issuers is much better.

We also shed light on the determinants of corporate bond spread and its liquidity related component. According to our estimation, bond credit ratings, the accounting performance of issuers, ten-year treasury bond yield, and state ownership are essential factors explaining the total corporate bond spread in China. For liquidity spreads, we evidence that the corporate bond of the issuers with smaller size and better accounting performance can have the liquidity premium of Chinese corporate bonds and that state-ownership can also lead to a lower liquidity spread. These conclusions generate some questions meriting further study: is there any preference of active secondary bond market participants when they make portfolio decisions? The peculiar correlation between liquidity premium and the accounting and ownership characteristics emerges maybe because trading-intensive investors like small-medium competent state-owned issuers more.

Regarding the policy perspectives, we measure the dynamics of Chinese corporate bond liquidity and show that the liquidity keeps improving over our sample period. More importantly, the market participants seem to weigh more on liquidity when pricing corporate bonds. Both signal that the open and reform policy in Chinese bond markets is successful, at least in boosting the market liquidity. Our findings offer some crucial policy suggestions in addition to policy evaluation. The efforts to lower transaction costs and improve bond market liquidity alone are not sufficient enough if the Chinese policymakers plan to relieve the borrowing costs of Chinese firms. Instead, reducing default cost should be a more effective route, such as introducing a better legal and regulatory framework for corporate default and bankruptcy. Meanwhile, the macro-prudential policy should focus more on default risk rather than liquidity risk monitoring, as the former one is the dominant part of the corporate bond spread, particularly when they intend to stabilize the fixed-income markets.

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Table 1: Pearson correlation matrix

This table shows correlations among the liquidity proxies and corporate bond yield spread. The data come from Wind Information and the sample period is from 2009 to 2016. There is a total 596 bond-year observations and 427 unique bonds.

	Yield Spread	Amihud Measure	Amihud Risk	Roll Measure	Turnover	Bond Zero Trade	Issuer Zero Trade	Trade Interval	High-Low Spread	Price Dispersion	CHL Spread
Yield Spread	1										
Amihud Measure	−0.002	1									
Amihud Risk	−0.032	0.468***	1								
Roll Measure	0.049	0.291***	0.453***	1							
Turnover	−0.069**	−0.077**	−0.161***	−0.019	1						
Bond Zero Trade	−0.232***	0.131***	0.138***	0.032	0.059*	1					
Issuer Zero Trade	−0.146***	0.064*	0.100***	0.044	0.065*	0.834***	1				
Trade Interval	−0.249***	0.171***	0.140***	−0.066	−0.002	0.532***	0.473***	1			
High-Low Spread	0.232***	0.071*	0.112***	0.051	−0.146***	−0.350***	−0.292***	−0.178***	1		
Price Dispersion	0.290***	0.126***	0.159***	0.172***	0.003	−0.170***	−0.167***	−0.050	0.246***	1	
CHL Spread	0.070*	0.12***	0.245***	0.337***	−0.045	−0.028	−0.035	0.060	0.290***	0.263***	1

Table 2: Liquidity Summary Statistics and Principal Components Analysis

This table reports statistics on the liquidity proxies, including *Price Dispersion, High-Low Spread, CHL Spread, Turnover, Bond Zero Trade, Issuer Zero Trade,* and *Trade Interval*, which are described in Section 4.3. Statistics are based on 596 yearly observations for individual corporate bonds. Panel A reports summary statistics. Panel B reports the results of a principal components analysis. The principal components analysis is performed on the correlation matrix, which accounts for different variances among the variables. The reported values are standardized scoring coefficients scaled up by a factor of 100. Panel C presents a simple comparison of medians for some selected liquidity metrics also used by extant literature Dick-Nielsen et al. (2012) or Helwege et al. (2014) with our results.

Panel A: Summary Statistics

Liquidity Variables	Mean	StDev	p10	p50	p90
Price Dispersion	1.53	3.51	0.00	0.50	3.63
High-Low Spread(%)	8.03	34.21	0.00	0.10	22.00
CHL Spread(%)	0.28	0.63	0.00	0.12	0.64
Turnover(%)	17.46	52.45	0.00	0.00	49.25
Bond Zero Trade	0.77	0.27	0.34	0.88	1.00
Issuer Zero Trade	0.68	0.29	0.19	0.78	0.98
Trade Interval	8.00	15.79	1.13	4.28	17.00

Panel B: Principal Components Analysis

	1PC	2PC	3PC	4PC	5PC	6PC	7PC
Price Dispersion	0.18	0.52	-0.27	0.77	0.01	0.14	-0.01
High-Low Spread	0.37	0.38	0.05	-0.32	-0.78	0.04	0.06
CHL Spread	0.11	0.65	-0.07	-0.50	0.56	0.01	-0.02
Turnover	0.13	0.11	0.93	0.18	0.12	0.24	0.01
Bond Zero Trade	0.56	-0.17	0.01	0.03	0.10	-0.30	-0.74
Issuer Zero Trade	0.55	-0.16	0.02	0.07	0.18	-0.45	0.66
Trade Interval	0.43	-0.32	-0.22	-0.11	0.13	0.79	0.09
Cumulative % Explained	37.0%	57.2%	71.6%	82.1%	90.1%	97.7%	100%

Table 3: Bond and Issuer Characteristics Summary Statistics

This table summarizes the distributions of bond characteristics, issuers' financial variables, and the proportion of bonds under different credit rating categories. Panel A describes the distributions of bond characteristics and issuers' financial variables. Panel B reports the proportion of bond-year observations under different credit rating categories.

Panel A: Summary Statistics

Variables	Mean	StDev	p10	p50	p90
Duration	2.42	1.93	0.05	2.11	4.46
Issue Size (RMB Billion)	1.46	1.16	0.50	1.00	3.00
Years to Maturity	4.95	2.04	3.00	5.00	8.00
Bond Age	2.45	1.79	0.43	2.11	4.98
Coupon Rate(%)	5.69	1.04	4.56	5.60	7.05
Yield Spread(%)	2.01	1.20	0.69	1.86	3.22
ROA(%)	3.38	4.49	0.05	3.02	8.08
Leverage	0.60	0.15	0.36	0.62	0.78
Growth	0.25	2.95	-0.23	0.08	0.49
Profit Margin(%)	11.57	26.98	-1.91	8.29	30.95
Firm Size (Log(Assets+1))	23.99	1.20	22.53	23.92	25.77

Panel B: Distribution of Bond Credit Ratings

Ratings	AAA	AA+	AA	AA-	A	CC
Frequency (%)	43.29	27.68	24.50	3.19	0.84	0.50
Frequency	258	165	146	19	5	3

Table 4: Liquidity Pricing Regressions: Benchmark Model

This table reports regressions of corporate yield spreads on liquidity factors. The dependent variable is the *Yield Spread* described in Section 4.1, which equals the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. The liquidity variable $Z(\lambda_1)$ is the first principal component weighted score of the seven normalized liquidity metrics. The liquidity variable $Z(\lambda_2)$ is the second principal component weighted score of the seven normalized liquidity metrics. The rating variables are dummies equal to one if the bond is in that rating category. Year fixed effects are included in the fifth specification, and both year and industry fixed effects are included in the last specification. Both bond and issuer characteristics are included in the last two specifications, including bond *Duration*, coupon rate (*Coupon*), *Bond Age*, log of issue amount (*Issue Size*), return on assets (*ROA*), debt to asset ratio (*Leverage*), sales growth rate *Growth*, log of total assets (*Firm Size*), and *Profit Margin*. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)
Z(λ_1)		33.4***	33.6***	26.9**	19.9***	22.1***
		(2.92)	(3.11)	(3.38)	(3.09)	(2.89)
Z(λ_2)			9.3			
			(1.45)			
A Rated	-112.9**	-90.1	-77.2	-49.3	-26.1	-23.4
	(-2.05)	(-1.26)	(-1.16)	(-0.60)	(-0.37)	(-0.34)
AA Rated	-319.6***	-277.4***	-258.5***	-221.7***	-186.9***	-187.4***
	(-5.43)	(-6.55)	(-5.63)	(-12.01)	(-5.12)	(-5.43)
AA+ Rated	-339.9***	-300.2***	-283.8***	-218.5***	-191.1***	-197.4***
	(-8.39)	(-8.36)	(-7.37)	(-11.47)	(-5.16)	(-5.81)
AAA Rated	-413.9***	-372.7***	-355.7***	-232.4***	-217.1***	-222.2***
	(-9.64)	(-12.51)	(-10.72)	(-10.36)	(-5.92)	(-6.20)
Duration				1.1	1.2	0.6
				(0.18)	(0.32)	(0.16)
Coupon				0.3***	0.3***	0.3***
				(5.15)	(5.30)	(4.78)
Bond Age				-3.07	-3.0	-5.1**
				(-0.74)	(-1.26)	(-2.08)
Issue Size				7.7	2.9	-3.3
				(0.87)	(0.36)	(-0.44)
ROA				-4.6***	-5.6***	-6.1***
				(-3.80)	(-5.21)	(-8.16)
Leverage				29.6	8.8	2.7
				(0.69)	(0.27)	(0.07)
Growth				-0.3	-0.0	0.1
				(-0.92)	(-0.01)	(0.23)
Firm Size				-26.4***	-17.4***	-12.0**
				(-5.79)	(-4.00)	(-2.53)
Profit Margin				-100.4**	-91.7**	-66.3**
				(-2.53)	(-2.29)	(-2.02)
Constant	556.8***	516.7***	499.6***	879.1***	690.6***	622.8***
	(10.50)	(10.89)	(10.58)	(9.14)	(9.43)	(12.19)
Industry FEs	NO	NO	NO	NO	NO	YES
Year FEs	NO	NO	NO	NO	YES	YES
N	596	596	596	596	596	596
R^2	0.34	0.41	0.42	0.56	0.63	0.64

Table 5: Liquidity Pricing: Sub-Sample

This table reports regressions of corporate yield spreads on liquidity factors, based on the data with shorten sample period from 2010-2016. The dependent variable is the *Yield Spread* described in Section 4.1, which equals the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. The liquidity variable $Z(\lambda_1)$ is the first principal component weighted score of the seven normalized liquidity metrics. The liquidity variable $Z(\lambda_2)$ is the second principal component weighted score of the seven normalized liquidity metrics. The rating variables are dummies equal to one if the bond is in that rating category. Year fixed effects are included in the fifth specification, and both year and industry fixed effects are included in the last specification. Both bond and issuer characteristics are included in the last two specifications, including bond *Duration*, coupon rate (*Coupon*), *Bond Age*, log of issue amount (*Issue Size*), return on assets (*ROA*), debt to asset ratio (*Leverage*), sales growth rate *Growth*, log of total assets (*Firm Size*), and *Profit Margin*. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)
$Z(\lambda_1)$		34.0***	34.3***	28.9***	21.5***	23.6***
		(2.90)	(3.15)	(3.59)	(3.48)	(3.12)
$Z(\lambda_2)$			11.1*			
			(1.67)			
A Rated	-118.1**	-95.4	-80.6	-49.1	-26.4	-24.9
	(-2.05)	(-1.30)	(-1.18)	(-0.91)	(-0.38)	(-0.35)
AA Rated	-321.3***	-277.5***	-255.1***	-217.2***	-182.0***	-183.8***
	(-5.13)	(-6.12)	(-5.21)	(-10.64)	(-4.93)	(-5.17)
AA+ Rated	-342.1***	-300.1***	-280.8***	-213.4***	-185.9***	-193.7***
	(-7.57)	(-7.63)	(-6.71)	(-10.16)	(-4.97)	(-5.62)
AAA Rated	-415.9***	-371.9***	-351.6***	-224.4***	-210.2***	-216.6***
	(-8.80)	(-11.26)	(-9.66)	(-22.71)	(-5.74)	(-6.00)
Duration				1.8	1.8	1.2
				(0.44)	(0.50)	(0.31)
Bond Age				-3.3	-2.5	-4.5*
				(-1.14)	(-1.07)	(-1.92)
Coupon				0.3***	0.3***	0.3***
				(6.97)	(5.43)	(4.83)
Issue Size				6.7	1.8	-4.2
				(0.80)	(0.22)	(-0.56)
ROA				-4.8***	-6.0***	-6.3***
				(-5.09)	(-5.61)	(-7.25)
Leverage				33.0	9.6	5.6
				(0.92)	(0.28)	(0.13)
Growth				-0.2	0.0	0.1
				(-0.69)	(0.15)	(0.39)
Firm Size				-27.1***	-17.5***	-12.5**
				(-6.25)	(-3.95)	(-2.56)
Profit Margin				-98.9***	-88.9**	-65.1**
				(-2.60)	(-2.30)	(-2.01)
Constant	556.8***	516.0***	495.7***	887.2***	703.4***	646.8***
	(9.71)	(10.24)	(9.92)	(9.19)	(10.99)	(15.22)
Industry FEs	NO	NO	NO	NO	NO	YES
Year FEs	NO	NO	NO	NO	YES	YES
N	575	575	575	575	575	575
R^2	0.33	0.41	0.42	0.56	0.62	0.64

Table 6: Liquidity Pricing: Individual Liquidity Metrics with the same Sample Size

This table reports regressions of corporate yield spreads on individual liquidity proxies to test the robustness on bond liquidity pricing. The dependent variable is the *Yield Spread* described in Section 4.1, which equals the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. The liquidity variables are those used in the principal components analysis, which are described in Section 4.3. The rating variables are dummies equal to one if the bond is in that rating category. Both bond characteristics and issuers' characteristics are included in all specifications, including bond *Duration*, coupon rate (*Coupon*), *Bond Age*, log of issue amount (*Issue Size*), return on assets (*ROA*), debt to asset ratio (*Leverage*), sales growth rate *Growth*, log of total assets (*Firm Size*), and *Profit Margin*. We do not report the coefficients of these control variables for brevity and instead denote them by *Controls*. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Price Dispersion	18.0***						
	(3.62)						
High-Low Spread		12.0*					
		(1.94)					
CHL Spread			2.0				
			(0.91)				
Bond Zero Trade				24.7***			
				(2.84)			
Issuer Zero Trade					22.5***		
					(2.60)		
Trade Interval						27.2***	
						(5.07)	
Turnover							2.0
							(0.41)
A Rated	-48.3	-55.7	-80.2*	-68.4	-70.9	-71.7	-79.5*
	(-1.25)	(-0.95)	(-1.69)	(-1.64)	(-1.36)	(-1.60)	(-1.70)
AA Rated	-217.9***	-231.1***	-257.7***	-246.0***	-247.2***	-249.8***	-256.8***
	(-28.10)	(-7.54)	(-8.52)	(-12.72)	(-11.75)	(-8.99)	(-8.82)
AA+ Rated	-213.3	-227.6***	-251.7***	-241.6***	-241.6***	-242.5***	-251.0***
	(-7.03)	(-7.84)	(-10.72)	(-27.24)	(-19.34)	(-9.80)	(-12.12)
AAA Rated	-229.2	-243.9***	-268.2***	-256.8***	-254.8***	-255.4***	-268.5***
	(-6.21)	(-8.72)	(-10.17)	(-25.59)	(-25.59)	(-13.14)	(-10.91)
Controls	YES	YES	YES	YES	YES	YES	YES
Constant	780.7***	787.3***	799.2***	820.9***	972.8***	847.2***	790.0***
	(6.05)	(8.51)	(7.21)	(9.34)	(8.49)	(8.82)	(6.78)
Industry FEs	NO	NO	NO	NO	NO	NO	NO
Year FEs	NO	NO	NO	NO	NO	NO	NO
N	596	596	596	596	596	596	596
R^2	0.54	0.53	0.52	0.55	0.55	0.54	0.52

Table 7: Liquidity Pricing: Individual Liquidity Metrics with the same Sample Size and Fixed Effects

This table reports regressions of corporate yield spreads on individual liquidity proxies to test the robustness on bond liquidity pricing. The dependent variable is the *Yield Spread* described in Section 4.1, which equals the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. The liquidity variables are those used in the principal components analysis, which are described in Section 4.3. The rating variables are dummies equal to one if the bond is in that rating category. Both bond and issuer characteristics are included in all specifications, including bond *Duration*, coupon rate (*Coupon*), *Bond Age*, log of issue amount (*Issue Size*), return on assets (*ROA*), debt to asset ratio (*Leverage*), sales growth rate *Growth*, log of total assets (*Firm Size*), and *Profit Margin*. We do not report the coefficients of these control variables for brevity and instead denote them by *Controls*. In addition, year and industry fixed effects are controlled in all specifications. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Price Dispersion	13.0**						
	(2.37)						
High-Low Spread		6.1					
		(1.12)					
CHL Spread			2.1				
			(0.74)				
Bond Zero Trade				20.2**			
				(2.36)			
Issuer Zero Trade					17.6*		
					(1.71)		
Trade Interval						23.8***	
						(4.88)	
Turnover							-13.2***
							(-7.52)
A Rated	-27.3	-35.9	-48.4	-38.2	-43.1	-39.7	-55.0
	(-0.43)	(-0.53)	(-0.73)	(-0.62)	(-0.63)	(-0.61)	(-0.88)
AA Rated	-179.2***	-194.6***	-205.1***	-204.7***	-205.9***	-202.0***	-210.6***
	(-4.90)	(-5.19)	(-6.15)	(-6.44)	(-6.26)	(-5.87)	(-6.61)
AA+ Rated	-192.3***	-207.3***	-218.2***	-214.4***	-216.4***	-212.2***	-224.2***
	(-5.61)	(-5.74)	(-6.89)	(-7.71)	(-7.25)	(-6.33)	(-7.83)
AAA Rated	-223.6***	-238.6***	-250.6***	-241.9***	-242.0***	-239.1***	-253.1***
	(-5.70)	(-5.70)	(-6.75)	(-7.04)	(-6.61)	(-6.85)	(-7.23)
Controls	YES	YES	YES	YES	YES	YES	YES
Constant	513.2***	516.4***	510.9***	568.5***	672.4***	561.9***	546.8***
	(7.39)	(14.96)	(13.39)	(13.20)	(4.52)	(19.42)	(24.40)
Industry FEs	YES	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES	YES
N	596	596	596	596	596	596	596
R^2	0.63	0.62	0.62	0.64	0.64	0.64	0.63

Table 8: Liquidity Pricing: Individual Liquidity Metrics with different Sample Size

This table reports regressions of corporate yield spreads on individual liquidity proxies to test the robustness on bond liquidity pricing, based on the different number of observations for different liquidity proxies according to data availability. The dependent variable is the *Yield Spread* described in Section 4.1, which equals the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. The liquidity variables are those used in the principal components analysis, which are described in Section 4.3. The rating variables are dummies equal to one if the bond is in that rating category. Both bond characteristics and issuers' characteristics are included in all specifications, including bond *Duration*, coupon rate (*Coupon*), *Bond Age*, log of issue amount (*Issue Size*), return on assets (*ROA*), debt to asset ratio (*Leverage*), sales growth rate *Growth*, log of total assets (*Firm Size*), and *Profit Margin*. We do not report the coefficients of these control variables for brevity and instead denote them by *Controls*. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Price Dispersion	17.4***						
	(3.18)						
High-Low Spread		13.3**					
		(2.30)					
CHL Spread			1.4				
			(0.64)				
Bond Zero Trade				27.6**			
				(2.09)			
Issuer Zero Trade					26.2**		
					(2.31)		
Trade Interval						20.5***	
						(7.04)	
Turnover							-0.1
							(-0.02)
A Rated	-113.2	-111.0	-85.8*	-84.9**	-82.4**	-100.7***	-72.1*
	(-1.65)	(-1.54)	(-1.86)	(-2.56)	(-2.06)	(-5.53)	(-1.69)
AA Rated	-253.6***	-257.2***	-251.6***	-260.4***	-256.3***	-251.9***	-234.1***
	(-2.92)	(-3.25)	(-10.53)	(-9.49)	(-9.46)	(-13.37)	(-6.96)
AA+ Rated	-256.9***	-262.3***	-252.8***	-259.2***	-253.9***	-251.8***	-237.6***
	(-3.13)	(-3.59)	(-20.84)	(-10.21)	(-9.96)	(-57.97)	(-7.70)
AAA Rated	-271.0***	-275.7***	-270.3***	-260.3***	-254.8***	-266.5***	-242.3***
	(-3.05)	(-3.34)	(-17.18)	(-7.11)	(-7.44)	(-9.35)	(-6.99)
Controls	YES	YES	YES	YES	YES	YES	YES
Constant	817.6***	816.9***	754.8***	919.7***	1088.2***	781.1***	890.4***
	(5.66)	(7.40)	(6.16)	(5.14)	(7.16)	(8.88)	(5.54)
Industry FEs	NO	NO	NO	NO	NO	NO	NO
Year FEs	NO	NO	NO	NO	NO	NO	NO
N	756	756	615	851	851	705	870
R^2	0.53	0.52	0.54	0.55	0.55	0.54	0.53

Table 9: Liquidity Pricing: Individual Liquidity Metrics with different Sample Size and Fixed Effects

This table reports regressions of corporate yield spreads on individual liquidity proxies to test the robustness on bond liquidity pricing, based on the different number of observations for different liquidity proxies according to data availability. The dependent variable is the *Yield Spread* described in Section 4.1, which equals the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. The liquidity variables are those used in the principal components analysis, which are described in Section 4.3. The rating variables are dummies equal to one if the bond is in that rating category. Both bond and issuer characteristics are included in all specifications, including bond *Duration*, coupon rate (*Coupon*), *Bond Age*, log of issue amount (*Issue Size*), return on assets (*ROA*), debt to asset ratio (*Leverage*), sales growth rate *Growth*, log of total assets (*Firm Size*), and *Profit Margin*. We do not report the coefficients of these control variables for brevity and instead denote them by *Controls*. In addition, year and industry fixed effects are controlled in all specifications. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Price Dispersion	10.4*						
	(1.68)						
High-Low Spread		6.4					
		(1.53)					
CHL Spread			1.9				
			(0.65)				
Bond Zero Trade				18.0			
				(1.47)			
Issuer Zero Trade					16.6		
					(1.42)		
Trade Interval						16.2***	
						(9.02)	
Turnover							-14.5***
							(-9.33)
A Rated	-98.9**	-99.0*	-57.5	-89.5***	-88.2**	-59.5	-93.0**
	(-2.03)	(-1.96)	(-0.86)	(-2.60)	(-2.27)	(-1.24)	(-2.27)
AA Rated	-233.6***	-238.2***	-201.1***	-255.3***	-252.4***	-200.5***	-248.0***
	(-2.71)	(-2.96)	(-6.57)	(-13.61)	(-13.37)	(-6.95)	(-12.93)
AA+ Rated	-254.4***	-259.4***	-220.1***	-269.8***	-267.2***	-218.9***	-270.2***
	(-3.19)	(-3.58)	(-7.89)	(-19.60)	(-18.19)	(-8.82)	(-17.55)
AAA Rated	-283.5***	-287.7***	-253.7***	-280.1***	-277.2***	-247.4***	-283.4***
	(-2.97)	(-3.19)	(-7.59)	(-9.61)	(-9.83)	(-8.34)	(-11.19)
Controls	YES	YES	YES	YES	YES	YES	YES
Constant	574.9***	573.8***	479.4***	701.5***	799.5***	495.0***	660.1***
	(7.62)	(9.89)	(15.16)	(4.45)	(5.64)	(20.30)	(4.36)
Industry FEs	YES	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES	YES
N	756	756	615	851	851	705	870
R^2	0.63	0.63	0.64	0.61	0.61	0.65	0.62

Table 10: Liquidity Pricing: Three-Stage Least Square Estimation

This table reports the simultaneous equation model results on bond liquidity pricing, using our liquidity measure $Z(\lambda_1)$. The *Yield Spread* exogenous variables include bond-specific effects (*Credit Rating* that equals 1 for the bonds below A rated, 2 for A, A+, or AA- rated, 3 for AA rated, 4 for AA+ rated, and 5 for AAA rated, *Duration*, and coupon rate (*Coupon*)), and issuer-specific accounting variables (return on assets (*ROA*), debt to asset ratio (*Leverage*), sales growth rate *Growth*, log of total assets (*Firm Size*), and *Profit Margin*). The liquidity exogenous variables include bond *Duration*, *Bond Age*, log of issue amount (*Issue Size*), and *Credit Rating*. The bond rating (*Credit Rating*) exogenous variables are *Bond Age*, and issuer-specific accounting variables. The unit of *Yield Spread* is bp in Column (1), while it is percentage in the last two columns. The z-scores are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

Instrumental Variable	(1) Yield Spread	(2) $Z(\lambda_1)$	(3) Credit Rating
$Z(\lambda_1)$	51.1***		
	(2.75)		
Credit Rating	-77.3***	0.4	
	(-3.72)	(1.05)	
Yield Spread		0.7**	-0.4***
		(2.49)	(-6.05)
Duration	2.1	0.0	
	(1.05)	(0.39)	
Coupon	0.2**		
	(2.47)		
ROA	-2.7**		1.9**
	(-2.14)		(2.39)
Leverage	-65.6*		-0.6***
	(-1.84)		(-2.69)
Growth	-0.2		0.0
	(-0.32)		(0.18)
Firm Size	2.8		0.3***
	(0.32)		(7.89)
Profit Margin	-66.3***		0.1
	(-2.84)		(0.48)
Bond Age		0.0	0.0**
		(0.44)	(2.39)
Issue Size		0.2**	
		(2.27)	
Constant	377.4**	-3.2	-2.3**
	(2.33)	(-1.59)	(-2.34)
N	596	596	596
R^2	0.38	0.04	0.42

Table 11: Endogeneity Tests

This table presents the Durbin-Wu-Hausman test for potential endogeneity bias on the liquidity pricing regressions. This table shows for each liquidity variable the χ^2 statistics, p-values, and R^2 for the first-stage regression. The liquidity variables are those used in the principal components analysis, which are described in Section 4.3.

	χ^2 Value	P-Value	R^2
Z(λ_1)	1.10	0.29	83.7%
Price Dispersion	0.77	0.38	85.2%
High-Low Spread	1.85	0.17	79.4%
CHL Spread	2.53	0.11	82.2%
Bond Zero Trade	1.18	0.28	83.2%
Issuer Zero Trade	1.94	0.16	70.4%
Trade Interval	5.57	0.02	72.1%
Turnover	1.70	0.19	84.3%

Table 12: Summary Statistics for the Yield Spread Decomposition

This table presents summary statistics for the bond spread decomposition. Observations for the last four rows are reported at the bond-year level, while for the first rows on the daily basis. *Market Yield* is the corporate bond yield to maturity implied by its market price. *Implicit Yield* is the hypothetical matched treasury bond yield to maturity. *Yield Spread* is the difference between *Market Yield* and *Implicit Yield*. *Liquidity Spread* and *Default Spread* are the respective components of the yield spread resulting from the bond spread decomposition outlined in Section 4.2. *Liquidity Beta* is the regression coefficient estimated for each year from Equation (8) outlined in Section 4.2.

Variable	Mean	StDev	p10	p50	p90	N
Market Yield(%)	5.27	8.54	3.21	4.94	6.84	137,349
Implicit Yield(%)	2.94	0.42	2.53	2.93	3.43	137,349
Yield Spread(%)	2.01	1.20	0.69	1.86	3.22	596
Liquidity Spread(bps)	41.76	37.98	6.09	33.93	82.80	596
Default Spread(bps)	157.29	125.14	7.29	153.54	286.53	596
Liquidity Beta(%)	0.24	0.21	0.04	0.21	0.55	596

Table 13: Determinants of Liquidity and Default Spreads

This table presents panel regressions of bond spreads on bond and issuer characteristics. *Yield Spread* is the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. *Liquidity Spread* and *Default Spread* are the respective components of the yield spread resulting from the bond spread decomposition outlined in Section 4.2. The rating variables are dummies equal to one if the bond is in that rating category. *Duration* is the bond's duration. *Coupon* is the bond's coupon rate. *Bond Age* is the number of years since issuance. *Issue Size* is the log of the hundred million Chinese Yuan amount in the bond issue. *ROA* is return on assets. *Leverage* is the yearly debt to asset ratio. *Growth* is yearly sales growth rate. *Firm Size* is the log of year-end total assets. *Profit Margin* is the net profit percentage of the revenue. *SOE* is the ownership dummy variable equal to one for state-owned enterprises and zero otherwise. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

	(1) Yield Spread	(2) Liquidity Spread	(3) Default Spread
A Rated	-67.2*	36.0*	-103.1***
	(-1.90)	(1.81)	(-3.54)
AA Rated	-244.5***	48.7**	-293.2***
	(-11.05)	(2.37)	(-8.29)
AA+ Rated	-236.1***	38.0	-274.1***
	(-30.59)	(1.64)	(-11.01)
AAA Rated	-250.0***	20.4	-270.3***
	(-16.42)	(1.15)	(-10.88)
Duration	0.8	-1.9	2.7
	(0.18)	(-1.06)	(0.65)
Bond Age	-4.1	3.8*	-7.9*
	(-1.27)	(1.88)	(-1.82)
Coupon	0.4***	-0.1*	0.5***
	(8.26)	(-1.93)	(7.14)
Issue Size	16.1*	-2.7	18.7*
	(1.70)	(-0.79)	(1.83)
ROA	-5.4***	-2.5**	-2.9**
	(-5.73)	(-2.31)	(-2.21)
Leverage	-7.7	-57.0***	49.2
	(-0.20)	(-3.24)	(1.08)
Growth	-0.2	0.6*	-0.8***
	(-0.68)	(1.82)	(-2.61)
Firm Size	-23.1***	16.2***	-39.3***
	(-4.03)	(7.41)	(-5.33)
Profit Margin	-116.9**	-17.3	-99.6**
	(-2.44)	(-1.59)	(-2.11)
SOE	-18.7*	-14.2***	-4.5
	(-1.92)	(-4.04)	(-0.43)
Constant	814.5***	-291.5***	1106.0***
	(7.76)	(-8.00)	(7.78)
N	596	596	596
R^2	0.52	0.30	0.49

Table 14: Determinants of Liquidity and Default Spreads with Fixed Effects

This table presents panel regressions of bond spreads on bond and issuer characteristics to test the robustness by controlling for the year and issuer fixed effect. *Yield Spread* is the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. *Liquidity Spread* and *Default Spread* are the respective components of the yield spread resulting from the bond spread decomposition outlined in Section 4.2. The rating variables are dummies equal to one if the bond is in that rating category. *Duration* is the bond's duration. *Coupon* is the bond's coupon rate. *Bond Age* is the number of years since issuance. *Issue Size* is the log of the hundred million Chinese Yuan amount in the bond issue. *ROA* is return on assets. *Leverage* is the yearly debt to asset ratio. *Growth* is yearly sales growth rate. *Firm Size* is the log of year-end total assets. *Profit Margin* is the net profit percentage of the revenue. *SOE* is the ownership dummy variable equal to one for state-owned enterprises and zero otherwise. Both year and issuer fixed effects are included in the regressions. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding *p*-values are less than 0.10, 0.05, and 0.01, respectively.

	(1) Yield Spread	(2) Liquidity Spread	(3) Default Spread
A Rated	-21.9	3.3	-25.2
	(-0.37)	(0.39)	(-0.51)
AA Rated	-176.0***	0.9	-176.9***
	(-7.57)	(0.15)	(-7.28)
AA+ Rated	-187.4***	4.0	-191.4***
	(-9.28)	(0.44)	(-12.87)
AAA Rated	-215.8***	-3.1	-212.7***
	(-8.00)	(-0.68)	(-8.76)
Duration	-0.5	-0.9	0.3
	(-0.11)	(-1.25)	(0.09)
Bond Age	-4.4*	1.4	-5.8**
	(-1.70)	(1.43)	(-2.40)
Coupon	0.3***	0.0***	0.3***
	(4.63)	(4.70)	(4.00)
Issue Size	1.4	7.3*	-5.9
	(0.21)	(1.68)	(-0.89)
ROA	-7.4***	-1.2*	-6.2***
	(-9.31)	(-1.84)	(-7.46)
Leverage	-31.7	-45.8***	14.1
	(-0.78)	(-2.74)	(0.33)
Growth	0.5	0.0	0.5
	(1.05)	(0.11)	(1.25)
Firm Size	-6.0	4.1**	-10.0**
	(-1.31)	(2.39)	(-2.08)
Profit Margin	-86.5**	-39.1**	-47.4
	(-2.10)	(-2.56)	(-1.37)
SOE	-31.9***	-8.5***	-23.4**
	(-2.86)	(-3.84)	(-2.22)
Constant	546.4***	-115.0***	661.4***
	(22.14)	(-2.97)	(8.54)
Industry FEs	YES	YES	YES
Year FEs	YES	YES	YES
N	596	596	596
R^2	0.63	0.70	0.70

Table 15: Determinants of Liquidity and Default Spreads with Macro Factors

This table presents panel regressions of bond spreads on bond and issuer characteristics to test the robustness by controlling for macroeconomic factors and the year and issuer fixed effect. *Yield Spread* is the corporate bond yield to maturity minus the entire cash flow matched treasury bond yield to maturity. *Liquidity Spread* and *Default Spread* are the respective components of the yield spread resulting from the bond spread decomposition outlined in Section 4.2. The rating variables are dummies equal to one if the bond is in that rating category. *Duration* is the bond's duration. *Coupon* is the bond's coupon rate. *Bond Age* is the number of years since issuance. *Issue Size* is the log of the hundred million Chinese Yuan amount in the bond issue. *ROA* is return on assets. *Leverage* is the yearly debt to asset ratio. *Growth* is yearly sales growth rate. *Firm Size* is the log of year-end total assets. *Profit Margin* is the net profit percentage of the revenue. *SOE* is the ownership dummy variable equal to one for state-owned enterprises and zero otherwise. *Inflation* is the yearly inflation rate. *M2* is the yearly change of M2 growth rate. *TB_Yield* is the ten-year treasury yield to maturity. Both year and issuer fixed effects are included in the regressions. The t-statistics based on standard errors clustered by bond issuer and year are reported in parentheses. *, **, and *** indicate that the corresponding p-values are less than 0.10, 0.05, and 0.01, respectively.

	(1) Yield Spread	(2) Liquidity Spread	(3) Default Spread
A Rated	-35.2	28.9**	-64.1
	(-0.63)	(2.15)	(-1.22)
AA Rated	-207.1***	41.1***	-248.2***
	(-7.23)	(2.92)	(-8.16)
AA+ Rated	-199.4***	29.1*	-228.5***
	(-9.48)	(1.73)	(-11.36)
AAA Rated	-219.5***	13.6	-233.1***
	(-8.49)	(1.00)	(-8.23)
Duration	2.4	-2.6	5.0
	(0.69)	(-1.39)	(1.52)
Bond Age	-4.7*	4.0**	-8.7**
	(-1.67)	(2.10)	(-2.24)
Coupon	0.4***	-0.1**	0.5***
	(6.79)	(-2.00)	(5.61)
Issue Size	14.4*	-3.0	17.4
	(1.65)	(-0.66)	(1.57)
ROA	-5.8***	-2.6***	-3.3***
	(-4.61)	(-3.10)	(-2.67)
Leverage	-4.5	-63.4***	58.9
	(-0.11)	(-4.75)	(1.46)
Growth	-0.1	0.5*	-0.6
	(-0.23)	(1.65)	(-1.51)
Firm Size	-20.9***	16.6***	-37.5***
	(-3.40)	(6.32)	(-4.62)
Profit Margin	-102.5**	-23.0*	-79.5
	(-2.08)	(-1.70)	(-1.62)
SOE	-23.8**	-12.2***	-11.6
	(-2.29)	(-3.31)	(-1.00)
Inflation	7.7	5.6	2.1
	(1.09)	(1.06)	(0.21)
M2	1.6	-0.5	2.1
	(0.55)	(-0.16)	(0.37)
TB_Yield	3.0***	-1.0	4.0***
	(3.65)	(-1.36)	(3.22)
Constant	-427.2	58.8	-486.0
	(-1.30)	(0.19)	(-0.87)
N	596	596	596
R^2	0.58	0.37	0.57

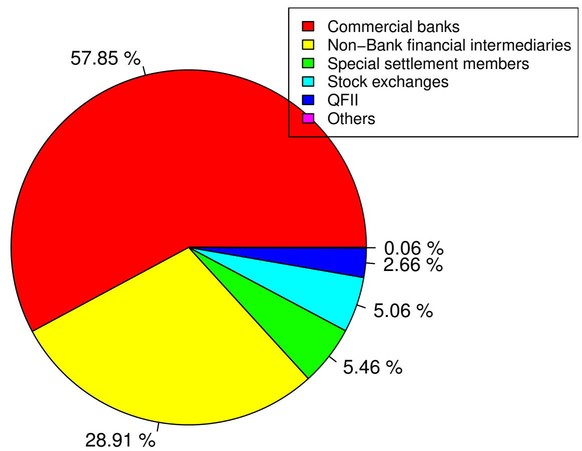

Figure 1: Investor composition of the Chinese bond market. This figure presents the investor composition of the Chinese bond market, including commercial banks, non-bank financial intermediaries, special settlement members, stock exchanges, qualified foreign institutional investors (QFII), and others as of August 2017 from China Central Depository & Clearing Co., Ltd.

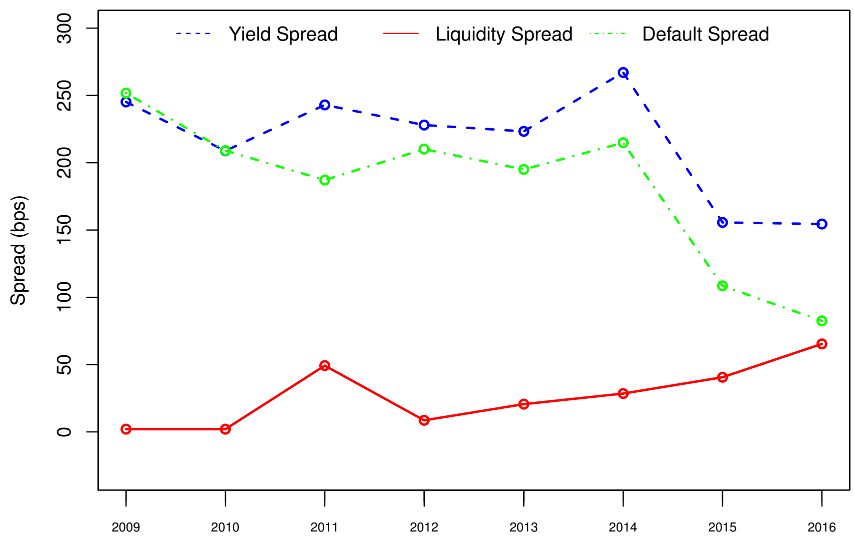

Figure 2: Time series of mean of decomposed bond spreads. This figure presents time-series plots of decomposed spreads. Each line presents equal-weighted averages over year windows. The blue line is the yield spread, the green line is the default spread, and the red line is the liquidity spread.

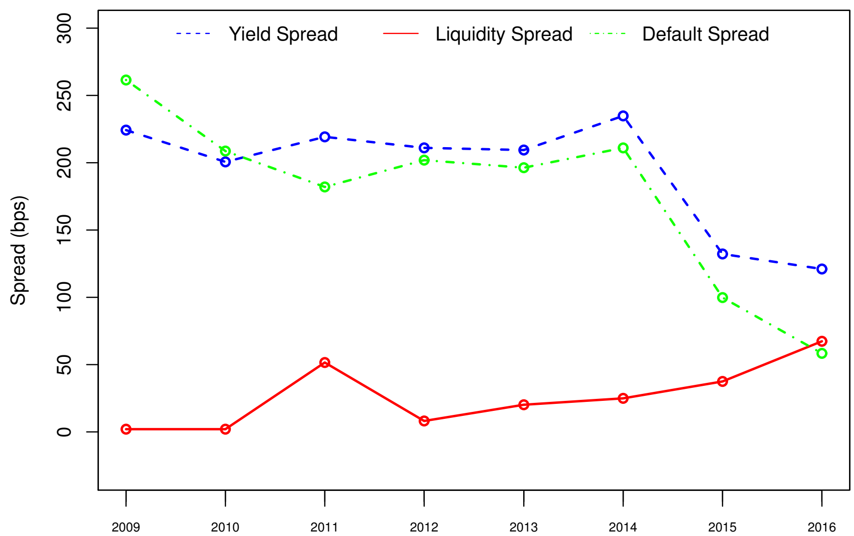

Figure 3: Time series of median of decomposed bond spreads. This figure presents time-series plots of decomposed spreads. Each line presents yearly median spread. The blue line is the yield spread, the green line is the default spread, and the red line is the liquidity spread.

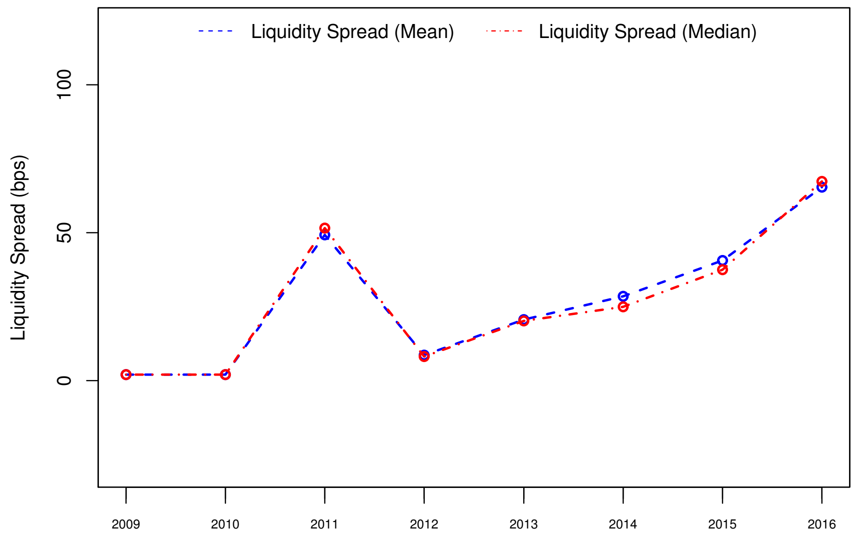

Figure 4: Time series of liquidity spreads. This figure presents time series plots of yearly mean and yearly median of bond liquidity spreads. The blue line presents the time series of yearly mean of liquidity spread, and the red line presents the time series of yearly median of liquidity spreads.

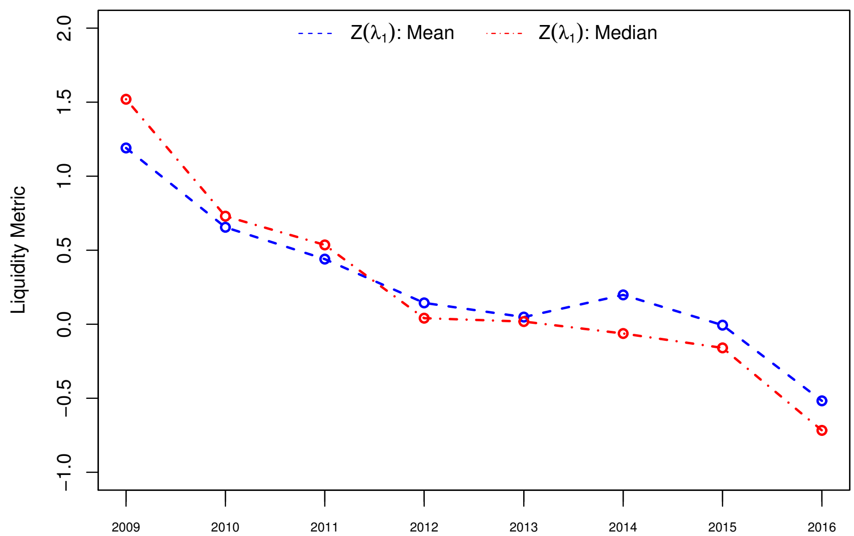

Figure 5: Time series of bond liquidity. This figure presents time series plots of bond liquidity measure (the first principal component score). The blue line is yearly mean of $Z(\lambda_1)$, defined in Section 4.2, and the red line is yearly median of $Z(\lambda_1)$.