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Keywords: Default events, credit spread, illiquidity premium, flight-to-liquidity
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Bond Default Matters in China: Evidence from Illiquidity Premium[*]

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Abstract

This paper studies how market-wide credit risk affects the liquidity pricing in the bond market. With the emerging wave of China's bond defaults, the illiquidity premium is observed only after the first bond default, and it becomes significantly larger with the rising market-wide credit risk. In the presence of the default risk, the illiquidity premium is more pronounced among the non-SOE bonds and low-rated bonds. Our evidence suggests that breaking the expectation of rigid redemption increases the effectiveness of price discovery in China's capital market. As liquidity concern starts to play a nontrivial role, bond default matters after all.

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[*] All errors are our own.

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1. Introduction

Extensive theoretical and empirical research on bond pricing has shown that credit risk cannot fully explain the level and changes in corporate spreads, and therefore, the illiquidity factor plays a significant role (Amihud and Mendelson, 1986; Collin-Dufresne, Goldstein, and Martin, 2001; Huang and Huang, 2012). While credit risk is probably the most mimportant determinet for bond yield spread, investors are likely to demand a illiquidity premium for illiquid securities with lower prices (Chen, Lesmond, and Wei, 2007; Bao, Pan, and Wang, 2011). It can be shown that the bond-level illiquidity instruments can largely explain the variations in individual bond yield spreads. However, the exact interactions between the credit risk and the illiquidity premium are relatively underexplored. This paper aims to fill this gap by exploiting the unique context of China's unprecedented wave of bond defaults which started in early 2014.

Earlier theories demonstrate that default risk mainly determines the corporate spreads (Merton, 1974). Liquidity was later identified as an additional and important factor for pricing corporate bonds (e.g., Chen, Lesmond, and Wei, 2007; Bao, Pan, and Wang, 2011; Bao and Pan, 2013). Moreover, Beber, Brandt, and Kavajecz (2009) look into data on the Euro-area government bond market and find that the relative contribution of credit quality and liquidity to bond pricing is conditional and time-varying. They show that the liquidity concern among investors is particularly strong when the market is stressed and undergoing greater volatility. The market volatility potentially drives the co-movements of flight-to-quality and flight-to-liquidity motives among investors.[1] In this paper, however, we contribute to this strand of literature by documenting that the bond default risk directly shifts the degree of illiquidity pricing in the China's bond market.

China never had an official bond default before 2014. The recent emerging wave of credit events in China's bond market clearly provides a unique and exogenous context to explore the time variation of bond defaults and examine how the illiquidity premium is directly affected by the market-wide credit risk.[2] We therefore hypothesize that investors in an environment without any risk exposure to credit events before 2014 should not exhibit any particular preferences toward flight-to-liquidity, given that all bonds traded have all their future cash inflows predetermined without uncertainty. Without any materializable credit risk, bond investors' optimal strategy is to hold default-free bonds until maturity, as trading in such an illiquid market is extremely costly.[3] We then test the flight-to-liquidity hypothesis after 2014 and find that investors are compensated for holding illiquid bond securities. That is, the illiquidity premium will be required in response to rising market-wide credit risk.

In specific, we study Chinese corporate bond data for years from 2009 to 2019 in the exchange market to test the empirical hypothesis.[4] Following Dick-Nielsen,

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[1] However, it should be pointed out that disentangling the flight-to-quality from flight-to-liquidity channel can be difficult. For example, the risk attitudes toward characteristics of corporate bonds are positively correlated in the U.S. data. See Ericsson and Renault (2006) and Beber, Brandt, and Kavajecz (2009) for more detailed discussions. More recently, Dick-Nielsen, Feldhütter, and Lando (2012) show that the flight-to-quality effect is confined in the AAA-rated bonds during the financial crisis in the U.S. bond markets.

[2] The first bond default event in China occurred in March 2014, when Shanghai Chaori Solar Energy missed its interest payment to bond investors. As noted by He and Milbrad (2014), there possibly exist endogenous interactions between firm's default and its asset liquidity. However, we deem this rising market-wide credit risk after March 2014 as approximately exogenous at the aggregate level when studying corporate spreads at the bond level.

[3] Chinese corporate bonds are less liquid compared to the U.S corporate bonds (Amstad and He, 2020), especially before 2014, as the turnover rate of Chinese corporate bonds was very low, and investors had weak trading incentives.

[4] There are two market segments of China's bond market, i.e., the exchange market and the interbank market. There are both institutional and retail investors in the exchange market but only institutional investors in the interbank

Feldhütter, and Lando (2012), we use the principal component analysis (PCA) to construct the illiquidity factor and examine how investors in the bond market price this illiquidity factor before and after the first official default event in China. We find significantly positive illiquidity premium only after 2014, whereas illiquidity is even negatively priced in the bond market before 2014. Our evidence implies that investors become concerned about the bond liquidity once the bonds are defaultable. In addition, we further show that the illiquidity premium of the bond yields increases with the market-wide credit risk. Our paper then explores the heterogeneous effect of market-wide credit risk on the illiquidity premium. In particular, we find that the impacts of bond market defaults on the illiquidity premium are stronger among bonds with lower credit ratings, and bonds issued by the Private-Owned Enterprises (POE) and by lower-quality firms with lower return-on-assets (ROA) and higher debt-EBIT ratios. Our findings support that these bonds are more exposed to credit risk and are more likely to default since 2014.[1] We show our empirical results are robust with alternative measures of illiquidity, including the turnover ratio (Roll, 1984), the Amihud measure (Amihud, 2002), and price reversal (Bao, Pan, and Wang, 2011).

Our paper contributes to the literature in the following respects. First, our paper provides strong evidence to solidify the understanding of the interactions between

market. Investors in the exchange market are more active and the exchange is representative of the trading forces. Corporate bonds here refer to the exchange-traded corporate bonds that are issued in the exchange market. There is another form of corporate bonds in the Chinese bond market, namely, the enterprise bonds that are simultaneously traded in the exchange market and the interbank market. We show that our key empirical results are robust if we include the sample of the enterprise bonds traded in the exchange market in the regressions (See Table X).

[1] The State-Owned Enterprises (SOEs) enjoy pervasive implicit guarantees and the government bailouts (Zhu, 2016; Song, and Xiong, 2018). Bonds issued by the SOEs are considered to have low default risk and are routinely attached with higher credit ratings than those issued by the Private-Owned Enterprises (POE). The POE bonds are more prone to the default risk since 2014.

market-wide credit risk and illiquidity premium of bonds. Prior studies (e.g., He and Milbrad, 2014, Chen et al., 2018) highlight the strategic and endogenous interactions at the firm-level between corporate default and bond liquidity, and examine how the interactions affect the bond pricing.[1] Few research papers have addressed the impact of market-wide credit risk on bonds' illiquidity premium.

Second, we provide supportive evidence to identify the flight-to-liquidity effect under the condition of surging market-wide credit risk and further reveals how bond default matters for pricing the bond illiquidity. Our paper explores the unique features of China's bond market, which has been undergoing rising credit risk since 2014 and helps isolate the impact of bond defaults on the illiquidity premium. Our findings suggest that China's corporate bond market shares some similarities with European treasury bond markets (Beber, Brandt, and Kavajecz, 2009) and document that flight-to-liquidity can be a direct result of a deteriorated credit quality in the bond market.

Third, our paper complements the asset pricing literature trying to identify the determinants of the illiquidity premium in the bond market. Existing work has been focused on studying the link between the time variation in the illiquidity premium and aggregate credit conditions (Jensen and Moorman, 2010), the effects of macroeconomic factors on the illiquidity premium (Lu-Andrews and Glascock, 2010; Chen et al., 2018), and the forecasting ability of macro shocks on the term structure of bond market illiquidity premium (Goyenko, Subrahmanyam, and Ukhov, 2011). In this paper, we examine the pricing impact of changing market-wide bond default risk on the illiquidity

[1] Chen et al. (2018) develops a structural model and find that interactions between default and liquidity can account for 10% to 24% of the credit spread.

premium.

Fourth, our paper delves deeper into China's bond market, which itself is uniquely interesting. On the one hand, previous studies focus on bond credit ratings in China (e.g., Kennedy, 2008; Poon and Chan, 2008; Dhawan and Yu, 2015; Livingston, Poon, and Zhou, 2018; Jiang and Packer, 2019). On the other hand, the value of pledgeability in Chinese corporate bonds (Chen et al., 2019), the premium caused by China's yield-chasing retail investors (Liu et al., 2019), and the policy intervention in the Chinese bond market (Mo and Subrahmanyam, 2019) have been extensively explored. Geng and Pan (2021) study the impact of default events in China's bond market on the informativeness of credit spread, which is very close to ours. Our paper, however, explores the liquidity pricing of Chinese corporate bonds conditional on rising bond defaults, and thus is complementary to this booming literature on China.

The rest of the paper is organized as follows. Section 2 provides an overview of the institutional background and the bond default events in China. We describe our sample of corporate bonds and report the summary statistics in Section 3. Section 4 examines the implications of rising defaults and the spiking-up of market liquidity for pricing corporate bonds in China. We conclude the paper in Section 5.

2. Institutional Background

2.1 Bond Defaults in China

Before 2014, there was no materialized credit default in China's bond market, although there were some bond default crises, such as the Shanghai Fuxi event in 2006 and the

Shandong Helong event in 2012. The last-minute government bailout in China eliminated these bond default crises. The implicit guarantee by the government has thus gradually shaped the market expectations, and the effectiveness of bond market pricing has also been questioned. However, since the beginning of 2014, there has been a wave of bond defaults in China. In March 2014, the domestic credit bonds defaulted for the first time, when Shanghai Chaori bonds missed the interest payment.[1] Since then, the number of bond defaults has increased significantly.

[Insert Figure 1 here]

Panel A in Figure 1 shows the number and the total amount of China's credit bond default events by year. There were five bond defaults in 2014, 28 in 2015, 53 in 2016, and 27 in 2017, but they significantly increased to 115 and 144 in 2018 and 2019, respectively.[2] Meanwhile, China's total amount of credit bond defaults was 1.34 billion RMB in 2014, peaking at 37.7 billion in 2016, and decreasing to 21.8 billion in 2017 but rebounding to 113.1 billion and 112.2 billion in 2018 and then in 2019. By the end of 2019, 374 domestic bonds had defaulted. Although the Chinese government may be readily available to intervene and rescue in the bond market, especially for the bonds issued by the State-Owned Enterprises, i.e. the SOE bonds, bond default events have occurred routinely since 2014.

Panel B in Figure 1 displays the number and bond default rate by defaulting entities in China. By the end of 2019, there had been 141 defaulting entities. A total of

[1] As reported in a news article, “Chaori Solar’s default would mark the first time a company has defaulted on publicly traded debt in China since the central bank began regulating the market in the late 1990s”. More information can be found: https://www.ft.com/content/56a3b69b-82e3-3e63-8da8-da9f98fc7f1a.

[2] More than 20 bonds had the principal and interest payment rolled over in 2019 and technically more bonds could have defaulted.

118 private entities accounted for a significant proportion of defaulting issuers. The rest are SOEs, of which 9 are central government-owned SOEs and 14 are local government-owned SOEs. The default rate turned positive in 2014 and rose sharply in 2015. It fell in 2017 but skyrocketed in 2018 and 2019. Panel C in Figure 1 shows the rolling monthly default rate, calculated as the ratio of the number of defaulted bonds during the past 12 months over the average number of all credit bonds in the credit market over the past 12 months. We observe an increasing trend of market-wide credit risk and bonds are increasingly defaultable.

2.2 Bond Default of Shanghai Chaori Solar Energy

In the evening of March 4, 2014, Shanghai Chaori Solar Energy, a listed company in Shenzhen Stock exchange, made a formal announcement that the company could not pay the outstanding balance of interests of "11 Chaori debt" in full on schedule.[1] Since then, "Chaori debt" has officially been known as China's first defaulted bond, which also indicates that the government's implicit guarantee for ensuring zero default for the public debt has been officially broken. In fact, Shanghai Chaori Solar Energy has shown difficulties in operations and liquidity before the bond default. From December 20, 2012 to May 18, 2013, the credit rating of Shanghai Chaori Solar Energy was downgraded from AA to CCC, and the company was listed as an ST (special treatment) company due to continuous operating losses. However, it was widely believed that the government would provide liquidity to bail out the debt crisis. Nonetheless, the

[1] "11 Chaori debt" was issued by Shanghai Chaori Solar Energy on March 7, 2012 with a security code "112061". The original interest payment date of "11 Chaori debt" is on March 7, 2014, and the company was able to pay a total of RMB 4 million, which only accounted for 4.5% of the total amount of interest payment.

expectation of rigid redemption was broken for the first time ever in China per the Chaori bond default.

The bond default of Shanghai Chaori Solar Energy can be seen as the starting point for the "no bailout" reform in China (Mo, Gao, and Zhou, 2021). In the early stage of the development of the bond market in China, investors were reluctant to trade and the market liquidity was pretty low. In order to encourage investors to participate, both the government bailouts and the third-party guarantees ensured the rigid redemption of corporate bonds. However, the implicit government guarantee also distorted investors' perception of the underlying credit risk, which significantly affected the pricing of bond liquidity in the market. As a result, the illiquidity was not effectively priced without any materializable credit risk. We show that the Chaori bond default has significantly updated investors' perceptions of bond credit risk, resulting in rational expectation equilibrium and thus more effective bond pricing. Therefore, by breaking the expectation of the government's rigid redemption, the Chaori bond default event naturally serves as the critical turning point in our paper for the subsample analysis and for exploiting the time variation in the relationship between the illiquidity premium and the market-wide credit risk in the bond market.

3. Data Description

The Chinese economy consistently and heavily relies on the banking system, which left the Chinese bond market relatively underdeveloped until recently. The total capitalization of the bond market in China was as small as approximately 35% of its

GDP in 2008, in which the credit bond market took a minuscule share of 15% of the total valuation of the bond market (Amstad and He, 2020). We thus focus on a sample of a more matured and fast-growing market segment of corporate bonds starting from 2009, which also abstracts from the financial turmoil in 2008. Our analysis is carried out using a range of data sources. First, the bond market transaction data and the associated credit ratings are obtained from the China Stock Market & Accounting Research (CSMAR) database. Second, the accounting data from the financial statements of bond issuers are accessed through the WIND database. Third, the macroeconomic data are directly obtained from the CEIC database.

We primarily work with the credit spread of corporate bonds. In particular, the monthly yields of a bond are calculated using closing prices on the last day of each month. The credit spread is computed as the yield of a bond minus the matched treasury yields of similar maturity. Our study focuses on corporate bonds in China for the following reasons. First, corporate bonds are issued and traded on the exchange markets involving institutional and retail investors. Notably, issuers of corporate bonds are primarily listed firms that maintain good financial reporting practices and high-quality accounting data. Second, issuing corporate bonds generally does not require third-party sponsorships, which means that the market price better reflects the ongoing credit risk and liquidity dynamics. Third, since March 2014, when China first registered its official bond defaults, corporate bonds accounted for the most significant percentage of defaulted bonds and have been greatly affected by market-wide defaults and changes in the risk profiles.

After applying several data filters, we finalize with a sample of bond-level panel data covering 2,233 bonds of 57,290 monthly observations. Our credit spread sample has been winsorized by the top and bottom five percentiles of the distribution, which effectively removes the negative spreads and extreme values.[1] Table I reports the main descriptive statistics of our data sample. Our summary statistics suggest a mean credit spread of 6.281% and a median of 4.025%. In addition, Table I presents the summary metrics of the corporate bond issuers regarding the firm's size, capital structure, profitability, and debt repayment ability. These dimensions are measured by the log of total asset, leverage, net incomes over total asset (ROA), and the ratio of interest-bearing debt over earnings before interest and taxes (EBIT) (Debt-to-EBIT ratio), respectively.

Next, we discuss our empirical measures of market liquidity. First, the measure proposed by Amihud (2002) is one of the most widely used proxies in the literature for measuring market illiquidity. It has a simple construction that uses the absolute value of the daily return-to-volume ratio and multiplied by 10. We use the average of the absolute value of the daily return-to-volume ratio in a month to capture the degree of a bond's illiquidity. In addition, we compute the turnover rate of a bond, taking the ratio of the total trading volume in a quarter over the amount outstanding at the beginning of the quarter. Roll (1984) and Bao, Pan, and Wang (2011) argue that the covariance between consecutive bond returns reflects the information of bond liquidity. We follow

[1] The winsorization is motivated by the fact that our original sample of China's corporate bond credit spread contains some extremely large and negative values. Cutoffs at the five percentiles could be good choices because trimming too little at the bottom otherwise would include a significant margin of negative credit spread. We show that our empirical results are robust if we apply the top and bottom one or ten percentiles of winsorizations.

these approaches and compute the daily Roll measure and Gamma measure using a rolling window of 15 trading days. Our definitions of monthly Roll and Gamma measures are to take the average of daily measures in a month. Finally, we follow Dick-Nielsen, Feldhütter, and Lando (2012) and use the first principal component out of the four aforementioned measures of market liquidity or illiquidity as the baseline proxy for the illiquidity factor of each bond.[1] To ensure the robustness of our results, we further experiment with each proxy for regressions. The summary statistics of these variables are also shown in Table I.

[Insert Table I here]

In Figure 2, we plot the mean credit spread and the average market illiquidity factor of bonds in our sample over years. The average credit spread was flattened before 2014 and started growing with an accelerated rate since 2014, indicating a rising credit risk premium over time. On the other hand, the average bond illiquidity factor exhibited a downward trend, which suggests that the overall market liquidity of China's corporate bond market is improving, and trading is increasingly active. Before early 2014, we can see that the credit bond market was relatively illiquid due to the limited number of bonds and infrequent transactions. With the advancement of China's bond market reform in recent years, China's bond market has gained the sophistication and the market liquidity has been significantly enhanced.

[Insert Figure 2 here]

[1] The loading coefficients of the first principal component on Amihud measure, turnover measure, Roll measure and gamma measure are 0.3118, -0.1944, 0.6617, 0.6535, respectively. The first component explains 52% of the variation in these empirical proxies of liquidity measures given our baseline sample. Our measures of the market illiquidity factor for each bond thus increases when a bond's market liquidity is lower.

We then divide our bond sample into eight categories by examining the bond credit ratings. We create a categorical variable that equals 1 for AAA, 2 for AA+, 3 for AA, 4 for AA-, 5 for A+, A and A-, 6 for BBB, 7 for BB+, BB and BB-, 8 for B and below. Table II reports the credit spread distribution by bond rating and by the ownership status of bond issuers, i.e., the central state-owned enterprises (Central SOE), local state-owned enterprises (Local SOE), and privately-owned enterprises (POE). According to Table II, bond data observations are mainly concentrated in high rating classes of AAA, AA+, and AA. The distribution shows that, on average, Chinese corporate bond ratings are at the investment grades. In addition, note that the credit spread of central SOEs is much lower than those of local SOEs and POEs, suggesting that corporate bonds issued by central SOEs are on average less risky than those issued by local SOEs and POEs.

[Insert Table II here]

4. Empirical Results

This section examines the implications of rising defaults in China for pricing the liquidity in the spreads of corporate bonds. We show that corporate bonds in China are being traded at credit spread that is increasingly sensitive to market liquidity given heightened market-wide default risk. We further delve into the mechanism behind our empirical findings. Our evidence strongly suggests that the corporate bond market in China has exhibited a strong flight-to-liquidity effect ever since bonds became defaultable.

4.1 Hypotheses and Specifications

As we have shown in the data description section, China's bond market had never seen default risk materialized before March 2014. In theory, it can be optimal for bond investors to hold debt securities until maturity without default risk, which means there is little transaction motive after holding low-risk default-free security with high yield-to-maturity.[1] This explains why bond trading was thin, and the market was relatively illiquid before this critical point of time.

In contrast, given gradually heightened default risk since early 2014, market trading picked up because positive default risk triggered motives for turnovers, which compensated investors for holding these corporate bonds without trading upon rising credit risk in the market. To disentangle how the increasing market-wide credit risk affects the illiquidity premium in bond credit spread, we hypothesize that corporate bond credit spread could have exhibited heightened sensitivity to measures of market liquidity conditions once default risk started rising.

Hypothesis 1. *The credit spread of corporate bonds with lower market liquidity is increasingly larger than those with greater market liquidity when the market-wide default risk is increasing.*

We first provide an indirect test of Hypothesis 1. By simply dividing our bond data sample into two subsamples split by March 2014, we explore how the credit spread of

[1] When the official benchmark loan rate in China was still effectively bounded below before 2014, debt financing without the option of default could be very costly. This implies that the yield-to-maturity for debts used to be high.

corporate bonds is affected by their market liquidity measures with or without default risk. We choose March 2014 as the breaking point for our subsample analysis mainly because investors' expectation of rigid redemption has been shifted by the Chaori bond default in March 2014, which is the first ever official bond default in China.[1] Therefore, within each subsample, we run the following regression in a panel setting:

$$cs_{i,t} = \alpha + \beta \cdot illiquidity_{i,t} + controls_{i,t} + mcontrols_t + \lambda_y + \gamma_i + \varepsilon_{i,t} \quad (1)$$

According to Equation (1), the dependent variable, $cs_{i,t}$, denotes the credit spread of bond i traded in month t. Our key variable of interest is $illiquidity_{i,t}$, which measures the market illiquidity of bond i traded in a month and our baseline measure is the bond-specific market illiquidity factor. In a vector of control variables, $controls_{i,t}$, we include the total asset, leverage, ROA, debt-to-EBIT ratio, all at the issuer level, along with a bond's time to maturity and its credit rating.[2] In addition, we control for a range of macroeconomic variables at the monthly frequency as captured by $mcontrols_t$, which includes a risk-free rate measure, the slope of the yield curve, the CPI inflation, the aggregate stock index return, and the money (M2) growth rate.[3] Additionally, we take additional controls of the year fixed effects and the bond-specific

[1] As a simple exercise, we take March 2014 only as one of the important trigger points in time by which bonds are publically known to start being exposed to market default risk. This is motivated by the fact that the Chaori bond default was the first official known default event in China and was considered having huge impacts on bond pricing in China. We are not taking a strong stand by excluding the possibility that other default events after March 2014 can be used for identifying changes in bond spread beta on market illiquidity.

2 We match the credit spread in month *t* with the latest accounting and credit ratings data prior to month t from the issuer's financial statements.

3 We take the 7-day Shanghai interbank lending rate as the risk-free interest rate. The difference between the 10-year Treasury yield and the 1-year Treasury yield is used to capture the degree of the slope of the yield curve. The CPI inflation rate is measured by the year-over-year growth rate of the consumer price index. The monthly index of the Shanghai and Shenzhen 300 Index (HS 300 Index) are taken for computing monthly stock returns. Money growth rate is measured by the year-over-year growth rate of the broad-measure of Monetary Aggregates (M2).

fixed effect, which are denoted by λ_y and γ_i , respectively. We are primarily interested in the difference in the coefficient estimate of β before and after March of 2014, i.e., the change in bond pricing elasticity to market illiquidity between the two different subsamples.

To formally establish Hypothesis 1, we run regressions to identify if the potential shift in the bond's credit spread elasticity is driven by the rising default risk in the post-March 2014 subsample. The regression specification is outlined below:

$$cs_{i,t} = \alpha + \beta \cdot illiquidity_{i,t} + \omega \cdot illiquidity_{i,t} \cdot d_t + \phi \cdot d_t + controls_{i,t} + mcontrols_t + \lambda_y + \gamma_i + \varepsilon_{i,t} \quad (2)$$

Equation (2) augments the baseline specification of Equation (1) by introducing an aggregate measure of bond market default in month *t*, d_t, and its interaction term with the illiquidity measure. The market-wide bond default probability is calculated as the fraction of bonds defaulted over the past 12 months of all corporate bonds by month *t*. Instead of running regressions in subsamples, we estimate Equation (2) using our entire sample observations. The coefficient ω reflects whether the elasticity changes are associated with changing default probability.

Next, we delve deeper to understand the mechanism behind the changes in corporate bonds' risk loading of market illiquidity given rising default risk. The effective rate of defaults since March 2014 was not uniform across different types of corporate bonds. For example, bonds issued by POEs were much more likely to default relative to those issued by SOEs. In addition, the credit ratings of bonds and the profitability and repayment ability of bond issuers affect the credit risk of corporate bonds. Therefore, holding riskier bond types without trading requires an extra risk premium relative to the case when loading off these bonds through trading. On the other hand, the credit spread of low default risk bonds might become less sensitive to market trading because they are little affected by rising default risk in the market. Little trading motives are justified among these less risky bonds. Therefore, the flight-to-liquidity channel could play a role only when aggregate default probability rises, which says that investors are compensated more for holding defaultable bonds while these bonds are thinly traded. In equilibrium, trading and holding riskier bonds of low market liquidity require an increased risk premium as a compensation for investors. We then hypothesize that the riskier type of bonds exhibits larger pricing elasticity to market illiquidity when the aggregate default rate increases. Thus, we present our second hypothesis:

Hypothesis 2. *Riskier bonds with larger default risk exposure load more risk premium on the illiquidity factor, whereas less risky bonds load less risk premium on the illiquidity factor.*

To test Hypothesis 2, we run regressions with triple interaction terms conditional on measures of a bond's relative riskiness, market-wide default probability, and the illiquidity measures. Our regression specifications are as follows:

$$cs_{i,t} = \alpha + \beta \cdot illiquidity_{i,t} + \gamma \cdot illiquidity_{i,t} \cdot d_t \cdot RelRisky_{i,t} + controls_{i,t} + mcontrols_t + \lambda_y + \gamma_i + \varepsilon_{i,t} \quad (3)$$

In Equation (3), $RelRisky_{i,t}$ denotes a bond's relative riskiness in the bond universe. We take the bond issuer's ownership status (POE vs. SOE), profitability (ROA), debt repayment coverage (Debt-to-EBIT), as well as the credit ratings of bonds (AAA vs. non-AAA), to capture the relative riskiness across bond types. Note that in the regressions of these specifications, our control variable vector is expanded to include the interaction and level terms derived from the triple interaction term. Importantly, we are interested in knowing the coefficient estimate γ, which tells us if riskier bond types are loading more risk premium on market illiquidity.

4.2 Estimation Results

We test Hypothesis 1 by conducting both panel regressions and the Fama-MacBeth regressions of Equation (1). Before showing our regression results, we first plot the time series of the rolling averages of corporate bond illiquidity betas over the past 12 months derived from monthly Fama-MacBeth regressions and the market default rate in Figure 3.[1] The market default rate is calculated as the fraction of bond defaults over the past 12 months by month *t*. According to Figure 3, we observe that the illiquidity betas were negative and relatively unchanged along with zero default probability before 2014. Since March 2014, the default rate turned positive and started increasing over time, which was followed by a gradual climb-up of the illiquidity betas among corporate bonds. Therefore, time series plots in Figure 3 suggest that bond market

[1] The illiquidity betas are the rolling window regression coefficients of credit spread on the bond illiquidity factor as the first stage of Fama-Macbeth regressions.

defaults lead the bond spread sensitivities to vary with market illiquidity over time.

[Insert Figure 3 here]

Next, we estimate Equation (1) using subsamples, and the results are summarized in Table III. Focusing on the subsample ranging from January 2009 to February 2014, Columns 1, 2, and 3 of the left panel report the coefficient estimates related to corporate bond pricing before the first official default incident. Across columns and regardless of the set of controls, a significantly negative estimate of coefficient β from Equation (1) suggests that corporate bonds with illiquid trading exhibited lower credit spread. Our findings are consistent with the rationale that investors have little incentive to trade assets with trivial credit risk. In addition, it says that when a bond is traded more frequently over this period, the corporate spread is larger. Therefore, before early 2014, we find that corporate bonds in China had smaller credit spread once traded thinly.

[Insert Table III here]

Moving to the right panel of Table III, we have the estimation results based on the second subsample between March 2014 and December 2019. In contrast, the coefficient estimates of β from Equation (1) across Columns 4, 5, and 6 all turn positive, suggesting a significantly positive correlation between the market illiquidity and the credit spread of a corporate bond in more recent years. In other words, the pricing elasticity of corporate bonds on market illiquidity increased, and corporate bonds in China started exhibiting illiquidity premium. Therefore, bond investors started being compensated by a larger risk premium for holding corporate bonds of limited market liquidity in more recent years when market-wide default risk turned positive.

In addition, comparing estimates between Columns 3 and 6, larger bond issuers in terms of total assets tend to have their bonds traded at smaller spreads. On the other hand, bonds issued by more leveraged issuers are being traded with additional premiums. More importantly, these relationships have been reinforced in later years since 2014. Additionally, less profitable issuers with limited debt repayment abilities would have their bonds traded with a larger spread in recent years. Hence, our results in Table III suggest that the structural relationship between the credit spread of corporate bonds in China and their market illiquidity has been shifted over time. Illiquidity has been priced in corporate spreads ever since early 2014.

[Insert Table IV here]

In addition, we further conduct monthly Fama-MacBeth regressions to identify the illiquidity premium among corporate bonds in China over time following Fama and MacBeth (1973). We first run the cross-sectional Fama-MacBeth regressions by regressing corporate spreads of bonds on their illiquidity measures and the control variables for each month.[1] In Table IV, we report the results of the average coefficients of the Fama-MacBeth regressions for our two subsamples as split by March 2014 Consistent with Table III, corporate bonds in China picked up the positive spread sensitivity to market illiquidity in more recent years since early 2014. Hence, we confirm that the credit spread of corporate bonds with low market liquidity becomes increasingly larger in more recent years when default risk turns positive.

[Insert Table V here]

[1] Given the cross-sectional regression setting, we leave with the macroeconomic variables from the control variable set for regressions.

We further present the estimation results based on Equation (2) in Table V. Note that our baseline measure of the market default rate is the fraction of bond defaults over the past 12 months by month t, i.e., DR1. With and without bond-level and issuer-level controls, the coefficient estimates of ω in Columns 1 and 2 are both positive and significantly different from zero. That is, given that the market liquidity of a bond is worsen by one standard deviation, one percentage point increase in the rate of market defaults leads to 41 basis point jumps in the credit spread, which is a sizable loading up of risk premium on market illiquidity. This finding suggests that corporate bonds of limited market liquidity are being traded with a larger risk premium given rising default probability in the corporate bond market.

We then rerun estimations using later subsample data when the probability of defaults turned positive. It shows that our coefficient estimates across Columns 3 and 4 of Table V regardless of measures of the market-wide default probability find that the credit spread increases with the market illiquidity when default risk is increased. More importantly, as the average default rate in the post-2014 years is approximately 0.3%, using coefficient estimates from either column from the right-hand side panel almost recovers the bond pricing elasticity on the market illiquidity estimate of approximately 0.17, as shown in Columns 4, 5, and 6 of Table III over the same years. Therefore, the increased sensitivity of corporate bonds' credit spread on market illiquidity since March 2014 can be predominantly explained by the heightened default risk in China.

[Insert Table VI here]

To examine Hypothesis 2, we provide empirical evidence and demonstrate that the riskier type of corporate bonds loads more risk premium on the market illiquidity factor. First, given that bond-issuing firm's ownership status has a great influence on bond pricing (Ding, Xiong, and Zhang, 2020), we separate our bond sample by issuer's ownership into three groups, i.e., the central SOEs, the local SOEs, and the POEs. On average, the POE bonds exhibit larger credit risk than the Central and Local SOE bonds for various reasons. For example, the POEs are considered lacking government explicit or implicit sponsorship, have limited patent protection, and face more aggressive competition among peers (Livingston, Poon, and Zhou, 2018; Geng and Pan, 2021). In addition, it is the POE bonds that maintained a significantly positive probability of default since March 2014. Therefore, we check whether the POE bonds are becoming more sensitive to bond liquidity changes. In Table VI, we show coefficient estimates per Equation (3) that include the triple interaction terms taking a dummy variable (POE = 1) to measure the relative riskiness of the POE bonds compared to the SOE bonds. For comparisons, we take all the SOE bonds, the Central SOE bonds and Local SOE bonds as reference groups (POE = 0). The estimation results are tabulated in Columns 4, 5, and 6 of Table VI, respectively.

Focusing on Column 4 of Table VI, the coefficient estimate of γ from Equation (3) is significantly positive, suggesting that POE bonds load more on the size of the risk premium than that of the SOE bonds. This reflects the divergence in bond pricing dynamics between the POE bonds and the SOE bonds, given rising default probability in the market. As the POE bonds are relatively riskier than the SOE bonds, investors require more risk premium from holding the POE bonds conditional on thin trading.

Moving to Column 5, we see that POE bonds load much more risk premium on market illiquidity than central SOE bonds. Investors are compensated more for the infrequent trading of POE bonds. The central SOE bonds, conditional on rising aggregate default risk in the market, appear to be relatively safer. Trading safer central SOE bonds is less costly. This explains why the credit spread of the central SOE bonds with low market liquidity is smaller even if market default probability has picked up according to the estimate in Column 5. According to results in Column 6, the POE bonds and the local SOE bonds are indifferent in terms of how much market illiquidity would affect the credit spread. All these results reflect that Central SOE bonds are comparatively safer than POE bonds which are on par with Local SOE bonds in terms of riskiness. Our empirical evidence is consistent with Hypothesis 2 that credit riskier bond types are loading up the risk premium on market illiquidity.

[Insert Table VII here]

Following this line of exploration, we further classify the bond universe into riskier and safer bond types by their credit ratings, bond issuers' profitability and repayment ability metrics. In Table VII, we present the estimation results of Equation (3) to draw additional inference on Hypothesis 2. Across Columns 1, 2, and 3, when aggregate default probability rises, the coefficient estimates suggest that non-AAA rated bonds and bonds issued by less profitable firms as measured by low ROA or more leveraged firms given a low repayment ratio exhibit extra spread sensitivity to market illiquidity. Therefore, riskier bond types with larger default probabilities load more risk premium on market illiquidity, whereas less risky bond types load less of the illiquidity factor.

Hypothesis 2 is again consistent with the empirical evidence.

In summary, we provide a series of empirical evidence showing that market liquidity conditions have become a critically important factor for pricing corporate bonds since the first corporate bond default in early 2014. This dramatic increase in spread elasticity concerning the illiquidity factor suggests that investors become increasingly concerned with market liquidity when default risk grows in the market at the aggregate level. This is precisely the evidence supporting flight-to-liquidity, and we show that market-wide credit risk could have a significant impact on bringing forth the illiquidity premium in corporate spreads.

Next, to formally establish the flight-to-liquidity channel as the key mechanism behind our empirical evidence, we follow Beber, Brandt, and Kavajecz (2009) and illustrate by computing the absolute and relative size of the explanatory power of the illiquidity factor derived from the estimated Equation (1). Table VIII presents our calculated statistics. Rows 1 and 2 suggest that regardless of our absolute or relative measure, the part of the credit spread that can be explained by the illiquidity factor between March 2014 and December 2019 has increased dramatically relative to that in the earlier years. This clearly indicates that the bond's illiquidity plays a role in pricing in the later sample after the first default event took place in March 2014. Furthermore, we break our sample of bonds according to the riskiness of the bonds and examine which bond type picks up more of the illiquidity premium. Across Rows 3-11, our calculations based on the later sample from March 2014 to December 2019 strongly suggest that the illiquidity factor matters more among more risky bonds in the mid of rising aggregate default risk. In particular, the POE bonds and those issued by less profitable firms as measured by low ROA and more leveraged firms given a low repayment ratio appear to price in a larger amount of the illiquidity premium in recent years. We thus conclude that rising default risk in China's bond market since early 2014 helps trigger the flight-to-liquidity effects among corporate bonds, by which the illiquidity starts to be better captured in bond pricing in China.

[Insert Table VIII here]

4.3 The Results of Robustness

Finally, we provide additional empirical evidence to confirm the robustness of our baseline results. We first experiment with alternative measures of bonds' market liquidity conditions commonly used in the literature. The Amihud measure, Roll measure and Gamma measure are gauges of the degree of illiquidity. However, the turnover ratio of a bond proxies for the extent of liquidity. We then re-estimate the regression specification of Equation (1) using two different subsamples split by March 2014. Our estimation results are collected in Table IX. According to the coefficient estimates shown on the left-hand side panel based on sample data before the first default incidence, the three illiquidity measures are negatively correlated, whereas the turnover ratio is positively associated with the credit spread of corporate bonds. Moving to the right-hand panel, the coefficient estimates of the three illiquidity measures reversed signs, while that of the turnover ratio becomes insignificant, suggesting that corporate bond spreads have loaded more risk premiums on market illiquidity in more recent years since early 2014. These results are consistent with our baseline findings reported in Table III. Therefore, the increasing pricing elasticity changes with respect to market illiquidity in the midst of rising default risk are well detected regardless of how we measure bonds' market liquidity conditions.

[Insert Table IX here]

Next, we specifically explore whether rising default risk explains the risk loading changes among corporate bonds over time. First, the enterprise bonds, which are simultaneously traded in the exchange and interbank markets, are another important form of corporate bonds in China's bond market. We therefore include the enterprise bonds traded in the exchange market in our sample for regressions of the specification per Equation (2). The estimation results are shown in Column 1 of Table X, and our strong empirical results carry over if enterprise bonds are also considered. Second, on average, the actual trading of bonds in the Chinese market is less active than that in the U.S. counterpart or compared to stock trading in China. We, therefore, exclude those trading observations of infrequently traded bonds if a bond is traded in fewer than seven days in a month. We then run the regressions of Equation (2) specification based on a refined bond sample with more actively traded bonds. The estimation results are shown in Column 2 of Table X. It shows that among these bonds that are traded more frequently, the heightened aggregate market default risk still raises the risk loading of corporate bonds spreads on market illiquidity, although quantitatively, the coefficient estimate on the interaction term is somewhat larger. Additionally, substituting out the baseline measure of market liquidity condition using Amihud, Roll, and Gamma and the turnover ratio individually, we estimate Equation (2) based on our full sample data and report the results in Columns 3 to 6 correspondingly in Table X. The estimation results suggest that the rising risk of market default brings corporate bond spreads more closely affected by the market liquidity conditions. These results suggest that our baseline results are consistently robust.

[Insert Table X here]

In addition, to ensure the robustness of our results, we further conduct a series of regressions by exploiting different bond samples as divided by bond issuances and maturities. We report the regression results in Table XI. Column 1 presents the estimation results based on a sample of bonds with maturities ended before Mar 2014, i.e., the bonds issued and matured both before the rigid redemption expectation was broken whereby the market-wide default probability was zero. Column 2 and 3 report the estimation results taking all bonds issued before March 2014 regardless of their maturities. Therefore, relative to the bond universe as captured by Column 1, the sample for estimations included those bonds that were affected by the market default risk in later years since 2014. Columns 4 and 5 summarize the results of estimations based on a sample of bonds with trading launched only after March 2014, i.e., the newly issued bonds after the market default risk turned positive.

We have the following observations given results reported in Table XI. First, our subsample analysis finds that the bond spread beta on the market illiquidity factor was negative before March 2014. According to Column 1, this result can be largely driven by those earlier issued and matured bonds which were not subject to any default risk.

Trading of those non-defaultable credit bonds in early days of China's bond market increased market liquidity but incurred costs that lowered the bond prices. Holding illiquid bonds back then was not compensated with additional risk premium. Second, focusing on Column 2 and 4, we find that regardless of whether the corporate bonds were issued before or after March 2014, the spread beta on the market illiquidity factor turned significantly positive factor once we included additional bonds that had exposure to positive market default risk since early 2014. Therefore, the increased sensitivity of bond pricing to the market illiquidity is completely driven by the "risk exposure" to rising market default risk. Third, by directly examining the results uncovering the impacts of rising market default risk on bond spreads in Columns 3 and 5, the illiquidity beta on average was indifferent from zero but can be positive if and only if the market default risk is positive. This exactly highlights the differences of bond spreads between bonds issued and matured before March 2014 by which default risk cannot be a risk factor, and those bonds that started having exposed to default risk after March 2014 regardless of dates of issuance. Clearly, the coefficient related to the interaction term again shows that the increasing market default risk significantly raises the liquidity spread beta. Collecting our results across columns, we conclude that it is the bonds' risk exposure to market-wide defaults after March 2014, i.e., the critical time for the break-down of the rigid redemption in the bond market, that generates effective bonds pricing sensitive to market liquidity conditions. While the bond universe before and after the March 2014 cannot explain our main findings in this paper, defaults matter a lot for triggering the liquidity pricing in China's bond markets.

[Insert Table XI here]

5. Conclusion

In this paper, we study the impact of market-wide credit risk on liquidity pricing in the corporate bond market in China. We show that the occurrence and the increasing likelihood of bond default significantly affects the illiquidity premium of corporate bonds. In particular, conditional on the emergence of credit events in China's bond market, the illiquidity premium turned significantly positive only after the first officially registered bond default in early 2014 and increased ever since with the aggregate credit risk in the bond market. Thus, our documented evidence from the bond market in China demonstrates that liquidity is correctly priced only among defaultable bonds.

This dramatic increase in the elasticity of the corporate spread concerning the illiquidity factor suggests that investors become increasingly concerned with market liquidity when default risk grows at the aggregate level. We present the factual evidence supporting the flight-to-liquidity effect when default probability is effectively nonzero. While the reshuffling of bond universes over time cannot explain our main findings, our paper highlights that exposures to market-wide credit risk could significantly impact the illiquidity premium in the corporate bond market. Bond default matters after all, as the liquidity concern starts to play a nontrivial role. Our results imply that breaking the expectation of rigid redemption contributes to the effectiveness of price discovery in China's capital market.

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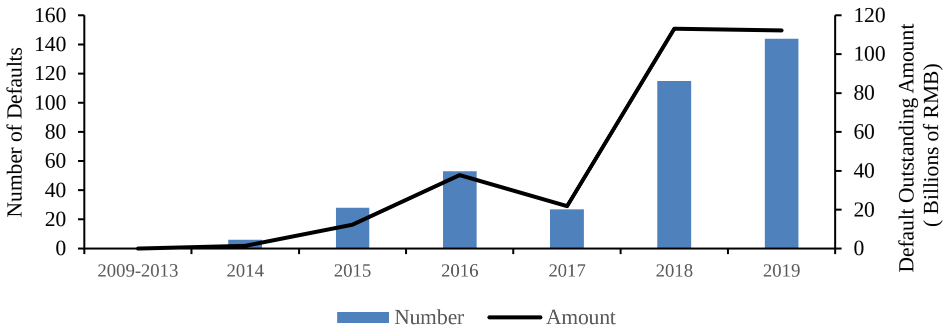
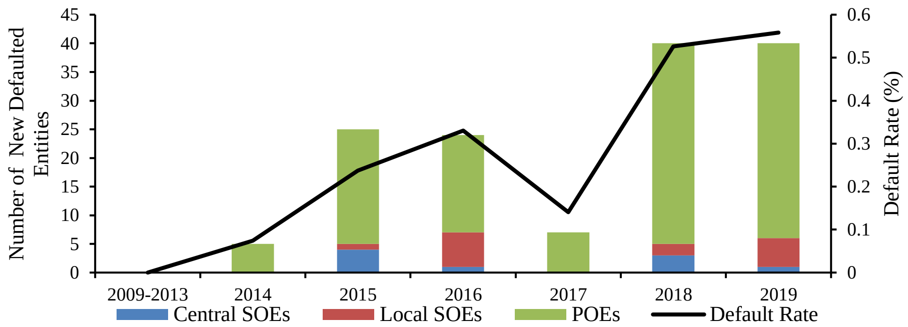
(a) Number and amount of Chinese credit bond defaults by year



(b) Number of Chinese defaulted entities and default rate by year



(c) Rolling monthly default rate

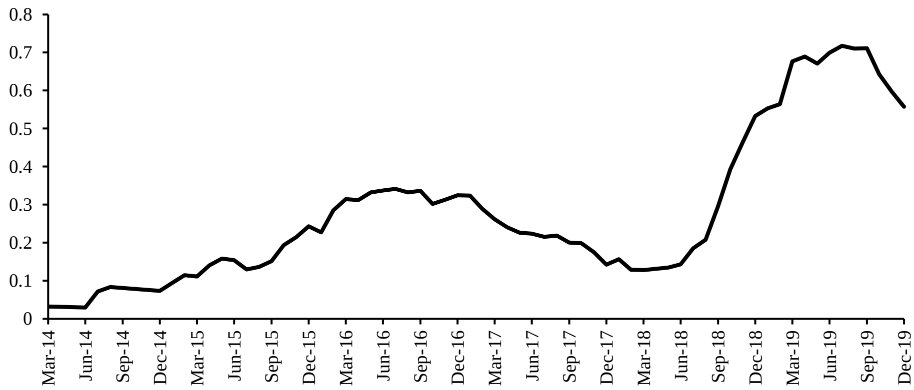


Figure 1. Chinese credit bond defaults and default rate

In this figure, we count the principal value of defaulted bonds in Chinese exchange and interbank bond markets. We exclude triggering cross-default clauses, technical defaults, principal, and interest rollovers, guarantee defaults according to Wind's criteria. Wind Database records duplicates of defaulted bonds in different years in the annual statistics of defaulted bonds and mount. We only keep one record. We count new defaulted entities in Chinese exchange and interbank bond markets every year. The default rate by year equals the ratio of defaulted bonds to the average of all credit bonds in the Chinese credit market at the beginning and end of the year. The rolling monthly default rate equals the ratio of defaulted bonds over the past 12 months including the current month to the average of all credit bonds in the Chinese credit market over the past 12 months including the current month.

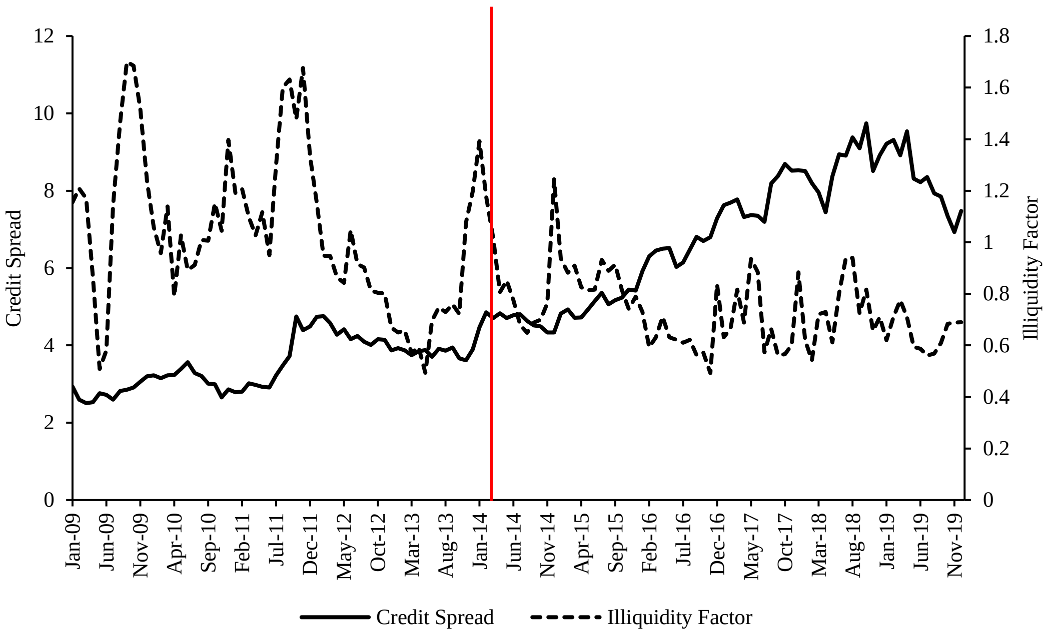


Figure 2. The time series of the mean credit spread and illiquidity factor

In this figure, the solid black line is the time series of monthly mean credit spread, and the black dashed line denotes the time series of monthly averages of bond illiquidity factor, and the red line denotes March 2014.

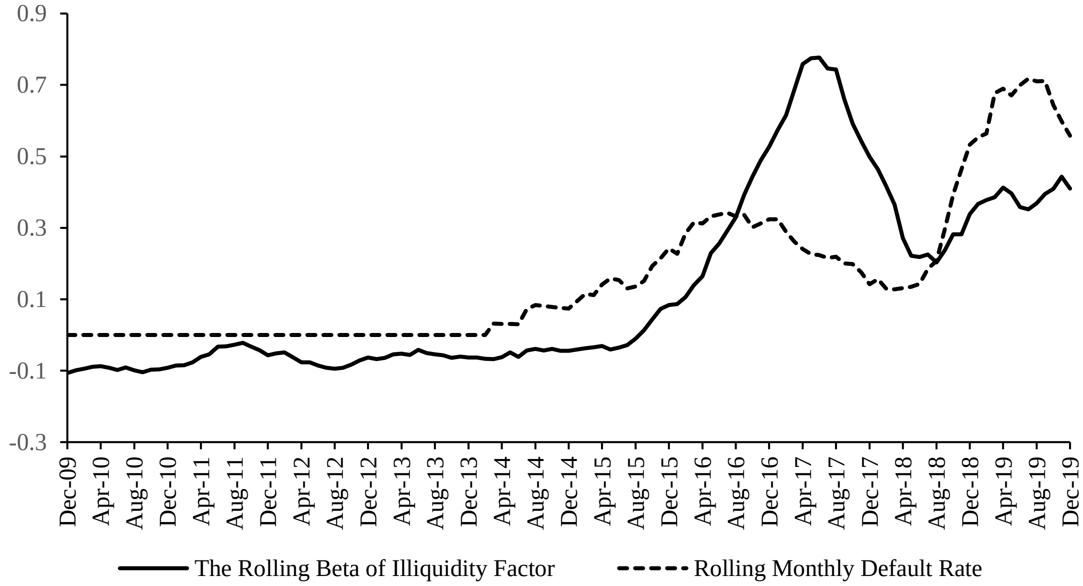


Figure 3. The relationship between illiquidity beta and default rate

In this figure, we plot the time series of illiquidity betas from monthly Fama-MacBeth regressions (i.e., the regression coefficients of illiquidity factor in the first stage) and the default rates. The solid black line denotes the time series of mean rolling (averaged over the past 12 months) corporate spread's beta of the bond illiquidity factor, and the black dashed line captures the time series of rolling monthly default rate that is the bond default rate of the past 12 months including the current month.

Table I. Descriptive statistics

Notes: This table reports the summary statistics of variables. The Amihud measure takes the absolute value of the daily return-to-volume ratio and multiplied by 10^6, as proposed by Amihud (2002). The turnover measure denotes the value of the quarterly total trading volume over the past 3 months including the current month to outstanding amount ratio. Roll measure is the liquidity proxy proposed by Roll (1984), and is calculated as functions of serial correlations of returns R_i exactly according to $2\sqrt{-cov(R_i, R_{i-1})}$. If $-cov(R_i, R_{i-1})$ is negative, the value of Roll measure is assigned to be zero. Gamma measure is the liquidity proxy proposed by Bao, Pan, and Wang (2011), and is computed according to $-cov(R_i, R_{i-1})$. We define a daily Roll measure and Gamma measure on days with at least one transaction using a rolling window of 15 trading days. We define the monthly Amihud, Roll, Gamma measures by taking the mean of daily measures within the month. The illiquidity Factor is the first principal component of the four proxies, including Amihud, Turnover, Roll, and Gamma measures.

Variables	Observations	Mean	Standard Deviation	10%	Median	90%
Credit spread (in percent)	57,290	6.281	7.139	1.926	4.025	12.434
Size (Log of total asset)	57,290	24.222	1.377	22.588	24.063	26.117
Leverage (in percent)	57,290	59.010	15.183	37.546	60.293	78.247
ROA (in percent)	57,290	2.442	3.081	0. 023	1.738	6.481
Interest-bearing debt to EBIT ratio	57,290	12.243	18.266	1.861	6.658	27.548
Amihud measure	57,290	0.984	3.275	0.0001	0.010	2.121
Turnover measure	57,290	0.097	0.142	0.001	0.041	0.265
Roll measure	57,290	0.520	0.862	0.000	0.190	1.437
Gamma measure	57,290	0.255	0.875	-0.015	0.010	0.562
Illiquidity Factor	57,290	0.777	1.561	-0.024	0.179	2.217

Table II. Credit spread distribution by bond rating or ownership

Notes: This table reports the credit spread distribution by bond rating or ownership status. Central SOEs are the state-owned enterprise owned by the central government, Local SOEs are local government's associated state-owned enterprise, and POEs refer to the privately-owned enterprise.

Category	Observations	No. of Bonds	Mean	Median	Standard Deviation
AAA	12,183	660	4.132	2.450	5.570
AA+	14,916	687	5.846	3.623	6.857
AA	28,183	1,139	7.241	4.497	7.765
AA-	4,730	206	7.375	5.401	6.567
A+, A, A-	589	41	8.018	5.951	6.766
BBB	63	17	10.790	9.409	5.544
BB+, BB, BB-	21	6	11.950	11.423	3.831
B and below	36	9	13.187	10.980	7.199
Central SOEs	6,763	277	3.672	2.476	4.609
Local SOEs	27,877	1,128	7.151	3.978	8.568
POEs	22,650	828	5.988	4.557	5.400

Table III. Illiquidity premium before and after the Chaori bond default

Notes: This table reports the credit spread regressions where the dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, in percent). The main explanatory variables of interest are the *Illiquidity Factor*. Control variables include *Size*, *Leverage*, ROA, *Debt to EBIT ratio*, and other control variables (time to maturity, interest rate, yield slope, CPI, stock return and money (M2) growth rate, year dummy, rating dummy). The numbers in parentheses are *t* statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5%, and 10% levels, respectively.

	1	2	3	4	5	6
	Jan 2009-Feb 2014			Mar 2014-Dec 2019		
Illiquidity Factor	**-0.053***** **(-3.658)**	**-0.056***** **(-3.876)**	**-0.057***** **(-3.930)**	**0.170***** **(8.463)**	**0.170***** **(8.571)**	**0.170***** **(8.613)**
Size			-0.636*** (-5.220)			-2.337*** (-12.576)
Leverage			0.021*** (4.521)			0.147*** (22.360)
ROA			-0.006 (-0.451)			-0.138*** (-8.174)
Debt to EBIT ratio			-0.004** (-2.056)			0.007*** (2.904)
Intercept	2.832*** (14.717)	7.614*** (11.981)	22.323*** (7.117)	-1.587*** (-7.052)	12.668*** (18.067)	62.988*** (13.630)
Other Control Variables	No	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	Yes	No	Yes	Yes
Bond fixed effects	Yes	Yes	Yes	No	Yes	Yes
Number of Observations	11,651	11,651	11,651	45,639	45,639	45,639
Adjusted R^2	0.048	0.054	0.057	0.231	0.246	0.260

Table IV. Fama-MacBeth regression for illiquidity premium before and after the Chaori bond default

Notes: This table reports the Fama-MacBeth regressions for credit spread in which the dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, measured in percentage of basis points). The main explanatory variables of interest are the *Illiquidity Factor*. Control variables include *Size*, *Leverage*, ROA, *Debt to EBIT ratio*, and other control variables (time to maturity, rating dummy). The numbers in parentheses are *t* statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5%, and 10% levels, respectively.

	1	2	3	4
	Jan 2009-Feb 2014		Mar 2014-Dec 2019	
Illiquidity Factor	**-0.210***** **(-21.061)**	**-0.076***** **(-8.655)**	**0.359***** **(6.018)**	**0.313***** **(7.894)**
Size		-0.033 (-1.408)		0.595*** (14.660)
Leverage		-0.001 (-0.964)		-0.088*** (-10.707)
ROA		-0.038*** (-5.086)		-0.357*** (-13.827)
Debt to EBIT ratio		0.002 (1.257)		0.071*** (9.607)
Intercept	3.753*** (43.152)	4.595*** (7.779)	6.660*** (38.854)	-3.871*** (-3.252)
Other Control Variables	No	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	No	Yes
Bond fixed effects	Yes	Yes	No	Yes
Monthly Average Number of Observations	188	188	652	652
The Average of R^2	0.068	0.312	0.015	0.237

Table V. The impact of market default rate on the illiquidity premium

Notes: This table reports the results of credit spread regressions where the dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, measured in percentage of basis points) and the main explanatory variables of interests is the *Illiquidity Factor* and the interaction term between *Illiquidity Factor* with *Default rate*. Control variables include *Size Leverage*, ROA, *Debt to EBIT ratio*, *Default rate*, and other control variables (time to maturity, interest rate, yield slope, CPI, stock return, and money (M2) growth rate, year dummy, ratings dummy). *DR1* is the bond default rate of the past 12 months including the current month, and *DR2* is the bond default rate of the past 12 months rolling back from last month. The numbers in parentheses are t statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5%, and 10% levels, respectively.

	1	2	3	4
	Full Sample		Mar 2014-Dec 2019	
	DR1	*DR1*	*DR1*	*DR2*
Illiquidity Factor	0.064***	0.057**	0.065**	0.072**
	(2.804)	(2.543)	(1.962)	(2.193)
Default rate × Illiquidity Factor	**0.412*****	**0.408*****	**0.396*****	**0.382*****
	(5.215)	**(5.209)**	**(3.933)**	**(3.749)**
Size		-1.301***	-2.311***	-2.321***
		(-9.865)	(-12.431)	(-12.483)
Leverage		0.103***	0.147***	0.147***
		(21.358)	(22.335)	(22.332)
ROA		-0.131***	-0.136***	-0.137***
		(-9.987)	(-8.107)	(-8.122)
Debt to EBIT ratio		0.003	0.007***	0.007***
		(1.411)	(2.916)	(2.910)
Default rate	4.060***	1.142***	0.405	-0.660
	(11.430)	(2.897)	(0.935)	(-1.309)
Intercept	-1.753***	43.507***	62.032***	62.848***
	(-5.759)	(12.774)	(13.388)	(13.560)
Other Control Variables	No	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	Yes	Yes
Bond fixed effects	Yes	Yes	Yes	Yes
Number of Observations	57,290	57,290	45,639	45,639
Adjusted R^2	0.231	0.248	0.260	0.260

Table VI. The heterogeneous impact of market default rate on the illiquidity premium: the SOEs vs. POEs bonds

Notes: This table reports the credit spread regressions using the sample from Mar 2014 to Dec 2019. The dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, measured in percentage of basis points). The main explanatory variables of interests are the *Illiquidity Factor* and the interaction term between *Illiquidity Factor* with *Default rate*. *POE dummy* is equal to 1 if the bond is POE bond, otherwise equal to 0. Control variables include *Size, Leverage*, ROA, *Debt to EBIT ratio*, *Default rate*, and other control variables (time to maturity, interest rate, yield slope, CPI, stock return and money (M2) growth rate, year dummy, ratings dummy). *Default rate* is the bond default rate of the past 12 months including the current month. The numbers in parentheses are *t* statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5% and 10% levels, respectively.

	1	2	3	4	5	6
	All SOEs	Only central SOEs	Only local SOEs	All SOEs	Only central SOEs	Only local SOEs
Illiquidity Factor	**0.130*****	**0.067**	**0.126*****	0.104**	0.324***	-0.040
	(5.219)	**(1.314)**	**(4.583)**	(2.482)	(4.448)	(-0.828)
Default rate × Illiquidity Factor				0.133	-1.683***	0.785***
				(0.865)	(-6.410)	(4.430)
Default rate × Illiquidity Factor × POE dummy				**0.428****	**2.229*****	**-0.222**
				(2.015)	**(7.712)**	**(-0.959)**
Default rate × POE dummy				-1.112***	4.065***	-2.927***
				(-2.866)	(8.211)	(-6.930)
Illiquidity Factor× POE dummy	0.107***	0.200***	0.095**	0.107***	-0.248***	0.073
	(2.619)	(3.465)	(2.225)	(2.619)	(-2.815)	(0.939)
Size	-2.331***	-1.311***	-2.730***	-2.273***	-1.426***	-2.567***
	(-12.541)	(-6.828)	(-13.674)	(-12.187)	(-7.443)	(-12.817)
Leverage	0.147***	0.003	0.153***	0.146***	0.004	0.147***
	(22.425)	(0.434)	(21.998)	(22.117)	(0.547)	(21.090)
ROA	-0.137***	-0.174***	-0.147***	-0.138***	-0.168***	-0.150***
	(-8.150)	(-9.933)	(-8.146)	(-8.163)	(-9.606)	(-8.321)
Debt to EBIT ratio	0.007***	0.002	0.009***	0.007***	0.003	0.009***
	(2.904)	(0.529)	(3.409)	(2.907)	(0.696)	(3.407)
Default rate				0.975**	-2.096***	2.066***
				(2.061)	(-3.430)	(3.958)
Intercept	62.776***	44.430***	72.954***	61.126***	46.698***	68.823***
	(13.583)	(9.287)	(14.723)	(13.155)	(9.752)	(13.819)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	45,639	24,318	40,545	45,639	24,318	40,545
Adjusted R^2	0.260	0.208	0.281	0.260	0.215	0.282

Table VII. The heterogeneous impact of market default rate on the illiquidity premium of bonds with different ratings or solvency

Notes: This table reports the credit spread regressions using the sample from Mar 2014 to Dec 2019. The dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, measured in percentage of basis points). The main explanatory variables of interest are the *Illiquidity Factor* and the interaction term between *Illiquidity Factor* with *Default rate*. *Non-AAA dummy* is equal to 1 if the bond is non-AAA bond, otherwise equal to 0. *Low ROA dummy* is equal to 1 if the ROA of the firm issuing the bond is smaller than the median each month. Otherwise equal to 0. *High Debt to EBIT dummy* is equal to 1 if the High Debt to EBIT of the firm issuing the bond is bigger than the median each month, otherwise equal to 0. Control variables include *Size, Leverage*, ROA, *Debt to EBIT ratio*, *Default rate*, and other control variables (time to maturity, interest rate, yield slope, CPI, stock return and money (M2) growth rate, year dummy, rating dummy). *Default rate* is the bond default rate of the past 12 months including the current month. The numbers in parentheses are *t* statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5%, and 10% levels, respectively.

	1	2	3
	AAA	ROA	Debt to EBIT
Illiquidity Factor	0.582***	0.120**	0.263***
	(7.743)	(2.574)	(5.446)
Default rate × Illiquidity Factor	-1.406***	0.042	-0.195
	(-6.328)	(0.295)	(-1.364)
Default rate × Illiquidity Factor ×Non - AAA dummy	**2.137*****		
	(8.570)		
Default rate × Non-AAA dummy	5.644***		
	(13.489)		
Illiquidity Factor× Non -AAA dummy	-0.636***		
	(-7.603)		
Default rate × Illiquidity Factor × Low ROA dummy		**0.677*****	
		(3.578)	
Default rate × Low ROA dummy		2.370***	
		(9.166)	
Illiquidity Factor× Low ROA dummy		-0.106*	
		(-1.771)	
Default rate × Illiquidity Factor × High Debt to EBIT dummy			**1.065*****
			(5.591)
Default rate × High Debt to EBIT dummy			1.651***
			(5.987)
Illiquidity Factor× High Debt to EBIT dummy			-0.346***
			(-5.618)
Size	-2.377***	-2.288***	-2.387***
	(-12.838)	(-12.322)	(-12.831)
Leverage	0.142***	0.142***	0.141***
	(21.790)	(21.598)	(21.357)
ROA	-0.134***	-0.076***	-0.129***
	(-8.011)	(-4.209)	(-7.627)
Debt to EBIT ratio	0.007***	0.007***	0.005*
	(2.819)	(2.598)	(1.900)

Default rate	-3.469***	-0.778*	-0.375
	(-6.693)	(-1.721)	(-0.827)
Intercept	65.147***	61.548***	64.270***
	(14.115)	(13.302)	(13.852)
Other Control Variables	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	Yes
Bond fixed effects	Yes	Yes	Yes
Number of Observations	45,639	45,639	45,639
Adjusted R^2	0.267	0.262	0.261

Table VIII. Explanatory power of the market illiquidity

Notes: This table reports the explanatory power of the illiquidity factor based on the estimated Equation (1). The total contribution and the relative proportion of the illiquidity as a factor that explains the credit spread are calculated according to the following: (a) Contribution: $\hat{\beta} \cdot (\text{Sample Average of Bond's Illiquidity Factor})$, and Other: (Sample Average of Bond's Spread - illiquidity's contribution). (b) Proportion: $(|\text{illiquidity contribution}| / (|\text{illiquidity contribution}| + |\text{other contribution}|)) \cdot 100$, and other proportion: (100 - illiquidity proportion). The sample coverage for computing these subgroups from rows 3 to row 11 is from Mar 2014 to Dec 2019.

		Contribution		Proportion	
		Liquidity	Others	Liquidity	Others
1	Jan 2009-Feb 2014	-0.208	4.033	4.90	95.10
2	Mar 2014-Dec 2019	0.856	6.051	12.39	87.61
3	Central SOEs	-0.117	4.038	2.82	97.18
4	Local SOEs	1.001	7.174	12.24	87.76
5	POE	0.966	5.327	15.36	84.64
6	AAA	0.51	3.812	11.81	88.19
7	Non -AAA	0.806	6.847	10.54	89.46
8	High ROA	0.565	4.940	10.26	89.74
9	Low ROA	0.973	7.330	11.72	88.28
10	Low Debt to EBIT	0.601	5.138	10.48	89.52
11	High Debt to EBIT	1.125	6.954	13.93	86.07

Table IX. The robustness tests of the illiquidity premium before and after the Chaori bond default

Notes: This table reports the credit spread regressions where the dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, measured in percentage of basis points). The main explanatory variables of interest are different *Illiquidity* measures. Control variables include *Size, Leverage*, ROA, *Debt to EBIT ratio*, and other control variables (time to maturity, interest rate, yield slope, CPI, stock return and money (M2) growth rate, year dummy, rating dummy). The numbers in parentheses are *t* statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5%, and 10% levels, respectively.

	1	2	3	4	5	6	7	8
	Jan 2009-Feb 2014				Mar 2014-Dec 2019			
Amihud	-0.011*				0.041***			
	(-1.707)				(4.983)			
Turnover		1.702***				0.415		
		(8.944)				(1.529)		
Roll			-0.103***				0.293***	
			(-4.043)				(7.710)	
Gamma				-0.055**				0.308***
				(-2.402)				(8.409)
Size	-0.634***	-0.567***	-0.630***	-0.635***	-2.316***	-2.309***	-2.349***	-2.332***
	(-5.196)	(-4.655)	(-5.172)	(-5.209)	(-12.454)	(-12.414)	(-12.635)	(-12.546)
Leverage	0.021***	0.020***	0.021***	0.021***	0.147***	0.146***	0.147***	0.146***
	(4.519)	(4.472)	(4.548)	(4.552)	(22.334)	(22.246)	(22.400)	(22.296)
ROA	-0.006	-0.003	-0.005	-0.005	-0.139***	-0.137***	-0.137***	-0.137***
	(-0.438)	(-0.235)	(-0.420)	(-0.430)	(-8.258)	(-8.128)	(-8.119)	(-8.111)
Debt to EBIT ratio	-0.004**	-0.004*	-0.004**	-0.004**	0.007***	0.007***	0.007***	0.007***
	(-2.022)	(-1.937)	(-2.032)	(-2.038)	(2.880)	(2.870)	(2.906)	(2.919)
Intercept	22.161***	20.469***	22.139***	22.167***	62.476***	62.339***	63.310***	62.919***
	(7.062)	(6.537)	(7.061)	(7.065)	(13.513)	(13.480)	(13.695)	(13.615)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	11,651	11,651	11,651	11,651	45,639	45,639	456,39	45,639
Adjusted R^2	0.056	0.063	0.057	0.057	0.259	0.258	0.259	0.260

Table X. The robustness tests of the impact of market default rate on illiquidity premium

Notes: This table reports the credit spread regressions using the sample from Mar 2014 to Dec 2019. The dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, measured in percentage of basis points) and the main explanatory variables of interests is the *Illiquidity Factor* and the interaction term between *Illiquidity Factor* or different *Illiquidity* measures with *Default rate*. Control variables include *Size*, *Leverage*, ROA, *Debt to EBIT ratio*, *Default rate*, and other control variables (time to maturity, interest rate, yield slope, CPI, stock return and money (M2) growth rate, year dummy, rating dummy). *Default rate* is the bond default rate of the past 12 months including the current month. The first column presents the results based on estimations taking a larger bond coverage including the enterprise bonds. The second column shows the results of a smaller sample of bonds by excluding trading observations of bonds traded in fewer than seven days in a month. The numbers in parentheses are *t* statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5%, and 10% levels, respectively.

	1	2	3	4	5	6
	Including Enterprise Bonds	Smaller Sample	Amihud	Turnover	Roll	Gamma
Illiquidity Factor	0.075***	-0.002				
	(3.867)	(-0.043)				
Default rate × Illiquidity Factor	**0.348*****	**1.062*****				
	(4.924)	**(6.789)**				
Amihud			0.011			
			(1.075)			
Default rate × Amihud			**0.124*****			
			(3.463)			
Turnover				1.601***		
				(5.516)		
Default rate × Turnover				**-6.365*****		
				(-5.916)		
Roll					0.125***	
					(3.104)	
Default rate × Roll					**0.490*****	
					(3.417)	
Gamma						0.181***
						(4.743)
Default rate× Gamma						**0.343*****
						(2.595)
Size	-0.971***	-1.185***	-1.288***	-1.258***	-1.310***	-1.300***
	(-7.767)	(-6.597)	(-9.767)	(-9.536)	(-9.933)	(-9.864)
Leverage	0.115***	0.049***	0.104***	0.103***	0.103***	0.103***
	(24.818)	(6.932)	(21.377)	(21.277)	(21.367)	(21.267)
ROA	-0.122***	-0.126***	-0.133***	-0.133***	-0.131***	-0.131***
	(-9.356)	(-6.648)	(-10.106)	(-10.084)	(-9.959)	(-9.970)
Debt to EBIT ratio	0.006***	-0.007**	0.003	0.003	0.003	0.003
	(4.378)	(-2.374)	(1.392)	(1.400)	(1.416)	(1.417)
Default rate	0.989***	0.594	1.287***	1.784***	1.211***	1.353***
	(2.617)	(0.841)	(3.281)	(4.502)	(3.058)	(3.457)

Intercept	34.948***	-1.185***	43.177***	42.399***	43.809***	43.566***
	(10.815)	(-6.597)	(12.673)	(12.437)	(12.855)	(12.790)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	65,256	23,149	57,290	57,290	57,290	57,290
Adjusted R^2	0.270	0.265	0.247	0.247	0.247	0.247

Table XI. The robustness tests of the impact of market default rate on the illiquidity premium: bond issuances and maturities

Notes: This table reports the credit spread regressions with different bond samples split by bond issuance dates and maturities. The dependent variable is the bond credit spread (i.e., bond yield to maturity less a benchmark Treasury yield to maturity, measured in percentage of basis points) and the main explanatory variables of interests is the *Illiquidity Factor* and the interaction term between *Illiquidity Factor* or different *Illiquidity* measures with *Default rate*. Control variables include *Size*, *Leverage*, ROA, *Debt to EBIT ratio*, *Default rate*, and other control variables (time to maturity, interest rate, yield slope, CPI, stock return and money (M2) growth rate, year dummy, rating dummy). *Default rate* is the bond default rate of the past 12 months including the current month. The first column presents the results based on a sample of bonds both issued and matured before Mar 2014. The second and third columns summarize the results of estimations based on a sample of bonds issued before Mar 2014 regardless of bond maturities. The fourth and fifth columns summarize the results of estimations based on a sample of bonds with trading launched after Mar 2014, i.e. a sample of newly issued bonds. The numbers in parentheses are *t* statistics. ***, **, * denotes coefficient is statistically significant at the 1%, 5%, and 10% levels, respectively.

	1	2	3	4	5
	Issued and Matured Before Mar 2014	Issued Before Mar 2014		Issued After Mar 2014	
Illiquidity Factor	-0.322**	0.195***	0.040	0.157***	0.072
	(-2.134)	(6.710)	(1.486)	(6.450)	(1.564)
Default rate × Illiquidity Factor			0.720***		0.249**
			(5.298)		(2.235)
Size	1.409	-0.636***	-0.311	-3.835***	-3.739***
	(0.848)	(-5.220)	(-1.147)	(-15.608)	(-15.216)
Leverage	-0.132*	0.021***	0.176***	0.121***	0.119***
	(-1.836)	(4.521)	(19.703)	(12.655)	(12.546)
ROA	-0.450**	-0.006	-0.105***	-0.261***	-0.259***
	(-2.181)	(-0.451)	(-4.491)	(-11.190)	(-11.116)
Debt to EBIT ratio	0.004	-0.004**	0.005	0.011***	0.011***
	(0.196)	(-2.056)	(1.497)	(2.889)	(3.071)
Default rate			-5.779***		3.166***
			(-7.452)		(6.919)
Intercept	1.515	11.676*	19.772***	104.064***	99.022***
	(0.039)	(1.746)	(4.819)	(16.825)	(15.945)
Other Control Variables	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Rating fixed effects	Yes	Yes	Yes	Yes	Yes
Bond fixed effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	413	24,491	36,142	21,148	21,148
Adjusted R^2	0.375	0.296	0.271	0.244	0.246