Liquidity Premium in the Eye of the Beholder: An Analysis of the Clientele Effect in the Corporate Bond Market*

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Abstract

This paper examines how liquidity and the heterogeneous liquidity preferences of investors interact to affect asset pricing. We use insurance firms' corporate bond holdings and measures of corporate bond illiquidity to quantify investors' liquidity preference. We find a wide dispersion of liquidity preference across investors. Such liquidity preferences persist over time and, importantly, are related to characteristics associated with investment horizons. Further, we find empirical evidence for the effect of liquidity clientele on bond pricing– the liquidity premium is substantially attenuated among corporate bonds heavily held by investors with a penchant for illiquidity.

Keywords: Liquidity Clientele Effect, Corporate Bond Illiquidity, Corporate Bond Holdings, Credit Risk

JEL Classifications: G01, G12, G22, C23

1 Introduction

The liquidity premium—the compensation demanded by investors for holding illiquid securities—has been well documented in various sectors of the financial market (see, e.g. Amihud, Mendelson, and Pedersen 2005 and references therein). More recently, a growing literature on the credit market has argued that liquidity may help explain the "credit spread puzzle" (Huang and Huang 2012) and/or the substantial unexplained component in corporate bond yield spread changes (Collin-Dufresne, Goldstein, and Martin 2001).[1] Indeed several empirical studies have reported a significant liquidity component in corporate bond yield spreads (see, e.g., Longstaff, Mithal, and Neis 2005; Chen, Lesmond, and Wei 2007; Bao, Pan, and Wang 2011; Dick-Nielsen, Feldhütter, and Lando 2012; Friewald, Jankowitsch, and Subrahmanyam 2012).

In this study we examine the related phenomenon of "liquidity clientele"—namely, due perhaps to heterogeneous investment horizons, some investors may require less compensation for holding illiquid securities and prefer holding more illiquid securities given the same level of compensation per extra unit of illiquidity, while other investors may prefer the opposite. When illiquid securities predominantly attract investors with low liquidity preference, the liquidity premium on these securities may be attenuated.

The idea of liquidity clientele can be traced to Amihud and Mendelson (1986), who show that when investors have different (exogenous) investment horizons, those with longer horizons tend to hold more illiquid securities. One important implication of this clientele effect is that the liquidity premium is a concave function of trading cost. Using a model with endogenous trading horizons, Constantinides (1986) shows that investors reduce their trading frequency in response to high trading cost and thus hold illiquid securities much longer than they hold liquid ones. These studies suggest that liquidity clientele is an important aspect

[1] The "credit spread puzzle" here refers to the stylized fact that structural models can explain only a small portion of investment-grade corporate bond yield spreads if the models are required to be consistent with historical default losses and the equity risk premium. Collin-Dufresne, Goldstein, and Martin (2001) document that proxies for credit risk explain only a small portion of spread changes and that the unexplained portion is driven mainly by factors that are independent of both credit-risk and standard liquidity measures.

when it comes to understanding the overall liquidity effect on asset pricing.[2] However, despite such prominent theoretical predictions, so far there is little direct empirical evidence on the existence of liquidity clientele and its impact on asset pricing in the corporate bond market—where liquidity presumably matters more than it does in the equity market or the Treasury market.

This study empirically analyzes the presence of liquidity clientele and its effects on corporate bond pricing using data on portfolio holdings of corporate bonds by insurance companies, which are by far the largest group of corporate bond investors.[3] Specifically, we construct a sample of 5,432 unique investment grade corporate bonds and 632 speculative grade bonds, held by 2,433 insurers, along with information on their quarterly holdings of these bonds over the period Q1 2003–Q4 2009. We focus mainly on investment grade bonds in our empirical analysis, because liquidity is likely a major determinant of their yield spreads (e.g., Huang and Huang 2012) and also because insurers have limited participation in the high-yield bond market, due to stringent risk and capital regulations (see, e.g., Campbell and Taksler 2003; Ellul, Jotikasthira, and Lundblad 2011; Ambrose, Cai, and Helwege 2012; Becker and Ivashina 2013).

Using the holdings data, we quantify the liquidity preference profile for each insurer based on the principle of revealed preference and then measure the liquidity clientele profile for each corporate bond. We estimate each bond's illiquidity by employing five commonly used bond-level illiquidity measures. An insurer's illiquidity preference (ILP) is taken to be the weighted average illiquidity of the corporate bonds that it holds (with a low ILP indicating a high preference for liquidity). Then, for each corporate bond, we quantify its illiquidity clientele (ILC) by the weighted average of its holders' ILPs, with a high ILC indicating the holders having a low preference for liquidity or equivalently a high penchant for illiquidity.

[2]Recently Beber, Driessen, and Tuijp (2012) extend the idea to liquidity risk clientele by combining Amihud and Mendelson (1986) and Acharya and Pedersen (2005), and use calibration analysis to show that endogenous liquidity risk clientele may substantially reduce the liquidity risk premium. See also Schuster, Trapp, and Uhrig-Homburg (2013). Jang, Koo, Liu, and Loewenstein (2007) extend Constantinides (1986).

[3]For example, according to the Federal Reserve Flow of Funds Accounts data, insurers collectively hold about one third of all corporate bonds issued in the U.S. market.

Using these measures, we shed light on several fundamental questions regarding the liquidity clientele effect in the corporate bond market.

We begin with an investigation of the liquidity preference of insurers and show that insurers' liquidity preference is widely dispersed. Such cross-sectional difference of liquidity preference is found to be also highly persistent, in that insurers with high illiquidity preference measures continue to have high *ILP*s at least three years after the initial ranking. Further, insurers' liquidity preference can be linked to various firm characteristics indicative of their investment horizons and more generally, their capability to hold illiquid securities. For example, insurers with higher *ILP*s tend to have lower trading turnover and hold bonds longer in their portfolios; these insurers are also older and larger, and are more likely to be life insurers (whose liability maturities are typically longer than those of property and casualty insurers). These patterns are consistent with the notion of liquidity "clientele effect" introduced by Amihud and Mendelson (1986; Proposition I).

We then examine the implication of this liquidity clientele for corporate bond yield spreads. Based on both double-sorted portfolios and panel regressions, we find that insurers' liquidity preference interacts with bond illiquidity to affect the yield spreads. Specifically, more illiquid bonds are found to command higher yield spreads, consistent with the liquidity premium effect. And more importantly for the purpose of this paper, we find that liquidity clientele attenuates the liquidity premium effect.

For example, consider the case where the bond-level illiquidity is proxied by the Amihud (2002) measure. Among corporate bonds in the lowest *ILC* quintile (bonds held by insurers with the least preference for illiquidity), the average yield spread difference between bonds in the top illiquidity quintile and those in the bottom quintile is 0.53%. By contrast, among bonds in the highest *ILC* quintile (bonds held by insurers with the strongest penchant for illiquidity), the average yield spread difference between the top illiquidity quintile and the bottom one is only 0.28%. Thus, going from the lowest to the highest *ILC* quintile, the liquidity premium component in the yield spread is reduced by almost half. Similar results obtain after controlling for bond credit rating, maturity, and other bond characteristics, and when other bond-level liquidity measures are used.

As a robustness check, we also construct a liquidity clientele measure based on insurers' portfolio turnover instead of the illiquidity of portfolio holdings, based on the notion of latent liquidity proposed in Mahanti, Nashikkar, Subramanyam, Chacko, and Mallik (2008). Our findings remain qualitatively the same under this alternative clientele measure.

Lastly, we examine the impacts of liquidity clientele on corporate bond yield spreads for subperiods and subsamples. (i) We split the sample into periods before the recent financial crisis and during the crisis, and find evidence of a strong clientele effect in both periods. (ii) We divide the full sample of investment-grade bonds into two groups by the bond maturity: bonds with a maturity of five years or shorter and bonds with a longer maturity. We find a strong clientele effect among long-term bonds but a fairly weak effect among short-term bonds. This is likely because the effective holding horizon on short-term bonds is short for any type of investors. In other words, for short-term bonds, long-horizon investors have little advantage in amortizing the trading cost. (iii) We examine bonds with high insurer ownership (i.e., above 20% of bonds outstanding held by insurers) versus those with low insurer ownership. We find that our liquidity clientele measures have a significantly negative impact on the liquidity premium for the former group but an insignificant impact for the latter group. (iv) Finally, we extend the analysis to high-yield bonds and find little evidence for the impact of liquidity clientele on the yields of these bonds. One possible reason for this result is that insurers, holding a relatively small amount of high-yield bonds, are not the marginal investors of such bonds. Another possible reason is that credit risk dominates liquidity as the determinant of spreads on high-yield bonds. The last two findings highlight the importance of relying on marginal investors' holdings in order to better measure the effect of liquidity clientele on bond pricing.

The rest of the paper is organized as follows. Section 2 describes the liquidity clientele effect and its impact on liquidity premium. This section also introduces our empirical measures for insurer-level illiquidity preference and bond-level illiquidity clientele. Section

3 discusses data and measures of bond illiquidity used in our empirical analysis. Section 4 presents empirical results. Section 5 concludes.

2 Implications of Liquidity Clientele Effects

In this section we first review the main implications of the Amihud and Mendelson (1986) model, which serve as the basis of our hypothesis on the liquidity clientele effect. We then introduce empirical measures of illiquidity preference and illiquidity clientele that can be used to test the hypothesis.

2.1 Liquidity Clientele and Its Effects on Yield Spreads

In the Amihud and Mendelson (1986) model, a security's trading cost (or illiquidity) is the bid-ask spread and an investor's liquidity preference is driven by her investment horizon. Both the bid-ask spread and the investment horizon are exogenously specified. An investor's net expected return per period on a security is the gross expected return per period (before trading cost) minus the amortized trading cost.

If investors have the same horizon, then in equilibrium, among securities with the same risk hence the same net expected return, those with higher trading cost must have higher gross expected return. This is known to be the *unconditional liquidity premium effect*.

If investors' horizons are heterogeneous, in equilibrium gross expected returns of two securities with different trading costs are such that longer- and short-horizon investors prefer the more illiquid and liquid securities, respectively. Intuitively, this is because investors with a longer horizon have a lower amortized trading cost and thus have a competitive advantage (i.e., requiring a lower gross return) for holding the illiquid security, relative to investors with a shorter horizon. The tendency for investors with less demand for liquidity (longer-horizon investors here) to hold more illiquid securities is known as the *liquidity clientele effect*.

This liquidity clientele effect has an asset pricing implication for the liquidity premium: It is lower for securities held by investors with longer horizons because they require less compensation in the gross expected return for per unit of trading cost. We refer to this as the impact of liquidity clientele on bond pricing. Amihud and Mendelson (1986) take this effect further to derive a concave relation between the trading cost and the liquidity premium: since illiquid securities tend to be owned by investors with a long horizon, after integrating out the effect of the security ownership (i.e., the liquidity clientele), the liquidity premium associated with per unit of trading cost decreases with trading cost.

Amihud and Mendelson (1986) empirically document a concave relation between the stock returns and the quoted bid-ask spreads, consistent with the liquidity clientele effect without explicitly conditioning on the liquidity clientele. However, efforts to find more direct evidence of the existence of liquidity clientele and liquidity clientele effect have been limited so far, due to data constraints to a large extent—typically we do not know the identities of security holders and their liquidity preferences.[4] As such, data on insurance companies' corporate bond holdings offer a unique opportunity to directly test the liquidity clientele effect in the corporate bond market.

2.2 Empirical Implications

Let S and ILQ denote the yield spread and the illiquidity of a bond, respectively.[5] The unconditional liquidity premium effect implies that

$$\pi = \frac{\partial \mathrm{S}}{\partial \mathrm{ILQ}} > 0. \tag{1}$$

where π, the association between yield spreads and illiquidity, is commonly interpreted as the liquidity premium per unit of illiquidity.

The existence of liquidity clientele suggests that the liquidity premium is lower when a bond is held by investors with less demand for liquidity, or a stronger illiquidity preference,

[4]Using the inverse of turnover as a proxy for the average holding period, Atkins and Dyl (1997) find that among NYSE stocks, those with higher bid-ask spreads have longer holding periods.

[5]We focus on yield spreads as this measure is widely used in studies of corporate bond liquidity effect. Our main findings hold qualitatively when expected yield spreads are used in the analysis (see Sections 3.2 and 4.4.4). As noted in Amihud, Mendelson, and Pedersen (2005), the expected yield of a corporate bond, equal to its promised yield less the bond's expected default losses, "provides a low-noise estimate of the expected return [of the bond]" (p. 332).

measured by *ILC* (the illiquidity clientele). Namely, we have

$$\frac{\partial \pi}{\partial \mathrm{ILC}} = \frac{\partial^2 \mathrm{S}}{\partial \mathrm{ILC}\, \partial \mathrm{ILQ}} < 0. \tag{2}$$

If long-horizon (short-horizon) investors always hold illiquid (liquid) securities as in the Amihud and Mendelson (1986) world, then *ILQ* and *ILC* are perfectly correlated. It follows from (2) that

$$\frac{\partial^2 \mathrm{S}}{\partial \mathrm{ILQ}^2} < 0, \tag{3}$$

This is analogous to the concave relation between the stock expected return and illiquidity documented in Amihud and Mendelson (1986).

In practice, *ILQ* and *ILC* can be imperfectly correlated due to several reasons. First, the corporate bond market is a dealer market with high trading and search cost, and there is no guarantee that investors can always locate a portfolio of securities that perfectly fits its liquidity preference. In addition, the empirical measures of *ILQ* and *ILC* are subject to measurement errors. As such, empirical tests of the liquidity clientele effect based on Eq. (2) are more general.

An additional relevant point is that, based on Eq. (1), as long as *ILC* is positively correlated with the illiquidity of a security, we have,

$$\frac{\partial \mathrm{S}}{\partial \mathrm{ILC}} > 0. \tag{4}$$

This allows us to relate *ILC* to the notion of "latent liquidity" introduced by Mahanti et al. (2008). Specifically, their latent liquidity measure for a given corporate bond is the weighted average of trading turnover of investors holding the bond. This latent liquidity measure is negatively correlated with *ILC* due to negative correlations between the portfolio illiquidity and the portfolio turnover. Mahanti et al. (2008) and Nashikkar et al. (2011) show that the latent liquidity measure is negatively related to bond yield spreads, consistent with Eq. (4). However, the focus of our study is different, and is on the effect of liquidity clientele on bond pricing, as described by Eq. (2).

2.3 Empirical Measure of the Illiquidity Clientele

We construct an empirical measure of the illiquidity clientele (ILC) in two steps. First, we measure an insurer's illiquidity preference (ILP) based on the illiquidity of the corporate bond portfolio that the insurer holds. Let $ILQ_{j,t}$ denote the time-t value of an illiquidity measure for bond j. Insurer i's portfolio illiquidity, or its illiquidity preference ($ILP_{i,t}$), is the weighted-average illiquidity of all corporate bonds held by the insurer:

$$\mathrm{ILP}_{i,t} = \sum_{j=1}^{N_i} w_{i,j,t}\mathrm{ILQ}_{j,t} = \frac{\sum_{j=1}^{N_i} V_{i,j,t}\mathrm{ILQ}_{j,t}}{\sum_{j=1}^{N_i} V_{i,j,t}} \tag{5}$$

where $w_{i,j,t}$ is the weight of bond j in insurer i's corporate bond portfolio, $V_{i,j,t}$ is the dollar value of holding by the insurer on bond j, and N_i is the number of corporate bonds held by the insurer. Thus, by definition, insurers holding more illiquid bonds have greater ILPs, i.e., exhibiting a preference for illiquidity.

In the second step, given the illiquidity preference $ILP_{i,t}$ of insurers, we quantify each bond's ILC as the weighted-average of illiquidity preferences across insurers holding the bond:

$$\mathrm{ILC}_{j,t} = \frac{\sum_{i=1}^{M} V_{i,j,t}\mathrm{ILP}_{i,t}}{\sum_{i=1}^{M} V_{i,j,t}} \tag{6}$$

where M is the total number of insurers. As such, corporate bonds held more by insurers with high ILPs (i.e., those with a strong illiquidity preference) have greater ILCs. Importantly, it follows from Eqs. (5) and (6) that the ILC and ILQ are correlated albeit not perfectly, as discussed earlier in Section 2.2.

3 Data

We use data from the National Association of Insurance Commissioners (NAIC), the Mergent Fixed Investment Securities Database (FISD), and the Trade Reporting and Compliance Engine (TRACE) over the period Q1 2003–Q4 2009.

Insurers are required by state insurance regulators to disclose their portfolio holdings and transactions each year on all financial securities including corporate bonds. Schedule

D data from NAIC include portfolio holdings for holding companies and subsidiaries. The FISD reports details for corporate debt securities, including information about the name of the issuer, seniority, coupon, face value, issuance date, maturity date, credit rating, and redemption features etc. TRACE provides information on bond transactions, such as the date and time of execution, the transaction price, and the yield to maturity at time of transaction. It is known that the TRACE data are developed in three phases: July 2002–February 2003, March 2003–September 2004, and October 2004–present. However, following Edwards, Harris, and Piwowar (2007) and Bao, Pan, and Wang (2011) we start our sample from Q1 2003, due to the concern about a limited number of corporate bonds included in phase I.[6] Below we describe how to construct the sample of corporate bonds along with their yield spreads and illiquidity levels, followed by summary statistics for the sample.

3.1 Sample

Our sample begins with all issues in the FISD that are included in the following eight categories of U.S. corporate bonds: i) Corporate Debentures; ii) Corporate MTNs; iii) Corporate MTZs; iv) Corporate passthrough trusts; v) Corporate PIK bonds; vi) Corporate zeros; vii) Corporate insured debentures; and viii) Corporate bank notes. The total number of unique corporate bonds in the initial sample is 25,857. Next, we restrict the sample to the plain-vanilla bonds and exclude bonds with optionality (e.g., call, put, sinking fund, convertible, and exchangeable), asset-backed securities, bonds with credit enhancements, floating-rate bonds, foreign-currency denominated bonds, preferred securities, and bonds with odd frequency of coupon payments. This filter drives the sample size down to 12,572 unique bonds. We then exclude bonds with missing data on bond characteristics such as issue date, maturity date, issue price, issuance size, coupon rate, and credit rating. This leaves 9,246 bonds in the sample.

[6] Untabulated results show that the main findings hold when the sample begins in either July 2002 (beginning of phase I) or October 2004 (beginning of phase III).

We extract data on corporate bond prices/yields and other information necessary for estimating each bond's illiquidity from TRACE. We start with bond transactions under regular sale condition and exclude transactions if the reported prices are special or include commissions, or if the bonds are purchased at issuance. We also follow Bessembinder, Kahle, Maxwell, and Xu (2009) to exclude trades under $100,000. Next, we use two sets of data-cleaning filters in order to alleviate potentially data errors in TRACE. The first set, based on Dick-Nielsen (2009), consists of the followings: (a) we delete duplicates identified by the message sequence number; (b) if a trade is subsequently reversed we exclude both the original trade and the reversal; and (c) we exclude the following two types of same-day corrections: if the correction is cancelation, both reports are deleted, and if it is a correction only the original is deleted. The second set includes a median filter and a reversal filter that help control for price errors (Edwards, Harris, and Piwowar 2007). The former filter eliminates any trade where the price deviates from the daily median or from a nine-trading-day median centered at the trading day by more than 10%; the latter filter eliminates any trade with an absolute price change deviating from the lead, lag, and average lead/lag price change by at least 10%.

We obtain information on insurers' corporate bond holdings and trades from the NAIC Schedule D data, which are detailed in Section 3.3. We exclude holdings reported by holding company-level firms.

Finally, we merge data on insurers' quarterly holdings of corporate bonds with data on corporate bond prices and illiquidity obtained from FISD and TRACE. We include a bond in the sample if it exists in the cleaned-up FISD sample described above and is held by at least one insurer during the sample period. Bonds with missing yields to maturity are excluded from the sample. In addition, similar to Lin, Wang, and Wu (2011) we eliminate bonds that have less than one year to maturity. As reported in Panel A of Table 1, our final sample includes 6,064 unique corporate bonds (5,432 investment grade and 632 high-yield bonds) over the period Q1 2003–Q4 2009. This accounts for more than 70% of the 8,414 bonds in the cleaned-up FISD sample.

3.2 Yield Spreads and Bond Illiquidity

For the purpose of our empirical analysis, we need quarterly yield spreads on bonds in our sample. However, it is known that many corporate bonds are infrequently traded. We obtain bond yields using the following method (e.g., Dick-Nielsen, Feldhütter, and Lando 2012): For a bond traded during the last month of a calendar quarter, we identify the day closes to quarter-end on which the bond is traded and take the average yield for all trades on this bond during that day. For a bond not traded during the last month of the quarter but traded during the first two months of the quarter, we take the average yield based on all trades on the bond during the quarter.

A corporate bond's yield spread is calculated as the difference between the bond's yield and the fitted Treasury yield with matching maturity. The quarter-end Treasury yields for constant maturities of 1, 2, 3, 5, 7, 10, 20, and 30 years are obtained from the Federal Reserve Bank of St. Louis.[7] Following Duffee (1998) and Collin-Dufresne, Goldstein, and Martin (2001), we use a linear interpolation scheme to fit the entire Treasury yield curve at the end of each quarter.

We implement the following five corporate bond illiquidity measures commonly used in the literature: (i) The Amihud (2002) measure of the price impact of per unit bond traded. (ii) The Roll's (1984) effective bid-ask spread, based on the negative covariance between returns of consecutive trades. Bao, Pan, and Wang (2011) consider a modified Roll's measure. (iii) The Lesmond, Ogden, and Trzcinka (1999; LOT) measure of round-trip transaction costs, based on the frequency of zero-return days. (iv) The imputed roundtrip cost (IRC) proposed by Feldhütter (2012). (v) Finally, the λ measure of Dick-Nielsen, Feldhütter, and Lando (2012) that takes the average of the normalized *Amihud*, IRC, the *Amihud* risk measure, and the IRC risk measure. See Appendix A for the details of these five illiquidity measures. We estimate them for each sample bond in each quarter during which the bond is traded. To alleviate the effect of outliers, we winsorize the estimates of

[7] The data are available at http://research.stlouisfed.org/fred2/categories/115.

each illiquidity measure at the top and bottom 1% in each quarter before using them in the analysis.

In Figure 1, we plot the average illiquidity estimates of sample bonds over the sample period, separately for investment-grade and speculative bonds. As shown in the figure, the estimates based on the five illiquidity measures exhibit similar patterns. In particular, illiquidity is high during the 2007-2009 financial crisis and peaks in the Q3 or Q4 in 2008, consistent with the existing literature.

Panel A of Figure 2 plots a piecewise relation between (investment-grade) yield spreads and illiquidity that highlights their nonlinear relationship, for each of the five illiquidity measures considered. We first breakdown the full range of the value of a given illiquidity measure into five groups. For instance, as the 5th and 95th percentiles of the Amihud measure are 0.02% and 3.69%, we choose 0.15%, 1.15%, 2.15%, 3.15%, and 4.15% as the breakpoints to form the five groups.[8] Next, we perform the piecewise linear regression within each group in each quarter, with the dependent variable being the yield spread and the explanatory variable being the illiquidity measure. We then take the average coefficient for each group over time to re-construct the average piecewise linear relation between yield spread and illiquidity. The plots across the five illiquidity measures are quite similar; that is, yield spreads are an increasing and concave function of bond illiquidity. These patterns resemble the concave relation between stock returns and stock trading cost (the relative bid-ask spread) shown in Amihud and Mendelson (1986).

Note that yield spreads are based on promised yields, not the expected yields to bond investors. To better resemble the setting of Amihud and Mendelson (1986), we further obtain expected yield spreads by subtracting the expected default losses from the promised yield spreads. Specifically, we take Moody's estimates of credit loss rates for each rating category in each year, based on their proprietary data starting in 1982. For example, to obtain expected yield spreads of all BBB-rated bonds in 2003, we use Moody's estimate for BBB-rated bonds published in early 2003 that is based on the period 1982–2002. The relation

[8] Additionally, the breakpoints we used are 1, 2, 3, 4, and 5 for *Roll* measure, 0.05, 0.25, 0.45, 0.65, and 0.85 for LOT measure, 0.15%, 0.35%, 0.55%, 0.75%, and 0.95% for *IRC*, and -0.5, 0, 0.5, 1, and 1.5 for λ.

between the expected yield spreads and illiquidity is illustrated in Panel B of Figure 2. The plot shows a concave relation between expected yield spreads and illiquidity regardless of the illiquidity measures used, consistent with the pattern illustrated in Panel A of the figure.

3.3 Insurers' Quarterly Holdings of Corporate Bonds

In order to implement the liquidity clientele measure defined in Eq. (6) in each quarter, we need data on each insurer's quarterly holdings of corporate bonds. Schedule D filings available in the NAIC database include both year-end holdings and information about intra-year transactions (such as their dates, prices, and quantities) on stocks, bonds, and other financial assets by insurance companies.[9] Appendix B provides details on how to extract quarterly holdings from reported annual holdings and trades.

For illustration, here we describe how to obtain the par value of an insurer's holdings of a bond during quarter t within a calendar year. We start with the par value of the insurer's holding of this bond at the beginning of the year. We then identify the par values of all trades on this bond by the insurer from the beginning of the year up until the end of quarter t. The quarter-t par value of the insurer's holdings of this bond is the initial par value plus the net par value of the trades up until quarter t.

Table 1 provides summary statistics on corporate bond holdings by insurance companies covered in our sample. As indicated in Panel A, the number of unique bonds in the cleaned FISD-TRACE sample (reported in column 2) varies between 2,671 in year 2003 to 5,026 in 2005, and the number of unique bonds held by insurers (column 3) varies between 1,421 (in 2009) and 3,204 (in 2005). Overall, 72% (6,064 out of 8,414) of bonds in the cleaned FISD-TRACE sample are held by insurers. Columns 4 through 8 report the numbers of bonds held by insurers across five rating groups, respectively: AAA, AA (including AA+, AA, AA-), A (including A+, A, A-), BBB (including BBB+, BBB, BBB-), and speculative

[9] Other studies that use NAIC transaction data on corporate bonds include Chakravarty and Sarkar (1999); Hong and Warga (2000); Collin-Dufresne, Goldstein, and Martin (2001); Schultz (2001); Campbell and Taksler (2003), among others. Chen, Sun, Yao, and Yu (2013) use the Schedule D holdings data on Treasury bonds.

bonds (Spec, including all ratings below BBB-). (If a bond's S&P rating is missing, we use its rating from Moody's or Fitch, in this order; bonds without any rating are excluded.) The majority of corporate bonds held by insurers are in the A and BBB groups, with a relatively small group of junk bonds. Columns 9 through 12 report respectively the number of bonds held across four maturity bins: shorter than 2 years, 2-5 years, 5-10 years, and exceeding 10 years. Insurers in our sample hold significant numbers of bonds in all the four maturity categories.

Panel B reports the cross sectional distribution for portfolio weights of various types of bonds held by insurers. We divide bonds into different groups using the same five credit rating categories or the four maturity bins as described above. We first compute the portfolio weights of an insurer in a given quarter for a credit rating category or a maturity category. Then we compute the cross-sectional statistics on the portfolio weights across insurers. The cross-sectional statistics include the 5th, 25th, 50th, 75th, and 95th percentiles, as well as the mean and standard deviations. The numbers reported in the table are the time-series averages of these cross-sectional statistics. Across the five rating categories, A-rated bonds have the highest mean portfolio weight (34.25%), followed by the AA category (25.62%). Speculative bonds have the lowest weight in insurers' portfolios (7.12%). Across the four maturity groups, bonds with 2 to 5 years of time to maturity have the highest mean portfolio weight (34.39%), followed by bonds with less than 2 years of time to maturity (30.52%).

In Panel C, we present the cross-sectional distribution of bonds held by insurers as fractions of the total bonds outstanding. Again, bonds are classified into five credit rating groups and four maturity groups. In each quarter for each bond, we compute the fraction of total bond outstanding held by sample insurers. We then average the fractions within each bond category and compute the cross-sectional distribution statistics of the fractional insurer holdings across various bond categories. The cross-sectional statistics are averaged over time and reported in the table. For reference purpose we also report the number of unique bonds held by insurers in each category. Note that the number of speculative bonds (305) is much lower than that of investment grade bonds (1,782). In terms of the fraction of holdings by insurers (relative to bonds outstanding), the mean and median for speculative bonds are 13.09% and 8.41%, much lower than the corresponding statistics for bonds in any of the four investment-grade categories. For example, the mean and median fractions of BBB bonds held by insurers are 39.57% and 37.76%, respectively. Further, the panel shows that insurance holdings as fractions of bonds outstanding are more prominent for long term bonds (e.g., bonds with maturity above 5 years) than for short term bonds.

It is interesting to observe that insurers hold a significant portion of short-term bonds, some of which can be long bonds at the time of purchase and become short-term ones as time goes by. Figure 3 depicts time to maturity of corporate bonds when they are purchased by insurers. For newly purchased bonds by property casualty insurers (panel A), the three types of maturities most often purchased are 10 years (22%), 5 years (21%) and 4 years (11%). In comparison, the most often purchased maturity categories for life insurers (panel B) are 10 years (33%), 30 years (13%), and 5 years (12%). The difference is consistent with the differential investment horizons across insurers: life insurers have more long-term liabilities than property insurers, as a result life insurers may have a longer investment horizon than property insurers do.

Given our focus on investment-grade (IG) bonds in this analysis, we report the cross-sectional distribution of insurers' holdings of such bonds over time in Panel D of Table 1. There are 5,432 unique IG bonds in the full sample. The number of these bonds ranges from 1,391 in 2009 to 2,871 in 2004, with a time-series average of 1,782. The mean fraction of IG bonds outstanding held by insurers is in the ranges of 30% to 41% over the sample period. This provides further evidence on the importance of insurers in the IG bond market.

Overall, the bond ownership statistics presented in Table 1 are in line with those reported by other studies. Hong and Warga (2000) report that insurance companies account for roughly 25% of the market for hig-yield debt, while their share of trading in the IG debt market is around 40%. Schultz (2001) estimates that life insurance companies by themselves hold about 40% of all corporate bonds. Further, Ellul, Jotikasthira, and Lundblad (2011) find that on average, insurance companies hold about 34 percent of IG bonds and only 8 percent of high-yield bonds. See also Campbell and Taksler (2003); Hotchkiss, Warga, and Jostova (2002).

4 Empirical Results

In this section we present results from our empirical analysis. Section 4.1 investigates liquidity preference of insurers and the persistence of such preference. In Section 4.2, we explore the determinants of insurers' liquidity preference. Section 4.3 tests the liquidity clientele effect in corporate bond yield spreads. Section 4.4 conducts a variety of robustness checks. As mentioned before, we restrict the sample to investment-grade bonds in the analysis that follows, unless noted otherwise.

4.1 Liquidity, Liquidity Preference, and Liquidity Clientele

In this subsection we provide statistics on the illiquidity preference (ILP) for individual insurers and illiquidity clientele (ILC) for individual bonds. Given a particular measure of corporate bond illiquidity introduced earlier, we estimate ILP and ILC using Eqs. (5) and (6), respectively. Due to the use of five different bond illiquidity measures (ILQ), we obtain five sets of estimates for both ILP and ILC.

Table 2 reports the cross-sectional statistics of bond yield spreads, ILQ, ILP, and ILC—four main variables used in our empirical analysis. The cross-sectional statistics reported include the 5th, 25th, 50th, 75th, and 95th percentiles, as well as the mean, and standard deviation of each variable. This provides an overall picture of the substantial cross-sectional variation of each variable. The statistics reported are first computed cross-sectionally in a given quarter and then averaged over time.

Panel A illustrates the distribution of bond yield spreads, with a mean of 1.86%, a median of 1.63%, and a standard deviation of 1.12%. These statistics are comparable to those reported in other studies such as Chen, Liao, and Tsai (2011) and Friewald, Jankowitsch, and Subrahmanyam (2012).

Panel B reports statistics for bond illiquidity (ILQ). The *Amihud* measure, *Amihud*, has a mean of 0.94%, a median of 0.41%, and a standard deviation of 1.66%. This means that a trade of $1,000,000 in a bond, on average, moves the price by 0.94%. The variation in illiquidity (by the *Amihud* measure) across bonds is remarkably high and ranges between 0.02% and 3.69% for the 5th and the 95th percentiles. This is consistent with the findings in Dick-Nielsen, Feldhütter, and Lando (2012) and Friewald, Jankowitsch, and Subrahmanyam (2012). The *Roll* measure has a mean of 1.67 and a standard deviation of 1.72, suggesting high variation across bonds as well. The mean of LOT is 15.36%, but the median is 3.27%. The median imputed roundtrip cost (IRC) in percentage of the price is 0.18%. IRC is less than 0.03% for the top 5% most liquid bonds. For the λ measure, we observe a mean of -0.10 and a median of -0.27, consistent with Dick-Nielsen, Feldhütter, and Lando (2012).

Panel C reports distributions of ILP_{Amihud}, ILP_{Roll}, ILP_{LOT}, ILP_{IRC}, and ILP_{λ}—five illiquidity preference measures with different underlying bond illiquidity measures. The mean and median of ILP_{Amihud} are 1.01% and 0.85%, respectively. The variation of this measure is markedly large with the range between 0.33% at the 5th percentile and 2.14% at the 95th percentile. We observe similar patterns in the other four ILP measures. These results suggest that corporate bond portfolios in our sample have very different levels of illiquidity.

Lastly, Panel D reports the cross-sectional distribution of bond-level illiquidity clientele, ILC. Based on the *Amihud* measure of bond illiquidity, the mean and median of ILC are 0.97% and 0.94%, and its 5th- and 95th-percentile values are 0.78% and 1.23%, respectively. The heterogeneity of LOT-based ILC measures is also significant with its range being between 5.99% in the 5th percentile and 22.52% in the 95th percentile. These results indicate a wide dispersion of liquidity clientele among bonds.

Table 3 presents the correlation matrix of the five illiquidity proxies and the corresponding ILCs. The correlations across the illiquidity measures are all positive. For example, the correlations among *Amihud*, *Roll*, and LOT range from 0.16 to 0.35. The correlations between *Amihud*, *IRC*, and λ are between 0.61 and 0.71. This is consistent with the findings in Dick-Nielsen, Feldhütter, and Lando (2012) and Friewald, Jankowitsch, and Subrahmanyam

(2012). Similarly, correlations among the five liquidity clientele measures (ILCs) are all positive, ranging from 0.39 to 0.94. Interestingly, correlations between each liquidity measure and the corresponding liquidity clientele measure are all around 0.40, suggesting that the liquidity measures and the liquidity clientele measures are positively correlated, consistent with the implication of the Amihud and Mendelson (1986) model.

4.2 Determinants of Insurers' Liquidity Preferences

One important issue is whether different levels of ILP across insurers indeed reflects their differences in liquidity preferences, a key element of the clientele hypothesis. We perform two sets of analysis to address this issue.

We examine first whether the constructed preference measures persist. If ILP captures insurers' stable illiquidity preference, its value must be persistent over time. Figure 4 illustrates such persistence. At the end of each year, we sort insurers into quintiles based on a given measure of ILP. We then calculate the average ILP of insurers in each initial quintile in the ranking year and the subsequent three years. As illustrated in the figure, insurers initially ranked in the highest ILP quintile continue to have high ILPs during the subsequent three years. This pattern holds regardless of bond-illiquidity measures used to construct the ILP.

Figure 5 shows that at the bond level, the liquidity clientele measure ILC is also highly persistent. Bonds in the highest ILC quintile in a given year continue to have high ILC level at least three years after the initial ranking. Bonds with low ILC initially also tend to keep low ILCs for long time. This suggests that liquidity clientele is a stable characteristic of corporate bonds.

Next, we link ILP to firm characteristics that potentially reflect insurers' illiquidity preferences. In Amihud and Mendelson (1986), liquidity preference is driven by investment horizon. Accordingly, we look at the relation between ILP and six firm characteristics that are related to insurers' investment horizons.

The first characteristic is the portfolio turnover, *TURN*. Following the conventional portfolio turnover definition (see, e.g., the CRSP Mutual Fund Database Guide (page 9)), we compute *TURN* as the minimum of the aggregate market value of bonds purchased by the insurer and the aggregate value of bonds sold by an insurer in each quarter, scaled by the aggregate portfolio value at the end of the quarter. Annual portfolio turnover is the quarterly measure multiplied by 4. A high portfolio turnover rate indicates a short portfolio investment horizon. The next two characteristics, *STURN* and *LTURN*, are variations of *TURN*. *STURN* is the turnover of an insurer's subportfolio that consists of bonds with maturity shorter than 5 years, and *LTURN* is the turnover of the subportfolio of bonds with maturity above 5 years. We look at turnover separately for the short-term and long-term bonds because the turnover on short-term bonds is mechanically high, and the difference in investment horizon is more likely to show up in the turnover for long-term bonds. The fourth characteristic is holding horizon, *HZ*, which is the average time length a bond is held by an insurer since its initial acquisition up to the current quarter. The NAIC's Schedule D data report the acquisition date of each bond by an insurer, which enables us to compute *HZ*.[10] We also include *MAT*, the average maturity of bonds purchased by insurers. If a long-horizon investor engages in a buy-and-hold strategy, the bonds the investor purchases should have long maturities. As the last characteristic, *LIFE* equals to 1 for a life insurer and 0 otherwise. Life insurance policies result in operating liabilities with much longer horizons relative to those for property and casualty policies. Since insurers use bond portfolios to hedge the interest rate risk of their operating liabilities, life insurers tend to buy and hold long-term bonds.

Columns 2 through 7 of Table 4 present the averages of these six characteristics across *ILP*-sorted insurer deciles, respectively. We rank insurers into *ILP* deciles each quarter and compute the average characteristics for each decile, and then take the averages over time. We also compute the differences in characteristics between the top (D10) and bottom (D1) deciles and the corresponding t-statistics using the Newey-West procedure with a four-

[10] Note that since *HZ* is computed on a bond that is still in an insurer's portfolio and not sold yet, it is therefore shorter than the true holding period of a bond.

quarter lag. In the discussion of Table 4 that follows we focus on the case where bond illiquidity is measured by the *Amihud* measure (Panel A), as results based on the other illiquidity measures are qualitatively similar.

Note first from the panel that portfolio turnover rates for insurers with higher *ILP* decile ranks are lower. Specifically, the average turnover drops from 16% per year for the bottom *ILP* decile to 9% per year for the top decile. The average turnovers of short-term bonds exhibit some variations across *ILP* deciles, while much larger variations are observed for the turnover of long-term bonds. In the case of the *Amihud* measure being used to construct *ILP*, the average $STURN$ for the D1 (D10) portfolio is 0.18 (0.15) while the average $LTURN$ for the D1 (D10) portfolio is 0.12 (0.05). The differences in $STURN$ between the D10 and D1 deciles are all insignificant while the differences in $LTURN$ are all significant regardless of the illiquidity measure used.

Note also from Panel A that the average holding horizon (*HZ*) increases in the decile rank of *ILP*. Under the *Amihud* illiquidity measure, the average holding horizon for D1 insurers is 1.93 years and it is 3.66 years for D10 insurers. The difference is statistically significant at the 1 percent level. The average maturity (MAT) of insurers' newly acquired bonds increases in insurers' *ILP* ranks, consistent with the notion of liquidity clientele. Additionally, note that the fraction of life insurers is roughly 20% in the bottom *ILP* decile portfolio and 46% for the top *ILP* decile.

Insurers' liquidity preferences for bond portfolios may be affected by factors other than their investment horizon. One such factor is insurers' ability to raise financing; when facing a liquidity need for cash, an insurer does not have to sell bonds if it can quickly raise cash through external financing. As such, we examine the following three characteristics that are related to insurers' financing constraints: total assets (*TA*), firm age (AGE), and a dummy for affiliated insurers (AFF). Here AGE is the number of years since the year of incorporation and affiliated firms are those affiliated with parent insurer groups or insurance holding companies. We expect larger insurers, more mature insurers, and affiliated firms are more resourceful in meeting liquidity needs and therefore are less constrained when investing in illiquid assets.

A related factor is the reinsurance ratio (*REINS*)—namely, the ratio of the insurance premiums that an insurer cedes to other insurers through the reinsurance arrangement relative to the sum of insurance premiums it collects and the insurance premium the insurer accepts from other insurers through the reinsurance arrangement. A high REINS indicates that the insurer outsources a large part of its insurance operating risk, suggesting a low capacity to bear operating risk. We hypothesize that such an insurer similarly have a low capacity to bear illiquidity.

In fact, *TA, AGE, AFF*, and *REINS* are considered to be proxies for an insurer's "illiquidity-bearing capacity." We obtain data on these characteristics from the NAIC Infopro database. The last four columns of Table 4 report results on the relation between Insurers' liquidity preferences and the four variables, respectively. Note first from Panel A that *ILP* is positively correlated with firm size and firm age. For instance, the average *TA* (*AGE*) for the bottom *ILP* decile is \$0.53 billion (39.50 years) and that of the top *ILP* decile is \$1.54 billion (50.61 years). That is, insurers with higher *ILP* tend to be larger and older. Further, high *ILP* firms have low reinsurance ratio. It is consistent with the notion that insurers' ability to internally absorb business risks is related it ability to absorb liquidity shocks.

Overall, the evidence presented above is largely consistent with the existence of liquidity clienteles: illiquid bond portfolios are more likely to be held by investors with longer horizons and more generally by investors with stronger capacity to bear illiquidity.

4.3 The Effect of Liquidity Clientele on Yield Spreads

4.3.1 Two-way Sorted Portfolios

We now investigate the potential effect of liquidity clientele on corporate bond pricing. In this subsection we use a two-way sorted portfolio approach that helps highlight the difference between the liquidity premium effect and the liquidity clientele effect. Specifically, in each quarter, we sort bonds based on a given bond illiquidity measure and *ILC* independently (i.e., sorting on *ILC* is not conditional on *ILQ*). This results in 25 (5 by 5) groups with equal number of bonds in each group. Across *ILQ*, *ILQ1* and *ILQ5* refer to the least illiquid (or most liquid) and liquid bonds, respectively. Across *ILC*, *ILC1* represents the group of bonds with the lowest *ILC* (held by insurers with the lowest liquidity preference or equivalently, insurers with the highest liquidity demand), and *ILC5* the group of bonds with the highest *ILC* (held by insurers with the highest *ILP*).

Table 5 reports the average yield spreads for each of the 25 bond portfolios. In the lowest *ILC* quintile (the *ILC1* group), the average bond yield spreads monotonically increase in bond illiquidity, regardless of the specific illiquidity measure used. For instance, measuring bond illiquidity with the *Amihud* measure (Panel A), we find that, for the lowest *ILC* group, the average yield spread for the most liquid bond group is 1.47%, while that of the most illiquid bonds is 2.00%. The liquidity premium, proxied by the difference in the yield spreads between these two groups, is 0.53% with a t-statistic of 2.45 in this case. The liquidity premium remains significantly positive for all the *ILC* ranks. In the highest *ILC* group (*ILC5*), the average yield spread of bonds in the top (bottom) *ILQ* quintile is 2.36% (2.08%), resulting in a liquidity premium of 0.28%. The liquidity clientele effect is measured by the difference in the liquidity premium between the top and bottom *ILC* quintiles, which is -0.25% and significant at the 5% level in this case. Thus, going from the bottom *ILC* quintile to the top *ILC* quintile, the liquidity clientele effect reduces the liquidity premium by one third. The same pattern holds for all other bond illiquidity measures—an increase in *ILC* reduces the liquidity premium component of corporate bond yield spreads.

One issue about the analysis above is that yield spreads are affected by factors unrelated to liquidity or investors' liquidity preference. To address this concern, we first use an intuitive approach and then consider panel regressions in the next subsection. We introduce the characteristics-adjusted yield spread, which is calculated as the (raw) yield spread minus the average yield spread of bonds within the same rating category and the same bond maturity range. Specifically,

$$\text{Spread}^a_{j,t} = \text{Spread}_{j,t} - \frac{1}{N}\sum_{k=1}^{N}\text{Spread}_{k,t}, \tag{7}$$

where k is an index for matched bonds based on rating categories and maturity bins and N is the total number of matched bonds. We use the same five credit rating categories and four maturity bins as described earlier in Section 3.3.

Results based on characteristics-adjusted yield spreads, reported in in columns 8 through 13 in Table 5, are qualitatively similar to those based on raw yield spreads. For example, consider the case where the *Amihud* bond illiquidity measure is used (Panel A). Among the bonds in the bottom *ILC* quintile, the difference in the average characteristic-adjusted spread between the top and bottom *ILQ* quintiles is 0.47% (t-stat =2.11). By contrast, among bonds in the top *ILC* quintile, the corresponding number is 0.19% (t-stat =2.86). The difference, i.e., the liquidity clientele effect, is -0.28% with a t-statistic of -2.33. Thus, the liquidity clientele effect is about one-third of the characteristics-adjusted measure of liquidity premium observed for bonds in the bottom *ILC* quintile.

Collectively, the results from the sorted portfolio analysis confirm that liquidity clientele plays a significant role in determining liquidity premiums.

4.3.2 Panel Regressions

In this subsection we estimate a panel regression model to test the liquidity clientele effect. To proceed as suggested by Eq. (2), we first classify all bonds into tercile groups based on a given bond liquidity clientele measure *ILC* (i.e., ILC_{Amihud}, ILC_{Roll}, ILC_{LOT}, ILC_{IRC}, and ILC_{λ}) in each quarter (untabulated results based on quintile groups of *ILC* are qualitatively similar). Let *T1 (T2, T3)* be the indicator variable that equals 1 if the bonds are in the first (second, third) tercile and zero otherwise.

The panel regression model has the following specification:

$$\begin{aligned}\text{Spread}_{i,t} = \alpha_0 + \alpha_1\text{ILQ}_{i,t} + \alpha_2\text{T2}_{i,t} + \alpha_3\text{T3}_{i,t} + \alpha_4\text{ILQ}_{i,t} * \text{T2}_{i,t} \\ +\alpha_5\text{ILQ}_{i,t} * \text{T3}_{i,t} + \alpha_6\text{Control}_{i,t} + \varepsilon_{i,t},\end{aligned} \tag{8}$$

where $Spread_{i,t}$ is the yield spread of bond i in quarter t; *ILQ* is a measure of bond illiquidity. The error term $\varepsilon_{i,t}$ includes both the time-fixed effects and the issuer-fixed effects.

Our main interests are on the interactions between *ILQ* and *T2* as well as those between *ILQ* and *T3* in Eq. (8), as they reflect the potential effect of liquidity clientele on liquidity premium. We expect that $\alpha_4 < 0$ and $\alpha_5 < 0$. That is, liquidity clientele attenuates the liquidity premium in yield spreads.

We include an extensive set of bond-specific and firm-specific control variables in Eq. (8). The bond specific control variables used include bond age (the time since issuance in years), a bond's time to maturity in years, the logarithm of bond issue size (i.e., the bond's face value issued in millions of dollars), coupon payments, and credit rating dummies.[11]

The firm-specific control variables include the ratio of operating income to sales, ratio of long term debt to assets (*LTD*), total debt to capitalization (*Leverage*), equity volatility, and four pretax interest coverage dummies.[12] The accounting data are obtained as of the end of the previous calendar year. The market value of equity is as of the end of the quarter. These control variables are similar to those used in Blume, Lim, and Mackinlay (1998); Collin-Dufresne, Goldstein, and Martin (2001); Campbell and Taksler (2003); Dick-Nielsen, Feldhütter, and Lando (2012). For robust statistical inference in a panel regression setting (e.g., Petersen 2009), we compute two-way clustered standard errors along the time and issuer dimensions, in addition to the control for the issuer- and time-fixed effects.

Columns 1 through 5 in Table 6 present respectively the baseline results from Eq. (8) in absence of any control variables, for each of five bond illiquidity measures considered. First, consistent with the literature, we find that the coefficient estimates on *ILQ* are positive and highly significant with a t-statistic ranging from 6 to 13 across the five bond illiquidity

[11]Bond ratings are obtained from Standard & Poor's. In cases where the Standard & Poor's rating is missing for a bond, we use Moody's and then we use Fitch's, in this order. A dummy for a specific rating (e.g., AAA) equals to 1 when it is the rating of a bond and the rating dummy is 0 if it is not the rating of a bond. In this way, we obtain 26 rating dummies corresponding to the full schedule of bond ratings from AAA to D and bonds with their rating not reported or suspended.

[12]Following Blume, Lim, and Mackinlay (1998), to control for the skewness of the distribution of pretax interest rate coverage (*PIRC*, measured as *EBIT* divided by interest expenses), we consider four pretax dummies. The first dummy is defined as the *PIRC* ratio if the *PIRC* is less than 5 and 5 if it is above. The second dummy is set to zero if *PIRC* is below 5, to the *PIRC* minus 5 if it lies between 5 and 10, and 5 if it lies above. The third is set to zero if *PIRC* is below 10, to the *PIRC* minus 10 if it lies between 10 and 20, and 10 if it is above. The fourth dummy is set to zero if *PIRC* is below 20 and is set to *PIRC* minus 20 if it is above 20 (truncating the dummy value at 80).

measures, indicating that high illiquidity demands high premium. For instance, note from column 1 that the bond yield spread would increase by 0.83% for a one-percent increase in the *Amihud* illiquidity ratio. Next, the coefficients on the dummy variables *T2* and *T3* are both significantly positive, suggesting that bonds with higher liquidity clientele have higher yield spreads. Most importantly, the coefficient estimates on the interactions between *ILQ* and *T2* as well as between *ILQ* and *T3* are significantly negative. This finding is consistent with the hypothesis that liquidity clientele reduces the liquidity premium.

Columns 6 through 10 report the results from regressions specified in Eq. (8) with the full set of control variables. We find that illiquidity is still positively related to the yield spread, even after controlling for various bond-specific and firm-specific variables, regardless of bond illiquidity measures used. Again, highly significant coefficients on the bond illiquidity measures are consistent with the theoretical prior that liquidity is priced in the yield spread. Next, note that the coefficient estimates on the interactions between *ILQ* and *T2* as well as those between *ILQ* and *T3* are significantly negative across all five different illiquidity measures used. For example, as shown in column 6 for the case of the *Amihud* liquidity measure being used, the coefficient on *ILQ**T2* is -0.28 (t-stat = -3.43) and that of *ILQ* and *T3* is -0.48 (t-stat = -5.51), indicating that liquidity clientele reduces the liquidity premium of corporate bonds.

Moreover, we note that the coefficients on control variables are largely consistent with those reported in the literature. For instance, the coefficients of bond maturity are significantly positive, consistent with the evidence that longer term bonds have higher yield spreads. Coefficient estimates on coupon payments are also significantly positive, suggesting that high coupon bonds (normally high-yield bonds) have high yield spreads. The firm-specific variables generally have expected signs when they are significant. As might be expected, the coefficient on the ratio of income to sales is negative while the coefficients on *LTD*, *Leverage*, and equity volatility are positive. Lastly, including control variables raises the adjusted R-squared from 31% to 34%.

Overall, the results from panel regressions indicate that corporate bond yield spreads are strongly correlated with the interaction between bond illiquidity and liquidity clientele. This finding supports the hypothesis that the liquidity premium is attenuated when illiquid securities predominantly attract investors with low liquidity preference.

4.4 Robustness Checks

In this subsection we conduct a variety of robustness checks, based on panel regressions specified in Eq. (8). First, we consider a liquidity clientele measure based on portfolio turnover instead of bond illiquidity. We then examine the financial crisis period and the pre-crisis period separately. Next, we look at subsamples of long- and short-term bonds, junk bonds, and bonds with different levels of insurance ownerships. Lastly, we examine the effect of clientele on liquidity premium using expected yield spreads.

4.4.1 Portfolio Turnover Based Clientele Measures

We first test the effect of liquidity clientele using a liquidity clientele measure based on portfolio turnover instead of bond illiquidity. The analysis is motivated by Mahanti et al. (2008), who introduce a latent liquidity measure based on the weighted average turnover of investors who hold a bond. They show that a bond tends to be more illiquid when it is held by investors with lower turnover. As portfolio turnover is inversely related to investment horizon, we use the reciprocal of an insurer's portfolio turnover ($1/TURN$) in place of *ILP* in Eq. (6) to construct the liquidity clientele measure. We implement portfolio turnover as defined before in Section 4.2 (see also Table 4).

Table 7 reports the results of panel regressions specified by Eq. (8) (with the full set of control variables) using the above turnover-based liquidity clientele measure. The results are consistent with those reported in Table 6 under the original *ILC* measures. First, the coefficients on *ILQ, T2*, and *T3* are all significantly positive regardless of bond illiquidity measures used. For example, under the *Amihud* measure (column 1), one percentage increase in this measure raises the yield spread by 0.39%. The coefficients on *T2* and *T3* are respectively 0.03 (t-stat = 2.15) and 0.20 (t-stat = 3.98), consistent with the effect of latent liquidity on yield spreads documented by Mahanti et al. (2008).

Further, the coefficient estimates on the interactions between *ILQ* and *T2* as well as those between *ILQ* and *T3* are all significantly negative. This result is consistent with the finding in Table 6 although the magnitudes of coefficients are slightly smaller. This suggests that liquidity clientele attenuates liquidity premium. The patterns of coefficients on control variables are similar to those in Table 6.

Taken together, the results from portfolio turnover based *ILC*s also show that bond yield spreads tend to increase in *ILC*, potentially a liquidity premium phenomenon (i.e., the latent liquidity effect); meanwhile the liquidity premium decreases in *ILC*, due to the impact of liquidity clientele.

4.4.2 Impacts of Liquidity Clientele before and during the Financial Crisis

We now divide the full sample into two subperiods: the pre-crisis period 2003:Q1–2007:Q1 and the crisis period 2007:Q2–2009:Q4. We are interested in whether the liquidity clientele effect differs in the pre-crisis and the crisis periods. On one hand, it is known that the liquidity premium spikes during the crisis (Dick-Nielsen et al. 2012; Friewald et al. 2012). Thus the crisis offers a great opportunity for long-horizon investors to earn liquidity premium. On the other hand, credit risk becomes a more important issue for investors to consider during the crisis period. If long-horizon investors focus more on credit risk than earning a liquidity premium, the liquidity clientele effect may be weaker during the crisis.

Table 8 reports results from running panel regressions specified by Eq. (8) for the two subperiods separately, where the original liquidity clientele measure (not the one based on portfolio turnover) is used. Also, all the control variables are included although, for the sake of brevity, their coefficient estimates are not reported in the table.

Notice that the coefficients on ILQ are much greater during the crisis (Panel B) than before the crisis (Panel A). This suggests an intensified liquidity premium during the crisis, consistent with the findings in the existing studies. The coefficients on the interaction terms are also larger during the crisis period. For example, under the *Amihud* ratio, the coefficients on *ILQ*T2* and *ILQ*T3* are respectively -0.11 (t-stat =-2.83) and -0.20 (t-stat =-4.21) before the crisis and are -0.26 (t-stat =-2.86) and -0.44 (t-stat =-3.41) during the crisis. This suggests that the clientele effect during the crisis period is at least as strong as the effect before the crisis.

4.4.3 Different Bond Subsamples

We consider first the subsamples of long- and short-term bonds. As discussed earlier, the impact of clientele on liquidity premium is expected to be stronger for long-term bonds because the holding horizon for short-term bonds is short by nature and long-horizon investors do not have an advantage in amortizing trading costs for such bonds. We divide sample bonds into two groups: short-term bonds with time-to-maturities below 5 years and long-term bonds with time-to-maturities at or above 5 years. Panels A and B of Table 9 report the results from regressions specified by Eq. (8), for the short- and long-term bonds, separately. For short-term bonds, most of the coefficients on the interaction terms are either statistically insignificant or have the wrong sign relative to what the effect of clientele suggests. By contrast, the effect is strong among long-term bonds. For instance, under the *Amihud* measure of illiquidity, across short-term bonds, the coefficient on *ILQ*T2* is -0.01 (t-stat = -0.03) and the coefficient on *ILQ*T3* is -0.01 (t-stat = -0.01); in a sharp contrast, across long-term bonds, the coefficients on *ILQ*T2* and *ILQ*T3* are -0.30 (t-stat = -3.67) and -0.49 (t-stat = -5.92), respectively.

Next, we consider the subsample of speculative bonds and report the results in Panel C of Table 9. The coefficients on *ILQ*T2* are insignificant across different illiquidity measures. The coefficients on *ILQ*T3* are significant only under the *Roll* or *LOT* measure. In other words, we have much less pervasive evidence for the impact of liquidity clientele on speculative bonds, relative to investment-grade bonds. This result is not surprising to a large extent. As discussed earlier, insurers are not the marginal investors of speculative bonds, therefore their liquidity preference exerts little influence on the pricing of these bonds. It is also known that for such bonds, credit risk matters more than liquidity in bond pricing.

Lastly, we seek to shed more light on insurers' role in both identifying liquidity clienteles in the bond market and in affecting bond pricing. To make *ILC* more accurately capture a bond's liquidity clientele, we restrict the sample to bonds with at least 20% of the total issue outstanding held by insurers and redo the analysis using this restricted sample. Results reported in Panel D of Table 9 are consistent with those shown in Table 6. We also redo the analysis using bonds with at least 30% held by insurers and find similar results (untabulated). On the other hand, when we consider only bonds with no more than 20% held by insurers, we find that the coefficients on the interaction term become insignificant (also untabulated).

4.4.4 Analysis based on Expected Yield Spreads

Lastly, we redo the panel regressions specified by Eq. (8) using expected yield spreads as the dependent variable and report regression results in Table 10. Recall that expected yield spreads are computed by adjusting the (promised) yield spreads with expected default losses (e.g., Section 3.2). The first five columns of the table show the results from the model specification without any of those control variables described in Section 4.3.2, for each of the five illiquidity measures considered in this analysis. Note that the coefficients on *ILQ*T2* and *ILQ*T3* remain significantly negative, regardless of illiquidity measures used. Results from the model specification including the full set of control variables, shown in columns 6 through 10 of the table, are also largely similar to those based on (promised) yield spreads reported in Table 6. As expected, the adjusted-R^2 from expected yield spreads is slightly higher than that from promised yield spreads for each of the 10 models considered. To sum, our main findings are robust to the use of expected yield spreads.

5 Conclusions

Although the notion of "liquidity clientele," first introduced by Amihud and Mendelson (1986), is well known in the finance literature, to our knowledge it has not been formally tested so far in the corporate bond market. In this study, we conduct such a test and investigate the effect of liquidity clientele on corporate bond spreads, based on the information about investment portfolios of insurance firms—the largest group of corporate bond investors—and more specifically, by taking advantage of data on insurance companies' quarterly holdings of corporate bonds.

Using measures of insurers' liquidity preference constructed directly based on their corporate bond holdings, we document empirical evidence on the existence of liquidity clienteles. Specifically, we present evidence of substantial heterogeneity in the liquidity preference across insurers. We also find that such liquidity preference is persistent over time and correlated with characteristics indicative of insurers' investment horizons and their capability to bear illiquidity in investment portfolios. Additionally, we find evidence that illiquid bonds are more likely to be held by investors with longer horizons and more generally by investors with stronger capacity to bear illiquidity.

Furthermore, we document that insurers' liquidity preference interacts with bond liquidity to affect corporate bond yield spreads. Specifically, we find that bonds with higher illiquidity have higher yield spreads, consistent with existing findings on the liquidity premium effect. More importantly, we find that liquidity clientele attenuates the liquidity premium. This effect of liquidity clientele on liquidity premium is especially strong among investment-grade bonds and among relatively long-maturity bonds, where insurers have a strong presence and hence their liquidity preference matters more for the pricing of such bonds.

A Illiquidity Measures for Corporate Bonds

In this appendix we describe in detail the procedure that we use to calculate bond illiquidity measures. We winsorize the top and bottom 1 percentile observations for each of the following liquidity measures.

A.1 Amihud illiquidity measure

It is computed as the daily average of absolute returns divided by the trade size (in million \$) of consecutive transactions.

$$\text{Amihud}_{i,t} = \frac{1}{N_{i,t}} \sum_{j=1}^{N_{i,t}} \frac{\left| \frac{P_{i,j} - P_{i,j-1}}{P_{i,j-1}} \right|}{Q_{i,j}}, \tag{9}$$

where $\mathrm{N}_{i,t}$ is the number of trades of bond i on day t; $P_{i,j}$ and $P_{i,j-1}$ are the prices for two consecutive trades ($j - 1^{th}$ and j^{th}), for bond i on day t; $Q_{i,j}$ is the size of the j^{th} trade for bond i. As such, at least two transactions are required on a given day to calculate the measure. A quarterly *Amihud* measure is the median of daily measures within the quarter. Note that the *Amihud* measure relates the price impact of trades to the trading volume. A larger *Amihud* measure indicates that trading a bond causes its price to move more in response to a given volume of trading, in turn, reflecting higher illiquidity.

A.2 Roll measure

The daily *Roll* measure equals two times the square root of negative covariance between consecutive returns, estimated as the difference in the prices of two consecutive trades scaled by the price of the first trade, using a rolling window of 21 trading days. Namely,

$$\text{Roll}_{i,t} = 2\sqrt{-cov(R_{i,t}R_{i,t-1})}, \tag{10}$$

where t is the time period for which the measure is calculated. If the covariance is non-negative, the observation is discarded. The measure is available when there are at least four transactions in the 21-day rolling windows. We obtain a quarterly *Roll* measure by taking the median of daily measures within the quarter. A larger *Roll* measure (i.e., more negative covariance) implies higher round-trip costs (i.e., greater bid-ask spreads), reflecting greater illiquidity.

A.3 LOT measure

This measure (Lesmond, Ogden, and Trzcinka 1999) is based on the idea that bond price would capture new information when investors trade. Given the same amount of new information, more illiquid bonds would have fewer trades, thus more zero returns. The measure is estimated as the following:

$$\mathrm{LOT}_{i,t} = \alpha_{2,j} - \alpha_{1,j} \tag{11}$$

where $\alpha_{1,j}$ and $\alpha_{2,j}$ are buy-side and sell-side costs that can be estimated using the MLE. A larger LOT measure indicates higher trading costs (i.e., fewer trades) and greater illiquidity. This measure is estimated on a quarterly basis.

A.4 Imputed roundtrip cost (IRC)

This measure is based on the dispersion of traded prices around the market-wide consensus valuation (Feldhütter 2012) and is defined as follows:

$$\mathrm{IRC}_{i,t} = \frac{P_{i,t}^{\max} - P_{i,t}^{\min}}{P_{i,t}^{\min}} \tag{12}$$

where P_{max} is the largest price in an imputed roundtrip transaction (IRT) and P_{min} is the smallest price in the IRT. If two or three trades on a given bond with the same trade size take place on the same day, they are likely the result of a dealer taking one side of a trade and then taking an offsetting trade subsequently. They are considered as imputed roundtrip transactions. The price differences among such trades likely reflect the bid-ask spread charged by the bond dealers. The daily IRC measure is the average of roundtrip costs on that day. A quarterly IRC measure is the average of the daily estimates. A larger IRC represents higher trading costs and higher illiquidity.

A.5 The measure λ

This measure, based on Dick-Nielsen, Feldhütter, and Lando (2012), is an equally weighted sum of four variables normalized to a common scale: *Amihud* measure, *IRC*, and the variability of each of these two measures. To be specific, for each bond and quarter, we first calculate the four liquidity measures: *Amihud*, *IRC*, and the standard deviations of the daily *Amihud* measure and *IRC* measure over a quarter. Then we normalize each measure and compute λ as follows:

$$\lambda_{i,t} = \sum_{j=1}^{4} \frac{L_{i,t}^{j} - \mu^{j}}{\sigma^{j}} \tag{13}$$

where $L_{i,t}^{j}$ is one of the four liquidity measures mentioned above, and μ^{j} and σ^{j} are the mean and standard deviation of each measure across bonds and quarters. A larger *Lambda* measure indicates higher illiquidity. See also Han and Zhou (2008).

B Quarterly Corporate Bond Holdings

We use corporate bond holdings and transactions data from Schedule D of insurance companies' annual statements provided by the NAIC to construct individual insurers' quarterly corporate bond holdings.[13] As mentioned earlier, Schedule D includes trading dates for all the transactions. We obtain quarterly holdings calculated based on i) long-term bonds owned on December 31 of a given year; ii) long-term bonds acquired within a year; iii) long-term bonds sold, redeemed or otherwise disposed in a year; and iv) long-term bonds acquired during the year and fully disposed in a year.

[13] The Schedule D data include holdings and transactions information for all types of financial assets held by insurance companies, such as corporate, municipal, and government bonds, stocks, and real estate, among others. Bonds included in the database fall into nine categories: i) U.S. government bonds, ii) all other government bonds, iii) States, territories and possessions, iv) political subdivisions of States, territories and possessions, v) special revenue and special assessment obligations and all non-guaranteed obligations of agencies and authorities of governments and their political subdivisions, vi) public utilities, vii) industrial and miscellaneous, viii) credit tenant loans, and ix) parents, subsidiaries and affiliates bonds. Within each category, bonds are further separated into issuer obligations and mortgage or asset backed securities. We consider issuer obligations of public utilities, industrial and miscellaneous bonds, and bonds issued by parents, subsidiaries and affiliates as corporate bonds.

Part of this exercise involves computing the par value of each individual corporate bond held by every insurer in our sample at the end of each quarter. We perform this task by sequentially estimating quarterly holdings, quarter by quarter in a given year. More specifically, we use the par value of each individual bond that an insurer purchases minus the par value of the same bond that the insurer sells in a quarter to compute the net trading of a quarter. Then the insurer's holdings of an individual bond in the first quarter of a year are the sum of the insurer's holdings at the end of the previous year and the net trading in the first quarter. The second quarter holdings are the sum of the holdings of the first quarter and the net trading in the second quarter. Holdings at the end of third and fourth quarters are estimated similarly.

Like other commercial databases, there are errors in Schedule D data. To address this problem, we compute a discrepancy ratio, measured as the absolute value of the difference between the year-end holdings reported in Schedule D of a year and the estimated fourth-quarter holdings in the same year scaled by the average of these two holdings. We consider the observation of a bond in a year as an outlier if its discrepancy ratio in the fourth quarter of the year exceeds 0.1 and remove such observations from the sample. Moreover, when an insurer has more than 10% of its holdings removed in a year, we drop the entire portfolio of the insurer from the sample in that year.

Before any cleanse, there are 1,945,926 insurer-bond-year observations corresponding to 3,461 unique life and nonlife insurers in the quarterly corporate bond holdings data set over the sample period from 2003 to 2009. Imposing the constraint on the discrepancy ratio reduces the sample to 1,843,687 insurer-bond-year observations and 3,226 unique insurers.

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Table 1: Statistics for Corporate Bonds Held by Insurers

This table reports the numbers of corporate bonds included in the analysis and the cross-sectional distributions of the percentage of insurance companies' aggregate holding in corporate bonds' market value broken down by both credit ratings and maturities, for each of the sample years. These bonds are required to have non-missing yields, non-missing credit rating, and maturities no shorter than 1 year. Panel A reports the number of unique cleaned corporate bonds covered in the FISD-TRACE databases (column 2); the number of bonds held by insurers (column 3); and the numbers of insurer-held bonds in different rating categories (columns 4 through 8) or in different maturity bins (columns 9 through 12). The number of unique bonds are counted at the end of each year (in the fourth quarter). The five rating groups are AAA, AA (including AA+, AA, AA-), A (including A+, A, A-), BBB (including BBB+, BBB, BBB-) and speculative bonds (with ratings below BBB-). The four maturity bins include <2 years; 2-5 years; 5-10 years; and > 10 years. The second last row captioned "All" reports the numbers of unique bonds in different categories throughout the entire sample period. The last row captioned "Average" reports the average number of bonds per year in each group. Panel B shows the distribution for portfolio weights of corporate bonds held by insurers, including the 5th, 25th, 50th, 75th, and 95th percentiles, as well as the mean and standard deviation, by both rating groups and maturity bins. The portfolio weight of a specific type of bond holding for an insurer is computed as the percentage of the insurer's holdings of that bond type in the insurer's aggregate corporate bond holdings in each year first, then averaged over time. Panel C reports the cross-sectional distributions of insurance companies' holdings as fractions of bonds outstanding in the aggregate market, across both rating and maturity groups. The reported number of bonds is the averaged number of bonds in the last quarter of each year for a group. The reported percentage holding by insurance companies is calculated in three steps. First is to compute the percentage holding of insurance companies for each bond in the last quarter of each year. Then the percentage holding of individual bonds is averaged across a specific group to obtain the average percentage holding of the group in a year. The last step is to compute the time series averages of fractional holding. Panel D reports the number of investment-grade bonds held by insurers and the distributions of percentage holdings of insurance companies. In the last row, both the number of unique bonds in the sample and the averages of the number of bonds at the end of each quarter and the distribution of percentage holding of bonds held by insurers in each quarter are reported. The sample period is from 2003:Q1 to 2009:Q4.

Panel A: Number of corporate bonds

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		Bonds held by insurers									
	# of bonds		by credit rating					by maturity			
Year	All	Insurer held	AAA	AA	A	BBB	Spec	<2y	2-5y	5-10y	>10y
2003	2,671	2,033	85	347	1,139	362	100	444	754	526	309
2004	4,196	3,079	91	377	1,313	1,090	208	901	1,073	665	440
2005	5,026	3,204	88	370	1,229	1,078	439	934	1,116	633	521
2006	4,751	2,875	83	353	1,125	984	330	919	941	510	505
2007	4,613	2,558	85	336	963	889	285	802	739	522	495
2008	4,867	2,127	55	142	791	882	257	628	601	486	412
2009	4,610	1,421	13	127	461	590	230	538	309	339	235
All	8,414	6,064	157	696	2,383	2,196	632	1,132	1,870	1,832	1,230
Average	3,535	2,087	59	291	825	607	305	543	719	415	410

Panel B: Insurers' portfolio weights on corporate bonds (%)

Year	P5	P25	Mean	Median	P75	P95	Std Dev
			i. by credit rating				
AAA	0.00	0.00	11.94	0.58	21.38	44.07	17.78
AA	0.00	6.01	25.62	23.37	38.19	66.28	22.55
A	0.34	17.69	34.25	30.41	45.87	99.49	25.62
BBB	0.00	0.21	21.07	17.81	32.40	64.11	22.32
Speculative	0.00	0.00	7.12	1.03	7.30	36.92	15.64
			ii. by maturity				
$<$ 2 years	0.30	10.32	30.52	28.65	45.57	86.89	25.91
2-5 years	0.03	16.08	34.39	31.93	48.47	96.82	25.52
5-10 years	0.00	2.00	23.95	21.69	36.57	67.10	23.15
$>$ 10 years	0.00	0.96	11.14	3.28	19.17	48.42	19.16

Panel C: Insurers' bond holdings as fractions of bonds outstanding (%)

Type	N	P5	P25	Mean	Median	P75	P95	Std Dev
				i. by credit rating				
AAA	59	2.61	7.95	20.23	15.82	28.63	50.58	18.76
AA	291	2.79	9.15	21.91	17.03	30.58	56.88	17.31
A	825	6.25	19.71	37.38	34.49	53.34	76.60	21.86
BBB	607	7.30	22.43	39.57	37.76	55.32	77.81	21.77
Speculative	305	0.53	3.78	13.09	8.41	20.29	42.24	13.34
				ii. by maturity				
$<$2 years	543	3.06	11.99	28.50	23.91	41.94	68.26	20.61
2-5 years	719	5.74	17.47	33.41	30.07	47.54	71.34	20.35
5-10 years	415	9.95	26.09	41.93	40.92	56.83	76.69	20.48
$>$ 10 years	410	3.61	26.19	45.04	46.22	62.73	85.85	24.69

Panel D: Distribution for percentage holding of insurers in investment-grade bonds (%)

Year	N	P5	P25	Mean	Median	P75	P95	Std Dev
2003	1,933	4.67	16.39	33.72	30.41	48.92	73.60	21.33
2004	2,871	5.00	19.92	39.66	37.76	57.31	82.47	23.94
2005	2,870	4.84	19.62	40.27	38.09	58.53	83.50	24.62
2006	2,545	5.38	20.94	40.86	38.01	58.70	85.21	24.55
2007	2,273	4.83	18.43	37.26	34.11	53.74	79.64	23.18
2008	1,870	4.68	18.66	37.54	34.23	54.05	80.85	23.51
2009	1,391	3.99	14.38	32.11	28.20	46.59	71.77	21.63
All/Average	5,432/1,782	4.77	18.33	37.34	34.40	53.98	79.58	23.25

Table 2: Cross-sectional Distributions of Yield Spreads, Liquidity, Liquidity Preference, and Liquidity Clientele Measures

This table reports the cross-sectional distribution of yield spreads, bond illiquidity measures, insurer liquidity preference, and bond clientele measures. Panel A reports the distribution of corporate bond yield spreads (in %), computed as the difference between the yield of a corporate bond and a U.S. Treasury yield with the same maturity. Panel B reports the distribution of bond illiquidity measures (ILQ) including the *Amihud* measure (in %), *Roll* measure, LOT (in %), imputed roundtrip cost IRC (in %), and the measure λ. Panel C reports insurers' liquidity preference measures (ILP) and Panel D reports bond liquidity clientele measures (ILC). The distributional attributes include the 5th, 25th, 50th, 75th and 95th percentiles, as well as the mean, and standard deviation "Std Dev" of each variable. We obtain each statistic in the fourth quarter of each year and then take the average over time. Column named "N" shows the average numbers of (investment-grade) bonds or insurers (Panel C) included in the calculations. The sample period is from 2003:Q1 to 2009:Q4.

Panel A: Yield spreads

	N	P5	P25	Mean	Median	P75	P95	Std Dev
spread (%)	1,782	0.61	1.11	1.86	1.63	2.28	4.01	1.12

Panel B: Bond illiquidity measures (ILQ)

	N	P5	P25	Mean	Median	P75	P95	Std Dev
Amihud (%)	1,345	0.02	0.14	0.94	0.41	0.99	3.69	1.66
Roll	1,577	0.42	0.78	1.67	1.19	1.90	4.38	1.72
LOT (%)	1,607	0.14	0.95	15.36	3.27	13.83	70.77	38.70
IRC (%)	1,309	0.03	0.10	0.26	0.18	0.32	0.78	0.28
λ	1,173	-0.70	-0.50	-0.10	-0.27	0.10	1.10	0.62

Panel C: Insurers' illiquidity preference measures (ILP)

	N	P5	P25	Mean	Median	P75	P95	Std Dev
ILP_{Amihud} (%)	2,419	0.33	0.65	1.01	0.85	1.14	2.14	0.79
ILP_{Roll}	2,432	0.78	1.08	1.47	1.33	1.70	2.60	0.65
ILP_{LOT} (%)	2,433	0.32	1.43	7.66	3.74	9.49	26.59	12.58
ILP_{IRC} (%)	2,418	0.14	0.21	0.28	0.26	0.32	0.50	0.14
ILP_{λ}	2,409	-0.38	-0.17	0.01	-0.04	0.11	0.55	0.34

Panel D: Bond illiquidity clientele measures (ILC)

	N	P5	P25	Mean	Median	P75	P95	Std Dev
ILC_{Amihud} (%)	1,782	0.78	0.87	0.97	0.94	1.02	1.23	0.26
ILC_{Roll}	1,782	1.35	1.61	1.79	1.78	1.95	2.32	0.30
ILC_{LOT} (%)	1,782	5.99	10.28	13.56	13.03	16.14	22.52	5.40
ILC_{IRC} (%)	1,782	0.24	0.27	0.30	0.29	0.31	0.36	0.05
ILC_{λ}	1,782	-0.10	-0.04	0.01	-0.01	0.04	0.14	0.12

Table 3: Correlation of Liquidity and Liquidity Clientele Measures

This table presents the correlation matrix of five liquidity measures (*Amihud, Roll, LOT, IRC*, and λ) and the associated liquidity clientele measures (ILC_{Amihud}, ILC_{Roll}, ILC_{LOT}, ILC_{IRC}, and ILC_{λ}). We compute the correlations in each quarter and then take the average over time. The sample period is from 2003:Q1 to 2009:Q4.

	Bond Illiquidity Measures					Illiquidity Clientele Measures				
	Amihud	Roll	LOT	IRC	λ	ILC$_{Amihud}$	ILC$_{Roll}$	ILC$_{LOT}$	ILC$_{IRC}$	ILC$_{\lambda}$
Amihud	1.00									
Roll	0.17	1.00								
LOT	0.16	0.35	1.00							
IRC	0.61	0.26	0.16	1.00						
λ	0.71	0.24	0.19	0.70	1.00					
ILC$_{Amihud}$	0.40	0.17	0.17	0.36	0.37	1.00				
ILC$_{Roll}$	0.16	0.47	0.30	0.26	0.20	0.39	1.00			
ILC$_{LOT}$	0.18	0.38	0.41	0.25	0.17	0.42	0.83	1.00		
ILC$_{IRC}$	0.32	0.26	0.22	0.44	0.40	0.84	0.62	0.59	1.00	
ILC$_{\lambda}$	0.33	0.21	0.17	0.40	0.44	0.88	0.49	0.45	0.94	1.00

Table 4: Liquidity Preference and Insurer Characteristics

This table reports firm characteristics across insurer deciles sorted on liquidity preference (*ILP*). We implement *ILP* based on five alternative bond illiquidity measures, i.e., *Amihud*, *Roll*, *LOT*, *IRC*, and λ, and report the corresponding results in five different panels. Six characteristics related to insurers' investment horizons are: bond portfolio turnover (*TURN*), turnover of short-term bonds (*STURN*), turnover of long-term bonds (*LTURN*), the average holding horizon (*HZ*, in years) since initial acquisition of bonds, the maturity of bonds purchased by insurers (*MAT*, in years), and the fraction of life insurers within an *ILP* decile (*LIFE*, in %). Four characteristics related to insurers' general illiquidity-bearing capacity are: total assets (*TA*, in $billion), firm age (*AGE*, in years), the percentage of affiliated firms (*AFF*, in %) in an *ILP* decile, and the fraction of reinsurance in an insurer's aggregate collected premiums (*REINS*, in %). We first compute the average characteristics within each decile in each quarter and then take the time-series averages. The difference between the top (D10) and bottom (D1) deciles and the associated t-statistics using the Newey-West procedure with a four-quarter lag are also reported. Significance at 10% level is marked *, at 5% marked **, and at 1% marked ***. The sample period is from 2003:Q1 to 2009:Q4.

	Investment Horizon						Illiquidity-bearing Capacity			
	TURN	STURN	LTURN	HZ	MAT	LIFE	TA	AGE	AFF	REINS
Panel A: Insurer deciles sorted by ILP_{Amihud}										
D1 (L)	0.16	0.18	0.12	1.93	4.18	19.80	0.53	39.50	0.62	39.01
D2	0.13	0.18	0.10	2.01	4.41	21.89	0.57	40.16	0.69	35.45
D3	0.14	0.18	0.08	2.14	4.96	24.99	1.05	40.65	0.68	33.60
D4	0.14	0.18	0.09	2.12	5.28	29.49	1.42	43.91	0.71	30.40
D5	0.13	0.18	0.09	2.19	5.55	31.10	1.97	45.76	0.72	30.40
D6	0.13	0.18	0.09	2.26	5.56	36.25	2.67	49.41	0.69	30.07
D7	0.12	0.17	0.08	2.49	5.83	38.75	2.67	51.41	0.70	29.82
D8	0.11	0.16	0.08	2.68	5.96	41.95	2.48	54.52	0.70	27.14
D9	0.10	0.15	0.07	3.00	6.46	44.86	1.75	53.99	0.70	27.10
D10 (H)	0.09	0.15	0.05	3.66	7.96	46.15	1.54	50.61	0.72	25.60
H-L	-0.07***	-0.03	-0.07***	1.73***	3.78***	26.35***	1.01***	11.11***	0.10***	-13.41***
(t-stat)	(-4.98)	(-1.69)	(-4.94)	(4.66)	(6.95)	(10.34)	(5.61)	(9.58)	(3.21)	(-8.98)
Panel B: Insurer deciles sorted by ILP_{Roll}										
D1 (L)	0.12	0.17	0.09	1.90	2.39	15.56	0.33	37.97	0.57	36.26
D2	0.11	0.17	0.07	1.87	3.39	15.82	0.29	40.11	0.60	33.51
D3	0.12	0.17	0.08	2.02	4.01	16.84	0.51	40.43	0.65	32.51
D4	0.13	0.18	0.08	2.13	4.53	20.63	0.68	44.26	0.66	32.48
D5	0.13	0.18	0.07	2.35	4.98	22.01	0.92	44.53	0.68	33.07
D6	0.13	0.18	0.07	2.48	5.46	29.55	1.35	46.31	0.70	31.18
D7	0.13	0.17	0.06	2.59	5.87	37.18	1.67	48.70	0.72	29.83
D8	0.12	0.17	0.07	2.71	6.65	39.20	3.07	51.87	0.73	28.55
D9	0.10	0.16	0.07	3.19	7.81	38.70	4.04	58.35	0.72	27.52
D10 (H)	0.09	0.16	0.06	3.79	8.20	40.00	3.09	55.80	0.70	23.52
H-L	-0.03***	-0.01	-0.03***	1.89***	5.81***	24.44***	2.76***	17.83***	0.13***	-12.74***
(t-stat)	(-2.86)	(-1.00)	(-2.94)	(6.28)	(13.98)	(18.29)	(12.25)	(12.42)	(4.77)	(-17.62)

	Investment Horizon						Illiquidity-bearing Capacity			
	TURN	STURN	LTURN	HZ	MAT	LIFE	TA	AGE	AFF	REINS
Panel C: Insurer deciles sorted by ILP_{LOT}										
D1 (L)	0.14	0.19	0.08	1.75	3.71	18.10	0.31	36.90	0.54	35.07
D2	0.13	0.18	0.07	2.20	4.02	14.85	0.37	39.43	0.56	34.24
D3	0.13	0.18	0.07	1.93	4.38	18.58	0.50	40.94	0.63	33.74
D4	0.13	0.17	0.07	2.10	4.77	19.45	0.64	43.39	0.65	31.95
D5	0.13	0.18	0.06	2.30	4.99	23.26	0.78	44.14	0.67	31.36
D6	0.13	0.18	0.06	2.41	5.43	29.48	0.98	45.38	0.69	32.55
D7	0.12	0.17	0.06	2.59	5.93	37.58	1.72	49.95	0.74	30.38
D8	0.12	0.17	0.06	2.85	6.57	40.46	3.12	53.89	0.76	28.27
D9	0.11	0.17	0.05	2.98	7.26	42.27	4.30	58.31	0.76	25.94
D10 (H)	0.10	0.17	0.05	3.68	9.08	41.36	3.20	55.69	0.74	24.98
H-L	-0.04***	-0.02	-0.03***	1.93***	5.37***	23.26***	2.89***	18.79***	0.20***	-10.09***
(t-stat)	(-2.66)	(-1.57)	(-4.20)	(6.54)	(8.93)	(11.61)	(9.37)	(15.98)	(8.91)	(-5.99)
Panel D: Insurer deciles sorted by ILP_{IRC}										
D1 (L)	0.13	0.17	0.10	1.97	3.19	18.12	0.39	40.25	0.64	37.09
D2	0.12	0.17	0.08	2.13	3.83	18.14	0.54	40.49	0.66	33.64
D3	0.12	0.18	0.09	2.15	4.32	22.99	0.79	41.49	0.67	33.57
D4	0.13	0.17	0.09	2.23	4.91	26.78	1.13	43.77	0.69	32.27
D5	0.13	0.18	0.09	2.23	5.22	31.90	2.03	45.13	0.70	30.61
D6	0.13	0.18	0.09	2.48	5.59	37.06	2.96	51.31	0.70	27.47
D7	0.13	0.18	0.07	2.51	5.98	39.91	2.79	50.53	0.73	29.12
D8	0.13	0.17	0.06	2.60	6.58	42.55	2.76	54.38	0.71	30.34
D9	0.11	0.16	0.05	2.78	7.46	41.11	1.77	52.61	0.67	27.71
D10 (H)	0.10	0.16	0.04	3.59	9.16	46.73	0.81	48.68	0.74	26.57
H-L	-0.03***	-0.01	-0.06***	1.62***	5.97****	28.61***	0.42***	8.43***	0.10***	-10.52***
(t-stat)	(-3.65)	(-1.31)	(-4.15)	(4.65)	(4.79)	(10.25)	(6.32)	(8.35)	(3.00)	(-6.34)
Panel E: Insurer deciles sorted by ILP_{λ}										
D1 (L)	0.12	0.16	0.09	2.08	3.48	18.27	0.48	40.49	0.60	37.85
D2	0.11	0.17	0.09	2.15	4.10	19.48	0.71	40.18	0.64	34.26
D3	0.13	0.16	0.07	2.13	4.46	24.75	0.87	42.62	0.67	32.63
D4	0.14	0.16	0.08	2.32	5.01	30.81	1.74	45.52	0.70	30.56
D5	0.13	0.16	0.09	2.26	5.35	34.29	2.44	46.99	0.71	29.39
D6	0.13	0.17	0.08	2.38	5.80	36.24	2.85	49.30	0.71	28.74
D7	0.14	0.17	0.08	2.46	6.09	37.72	2.61	50.56	0.72	30.97
D8	0.12	0.16	0.07	2.66	6.54	42.70	2.20	51.70	0.71	28.47
D9	0.11	0.16	0.07	2.72	6.79	46.87	1.49	53.07	0.73	28.32
D10 (H)	0.09	0.15	0.04	3.49	8.64	44.39	0.64	48.79	0.71	26.77
H-L	-0.03***	-0.01	-0.05***	1.41***	5.16***	26.12***	0.16	8.30***	0.11***	-11.08***
(t-stat)	(-2.78)	(-1.42)	(-4.97)	(4.28)	(4.38)	(17.22)	(1.41)	(9.64)	(4.49)	(-8.39)

Table 5: Yield Spreads for Liquidity and Liquidity Clientele Sorted Portfolios

This table reports both bond yield spreads and characteristics-adjusted yield spreads across different groups of liquidity and the liquidity clientele measures. The results using five different liquidity measures are reported in Panels A through E, respectively. A bond's yield spread, expressed in percentage points, is the difference between the yield of a corporate bond and the treasury yield with matching maturity. The liquidity clientele measures are described in Session 2.3. In each quarter we sort bonds into 5x5 groups based on the liquidity measures and *ILC* measures, and then calculate both (raw) yield spreads and adjusted yield spreads as defined in Eq. (7) in each group. We first compute the average yield spreads in each quarter, then calculate the average over time. Within each *ILC* quintile, the differences between the top (Q5) and bottom (Q1) liquidity quintiles and associated t-statistics using the Newey-West procedure with a four-quarter lag are reported in the last two rows of each panel. The difference in liquidity premiums between the two extreme *ILC* quintiles and the associated t-statistic using the Newey-West procedure with a four-quarter lag are also reported. Significance at 10% level is marked *, at 5% marked **, and at 1% marked ***.

	Raw yield spreads						Characteristics-adjusted yield spreads					
	ILC1	ILC2	ILC3	ILC4	ILC5	ILC5-ILC1	ILC1	ILC2	ILC3	ILC4	ILC5	ILC5-ILC1
ILQ	*ILC*						*ILC*					
Panel A. Illiquidity Measure: *Amihud*												
ILQ1	1.47	1.63	1.70	1.79	2.08	0.61	-0.40	-0.27	-0.18	-0.07	0.19	0.59
ILQ2	1.42	1.56	1.73	1.86	2.03	0.61	-0.48	-0.35	-0.21	-0.06	0.09	0.57
ILQ3	1.36	1.58	1.64	1.81	2.00	0.64	-0.53	-0.37	-0.31	-0.14	0.03	0.56
ILQ4	1.52	1.64	1.71	1.89	2.01	0.49	-0.39	-0.32	-0.26	-0.09	0.04	0.43
ILQ5	2.00	1.96	1.94	2.03	2.36	0.36	0.07	0.08	0.15	0.13	0.38	0.31
ILQ5-ILQ1	0.53**	0.33***	0.24***	0.24**	0.28***	-0.25**	0.47**	0.35**	0.33**	0.20**	0.19***	-0.28**
(t-stat)	(2.45)	(2.69)	(2.65)	(2.30)	(3.49)	(-2.24)	(2.11)	(2.51)	(2.41)	(2.02)	(2.86)	(-2.33)
Panel B. Illiquidity Measure: *Roll*												
ILQ1	1.04	1.29	1.57	1.77	1.88	0.84	-0.83	-0.59	-0.35	-0.17	0.01	0.83
ILQ2	1.35	1.47	1.67	1.94	1.80	0.45	-0.51	-0.43	-0.26	0.00	-0.08	0.43
ILQ3	1.75	1.74	2.05	2.03	1.89	0.14	-0.15	-0.20	0.06	0.08	0.01	0.16
ILQ4	2.11	2.17	2.27	2.23	1.90	-0.21	0.17	0.16	0.24	0.26	0.04	-0.13
ILQ5	2.40	2.18	2.42	2.36	2.11	-0.29	0.46	0.21	0.40	0.39	0.22	-0.24
ILQ5-ILQ1	1.36***	0.89***	0.85***	0.59***	0.23***	-1.13***	1.29***	0.80***	0.75***	0.56***	0.21**	-1.08***
(t-stat)	(4.39)	(4.21)	(4.18)	(6.07)	(2.97)	(-3.31)	(3.70)	(3.54)	(3.34)	(3.54)	(2.22)	(-3.74)
Panel C. Illiquidity Measure: *LOT*												
ILQ1	1.28	1.46	1.59	1.66	1.51	0.23	-0.62	-0.50	-0.37	-0.26	-0.37	0.25
ILQ2	1.48	1.57	1.66	1.62	1.58	0.10	-0.42	-0.37	-0.28	-0.27	-0.27	0.15
ILQ3	1.78	1.77	1.91	1.86	1.71	-0.07	-0.13	-0.17	-0.04	-0.06	-0.15	-0.02
ILQ4	2.37	1.97	2.26	2.14	2.00	-0.37	0.47	0.01	0.27	0.16	0.09	-0.38
ILQ5	2.47	2.04	2.23	2.32	2.23	-0.24	0.57	0.15	0.27	0.37	0.37	-0.20
ILQ5-ILQ1	1.19**	0.58***	0.64**	0.66***	0.72***	-0.47**	1.19**	0.65***	0.64***	0.63***	0.74***	-0.45**
(t-stat)	(2.18)	(3.92)	(2.48)	(2.67)	(3.05)	(-2.36)	(2.13)	(4.07)	(2.66)	(2.81)	(2.63)	(-2.53)
Panel D. Illiquidity Measure: *IRC*												
ILQ1	1.14	1.46	1.71	1.79	1.79	0.65	-0.74	-0.44	-0.22	-0.11	-0.03	0.71
ILQ2	1.12	1.42	1.69	1.77	1.81	0.69	-0.76	-0.51	-0.29	-0.17	-0.09	0.67
ILQ3	1.32	1.57	1.76	1.87	1.87	0.55	-0.57	-0.36	-0.23	-0.09	-0.03	0.54
ILQ4	1.67	1.80	1.98	2.10	2.00	0.33	-0.21	-0.14	-0.01	0.10	0.10	0.31
ILQ5	2.03	2.19	2.29	2.34	2.33	0.30	0.09	0.24	0.30	0.52	0.41	0.32
ILQ5-ILQ1	0.89**	0.73**	0.58***	0.55***	0.54***	-0.35***	0.83**	0.68*	0.52***	0.63**	0.44***	-0.39***
(t-stat)	(2.51)	(2.20)	(2.81)	(2.68)	(3.64)	(-2.57)	(2.22)	(1.95)	(2.57)	(2.33)	(2.92)	(-2.65)
Panel E. Illiquidity Measure: λ												
ILQ1	1.37	1.61	1.71	1.79	2.02	0.65	-0.51	-0.30	-0.20	-0.10	0.13	0.64
ILQ2	1.21	1.49	1.65	1.74	1.85	0.64	-0.67	-0.46	-0.32	-0.17	-0.09	0.58
ILQ3	1.35	1.50	1.67	1.75	1.77	0.42	-0.53	-0.42	-0.30	-0.20	-0.17	0.36
ILQ4	1.74	1.66	1.85	1.85	2.01	0.27	-0.15	-0.27	-0.12	-0.12	0.06	0.21
ILQ5	2.02	2.13	2.25	2.36	2.38	0.36	0.10	0.20	0.27	0.37	0.40	0.30
ILQ5-ILQ1	0.65***	0.52**	0.54**	0.57**	0.36***	-0.29**	0.61**	0.50*	0.47**	0.47**	0.27***	-0.34**
(t-stat)	(2.74)	(2.06)	(2.53)	(2.48)	(3.26)	(-2.25)	(2.47)	(1.94)	(2.51)	(2.29)	(3.31)	(-2.46)

Table 6: Panel Regressions of Yield Spreads

This table reports the results of panel regressions with the issuer- and time-fixed effects. The dependent variable is yield spread, in percentage. Each quarter, we sort bonds into terciles based on the liquidity clientele measures and define two indicators, *T2* (median *ILC* group) and *T3* (high *ILC* group), for bonds in tercile groups 2 and 3. Independent variables include alternative *ILQ* measures (that is, *Amihud, Roll, LOT, IRC*, and λ), *T2, T3*, and the interactions between *ILQ* and *T2* as well as *ILQ* and *T3*. The column heading specifies *ILQ* measures used in the regressions. The control variables include the year since the bond was issued, time to maturity, issue size, coupon payments, an issuer's ratio of operating income to sales, an issuer's ratio of long term debt to assets (*LTD*), an issuer's leverage ratio, an issuer's equity volatility (*EqVol*), and 4 pretax interest coverage dummies of an issuer (*Pretax1*, *Pretax2*, *Pretax3*, and *Pretax4*). The regressions additionally include dummies for each credit rating category, the issuer-fixed effects, and the time-fixed effects. The t-statistics reported in the parentheses are based on two-way clustered (by time and by issuer) standard errors. Significance at 10% level is marked *, at 5% marked **, and at 1% marked ***.

	(1) Amihud	(2) Roll	(3) LOT	(4) IRC	(5) λ	(6) Amihud	(7) Roll	(8) LOT	(9) IRC	(10) λ
Intercept	0.96***	0.63***	1.25***	0.50***	1.98***	-7.15***	-9.75***	-9.26***	-6.88***	-5.72***
	(15.70)	(4.78)	(28.32)	(4.79)	(9.58)	(-7.76)	(-9.72)	(-8.56)	(-7.63)	(-6.52)
ILQ	0.83***	0.78***	0.04***	5.30***	1.97***	0.64***	0.88***	0.05***	3.80***	1.61***
	(10.23)	(6.30)	(6.01)	(10.22)	(12.93)	(7.37)	(7.38)	(6.73)	(14.50)	(11.45)
T2	0.19***	0.39***	0.12**	0.19***	0.13**	0.08*	0.47***	0.14***	0.27***	0.15**
	(4.61)	(3.07)	(2.07)	(2.85)	(2.20)	(1.72)	(3.95)	(2.90)	(5.01)	(2.33)
T3	0.54***	0.65***	0.21***	0.64***	0.37***	0.28***	0.95***	0.31***	0.54***	0.34***
	(5.68)	(4.76)	(3.59)	(6.69)	(5.84)	(3.26)	(6.25)	(4.95)	(6.06)	(3.88)
ILQ*T2	-0.31***	-0.38***	-0.01**	-1.45***	-0.25*	-0.28***	-0.45***	-0.02***	-1.53***	-0.48***
	(-3.97)	(-3.36)	(-2.40)	(-3.90)	(-1.85)	(-3.43)	(-4.10)	(-3.51)	(-5.84)	(-3.38)
ILQ*T3	-0.63***	-0.62***	-0.03***	-3.88***	-1.03***	-0.48***	-0.73***	-0.04***	-2.78***	-1.19***
	(-8.42)	(-5.04)	(-4.93)	(-8.19)	(-8.30)	(-5.51)	(-6.24)	(-5.70)	(-10.02)	(-8.13)
Bond age						0.02**	0.05***	0.03***	0.03***	0.02**
						(2.25)	(5.61)	(3.09)	(2.93)	(2.05)
Maturity						0.38	1.30***	0.71***	1.02**	0.85**
						(1.32)	(3.98)	(3.01)	(2.52)	(2.27)
Issue size						0.23***	0.34***	0.33***	0.21***	0.22***
						(4.95)	(6.38)	(5.68)	(4.55)	(4.85)
Coupon						0.05***	0.05**	0.02	0.04***	0.06***
						(2.65)	(2.05)	(1.07)	(2.66)	(3.30)
Income to sales (%)						-0.59	-0.57*	-0.62*	-0.51	-0.51
						(-1.52)	(-1.95)	(-1.91)	(-1.28)	(-1.29)
LTD (%)						1.50	1.64	2.14**	1.60	1.42
						(1.41)	(1.63)	(2.12)	(1.62)	(1.43)
Leverage (%)						2.75*	2.97**	3.09**	2.32*	2.24
						(1.98)	(2.27)	(2.24)	(1.79)	(1.68)
EqVol						0.25**	0.25**	0.25**	0.23**	0.24**
						(2.14)	(2.31)	(2.12)	(2.06)	(2.07)
Pretax1 (%)						-1.79	-1.51	-1.46	-1.26	-1.54
						(-0.53)	(-0.79)	(-0.76)	(-0.40)	(-0.49)
Pretax2 (%)						-1.18	-1.92	-1.06	-0.55	-0.82
						(-0.36)	(-0.67)	(-0.34)	(-0.18)	(-0.28)
Pretax3 (%)						-3.26	-4.15**	-4.34**	-2.89	-2.79
						(-1.57)	(-2.06)	(-2.12)	(-1.48)	(-1.46)
Pretax4 (%)						0.81	0.58	0.35	0.86	0.87
						(1.19)	(1.02)	(0.56)	(1.46)	(1.41)
Rating dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect - issuer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect - quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R^2	0.15	0.16	0.15	0.17	0.17	0.48	0.50	0.46	0.48	0.49
N	37,663	44,177	45,008	36,656	32,838	15,079	17,073	17,316	14,725	13,440

Table 7: Panel Regressions of Yield Spreads based on Turnover-based Liquidity Clientele

This table reports the results of panel regressions with the issuer- and time-fixed effects using the turnover-based liquidity clientele measure. The turnover-based liquidity clientele measure for a bond is the averaged turnover ratio of insurers who hold the bond weighted by each insurers' holding amount. An insurer's portfolio turnover ratio is the minimum of the aggregate market value of bonds purchased by the insurer and the aggregate value of bonds sold by an insurer in a quarter scaled by the aggregate portfolio value at the end of the quarter. The dependent variable is yield spread, in percentage. Each quarter, we sort bonds into terciles based on the turnover-based liquidity clientele measures and define two indicators, *T2* (median *ILC* group) and *T3* (high *ILC* group), for bonds in tercile groups 2 and 3. Independent variables include alternative *ILQ* measures (that is, *Amihud, Roll, LOT, IRC*, and λ), *T2, T3*, and the interactions between *ILQ* and *T2* as well as *ILQ* and *T3*. The column heading specifies *ILQ* measures used in the regressions. The control variables include the year since the bond was issued, time to maturity, issue size, coupon payments, an issuer's ratio of operating income to sales, an issuer's ratio of long term debt to assets (*LTD*), an issuer's leverage ratio, an issuer's equity volatility (*EqVol*), and 4 pretax interest coverage dummies of an issuer (*Pretax1*, *Pretax2*, *Pretax3*, and *Pretax4*). The regressions additionally include dummies for each credit rating category, the issuer-fixed effects, and the time-fixed effects. The t-statistics reported in the parentheses are based on two-way clustered (by time and by issuer) standard errors. Significance at 10% level is marked *, at 5% marked **, and at 1% marked ***.

	(1) Amihud	(2) Roll	(3) LOT	(4) IRC	(5) λ
Intercept	-7.48***	-9.07***	-8.59***	-7.14***	-6.55***
	(-7.79)	(-8.67)	(-7.57)	(-7.40)	(-6.82)
ILQ	0.39***	0.30***	0.03***	2.22***	1.05***
	(7.50)	(6.55)	(5.15)	(8.18)	(8.42)
T2	0.03**	0.04**	0.01**	0.05**	0.12**
	(2.15)	(2.50)	(2.18)	(2.21)	(2.38)
T3	0.20***	0.25***	0.10**	0.26***	0.20**
	(3.98)	(3.66)	(2.27)	(4.31)	(2.25)
ILQ*T2	-0.13***	-0.14***	-0.01***	-0.44**	-0.24**
	(-2.64)	(-3.08)	(-2.97)	(-2.14)	(-2.19)
ILQ*T3	-0.22***	-0.23***	-0.02***	-0.91***	-0.53***
	(-4.14)	(-2.83)	(-2.98)	(-3.19)	(-4.14)
Bond age	0.02**	0.05***	0.03***	0.02***	0.01
	(2.30)	(5.05)	(3.21)	(2.78)	(1.67)
Maturity	0.42*	1.19***	0.66***	1.31***	1.11***
	(1.74)	(4.12)	(3.28)	(4.36)	(4.01)
Issue size	0.25***	0.32***	0.30***	0.23***	0.24***
	(4.99)	(5.80)	(4.92)	(4.50)	(4.85)
Coupon	0.05***	0.02*	0.03	0.05***	0.06***
	(2.78)	(1.87)	(1.26)	(2.58)	(3.29)
Income to sales (%)	-0.57	-0.59*	-0.63*	-0.50	-0.50
	(-1.45)	(-1.88)	(-1.84)	(-1.21)	(-1.25)
LTD (%)	1.76	1.68	2.18**	1.77*	1.62
	(1.64)	(1.62)	(2.10)	(1.73)	(1.58)
Leverage (%)	2.85**	3.24**	3.20**	2.52*	2.54*
	(2.01)	(2.35)	(2.27)	(1.81)	(1.88)
EqVol	0.25**	0.26**	0.26**	0.24**	0.21**
	(2.13)	(2.26)	(2.12)	(2.07)	(2.05)
Pretax1 (%)	-1.57	-1.39	-1.43	-1.47	-1.61
	(-0.46)	(-0.70)	(-0.72)	(-0.46)	(-0.51)
Pretax2 (%)	-1.40	-1.95	-1.12	-0.89	-1.10
	(-0.42)	(-0.63)	(-0.36)	(-0.28)	(-0.35)
Pretax3 (%)	-3.45	-4.22*	-4.50**	-3.00	-2.88
	(-1.65)	(-1.98)	(-2.14)	(-1.40)	(-1.42)
Pretax4 (%)	0.81	0.60	0.35	0.85	0.86
	(1.22)	(1.00)	(0.54)	(1.37)	(1.34)
Rating dummies	Yes	Yes	Yes	Yes	Yes
Fixed effect - issuer	Yes	Yes	Yes	Yes	Yes
Fixed effect - quarter	Yes	Yes	Yes	Yes	Yes
Adj.R^2	0.31	0.33	0.30	0.32	0.31
N	15,079	17,073	17,316	14,725	13,440

Table 8: Effects of Clientele on Liquidity Premium Before and During the Financial Crisis

This table reports the results of panel regressions specified in Eq. (8) before and during the financial crisis. The dependent variable is the bond yield spread (in percent). Each quarter, we sort bonds into terciles based on liquidity clientele measures and define two indicators, *T2* (median *ILC* group) and *T3* (high *ILC* group), for bonds in tercile groups 2 and 3. Independent variables include alternative *ILQ* measures (that is, *Amihud, Roll, LOT, IRC*, and λ), *T2, T3,* and the interactions between *ILQ* and *T2* as well as *ILQ* and *T3*. The column heading specifies *ILQ* measures used in the regressions. The control variables include the year since issued, time to maturity, issue size, coupon payments, the ratio of operating income to sales, ratio of long term debt to assets (*LTD*), leverage ratio, equity volatility (*EqVol*), and pretax interest coverage dummies. The regressions additionally include dummies for each credit rating category, the issuer-fixed effects, and the time-fixed effects. Panels A and B report the results for the pre-crisis and the crisis periods, respectively. The intercepts and coefficients on control variables are not reported. The t-statistics reported in the parentheses are based on two-way clustered (by time and by issuer) standard errors. Significance at 10% level is marked *, at 5% marked **, and at 1% marked ***.

	Amihud	Roll	LOT	IRC	λ	Amihud	Roll	LOT	IRC	λ
	A. Before the crisis					B. During the crisis				
ILQ	0.25***	0.41***	0.02**	0.67***	0.42***	0.48***	1.11***	0.05***	3.57***	1.40***
	(4.62)	(8.64)	(2.39)	(7.23)	(5.81)	(5.02)	(5.42)	(5.70)	(9.48)	(9.17)
T2	0.17***	0.28***	0.08***	0.18***	0.12***	0.13	0.79***	0.29***	0.44***	0.11*
	(4.45)	(7.79)	(3.60)	(8.18)	(5.11)	(1.22)	(3.38)	(3.23)	(3.27)	(1.87)
T3	0.28***	0.56***	0.16***	0.34***	0.20***	0.31**	1.45***	0.58***	0.98***	0.25**
	(3.57)	(12.20)	(4.94)	(7.81)	(4.13)	(2.18)	(5.34)	(5.02)	(4.67)	(2.16)
ILQ*T2	-0.11***	-0.15***	-0.01*	-0.19***	-0.19*	-0.26***	-0.59***	-0.03***	-1.17***	-0.32**
	(-2.83)	(-4.82)	(-1.95)	(-2.98)	(-1.89)	(-2.86)	(-3.15)	(-3.90)	(-2.98)	(-2.06)
ILQ*T3	-0.20***	-0.33***	-0.02**	-0.50***	-0.34***	-0.44***	-0.87***	-0.04***	-2.46***	-0.72***
	(-4.21)	(-6.10)	(-2.22)	(-5.27)	(-2.63)	(-3.41)	(-4.40)	(-5.06)	(-5.77)	(-5.05)
Adj.R^2	0.41	0.48	0.38	0.45	0.47	0.39	0.46	0.40	0.42	0.47
N	10,760	12,097	12,271	10,492	9,578	4,319	4,976	5,045	4,233	3,862

Table 9: Effects of Clientele on Liquidity Premium in Bond Subsamples

This table reports the results of panel regressions specified by Eq. (8) using different subsamples of bonds. The dependent variable is the bond yield spread (in percent). Panel A reports the result for short-term bonds with their maturities within 5 years. Panel B reports the result for long-term bonds with over 5-year maturity. Panel C reports the result using speculative bonds. Panel D reports the result for investment-grade (IG) bonds with more than 20% holding by insurance companies. In each quarter we sort bonds into terciles within respective samples based on liquidity clientele measures and define two indicators, *T2* (median *ILC* group) and *T3* (high *ILC* group), for bonds in tercile groups 2 and 3. Independent variables include alternative *ILQ* measures (that is, *Amihud, Roll, LOT, IRC*, and λ, as specified by the column heading), *T2, T3*, and the interactions between *ILQ* and *T2* as well as *ILQ* and *T3*. The control variables include the year since issued, time to maturity, issue size, coupon payments, the ratio of operating income to sales, ratio of long term debt to assets (*LTD*), leverage ratio, equity volatility (*EqVol*), and pretax interest coverage dummies. The intercepts and coefficients on control variables are not reported. The regressions additionally include dummies for each credit rating category, the issuer-fixed effects, and the time-fixed effects. The t-statistics reported in the parentheses are based on two-way clustered (by time and by issuer) standard errors. Significance at 10% level is marked *, at 5% marked **, and at 1% marked ***.

	Amihud	Roll	LOT	IRC	λ	Amihud	Roll	LOT	IRC	λ
	A. Short-term bonds					B. Long-term bonds				
ILQ	0.64***	1.68***	0.15***	5.13***	1.72***	0.63***	0.75***	0.04***	3.28***	1.26***
	(4.00)	(3.65)	(3.99)	(5.35)	(5.40)	(7.57)	(8.19)	(5.93)	(12.05)	(12.13)
T2	-0.02	0.93***	0.23**	0.02	0.06	0.07	0.35***	0.12**	0.24***	0.09
	(-0.23)	(2.79)	(2.27)	(0.12)	(0.37)	(1.30)	(3.30)	(2.22)	(4.70)	(1.49)
T3	-0.07	0.88*	0.23	-0.18	0.13	0.27***	0.90***	0.34***	0.54***	0.18*
	(-0.37)	(1.95)	(1.37)	(-0.31)	(0.34)	(2.80)	(7.09)	(4.99)	(7.03)	(1.81)
ILQ*T2	-0.01	-1.28**	-0.03*	-0.64	0.10	-0.30***	-0.31***	-0.01***	-1.16***	-0.26**
	(-0.03)	(-2.07)	(-1.83)	(-0.40)	(0.26)	(-3.67)	(-3.49)	(-2.56)	(-4.03)	(-2.35)
ILQ*T3	-0.01	-1.35**	-0.05*	-1.78	0.75	-0.49***	-0.61***	-0.02***	-2.37***	-0.74***
	(-0.01)	(-2.09)	(-1.86)	(-0.61)	(0.86)	(-5.92)	(-6.80)	(-4.85)	(-7.90)	(-5.45)
Adj.R^2	0.26	0.25	0.21	0.23	0.24	0.50	0.53	0.48	0.49	0.50
N	7,757	8,637	8,727	7,604	7,012	7,322	8,436	8,589	7,121	6,428
	C. Speculative-grade bonds					D. IG bonds $\geq$ 20% held by insurers				
ILQ	0.96***	0.90**	0.02***	8.04***	3.66***	0.54***	0.72***	0.03***	2.58***	1.15***
	(3.96)	(2.12)	(2.83)	(6.09)	(6.07)	(7.10)	(6.67)	(12.13)	(8.12)	(9.69)
T2	-0.69*	-0.08	0.31	0.61	-0.31	0.12**	0.35***	0.12**	0.21***	0.08***
	(-1.80)	(-0.63)	(1.09)	(1.28)	(-1.27)	(2.44)	(3.53)	(2.27)	(3.96)	(3.25)
T3	-0.26	-0.35	0.23	0.44	-0.70**	0.21***	0.84***	0.32***	0.47***	0.22***
	(-0.91)	(-0.48)	(0.64)	(0.74)	(-2.40)	(2.83)	(6.40)	(5.21)	(6.50)	(2.65)
ILQ*T2	-0.08	0.15	0.01	-2.16	-1.09	-0.23***	-0.31***	-0.02***	-1.25***	-0.22*
	(-0.24)	(0.30)	(0.19)	(-1.50)	(-1.54)	(-3.05)	(-4.09)	(-2.83)	(-4.41)	(-1.92)
ILQ*T3	-0.50**	-0.39	0.01	-3.14**	-1.52**	-0.39***	-0.59***	-0.03***	-2.35***	-0.70***
	(-2.03)	(-0.97)	(0.13)	(-2.01)	(-2.37)	(-5.06)	(-7.72)	(-5.33)	(-7.58)	(-5.81)
Adj.R^2	0.18	0.19	0.17	0.17	0.18	0.52	0.56	0.53	0.53	0.54
N	2,803	3,017	3,036	2,773	2,614	11,656	13,491	13,712	11,331	10,161

Table 10: Panel Regressions of Expected Yield Spreads

This table reports the results of panel regressions with the issuer- and time-fixed effects. The dependent variable is the expected yield spread, in percentage. Each quarter, we sort bonds into terciles based on the liquidity clientele measures and define two indicators, *T2* (median *ILC* group) and *T3* (high *ILC* group), for bonds in tercile groups 2 and 3. Independent variables include alternative *ILQ* measures (that is, *Amihud, Roll, LOT, IRC*, and λ), *T2, T3*, and the interactions between *ILQ* and *T2* as well as *ILQ* and *T3*. The column heading specifies *ILQ* measures used in the regressions. The control variables include the year since the bond was issued, time to maturity, issue size, coupon payments, an issuer's ratio of operating income to sales, an issuer's ratio of long term debt to assets (*LTD*), an issuer's leverage ratio, an issuer's equity volatility (*EqVol*), and 4 pretax interest coverage dummies of an issuer (*Pretax1*, *Pretax2*, *Pretax3*, and *Pretax4*). The regressions additionally include dummies for each credit rating category, the issuer-fixed effects, and the time-fixed effects. The t-statistics reported in the parentheses are based on two-way clustered (by time and by issuer) standard errors. Significance at 10% level is marked *, at 5% marked **, and at 1% marked ***.

	(1) Amihud	(2) Roll	(3) LOT	(4) IRC	(5) λ	(6) Amihud	(7) Roll	(8) LOT	(9) IRC	(10) λ
Intercept	0.91***	0.59***	1.19***	0.46***	1.91***	-7.32***	-9.84***	-9.33***	-7.03***	-4.69***
	(15.31)	(4.56)	(27.89)	(4.58)	(9.41)	(-7.80)	(-9.66)	(-8.47)	(-7.68)	(-4.92)
ILQ	0.80***	0.77***	0.04***	5.17***	1.92***	0.63***	0.88***	0.05***	3.80***	1.39***
	(10.14)	(6.35)	(6.05)	(10.30)	(13.14)	(7.64)	(7.71)	(6.86)	(14.53)	(14.97)
T2	0.18***	0.37***	0.11*	0.17***	0.11**	0.08*	0.47***	0.14***	0.27***	0.10**
	(4.20)	(2.96)	(1.93)	(2.62)	(2.15)	(1.72)	(4.06)	(2.91)	(4.99)	(2.13)
T3	0.51***	0.62***	0.19***	0.60***	0.37***	0.28***	0.93***	0.30***	0.55***	0.30***
	(5.53)	(4.60)	(3.37)	(6.46)	(5.14)	(3.39)	(6.63)	(5.23)	(6.26)	(3.68)
ILQ*T2	-0.29***	-0.37***	-0.01**	-1.39***	-0.17*	-0.27***	-0.45***	-0.02***	-1.52***	-0.40***
	(-3.72)	(-3.33)	(-2.41)	(-3.79)	(-1.94)	(-3.49)	(-4.27)	(-3.55)	(-5.72)	(-2.96)
ILQ*T3	-0.61***	-0.61***	-0.03***	-3.79***	-1.02***	-0.48***	-0.72***	-0.04***	-2.81***	-0.82***
	(-8.30)	(-5.04)	(-4.96)	(-8.26)	(-8.33)	(-5.76)	(-6.50)	(-5.80)	(-10.02)	(-7.99)
Bond age						0.02*	0.05***	0.03***	0.03**	0.02
						(1.78)	(5.19)	(2.69)	(2.40)	(1.68)
Maturity						0.43	1.34***	0.76***	1.07**	1.16**
						(1.40)	(4.08)	(3.14)	(2.50)	(2.42)
Issue size						0.24***	0.34***	0.33***	0.22***	0.18***
						(4.99)	(6.33)	(5.61)	(4.59)	(4.14)
Coupon						0.06***	0.04*	0.03	0.05***	0.07***
						(2.63)	(1.80)	(1.25)	(2.81)	(3.48)
Income to sales (%)						-0.50*	-0.50**	-0.55**	-0.41	-0.48*
						(-1.82)	(-2.33)	(-2.23)	(-1.48)	(-1.93)
LTD (%)						1.11	1.31	1.82	1.21	1.22
						(0.91)	(1.18)	(1.65)	(1.07)	(1.01)
Leverage (%)						2.98**	3.17***	3.28***	2.57**	2.09*
						(2.36)	(2.60)	(2.58)	(2.07)	(1.72)
EqVol						0.25**	0.25**	0.25**	0.23*	0.24**
						(2.03)	(2.18)	(2.00)	(1.96)	(2.03)
Pretax1 (%)						-1.05	-1.07	-1.02	-0.54	-0.95
						(-0.31)	(-0.55)	(-0.51)	(-0.17)	(-0.17)
Pretax2 (%)						-0.90	-1.57	-0.70	-0.54	-0.78
						(-0.28)	(-0.54)	(-0.22)	(-0.10)	(-0.22)
Pretax3 (%)						-3.25	-4.08**	-4.27**	-2.87	-2.30
						(-1.63)	(-2.10)	(-2.16)	(-1.52)	(-1.23)
Pretax4 (%)						0.76	0.54	0.32	0.82	0.78
						(1.17)	(0.99)	(0.52)	(1.45)	(1.49)
Rating dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect - issuer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect - quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R^2	0.17	0.18	0.17	0.18	0.18	0.50	0.53	0.48	0.50	0.50
N	37,663	44,177	45,008	36,656	32,838	15,079	17,073	17,316	14,725	13,440

Figure 1: Illiquidity Measures across Investment Grade and Speculative Bonds over Time

This figure reports the averages of illiquidity measures for both investment-grade and speculative-grade bonds in our sample over the period 2003:Q1–2009:Q4. Bond illiquidity measures implemented include those of Amihud (2002), Roll (1984), Lesmond, Ogden, and Trzcinka (1999); the imputed roundtrip cost (IRC) of Feldhütter (2012); and λ of Dick-Nielsen, Feldhütter, and Lando (2012).

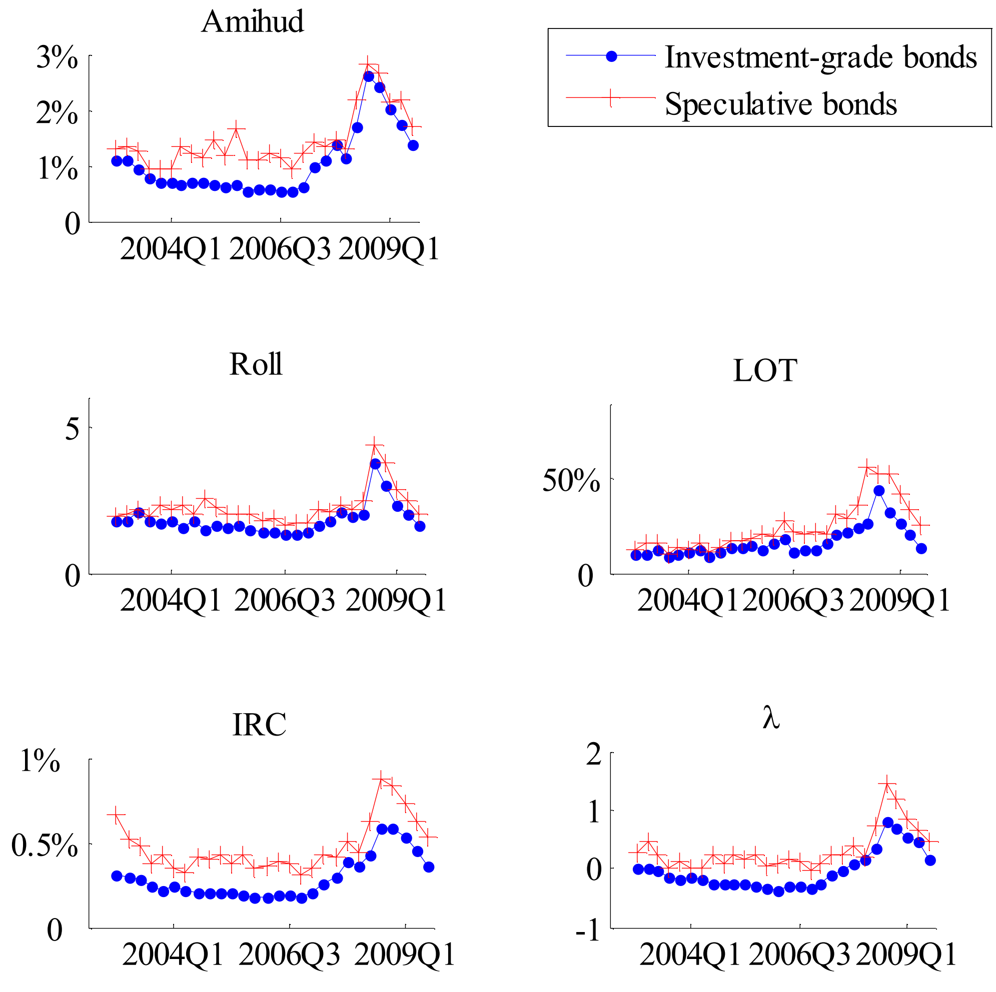


Figure 2: Corporate Bond Yield Spreads and Illiquidity Measures

The figure shows the relation between yield spreads/expected yield spreads and bonds' illiquidity based on piecewise regressions. Panel A plots the relation between yield spreads and illiquidity. Panel B plots the relation between expected yield spreads and illiquidity. A bond's yield spread is the difference between the yield of a corporate bond and the treasury yield with matching maturity. A bond's expected yield spread is the difference between the yield spread and expected default loss. In each quarter the full range of a illiquidity measure is classified into five groups to perform piecewise regressions between one of the illiquidity measures and expected yield spreads. We average the parameters (i.e., the intercept and the coefficients) over time and plotted the fitted yield spreads/expected yield spreads based on the average parameters.

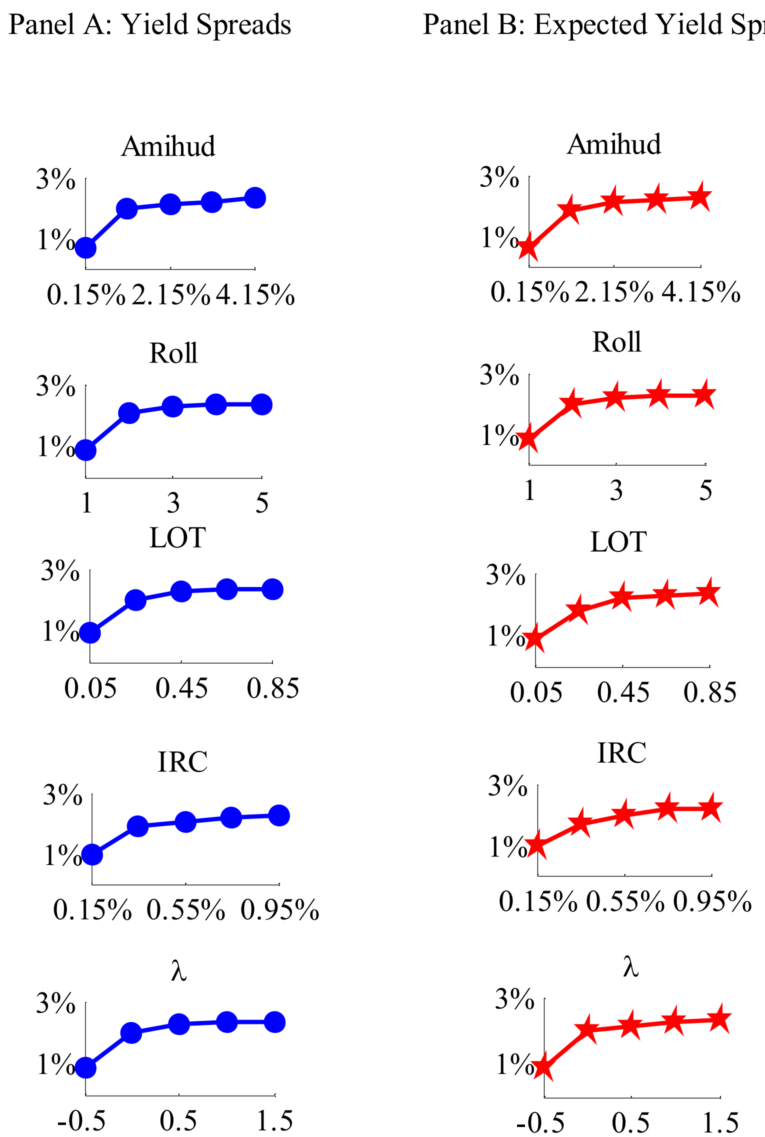
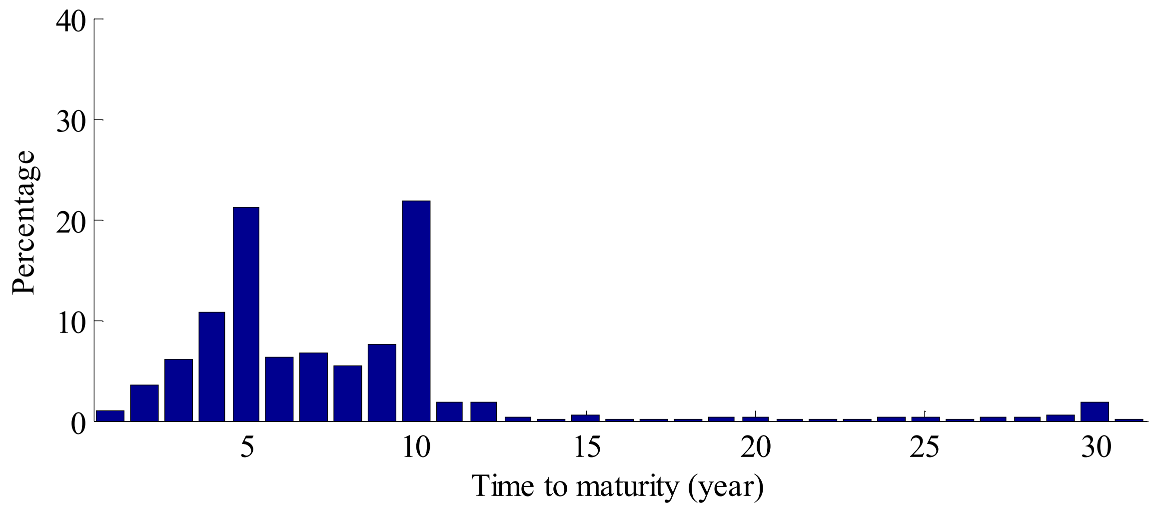


Figure 3: Distributions of Time-to-Maturities of Newly Purchased Corporate Bonds

This figure plots distributions of time to maturities of corporate bonds newly purchased by insurers throughout the sample period. Panel A is for bonds held by property casualty insurers. Panel B is for life insurers.

Panel A: For newly purchased bonds by property casualty insurers



Panel B: For newly purchased bonds by life insurers

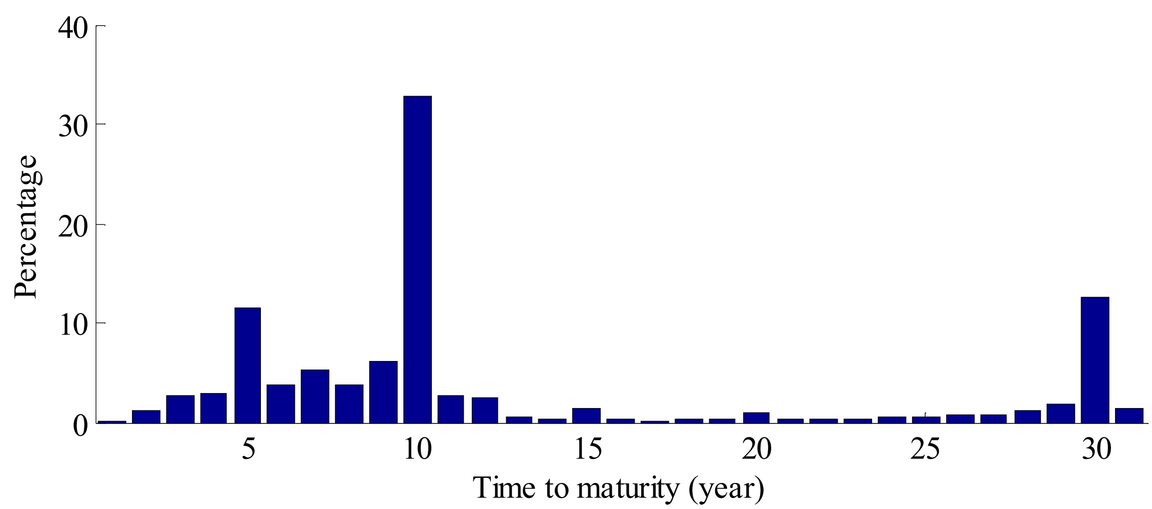


Figure 4: Persistence of Insurers' Illiquidity Preference

This figure plots insurers' illiquidity preference over three-year period after quintile formation. Illiquidity preference (ILP) is constructed using Eq. (5), based on each of five bond illiquidity measures *Amihud, Roll, LOT, IRC*, and λ separately. Given a measure of the ILP, at the end of each year, we sort insurers into quintiles based on their ILP levels. From the lowest quintile to the highest, each quintile is assigned a ranking from one (Q1) to five (Q5). We then trace the level of liquidity preference of each quintile for the ranking year and the next three years (Y, Y+1, Y+2, and Y+3). The sample period is from 2003:Q1 to 2009:Q4.

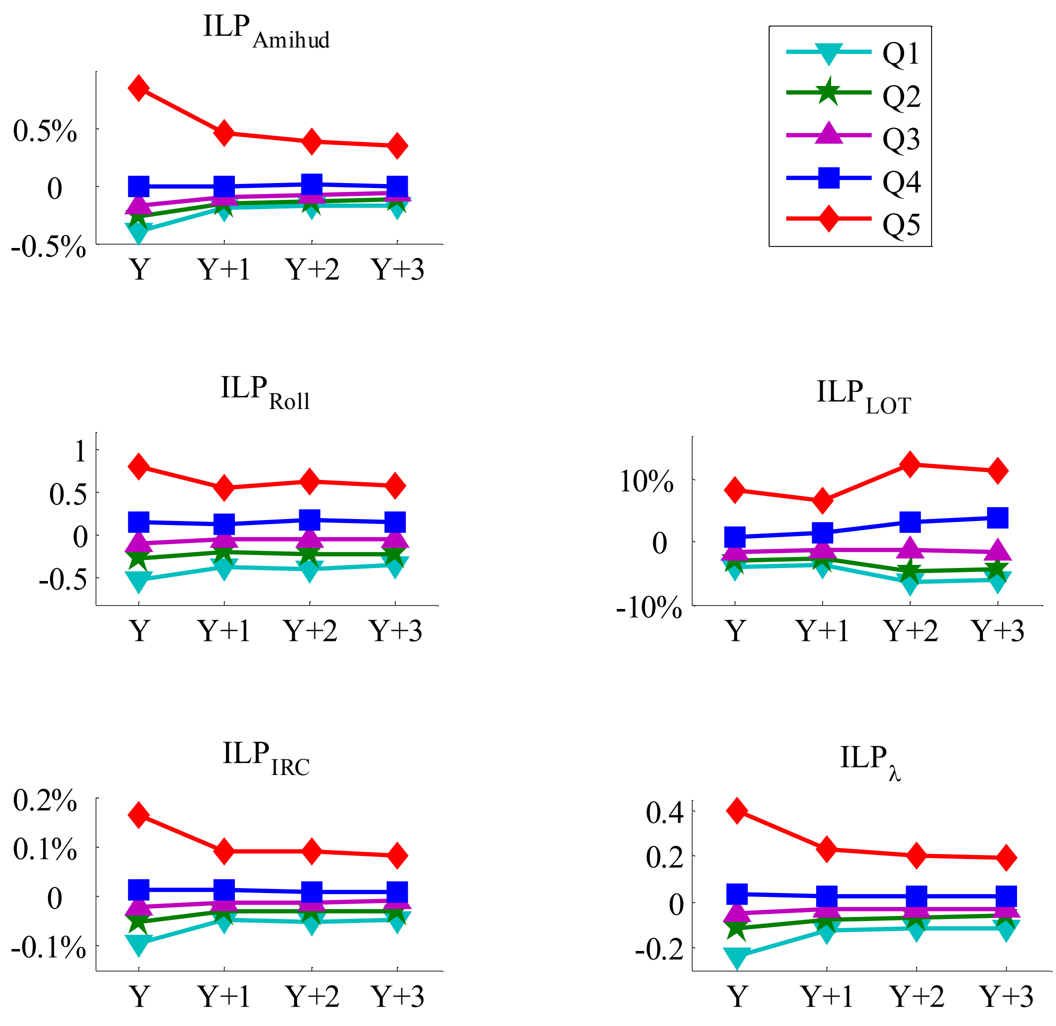


Figure 5: Persistence of Illiquidity Clientele

This figure plots illiquidity clientele of sample bonds over three-year period after quintile formation. We construct illiquidity clientele measures (ILC) using Eq. (6), based on each of ILP_{Amihud}, ILP_{Roll}, ILP_{LOT}, ILP_{IRC}, and ILP_{λ} separately. Given an illiquidity clientele measure, at the end of each year, we sort bonds into quintiles based on their ILC levels. From the lowest quintile to the highest, each quintile is assigned a ranking from one (Q1) to five (Q5). We then trace the level of illiquidity clientele of each quintile for the ranking year and the next three years (Y, Y+1, Y+2, and Y+3). The sample period is from 2003:Q1 to 2009:Q4.