Liquidity and Corporate Debt Market Timing

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Abstract

This paper investigates whether firm managers time debt issuances according to market liquidity conditions. Using transactions data in the U.S. market from July 2002 to December 2009, our results show that both the moment and volume of debt issuance are significantly associated with periods of high aggregate liquidity in the corporate bond market. The result is especially strong when liquidity is aggregated across bonds in the same risk class. Splitting the sample into timers and nontimers, we find that liquidity timers benefit from issuing in moments of debt overpricing obtaining financing at much lower cost.

Key words: corporate bonds issuances, liquidity, market timing, multi-way cluster, panel data, rating.

JEL Classification: G31, G32, G12

I. Introduction

The capital structure choice of firms is one of the most extensively researched fields in corporate finance. However, whether this choice is the result of an attempt to apply an optimal capital structure theory or to time the market is still an area of research. There has been much interest in the role of market timing in firm financial decisions and studies also find empirical evidence consistent with market timing behavior in financing. For example, Graham and Harvey (2001) show that market timing is a major concern of corporate executives: Two-thirds of CEOs admit that timing considerations play an important role in financing decisions. Generally speaking, market timing refers to the benefits that a firm can obtain by issuing securities at abnormally high prices and repurchasing at abnormally low prices.

Initially, the market timing analysis focused on equity issuances.[1] Debt market timing is relatively recent and almost all papers consider interest rates as the most relevant indicator of bonds mispricing in relation to issuance decisions. The main findings can be summarized as follows. The amount of debt issued or the probability of issuing debt is higher when interest rates are low (Barry et al., 2008, 2009; Doukas et al., 2011; Ooi et al., 2010). Barclay and Smith (1995), Guedes and Opler (1996), Kaya (2011), and Stohs and Mauer (1996) show that debt maturities tend to be shorter when the term spread is higher and Bancel and Mittoo (2004) and Graham and Harvey (2001) find that managers issue short-term debt when they believe that future long-term interest rates will fall. Finally, interest rates are also related to the type of coupon (fixed or floating) in new debt issues or loans (Faulkender, 2005; Vickery, 2008). Other variables such as changes in the maturity structure of government debt (Greenwood et al., 2010), measures of equity mispricing (Gao and Lou, 2013), and inflation or the risk spread (Zhou et al., 2012) have also been associated with debt market timing.

However, the benefits of this apparent market timing are not clear at all. On the one hand, Baker et al. (2003), Greenwood et al. (2010), and Greenwood and Hanson (2013) provide evidence supporting the timing hypothesis; they find that long-term and non–investment-grade debt issues are associated with lower future bond returns. On the other hand, Butler et al. (2006) present evidence that the managerial market timing found by Baker et al. (2003) is indeed the result of a spurious ex post relation between

[1] Stylized facts are that abnormal stock returns are reduced after a firm equity offering (Baker and Wurgler, 2000; Loughran and Ritter, 2002; Ritter, 1991; Spiess and Affeck-Graces, 1995) or that future firm leverage increases when decreases in the stock price or increases in the equity risk premium are observed (Baker and Wurgler, 2002; Huang and Ritter, 2009).

security issuance and market returns. In addition, Song (2009) shows that issuing long-term debt in years when the term spread is low has no effect on firm value and, therefore, this potential timing is not successful.

The contribution of this paper is to consider the aggregate liquidity of financial markets as an argument for debt timing. A commonly accepted fact is that liquidity is relevant to the price-generating process of financial assets: Illiquid securities have higher expected returns (lower prices) than liquid ones (Amihud and Mendelson, 1986, 1991). This theoretical asset pricing foundation has been used as the support of recent research papers. On the one hand, several studies examined the effects of illiquidity on corporate bond prices. Bao et al. (2011), Chen et al. (2007), Covitz and Downing (2007), Downing et al. (2009), Friewald et al. (2012), Houweling et al. (2005), and Longstaff et al. (2005) find a positive relation between the credit spread or the yield of a corporate bond and its illiquidity. Acharya et al. (2013), Bao et al. (2011), Bongaerts et al. (2012), and Friewald et al. (2012) show that aggregate liquidity conditions affect corporate bond prices.[2] Therefore, it seems clear that liquidity matters to corporate bond investors. On the other hand, and based also on the idea that increases in liquidity are associated with increases in asset prices, there are papers that relate liquidity and corporate asset issuances, but they are scarce and focus exclusively on equity issuances. Slutz et al (2014) use an international sample of 36 countries and show that stock market liquidity (both contemporaneous and lagged values) is an important determinant of equity issuances across the world. Butler et al (2005) and Gao and Ritter (2010) show that the higher the market liquidity the lower the expected costs of underwriters. And Lipson and Mortal (2009) use the negative relation between the stock liquidity and the cost of equity as the argumentation of advantages of equity financing relative to debt financing and show that firms with more liquid equity have lower leverage ratios.

However, the role of liquidity in timing considerations is fundamentally different and, as far as we are aware, this is the first paper analyzing this relation on debt issuances. We argue that liquidity can be used as an indicator of bond mispricing, so that market liquidity conditions may allow the identification of moments of overvaluation in the corporate debt market. If this is the case, firms may obtain benefits by acting as a debt timer.

Our argument is theoretically supported by the model of Baker and Stein (2004). They propose a microstructure model that accommodates the empirical finding in the corporate finance literature of a negative relation between security offerings and their

[2] Whether the aggregate illiquidity risk is priced by the corporate bond market is also analyzed (e.g., Bongaerts et al., 2012; Chacko, 2005; de Jong and Driessen, 2012; Lin et al., 2011;.Mahanti et al., 2008).

subsequent returns by using assets price pressures as the justification. The idea is that market liquidity can be interpreted as a sentiment indicator of irrational investors that overvalue assets. According to this model, the new information conveyed in an issuance or repurchase of assets by the insider (firm manager) is fully (partially) incorporated into the estimates of rational (irrational) investors or outsiders. The difference between the estimate of irrational investors and the fundamental value of the asset is the sentiment indicator. In equilibrium, pricing depends on the level of irrational investors participating in the market. If the sentiment indicator increases, with short-sales constraints for outsiders, the weight of irrational trades in the pricing function increases and, since they only partially incorporate the new information, the price impact is lower than in the case of rational investors' participation. Consequently, the market becomes more liquid and firm managers may time the market by issuing in those moments. This is precisely our argument. Baker and Stein provide indirect empirical support for their model, showing that i) aggregate measures of the turnover in the stock market and the number of equity issues are high and positively correlated, ii) high values of turnover are associated with moments of equity overvaluations (low dividend yield), and iii) both turnover and the number of issues are negatively related to next year's equity returns.

The aim of this paper is to show that Baker and Stein's (2004) argument also applies to the debt market.[3] Using all U.S. daily transactions registered in the Trade Reporting and Compliance Engine (TRACE) dataset covering the period between July 1, 2002, and December 31, 2009, our results show that liquidity in both the stock and bond markets does influence the debt issuance moment and volume, so that managers seem to be liquidity timers. This result is very consistent and robust to different ways of measuring liquidity, different estimation methodologies, and the inclusion of many control variables. Additionally, we analyze the benefits of timing and show that liquidity timers issue debt at abnormal high prices. We find that, on average, the yield spread at the moment of issuance is significantly higher for nontimers and that the yield spread for timers increases substantially in the three years following the issuance.

The paper is structured as follows. Section II describes the data and methodology used in the empirical analyses. Section III presents the main results regarding the relation between market liquidity measures and the debt issuance decision. Section IV compares bond and firm characteristics between firms that time their debt issuances and those that do not and analyzes the temporal evolution of yield spreads after the issuance. Section V runs further robustness checks, including an alternative illiquidity measure, different time windows to account for illiquidity, alternative ways

[3] Similar arguments are used by Gao and Lou (2013). They also employ a proxy of stock price pressures—mutual funds flow-induced trading—for investigating the timing of both equity and debt issues.

of estimating the models, and alternative measures for some of the control variables considered. Finally, Section VI summarizes and concludes the paper.

II. Data and methodology

A. Bond data

We employ the TRACE dataset, which compiles information on all corporate bond transactions taking place in the U.S. market. TRACE is a system with which all their members must report over-the-counter corporate transactions in the secondary market, following the rules approved by the U.S. Security and Exchange Commission in January 2001.[4] The increase in the quantity and quality of information provided by the TRACE system allows empirical studies to be conducted relating to the microstructure of the U.S. corporate bond market. In that sense, the implementation of the new system provides an opportunity to analyze improvements in the transparency and liquidity of the market. In addition, the intraday information allows liquidity measures and their components to be estimated more efficiently (Bessembinder et al., 2006; Dick-Nielsen et al., 2012; Edwards et al., 2007; Goldstein et al., 2007).

We consider all intraday information transactions that occurred between July 1, 2002, and December 31, 2009, and eliminate erroneous reporting data by applying the filters proposed by Dick-Nielsen (2009). Next, we use further filters to reduce the final number of bonds in our sample. First, we discard all bonds that are perpetual, with variable coupons, asset-backed issues, bonds denominated in a foreign currency, and those that include any type of option. Second, we require the bonds in our sample to be traded frequently in order to compute liquidity measures. In particular, we require the bonds to have at least one year of data in TRACE and to show trading activity on at least 75% of the business days. This results in a sample of 707 bond issues. However, two additional bonds are excluded due to outliers in their prices. Therefore, the final sample consists of 705 issues.[5]

In addition to the TRACE transaction dataset, we use the FISD (Fixed Income Securities Database) dataset to obtain individual bond characteristics such as the issue date, issuance size (par and dollar values), issue yield, the coupon rate, maturity, the issuer industry, and the historical credit ratings for each issue.

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[4] The actual reporting started in July 2002, with the dissemination of all trades in bonds with an initial issuance above $1 billion and in the 50 high-yield bonds. In March 2003, the dissemination was extended to trades in bonds with an initial issuance above $100 million and a rating of at least A-. Finally, the dissemination was completed in October 2004, with 99% of all trades reported in real time. As of July 2005, *in real time* means that trades are reported within 15 minutes.

[5] Specifically, the two excluded issues have ID numbers 124131 and 179091.

Table 1 reports summary statistics for our sample of bonds and for all bonds in the TRACE dataset. The bonds in our sample show a larger issuance volume and, given the selection criteria, are more frequently traded than the average of all bonds in TRACE. Out of the 1,892 trading days in our sample period, the selected bonds were traded, on average, during 873 days, while in the whole sample the average number of days with transactions was 172. The average coupon, yield, and spread regarding the benchmark Treasury issue are similar in our sample and in the whole sample. The average maturity of our bonds is 7.89 years, which is lower than the average maturity of the full sample in TRACE, with much lower dispersion. Finally, the bonds in our sample represent 12 out of the 33 industries in the whole dataset.

[Insert Table 1 around here]

B. Illiquidity measure

A traditional debate in the asset pricing literature discusses the empirical proxy that is used to measure illiquidity. Besides the well-known bid–ask spread measure, popular proxies associate the size of the trade with the size of the price change. This price impact approach is based on the classic theoretical paper of Kyle (1985), which estimates the adverse selection component of liquidity by linearly relating the net order flow to the price variation. One of the most widely used proxies of price impact is the Amihud (2002) ratio. This proxy has been extensively employed in papers about liquidity on the stock market[6] because of its advantages from a practical point of view: It can be easily computed for long periods since it only uses information on daily rates of returns and trading volume. Its use as an individual or aggregate illiquidity measure has also been recently translated to the bond markets. Among others, Jacoby et al. (2009), who uses the Amihud ratio for testing Acharya and Pedersen's (2005) model, and Dick-Nielsen et al. (2012), who extract the liquidity component from bond yields by using a combination of four liquidity variables, one of which is the Amihud ratio.

For each of the 705 selected bonds, we construct the Amihud ratio to proxy for the individual illiquidity measure on a daily basis. This ratio relates the absolute return of the bond to its trading volume (in dollars). When a big change in asset price is needed to accommodate the magnitude of the trading volume, the asset shows low levels of liquidity. For each bond *j* and each day *d*, the Amihud ratio is obtained as:

[6] The Amihud (2002) ratio is used as a proxy for liquidity in the stock market by Acharya and Pedersen (2005), Kamara et al. (2008), Korajczyk and Sadka (2008), and Watanabe and Watanabe (2008), among others.

$$\frac{\left|R_{j,d}\right|}{DVol_{j,d}}$$

where $\left|R_{j,d}\right|$ is the absolute daily return and $DVol_{j,d}$ is the total dollar volume traded during day *d*. The return is computed using close daily prices and the cumulative trading volume is obtained by adding all transactions during the day, on both a par and a dollar basis.

To obtain a measure representing the average illiquidity of a bond in the recent past, the daily ratios are averaged over all days within a window of *D* previous days:

$$Ami_{j,d}^{D} = \frac{1}{D}\sum_{\tau=d-D}^{d-1}\frac{\left|R_{j,\tau}\right|}{DVol_{j,\tau}}$$

We consider an initial window length of three months. To compute the average measure, we require a minimum number of daily observations to be within this window. In particular and consistent with Amihud (2002), we require that the bond be traded on the basis of at least 68% of the business days in the corresponding window.[7]

Since we aim to analyze the effect of illiquidity of corporate bonds on the issuance decision, we construct two aggregate measures of illiquidity. The first represents the level of illiquidity in the whole corporate bond market and is computed as the cross-sectional mean of all individual ratios:

$$Ami_{d}^{WD} = \frac{1}{N}\sum_{j=1}^{N} Ami_{j,d}^{D}$$

where *N* indicates all bonds in the sample.

The second measure represents the level of illiquidity for a given rating category. We use the historical rating changes provided by Mergent Bond Source, which includes Standard &Poor's, Moody's, and Fitch ratings. We assign the average rating between these three agencies for each bond each day. The illiquidity measure for each rating category is computed as the average across all bonds within this rating category:[8]

$$Ami_{d}^{RD} = \frac{1}{N^{R}}\sum_{j=1}^{N^{R}} Ami_{j,d}^{D}$$

[7] In Amihud's (2002) original work, at least 15 prices within a month (22 business days) are required, which represents 68% of the total number of days.

[8] When there is no rating information on the date of the issuance and so as not to lose data, we assign the rating level observed on the nearest day of any of the following five working days.

where N^R represents the number of bonds in the rating class R.

Additionally, we employ an aggregate illiquidity measure for the stock market. As shown in Gao and Lou (2013), there is a cross-market timing effect because both equity and debt are affected by the same non-fundamental shocks. Moreover, Acharya et al. (2013) find that corporate bond returns react to liquidity shocks in the stock market. Therefore, we use the Center for Research in Security Prices (CRSP) to obtain the daily stock prices, returns, and trading volumes for the 162 issuers in our sample. With this information, we estimate the Amihud illiquidity ratio for each issuer and obtain an aggregate measure as the cross-sectional average of all individual ratios. This measure is represented by Ami_d^{SD} .

Table 2 shows the usual descriptive statistics regarding liquidity measures for the seven rating categories, both for the bond market as a whole and for the stock market. As observed, there is a quasi-monotonous relation between illiquidity and risk. The exception is the BB-rated category, but this group is one of the less representative ones because a very low number of bonds in our sample have this rating level.[9] Generally, liquidity measures show positive skewness and excess kurtosis for all rating classes, with the exception of AAA bonds. The correlation between different measures is higher for adjacent rating categories, while the time-series pattern of the liquidity measures is very different between AAA bonds and bonds rated C or below. In fact, the liquidity of AAA bonds is negatively correlated with aggregate stock market liquidity, while the remaining rating categories show a positive correlation with the stock market measure. The correlation between the liquidity of bonds rated C or below and stock market liquidity is especially high. Therefore, in terms of liquidity, the riskiest bonds behave similarly to stocks, so that a "flight to liquidity" from stocks to AAA bonds takes place.

[Insert Table 2 around here]

C. Controls

1. State variables

Empirical evidence shows that variables representing economic and/or financial conditions can influence the timing of issuance decisions. For example, Baker et al. (2003) find that inflation, short-term real interest rates, and term spread predict one-year ahead excess bond returns and these variables are also related to the maturity of debt,

[9] The number of bonds in each rating category changes over time. On average, there are 39, 80, 202, 45, 13, seven, and eight bonds in each category from AAA to C and below.

suggesting some degree of timing behavior when selecting debt maturity. Barry et al. (2008) provide evidence that the amount of debt issued is substantially higher when interest rates are low. However, the evidence of interest rate-based timing behavior is not clear. Barry et al. (2009) do not find timing ability by examining interest rate changes subsequent to corporate debt issuances and Song (2009) shows that timers in terms of the term spread do not show higher firm values. Additionally, since the work of Fama and French (1993), unexpected changes in the term structure of interest rates and in default risk are considered the two most common risk factors in determining corporate bond returns.

Based on this evidence, we consider the following variables. Daily yields on U.S. Treasury securities for the eleven available maturities[10] and on Moody's Aaa and Baa corporate bonds are obtained from the Federal Reserve's webpage (http://www.federalreserve.gov/datadownload/). $TB1_d$ and $TB7_d$ refer to the yield of the one-month and seven years' maturity and are used for representing the short- and long-term interest rates.[11] $Term_d$ is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields, and $Default_d$ represents a default premium and is estimated as the difference between the yield on the corporate bond index and the yield on 10-year Treasury bonds. The yields on Treasury bonds for the remaining maturities are employed to estimate the full yield curve and compute yield spreads each day for all the bonds in our sample.

In addition to the default spread, we also control for VIX_d as an alternative proxy for risk expectations, which is a measure of implied volatility in index options that is calculated by employing model-free techniques. Bao et al. (2011) find that the most relevant relation is that between aggregate bond illiquidity and *VIX*. Close daily *VIX* prices are obtained from the Chicago Board Options Exchange website (http://www.cboe.com/micro/VIX/historical.aspx).

$Inflation_d$ refers to actual inflation. Monthly series for inflation are computed from the chained Consumer Price Index (all urban consumers) available in the database provided by the U.S. Bureau of Labor Statistics. Finally, we include the stock market return (RM_d) and industrial production growth ($IPIgrowth_d$) as indicators of financial and economic cycles, respectively. Daily returns on the value-weighted stock market portfolio are from Kenneth French´s webpage (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). Monthly data of the industrial production index are from the Federal Reserve, with series identifier G17/IP Major Industry Groups.

[10] One, three, and 6 months, and one, two, three, five, seven, 10, 20 and 30 years.
[11] Seven years is the maturity most similar to the average maturity of the bonds in our sample.

We assign the monthly values for the variables *IPIgrowth* and *Inflation* to all days within the correspondent month. Interest rates, market return, and *VIX* values are in annual basis. All the state variables are reported in percent.

2. Bond characteristics

We include the usual characteristics considered in the literature: $Maturity_{j,d}$ indicates the number of years to maturity of the corresponding bond, each day, and $Yield_j$ is the offering yield of each bond, in percent.

3. Firm characteristics

The variable $Cash_{j,d}$ denotes cash and short-term investment accounts (item 1); $CapExp_{j,d}$ refers to capital expenditures (item 128); $Ebitda_{j,d}$ is the operating income before depreciation (item 13); $Tangibility_{j,d}$ refers to the sum of property, plant, and equipment (item 8) and inventories (item 3). These four variables are normalized by total assets (item 6). $Size_{j,d}$ refers to the log of total assets (item 6); $LeverageR_{j,d}$ refers to the ratio between book debt (long-term debt, item 9, plus debt in current liabilities, item 34) and the sum of book debt and the market value of equity (using data from the CRSP to obtain the latter); and $TobinR_{j,d}$ is computed as the sum of the market value of equity (using data from the CRSP) and book debt divided by total assets. With the exception of the market value of equity, obtained from the CRSP, data regarding all the remaining variables are obtained from the Compustat database on an annual basis. All the variables are measured at the beginning of the fiscal year (as in Barry et al. (2009) and Doukas et al. (2011)). Due to the unavailability of a sufficient number of observations, we are not able to incorporate variables such as research and development expenditures and the proportion of fixed assets.

The expected impact of these control variables on debt issues is as follows. Doukas et al. (2011) indicate that firms issue debt even when internal funds are high, so a positive impact between cash and debt issues is expected. Regarding capital expenditures, the previous literature has found a positive although not significant coefficient. Earnings before interest, taxes, depreciation, and amortization (Ebitda) are expected to have a positive impact on debt issues, since the tax deductions for the interest payments of more profitable firms are higher (Modigliani and Miller (1963)), so these firm are expected to issue more debt even though they have more internal funds (Doukas et al. (2011)). The traditional literature on capital structure shows a positive relation between size and debt issues (Frank and Goyal, 2003; Rajan and Zingales, 1995; Titman and Wessels, 1988), but Doukas et al. (2011) find a negative relation, so that larger firms tend to depend on internally generated funds. Additionally, the literature on capital structure points out that firms with more tangible assets that can be used as collateral are expected to issue more debt (Myers and Majluf (1984)), which is also in line with Gao and Lou (2013). However, Doukas et al. (2011) find the opposite result and they state that firms in industries with highly tangible assets tend to issue less debt. Accordingly, firms are more likely to issue debt when their past leverage is relatively high and the authors state that this positive relation seems to be in accord with the idea that debt financing coincides with favorable debt market conditions. Finally, since the higher Tobin's Q, the higher a firm's growth opportunities, firms with a high Tobin's Q ratio are expected to issue less debt to protect their growth options (Doukas et al., 2011; Hovakimian, 2006).

D. Methodology

To analyze the effect of liquidity conditions on corporate bond issuances, we regress both the issuance moment and issuance volume on the three variables measuring illiquidity, controlling for the state, bond, and firm variables specified in the previous subsection. The most general model takes the form

$$IssueM_{j,d} = f\left(Liquidity\ Variables,\ State\ Indicators,\ Bond\ Characteristics,\ Firm\ Characteristics\right) + \varepsilon_{j,d} \qquad \text{(A)}$$

where $IssueM_{j,d}$ represents the issuance moment and is a dummy variable that takes the value of one on the day of each bond's issuance and zero otherwise and $\varepsilon_{j,d}$ is a noise process assumed to obey standard restrictions. Thus, this variable captures firm's managers decisions since it takes the value of one each time the firm issues bonds.

We also estimate the following model:

$$IssueV_{j,d} = f\left(Liquidity\ Variables,\ State\ Indicators,\ Bond\ Characteristics,\ Firm\ Characteristics\right) + \varepsilon_{j,d} \qquad \text{(B)}$$

where $IssueV_{j,d}$ represents the issuance volume and is obtained as the total amount of the issuance (bond's face value) on the day of the issuance, normalized by total assets, and zero otherwise. This model is estimated because issuance size allows us to exploit information that varies cross-sectionally. Moreover, Bao et al. (2011) find that individual bond liquidity is significantly related to its issuance size.

Model A is estimated using probit panel data regressions with random effects. Model B is estimated by considering either fixed or random effects, as indicated by the Hausman test. In both models, the errors are robust to autocorrelation and heteroskedasticity. The distinctive advantage of the panel data methodology is that it allows us to control for unobservable individual heterogeneity in the data, that is, it allows the most general specification, $\eta_i \neq 0$.

III. Market liquidity and debt issuances

Models 1 to5 in Table 3 show the results from the estimation of equation (A) (Panel A) and equation (B) (Panel B) when only liquidity variables are considered: the aggregate illiquidity of the whole corporate bond market, the aggregate illiquidity for the class of bonds within the same rating, and aggregate illiquidity in the stock market. The *p*-values regarding individual significance are reported in parentheses. The last row of Panels A and B provide the log-likelihood values and *p*-values of the Hausman test, respectively.

[Insert Table 3 around here]

The results indicate that liquidity in financial markets is significantly related to the timing of corporate bond issuances. Illiquidity measures regarding the bond market are negatively related to the moment of issuance, indicating that the likelihood of corporate bond issuance is significantly higher when liquidity in the corporate bond market is also high. In contrast, corporate bond issuances are significantly associated with decreases in the liquidity of the stock market. The results are consistent when various liquidity measures are combined and also when the dependent variable is the issuance volume.[12] We also find that the effect of stock market illiquidity on both the moment and the volume of debt issuances is stronger than that of bond market illiquidity. Therefore, in line with Gao and Lou (2013), we find that shocks in the stock market affect the timing decision in the bond market. Also our findings are consistent with some of the results of Acharya et al (2013). These authors also find that corporate bond returns respond more strongly to liquidity shocks in the stock market than in the bond market and that the illiquidity in both markets negatively affects corporate bond returns, although this is true for junk-grade bonds and not for investment-grade bonds. Our regressions in Table 3 do not distinguish between rating classes. However, given that AAA bonds liquidity is negatively correlated to stock market liquidity, the negative parameter associated with stock market illiquidity can be interpreted as a flight to liquidity phenomenon from the stock markets to the bond markets, on the one hand, and from high-risk to low-risk bonds, on the other hand.

Models 6 and 7 include also a selection of the cycle indicators that responds to the findings of a preliminary analysis that evaluates the individual timing capacity of each of the state variables described in Section II.C. In this analysis we find that the decision to issue debt is related to periods of positive expectation about future economic conditions, measured by increases in the *Term* spread or *IPIgrowth* and decreases in

[12] We do not include the two illiquidity measures in the bond market simultaneously to avoid multicolinearity problems. The results regarding the aggregate measure for the whole bond market lead to the same conclusions and are available upon request.

Default spread or *VIX*. The level of interest rates, the inflation rate, and the stock market return do not seem to determine the debt issuance moment. The relations with the issuance volume are much weaker but this variable is also higher for periods of low volatility in the stock market.

The results for Models 6 and 7 in both Panels A and B of Table 3 confirm that both the moment and volume of debt issuances are significantly related to market liquidity conditions, independent of the state variables considered. Additionally, *Default* and *VIX* are negative and significantly related to debt issuances and *IPIgrowth* is no longer relevant when liquidity variables are included. It also seems that firms issue higher volumes of debt when the *Term* spread is lower, but this variable becomes significant only when *Default* is not included in the model. [13]

Finally, the complete specification to test for the relevance of the liquidity measures includes cycle indicators, bond characteristics (issue yield and maturity), and several firm characteristics (as described in Section II.C). Table 4 provides the estimation results for a selection of five representative models. Tables 4a and 4b refer to the issuance moment and issuance volume, respectively. Consistent with previous results and independent of the combination of explanatory variables, the moment of issuance is positively associated with periods of high liquidity in the bond market, specifically for bonds within the same risk class, and periods of low liquidity in the stock market. Again, *VIX* is always negative and significant while *Term* is no longer relevant in the presence of additional explanatory variables. Regarding bond characteristics, maturity does not seem to determine the issue moment, but the bonds issued show significantly higher yields than the rest. In general, there are no relevant associations between the moment chosen for the issuance and firm characteristics. The only significant relations are with *Ebitda* and *Leverage*; we find that firms showing high earnings or a high leverage ratio at the end of the previous year are more likely to issue debt. As Doukas et al. (2011) find, although the result regarding the positive sign of leverage is not consistent with the trade-off hypothesis or with the view that firms actively rebalance their leverage to stay within an optimal range, it could be consistent with the idea that debt financing coincides with favorable debt market conditions. Although the results of Doukas et al. (2011) refer to the volume of debt issued and not the moment, this would be in line with our proposition, since firms would issue debt at periods of favorable liquidity in the bond market.

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[13] The serial correlation between *Default* and *VIX* in our sample period is 90%. For this reason we avoid the use of the two variables simultaneously and consider only *VIX* in the regression analyses. The results including *Default* instead of *VIX* are similar and available upon request.

Regarding regressions of issue volume and consistent with previous results, in all the models, bond market illiquidity by rating is significant and the volume issued is higher when the stock market liquidity is lower. *Term* is negatively related to the issuance volume but this relation is not significant when firm variables are included in the model. We also find that the volume issued is positive and significantly related to the maturity of bonds, to *Ebitda*, as with the issuance moment, and to firm size (as for Ooi et al. (2010)). Finally and in contrast to the results for the issue moment, the leverage ratio is not related to the issuance volume.

[Insert Tables 4a and 4b around here]

A. Is the crisis period special?

Our sample period is characterized by a very peculiar episode, the recent strong crisis, during which firm financial needs grew heavily. Therefore it seems reasonable to think that both the moment and the volume of debt issues could have been affected during this particular period. In addition, Acharya et al. (2013) show that the effects of liquidity shocks on bond prices are only relevant in periods of stress. Although we previously included cycle indicators in the regressions that already take this fact into account to some degree, it is interesting to analyze whether debt issues are specifically associated with crisis periods. To do so, we repeat the estimations in Tables 4a and 4b but include a dummy variable that equals one in recession periods; it is constructed from the recession dates provided by the National Bureau of Economic Research.

Tables 5a and 5b show the results for the issuance moment and issuance volume, respectively. The dummy for the crisis generally has a negative sign but is not significant. Therefore, firms do not tend to issue more debt in recession periods. No changes worth mentioning are found for the rest of the parameter values and their significance and, thus, the conclusions for the illiquidity variables remain unaltered.

[Insert Tables 5a and 5b around here]

B. Financial versus non-financial firms

Finally, it is also interesting to investigate whether the liquidity timing effect differs between financial and non-financial issuers. Given the liquidity requirements in the sample selection process, most of the bonds in our sample are issued by financial firms (around 75% of our sample). Additionally, it is known that financial firms suffered the worst financial problems during the crisis. Thus, financial and non-financial firms could be behaving in different ways. Tables 6a and 6b provide the estimation results for the issuance moment and issuance volume, respectively, but include a dummy that equals one if the issuer is not in the financial industry and zero otherwise, and also includes interactions between this dummy and the illiquidity variables. The dummy alone captures the differences between financial and non-financial firms through the constant term, while the interactions represent the differential effect of the liquidity variables for financial and non-financial firms.

As observed in Table 6a, no special conclusions can be drawn for non-financial firms. The parameters associated with the dummy and its interactions are not significant in any model, so we can conclude that firms in all industries choose periods of high liquidity in the bond market and/or low liquidity in the stock market to issue debt. The significance of the control variables remains unaltered, with the exception of the leverage ratio, which now becomes insignificant. Therefore, the positive relation found previously between the issuance moment and firm leverage ratio could indicate industrial differences between firms, since it is known that the leverage ratio is substantially higher for financial firms.[14] Now, these differences are represented by the intercept and the dummy variable instead. Regarding the issuance volume, again, no significant differences between financial and non-financial firms are found. The conclusions regarding the control variables remain unaltered and the liquidity variables continue to be significantly related to debt issuances, although the variable related to bond liquidity is only significant at the 10% level in the models that include firm variables.

[Insert Tables 6a and 6b around here]

IV. Liquidity timers and nontimers: Forward-looking debt timing

The results in the previous analyses indicate a significant and positive relation between the moment when corporate debt is issued and liquidity in the bond market. However, to conclude that a liquidity timing pattern exists, it is necessary to show that corporate bonds are overpriced in moments of high liquidity, so that firms can benefit from issuing at an abnormally low cost. To analyze if this is the case, we split our sample into two groups of bonds, distinguishing between those issued in periods of high liquidity in the corporate bond market (timers) and those issued in periods of low liquidity (nontimers). We use the median value of the aggregate illiquidity within the same rating class to classify firms as timers or nontimers.[15]

[14] The mean leverage ratios for financial and non-financial firms are 0.60 and 0.07, respectively, with median values of 0.64 and 0.04, respectively.

[15] We use the median value for splitting the sample since it produces a similar number of issues in each subsample: 204 timers and 183 nontimers. Other partitions, such as the first and third quartiles, produce highly asymmetric subsamples; however, the results are robust to this alternative definition.

The comparison between the different characteristics of the bonds and issuers in each subsample is shown in Table 7 and is based on the signed-rank test for the median values. All the variables are measured at the moment of issuance and refer to issue characteristics in Panel A—days until maturity, price, volume (in millions), yield, rating (average rating from S&P, Fitch, and Moody's), and yield spread, that is, the difference between the yield of the benchmark Treasury issue and the issue's offering yield—and issuer characteristics in Panel B—*Cash*, *CapExp*, *Ebitda*, *Size*, *Tangibility*, *LeverageR*, and *TobinR*, as defined in Section II. For each characteristic, we provide the mean and median values for the two subsamples and the *p*-values associated with the null of equal medians.

The results show that there are no relevant differences in the maturity, offering price, and volume of bonds issued by liquidity timers and nontimers. The offering yield is higher for timers, but it should be taken into account that the series of both timers and nontimers contain issuances associated with periods of different interest rate levels. Regarding rating, we find that nontimers have slightly better rating positions at the moment of issuance.[16] Finally, the most important result in Table 7 refers to the yield spread. We find that liquidity timers are able to issue debt at a much lower cost. The median difference between the corporate bond yield and the equivalent Treasury bond yield is approximately 83 basis points for bonds issued in periods of high bond market liquidity. In contrast, the yield spread is 95 basis points if the issuance is undertaken under poor liquidity conditions. Therefore, the use of information related to aggregate liquidity when deciding the offering date reduces the credit spread.[17] The results regarding the firm characteristics do not show significant differences between timers and nontimers, except for *Tangibility*, with timers showing larger values.

[Insert Table 7 around here]

A further analysis is performed to show that the lower yield spread for timers is associated with the overpricing of bonds issued in moments of high market liquidity. For each day during the three years following the debt issuance, we collect the transaction yields from TRACE and compute yield spreads by subtracting the Treasury yield with exactly the same number of days until maturity.[18] Then, for all the days between the issuance date (date 0) and 36 months after the issuance, we compute the

[16] A rating of five corresponds to A^+ and a rating of four to AA^- in the S&P and Fitch rankings.
[17] To confirm that the difference in yield spreads between timers and nontimers is not due to the criterion employed to split the sample, we reclassify issues using two alternative illiquidity measures: the mean and the median of the aggregate measure for the whole bond market. The results are robust to measures of liquidity computed in windows of different length.
[18] For each day, the full Treasury yield curve is estimated by linear interpolation using the yields on Treasury securities for the 11 available maturities.

average yield spread for the issues classified as timers and nontimers. Figure 1 represents the time evolution of the two series. The yield spread of timers is lower than that of nontimers at the moment of issuance, as shown in Table 7, as well as during the year subsequent to the issuance date, a period in which the yield spreads of both timers and nontimers rise. However, after a year from the issuance, the yield spread of bonds issued by timers continues to rise while that of nontimers reverts to its long-run mean.[19] In the case of timers, the increasing trend indicates that bonds are overvalued at the issuance moment and confirms the success of managers' liquidity timing decisions.

[Insert Figure 1 around here]

V. Robustness issues

In this section we consider some alternative issues to ensure the robustness of the results. In particular, we analyze the effect of alternative windows for measuring liquidity; an alternative proxy to measure liquidity; an alternative estimation methodology (cluster methodology); and alternative measures for certain firm characteristics. Overall, we find that the results are robust to all these considerations.[20]

A. Alternative windows for measuring liquidity

In this subsection we explore the sensitivity of our results to different window lengths when computing the Amihud illiquidity measures, of one, six, and 12 months.

The most remarkable findings are as follows. Focusing on the issuance moment, the significance of the liquidity variables, for both bond and stock markets, holds for all window lengths. This is the case not only when the liquidity variables are considered alone, but also when all the control variables are included. Generally, the coefficients are higher for the bond illiquidity measure and lower for the stock illiquidity variable as the window length increases. Regarding the issuance volume, the results for the one-month window are practically the same. For the six- and 12-month windows, we find that the bond illiquidity measure is only significant when the firm variables are not included, while the stock illiquidity maintains a significant relation with the issuance volume in almost all the models. Additionally, *VIX* is not relevant (except for some models) and the relations with the firm variables are very similar for these alternative window lengths. Finally, the different evolution over time of yield spreads between

[19] The yield spread changes from the moment of issuance to two and three years after are 2.473 and 3.302, respectively, for timers and 0.213 and 0.257, respectively, for nontimers. These values are significantly different between the two groups.

[20] We do not report the results for all the robustness checks to save space, but they are available upon request.

timers and nontimers provided in Figure 1 is also confirmed when liquidity is measured along these other window lengths.

B. Alternative proxy for the illiquidity measure

In this subsection we use an alternative proxy for measuring individual bond illiquidity, following that proposed by Bao et al. (2011), a measure also associated with the adverse selection component of liquidity. Under the assumption that bond prices consist of two components, one representing the fundamental value that follows a random walk and the other, which is transitory, representing the impact of illiquidity on price, these authors approximate illiquidity as the negative covariance between consecutive price changes:

$$\gamma_j = -Cov\left(\Delta p_{j,t}, \Delta p_{j,t+1}\right)$$

Consistent with the Amihud measure, Bao's illiquidity measure for bond *j* on a given day *d* is computed by considering the price changes for all the days in the last three months. We also construct daily aggregate measures as the average of the whole bond market, $\gamma_{j,d}^{WD}$, and of all bonds within the same rating category, $\gamma_{j,d}^{RD}$. Additionally, we compute Bao's aggregate measure for the stock market, $\gamma_{j,d}^{SD}$.

Figures 2 to 4 compare Amihud's and Bao's illiquidity measures. For the whole bond market (Figure 2) both measures show a similar pattern over time and present a strong co-movement with the business cycle.[21] Figure 3 confirms the similarities between the two illiquidity measures in the bond market in the cross-sectional pattern within rating categories.[22] The regression analysis when using the Bao's measure instead of the Amihud's one also show that both the issuance moment and volume are associated with high liquidity in the bond market (either considering an aggregate measure for the whole market or an aggregate measure within the same rating class). The strong relation for the issuance moment also holds when both the cycle indicators and firm characteristics are included in the regressions. However, regarding the issuance volume, all the parameters in almost all the models are estimated with much less precision than for the Amihud case.

[21] For the subsample before August 2007 (pre-crisis period), the mean and standard deviation are 0.39 and 0.09 for the Amihud measure and 0.27 and 0.14 for Bao's measure, respectively. For the subsample after August 2007 (post-crisis period), these values are 0.91 and 0.50 for the Amihud measure and 1.48 and 1.17 for Bao's measure, respectively. See Bao et al. (2011) for more details about the cyclic behavior of this proxy for illiquidity in the corporate bond market.

[22] It should be noted that the values represented in Figure 3 are the median values in time for each rating class.

[Insert Figure 2 around here]

[Insert Figure 3 around here]

Differences between Amihud's and Bao's measures are appreciable in Figure 4 for the stock market. Both measures are strongly time varying and present peaks associated with the technological boom at the end of 2002 and the recent U.S. financial crisis. However, Bao's measure is more extremely affected by the recent 2008 crisis. This explains why Bao's illiquidity measures in the stock and bond markets are highly correlated (0.75)[23] and also that the association between the stock market Bao's measure and timing is positive but weak and tends to disappear when other variables are included. Nevertheless, the comparison of the log-likelihood values between Amihud's and Bao's measures show that when only the illiquidity measures are considered, the adjustment is always better with the Amihud ratio.

[Insert Figure 4 around here]

C. Alternative estimation methodology

We also re-estimate regressions for both the issuance moment and the issuance volume by using an alternative methodology: probit and OLS pooled time-series cross-sectional regressions, respectively. These both implicitly assume $\eta_i = 0$, with two-way cluster-robust standard errors accounting for bond and day clusters. The distinctive characteristic of multi-way clustered errors is that this method allows us to carry out statistical inference that is robust by design to simultaneous dependences of unknown form in both the cross-sectional and time-series dimensions of the panel. Regression errors are assumed to be independent but not identically distributed across a number of clusters and can have fairly general patterns of within-cluster correlation and heteroskedasticity (Cameron et al., 2011; Gow et al., 2010; Petersen, 2009; Thompson, 2011).

This methodology produces still more favorable results in relation to the relevance of the illiquidity variables. For both the issuance moment and volume, we always find negative relations with the illiquidity measure for the bond market and positive relations with the illiquidity measure for the stock market, after including all the control variables and with even higher *t*-statistics than before. Conclusions regarding the control variables are similar in the case of the issuance moment and the most notable differences in explaining the issuance volume are as follows: The yield is now positive and relevant, while maturity is not; leverage has a positive and significant

[23] Moreover, the correlation between the stock and bond Bao measures increases as the window for the computation of the covariance increases.

impact on debt issuances (as in the case of the issuance moment); and, in contrast, we now find that the larger firm size, the lower the debt volume issued.

D. Alternative measures of some firm characteristics

The aim of this subsection is to check the robustness of the results regarding the liquidity timing evidence when certain firm characteristics are measured differently. This will also allow us to corroborate some striking results found regarding some firm characteristics.

Overall, we find that only a small number of firm characteristics are significant. Especially surprising are firm size and firm profitability, as well as the fact that firms with high leverage ratios are more like to issue debt the next year. To ensure that the results are not driven by the way in which the variables are measured, we consider alternative definitions. Now, we measure *Size* as the log of sales (item 12). We also consider two other alternative definitions for *Leverage*, in which the denominator is either i) total assets (item 6) or ii) the sum of book debt and the market value of equity (the latter is obtained with data from Compustat: common shares outstanding, item 25; by close price, item 199). In the same way, a second proxy for Tobin's Q, *TobinR*, incorporates the market value of equity, computed using information from Compustat.

Regarding the results for the issuance moment, the illiquidity variables continue to be highly significant, so that the results are robust to these new definitions. The new proxies for size and Tobin's Q continue to be insignificant in all the estimated models. The changes in the definition of the leverage ratio do not affect the results; both alternative measures are positive and significantly associated with the issuance moment, with higher coefficients when the debt value is normalized by total assets.

The results related to the effect of liquidity on the issuance volume are rather similar to those previously found, so that both the bond market liquidity and the stock market liquidity are relevant variables, no matter the change in the definition of the control variables. The only differences worth mentioning refer to some firm variables and are probably due to collinearity problems caused by the new definitions. For example, the new measure for size shows, as before, positive slopes but is only significant in some models (those in which *Ebitda* becomes insignificant). The leverage ratio, measured as the book debt value normalized by total assets, is negative and significantly related to the issuance volume, but only if Tobin's Q is also included in the model.

VI. Conclusions

The moment when firms decide to issue financial instruments to finance their investments seems to go beyond that of financial needs, so that there has been increasing interest in the literature in analyzing whether firms time the market when issuing equity or debt. This paper lies in this strand of literature. Characteristics such as debt maturity and debt issuance coupons are selected by managers, depending on market conditions, including whether the market is hot or cold in terms of interest rates and whether equity is mispriced or not. However, the literature has not yet analyzed the role that liquidity may play in debt timing decisions, despite the increasing use of liquidity in other research areas, such as corporate bonds asset pricing. This is the gap this paper aims to cover.

The disaggregated information compiled in the TRACE dataset enables us to compute a measure(s) of aggregate illiquidity based on the Amihud ratio. For each bond in our sample and each stock belonging to the bond issuer, the Amihud ratio is estimated on a daily basis by using a three-month window of past information. We obtain three aggregate illiquidity variables: i) the average for all bonds as a measure for the whole bond market, ii) the average for all bonds within each rating category, and iii) an aggregate measure for the stock market. The first aim of this paper is to analyze whether there are significant relations between debt issuances and markets' liquidity. Specifically, our results show that both the moment of debt issuance and volume issued are associated with periods of high liquidity in the bond market and low liquidity in the stock market. These results are strongly stable and robust to several checks. For example, the significance of liquidity holds when we consider other standard timing variables that capture the economic cycle. In fact, the liquidity variables absorb the explanatory power of other classical timing variables, such as the term spread. The results are also robust when controlling for firm characteristics approximating financial needs and they are not influenced by either the strong recession contained in our sample period or by the type of industry. Other robustness checks include three alternative window lengths for computing the liquidity measures, an alternative estimation methodology, and alternative measures for certain firm characteristics. In all cases, significant relations between stock and bond market liquidity and debt issuances are observed. Liquidity timing is also evidenced when using the illiquidity measure of Bao et al. (2011) in the bond market. However the results are less consistent and unstable regarding liquidity in the stock market.

The second analysis in this paper investigates whether being a liquidity timer produces any benefit for the issuer. We define an issue as a timer (nontimer) if it is issued when the bond market liquidity is high (low). Remarkable differences regarding bond and issuer characteristics between these two groups are not found, with the exception that timers are able to obtain financing at much lower cost; the yield spread is significantly lower if the issuance is undertaken under good liquidity conditions. Moreover, while the yield spread of bonds issued by timers continuously increases during the three years following the issuance, that of nontimers increases only during the first year, reverting to its long-run mean after that. The increasing trend shown by timers indicates that bonds are overvalued at the moment of issuance and confirms the success of managers' liquidity timing decisions. These results are robust to the use of the aggregate bond market liquidity or the aggregate liquidity measure by rating category, to different window lengths in the computation of the illiquidity measures, and to the use of the median value or the quartiles for splitting the sample. Overall, the evidence in this paper points to the importance of illiquidity as a key variable driving both the moment when managers decide to issue debt and the volume of debt issued.

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Table 1. Descriptive statistics on the bond sample.

	Bonds in our sample		*All bonds in TRACE*	
	Mean	Std	Mean	Std
Issuance	1,011.72	824.86	201.86	415.10
Yield	5.55	1.42	5.80	3.88
Treasury spread	116.69	74.70	149.57	126.37
Coupon	5.56	1.56	5.07	2.80
Maturity	7.89	1.55	10.21	9.25
Number of quotes	873	426	172	278
Number of bonds	705		38,869	
Number of issuers	162		4,544	
Number of industries	12		33	

Descriptive statistics for the following variables: Issuance is the volume issued in million dollars; Yield is the yield offered by the bond, as a percentage; Treasury spread is the treasury spread in basis points; Coupon is the coupon offered by the bond as a percentage; Maturity is the years to maturity of the bond; and Number of quotes is the number of trading days of the bond.

Table 2. Descriptive statistics on the illiquidity measures.

Statistics	AAA	AA	A	BBB	BB	B	Below	Bond, whole	Stock, whole
Median	0.735	0.923	1.194	1.342	3.238	1.946	4.812	0.434	0.497
Mean	0.743	0.987	1.470	3.180	5.107	2.659	17.542	0.562	0.603
SD	0.315	0.364	0.869	5.573	4.650	2.298	31.156	0.383	0.328
Skewness	0.169	1.381	2.539	3.451	1.785	2.094	2.542	2.688	1.643
Kurtosis	-0.120	2.891	7.113	12.551	2.044	3.778	5.785	7.758	2.600
Correlations		AA	A	BBB	BB	B	Below	Bond, whole	Stock, whole
AAA		0.361	0.485	0.222	0.122	0.328	0.092	0.483	-0.410
AA			0.601	0.476	0.248	0.448	0.361	0.582	0.177
A				0.698	0.546	0.764	0.650	0.946	0.073
BBB					0.638	0.436	0.782	0.697	0.069
BB						0.481	0.813	0.647	0.683
B							0.635	0.853	0.712
Below								0.741	0.832
Bond, whole									-0.017

Descriptive statistics for the Amihud ratio, obtained as the average for all bonds within the same rating category, for all bonds in our sample, and for all stocks in our sample of issuers. The Amihud ratio for a given day is computed by averaging daily information in a window that includes data on the three previous months.

Table 3. Illiquidity impact on issuance.

Panel A: Issuance moment ($IssueM_{j,d}$**)**

Ind. Var.	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Ami^{RD}	-0.162			-0.146		-0.094	-0.103
	(0.00)			(0.00)		(0.00)	(0.00)
Ami^{WD}		-0.056			-0.061		
		(0.00)			(0.00)		
Ami^{SD}			0.348	0.368	0.416	0.469	0.444
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Term_d$						0.015	-0.005
						(0.35)	(0.72)
$Default_d$						-0.160	
						(0.00)	
VIX_d							-0.009
							(0.00)
$IPIgrowth_d$						-0.0377	-0.020
						(0.10)	(0.37)
Constant	-2.901	-2.967	-3.366	-3.201	-3.262	-3.066	-3.127
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Loglikel.	-2916.25	-3205.92	-3186.90	-2841.45	-3100.95	-2829.58	-2832.27

Panel B: Issuance volume ($IssueV_{j,d}$**)**

Ind. Var.	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Ami^{RD}	-2.6E-4			-0.001		-2.9E-4	-3.93E-4
	(0.00)			(0.00)		(0.00)	(0.00)
Ami^{WD}		-0.002			-0.005		
		(0.00)			(0.00)		
Ami^{SD}			0.024	0.022	0.058	0.044	0.037
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Term_d$						-0.001	-0.003
						(0.25)	(0.00)
$Default_d$						-0.015	
						(0.00)	
VIX_d							-5.43E-4
							(0.00)
$IPIgrowth_d$						-0.0012	0.0012
						(0.27)	(0.27)
Constant	0.011	0.015	-0.005	-0.005	-0.015	0.010	0.0016
	(0.00)	(0.00)	(0.20)	(0.19)	(0.00)	(0.01)	(0.67)
Hausman	0.07	0.00	0.23	0.01	0.00	0.00	0.00

Estimated coefficients for probit panel data regressions with random effects and robust errors (Panel A) and ordinary least squares panel data regressions with robust errors (Panel B). In Panel B, the effects are treated as fixed or random, depending on the Hausman test. The dependent variables are IssueM: a dummy variable indicating the day of the issue of the corresponding bond (Panel A), and IssueV: the dollar volume issued by the corresponding bond, normalized by total assets (Panel B). The independent variables are Ami^{WD}, Ami^{RD}, and $Ami^{SD,}$ which represent the aggregate Amihud measures for the whole bond market, for bonds within the same rating category, and for the whole stock market, respectively; Term is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields; Default represents a default premium and is estimated as the difference between the mean yield on Moody’s Aaa and Baa corporate bonds and the yield on 10-year Treasury bonds; VIX refers to the implied volatility in index options; and IPIgrowth refers to industrial production growth. The *p*-values are in parentheses.

Table 4a. Illiquidity impact on issuance, controlling for cycle indicators and bond and firm characteristics: Issuance moment.

Ind. Var.	Model 1	Model 2	Model 3	Model 4	Model 5
Ami_d^{RD}	-0.101	-0.114	-0.117	-0.100	-0.117
	(0.00)	(0.00)	(0.02)	(0.05)	(0.02)
Ami_d^{SD}	0.440	0.454	0.564	0.590	0.566
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Term_d$	-0.006	4.41E-4	0.022	0.027	0.022
	(0.68)	(0.98)	(0.36)	(0.26)	(0.35)
VIX_d	-0.008	-0.010	-0.022	-0.023	-0.022
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Yield_j$		0.053	0.095	0.095	0.094
		(0.00)	(0.00)	(0.00)	(0.00)
$Maturity_{j,d}$		3.75E-5	1.84E-5	2.09E-5	1.98E-5
		(0.00)	(0.17)	(0.27)	(0.15)
$Cash_{j,d}$			-0.685	0.033	-0.625
			(0.13)	(0.94)	(0.19)
$CapExp_{j,d}$			-0.547	-0.455	-0.530
			(0.69)	(0.74)	(0.69)
$Ebitda_{j,d}$			1.735	1.209	1.952
			(0.02)	(0.14)	(0.03)
$Size_{j,d}$			0.047	0.057	0.048
			(0.19)	(0.10)	(0.17)
$Tangibility_{j,d}$			0.114	0.159	0.113
			(0.61)	(0.48)	(0.61)
$LeverageR_{j,d}$			0.416		0.400
			(0.00)		(0.01)
$TobinR_{j,d}$				-0.070	-0.028
				(0.27)	(0.67)
Constant $_{j,d}$	-3.141	-3.450	-4.387	-4.335	-4.401
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Estimated coefficients for probit panel data regressions with random effects (robust errors). The dependent variable is IssueM, a dummy variable indicating the day of the issue of the corresponding bond. The independent variables are as follows: Ami^{WD} and Ami^{SD} represent the aggregate Amihud measure for the whole bond market and for the whole stock market, respectively; Term is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields; VIX refers to the implied volatility in index options; Yield refers to the yield offered by the bond in percentage; Maturity refers to the time to maturity of each bond, measured in years; Cash refers to cash and short-term investment accounts, normalized by total assets; CapExp refers to capital expenditures, normalized by total assets; Ebitda refers to operating income before depreciation, normalized by total assets; Size refers to the log of total assets; Tangibility refers to the sum of property, plant, and equipment and inventories, normalized by total assets; LeverageR refers to book debt, normalized by the sum of book debt and the market value of equity; and TobinR refers to the sum of the market value of equity and book debt, normalized by total assets. The *p*-values are in parentheses.

Table 4b. Illiquidity impact on issuance, controlling for cycle indicators and bond and firm characteristics: Issuance volume.

Ind. Var.	Model 1	Model 2	Model 3	Model 4	Model 5
Ami_d^{RD}	-4.01E-4	-2.48E-4	-2.42E-4	-2.43E-4	-2.41E-4
	(0.00)	(0.01)	(0.03)	(0.04)	(0.04)
Ami_d^{SD}	0.037	0.022	0.038	0.038	0.039
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
$Term_d$	-0.003	-0.0022	-0.0020	-0.002	-0.002
	(0.00)	(0.03)	(0.12)	(0.10)	(0.13)
VIX_d	-5.76E-4	7.18E-4	-3.99E-4	-4.05E-4	-4.09E-4
	(0.00)	(0.62)	(0.02)	(0.02)	(0.01)
$Yield_j$		–	–	–	–
$Maturity_{j,d}$		1.64E-5	1.86E-5	1.82E-5	1.82E-5
		(0.00)	(0.00)	(0.00)	(0.00)
$Cash_{j,d}$			0.056	0.053	0.054
			(0.20)	(0.22)	(0.21)
$CapExp_{j,d}$			-0.655	-0.661	-0.658
			(0.20)	(0.20)	(0.20)
$Ebitda_{j,d}$			0.312	0.288	0.285
			(0.00)	(0.00)	(0.00)
$Size_{j,d}$			0.019	0.020	0.021
			(0.02)	(0.02)	(0.02)
$Tangibility_{j,d}$			0.032	0.029	0.028
			(0.57)	(0.62)	(0.62)
$LeverageR_{j,d}$			-0.001		-0.004
			(0.90)		(0.73)
$TobinR_{j,d}$				0.005	0.006
				(0.63)	(0.61)
Constant	0.0023	-0.031	0.297	0.305	0.309
	(0.51)	(0.00)	(0.01)	(0.01)	(0.01)
Hausman	0.00	0.00	0.00	0.00	0.00

Estimated coefficients for OLS panel data regressions (with robust errors), where effects are treated as fixed or random, depending on the Hausman test. The dependent variable is IssueV, the dollar volume issued by the corresponding bond, normalized by total assets. The independent variables are as follows: Ami^{WD} and Ami^{SD} represent the aggregate Amihud measure for the whole bond market and for the whole stock market, respectively; Term is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields; VIX refers to the implied volatility in index options; Yield refers to the yield offered by the bond in percentage; Maturity refers to the time to maturity of each bond, measured in years; Cash refers to cash and short-term investment accounts, normalized by total assets; CapExp refers to capital expenditures, normalized by total assets; Ebitda refers to operating income before depreciation, normalized by total assets; Size refers to the log of total assets; Tangibility refers to the sum of property, plant, and equipment and inventories, normalized by total assets; LeverageR refers to book debt, normalized by the sum of book debt and the market value of equity; and TobinR refers to the sum of the market value of equity and book debt, normalized by total assets. The *p*-values are in parentheses.

Table 5a. Illiquidity impact on issuance, controlling for crisis periods: Issuance moment.

Ind. Var.	Model 1	Model 2	Model 3	Model 4	Model 5
Ami_d^{RD}	-0.101	-0.114	-0.104	-0.088	-0.104
	(0.00)	(0.00)	(0.04)	(0.07)	(0.04)
Ami_d^{SD}	0.442	0.453	0.542	0.580	0.544
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Term_d$	-0.006	5.21E-4	0.024	0.030	0.024
	(0.68)	(0.97)	(0.32)	(0.22)	(0.31)
VIX_d	-0.008	-0.010	-0.019	-0.020	-0.019
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Yield_j$		0.053	0.096	0.100	0.095
		(0.00)	(0.00)	(0.00)	(0.00)
$Maturity_{j,d}$		3.75E-5	1.79E-5	2.29E-5	1.93E-5
		(0.00)	(0.19)	(0.26)	(0.16)
$Cash_{j,d}$			-0.692	-0.006	-0.630
			(0.13)	(0.99)	(0.19)
$CapExp_{j,d}$			-0.583	-0.525	-0.566
			(0.67)	(0.71)	(0.67)
$Ebitda_{j,d}$			1.790	1.291	2.011
			(0.01)	(0.13)	(0.02)
$Size_{j,d}$			0.052	0.063	0.053
			(0.15)	(0.08)	(0.14)
$Tangibility_{j,d}$			0.109	0.161	0.107
			(0.62)	(0.49)	(0.63)
$LeverageR_{j,d}$			0.412		0.395
			(0.01)		(0.01)
$TobinR_{j,d}$				-0.069	-0.028
				(0.30)	(0.66)
$DummyCrisis$	0.007	-0.005	-0.110	-0.131	-0.110
	(0.91)	(0.94)	(0.38)	(0.31)	(0.38)
Constant $_{j,d}$	-3.139	-3.452	-4.494	-4.490	-4.509
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Estimated coefficients for probit panel data regressions with random effects (robust errors). The dependent variable is IssueM, a dummy variable indicating the day of the issue of the corresponding bond. The independent variables are as follows: Ami^{WD} and Ami^{SD} represent the aggregate Amihud measure for the whole bond market and for the whole stock market, respectively; Term is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields; VIX refers to the implied volatility in index options; Yield refers to the yield offered by the bond in percentage; Maturity refers to the time to maturity of each bond, measured in years; Cash refers to cash and short-term investment accounts, normalized by total assets; CapExp refers to capital expenditures, normalized by total assets; Ebitda refers to operating income before depreciation, normalized by total assets; Size refers to the log of total assets; Tangibility refers to the sum of property, plant, and equipment and inventories, normalized by total assets; LeverageR refers to book debt, normalized by the sum of book debt and the market value of equity; TobinR refers to the sum of the market value of equity and book debt, normalized by total assets; and DummyCrisis is a dummy variable that equals one in recession periods (recession dates provided by the National Bureau of Economic Research). The *p*-values are in parentheses.

Table 5b. Illiquidity impact on issuance, controlling for crisis periods: Issuance volume.

Ind. Var.	Model 1	Model 2	Model 3	Model 4	Model 5
Ami_d^{RD}	-3.96E-4	-2.45E-4	-2.48E-4	-2.50E-4	-2.48E-4
	(0.00)	(0.01)	(0.03)	(0.04)	(0.04)
Ami_d^{SD}	0.0363	0.0217	0.0390	0.0392	0.0394
	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
$Term_d$	-0.0032	-0.0023	-0.0016	-0.0017	-0.0016
	(0.00)	(0.02)	(0.19)	(0.16)	(0.21)
VIX_d	-5.09E-4	1.37E-4	3.53E-4	3.58E-4	3.62E-4
	(0.00)	(0.35)	(0.04)	(0.04)	(0.04)
$Yield_j$		–	-	-	-
$Maturity_{j,d}$		1.72E-5	1.77E-5	1.71E-5	1.71E-5
		(0.00)	(0.00)	(0.00)	(0.00)
$Cash_{j,d}$			0.0556	0.0526	0.0540
			(0.20)	(0.22)	(0.21)
$CapExp_{j,d}$			-0.6699	-0.6774	-0.6743
			(0.20)	(0.19)	(0.20)
$Ebitda_{j,d}$			0.3250	0.2979	0.2946
			(0.00)	(0.00)	(0.00)
$Size_{j,d}$			0.0218	0.0227	0.0232
			(0.02)	(0.02)	(0.02)
$Tangibility_{j,d}$			0.0264	0.0222	0.0219
			(0.64)	(0.69)	(0.70)
$LeverageR_{j,d}$			-0.0012		-0.0040
			(0.91)		(0.71)
$TobinR_{j,d}$				0.0061	0.0066
				(0.58)	(0.56)
$DummyCrisis$	-0.0029	0.0039	-0.0048	-0.0051	-0.0051
	(0.34)	(0.19)	(0.29)	(0.26)	(0.25)
$Constant$	0.0019	-0.0323	-0.3245	-0.3355	-0.3399
	(0.59)	(0.00)	(0.01)	(0.01)	(0.01)
Hausman	0.00	0.00	0.00	0.00	0.00

Estimated coefficients for OLS panel data regressions (with robust errors), where the effects are treated as fixed based on the Hausman test. The dependent variable is IssueV, the dollar volume issued by the corresponding bond, normalized by total assets. The independent variables are as follows: Ami^{WD} and Ami^{SD} represent the aggregate Amihud measure for the whole bond market and for the whole stock market, respectively; Term is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields; VIX refers to the implied volatility in index options; Yield refers to the yield offered by the bond in percentage; Maturity refers to the time to maturity of each bond, measured in years; Cash refers to cash and short-term investment accounts, normalized by total assets; CapExp refers to capital expenditures, normalized by total assets; Ebitda refers to operating income before depreciation, normalized by total assets; Size refers to the log of total assets; Tangibility refers to the sum of property, plant, and equipment and inventories, normalized by total assets; LeverageR refers to book debt, normalized by the sum of book debt and the market value of equity; TobinR refers to the sum of the market value of equity and book debt, normalized by total assets; and DummyCrisis is a dummy variable that equals one in recession periods (recession dates provided by the National Bureau of Economic Research). The *p*-values are in parentheses.

Table 6a. Illiquidity impact on issuance, controlling for financial industry differences: Issuance moment.

Ind. Var.	Model 1	Model 2	Model 3	Model 4	Model 5
Ami_d^{RD}	-0.099	-0.112	-0.133	-0.124	-0.133
	(0.00)	(0.00)	(0.03)	(0.03)	(0.03)
$Ami_d^{RD} * DNoFin$	-0.006	-0.005	0.045	0.032	0.046
	(0.92)	(0.94)	(0.67)	(0.76)	(0.66)
Ami_d^{SD}	0.434	0.446	0.591	0.611	0.590
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Ami_d^{SD} * DNoFin$	0.042	0.051	-0.055	-0.053	-0.049
	(0.51)	(0.46)	(0.57)	(0.60)	(0.62)
$Term_d$	-0.005	0.001	0.025	0.030	0.026
	(0.72)	(0.95)	(0.30)	(0.23)	(0.29)
VIX_d	-0.008	-0.010	-0.022	-0.022	-0.022
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Yield_j$		0.052	0.097	0.098	0.096
		(0.00)	(0.00)	(0.00)	(0.00)
$Maturity_{j,d}$		3.73E-5	1.76E-5	1.94E-5	1.88E-5
		(0.00)	(0.27)	(0.28)	(0.17)
$Cash_{j,d}$			-0.801	-0.495	-0.746
			(0.09)	(0.29)	(0.13)
$CapExp_{j,d}$			-1.055	-1.328	-1.059
			(0.45)	(0.34)	(0.44)
$Ebitda_{j,d}$			2.339	2.531	2.566
			(0.01)	(0.01)	(0.01)
$Size_{j,d}$			0.056	0.061	0.057
			(0.13)	(0.10)	(0.12)
$Tangibility_{j,d}$			0.273	0.396	0.273
			(0.28)	(0.11)	(0.27)
$LeverageR_{j,d}$			0.276		0.260
			(0.11)		(0.14)
$TobinR_{j,d}$				-0.045	-0.027
				(0.50)	(0.68)
$DNoFin$	-0.088	-0.075	-0.198	-0.306	-0.207
	(0.41)	(0.50)	(0.35)	(0.13)	(0.33)
$Constant$	-3.125	-3.433	-4.462	-4.429	-4.468
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Estimated coefficients for probit panel data regressions with random effects (robust errors). The dependent variable is IssueM, a dummy variable indicating the day of the issue of the corresponding bond. The independent variables are as follows: Ami^{WD} and Ami^{SD} represent the aggregate Amihud measure for the whole bond market and for the whole stock market, respectively; DnoFin is a dummy variable that takes the value one for non-financial firms and zero otherwise; Term is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields; VIX refers to the implied volatility in index options; Yield refers to the yield offered by the bond in percentage; Maturity refers to the time to maturity of each bond, measured in years; Cash refers to cash and short-term investment accounts, normalized by total assets; CapExp refers to capital expenditures, normalized by total assets; Ebitda refers to operating income before depreciation, normalized by total assets; Size refers to the log of total assets; Tangibility refers to the sum of property, plant and equipment and inventories, normalized by total assets; LeverageR refers to book debt, normalized by the sum of the book debt and the market value of equity; and TobinR refers to the sum of the market value of equity and the book debt, normalized by total assets. The *p*-values are in parentheses.

Table 6b. Illiquidity impact on issuance, controlling for financial industry differences. Issuance volume.

Ind. Var.	Model 1	Model 2	Model 3	Model 4	Model 5
Ami_d^{RD}	-3.34E-4	-1.92E-4	-1.90E-4	-1.95E-4	-1.92E-4
	(0.00)	(0.03)	(0.07)	(0.07)	(0.07)
$Ami_d^{RD} * DNoFin$	-8.60E-4	-7.25E-4	-3.71E-4	-3.44E-4	-3.57E-4
	(0.14)	(0.21)	(0.43)	(0.45)	(0.44)
Ami_d^{SD}	0.036	0.021	0.036	0.036	0.037
	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
$Ami_d^{SD} * DNoFin$	0.003	0.009	0.005	0.005	0.004
	(0.89)	(0.64)	(0.82)	(0.83)	(0.84)
$Term_d$	-0.003	-0.002	-0.002	-0.002	-0.002
	(0.00)	(0.03)	(0.12)	(0.10)	(0.13)
VIX_d	-5.73E-4	-7.43E-5	-3.89E-4	-3.95E-4	-4.00E-4
	(0.00)	(0.61)	(0.01)	(0.01)	(0.01)
$Yield_j$		–	–	–	–
$Maturity_{j,d}$		1.62E-5	1.82E-5	1.78E-5	1.78E-5
		(0.00)	(0.00)	(0.00)	(0.00)
$Cash_{j,d}$			0.058	0.055	0.056
			(0.19)	(0.21)	(0.20)
$CapExp_{j,d}$			-0.660	-0.665	-0.661
			(0.21)	(0.20)	(0.21)
$Ebitda_{j,d}$			0.305	0.284	0.281
			(0.00)	(0.00)	(0.00)
$Size_{j,d}$			0.018	0.018	0.019
			(0.01)	(0.02)	(0.02)
$Tangibility_{j,d}$			0.029	0.027	0.026
			(0.60)	(0.64)	(0.65)
$LeverageR_{j,d}$			0.002		-0.004
			(0.86)		(0.71)
$TobinR_{j,d}$				0.005	0.005
				(0.68)	(0.66)
$DNoFin$	–	–	–	–	–
$Constant$	0.0024	-0.031	-0.273	-0.281	-0.286
	(0.49)	(0.00)	(0.01)	(0.01)	(0.01)
Hausman	0.00	0.00	0.00	0.00	0.00

Estimated coefficients for OLS panel data regressions (with robust errors), where the effects are treated as fixed based on the Hausman test. The dependent variable is IssueV, the dollar volume issued by the corresponding bond, normalized by total assets. The independent variables are as follows: Ami^{WD} and Ami^{SD} represent the aggregate Amihud measure for the whole bond market and for the whole stock market, respectively; DnoFin is a dummy variable that takes the value one for non-financial firms and zero otherwise; Term is the term spread computed as the difference between 10-year Treasury bonds and one-month Treasury bill yields; VIX refers to the implied volatility in index options; Yield refers to the yield offered by the bond in percentage; Maturity refers to the time to maturity of each bond, measured in years; Cash refers to cash and short-term investment accounts, normalized by total assets; CapExp refers to capital expenditures, normalized by total assets; Ebitda refers to operating income before depreciation, normalized by total assets; Size refers to the log of total assets; Tangibility refers to the sum of property, plant and equipment and inventories, normalized by total assets; LeverageR refers to book debt, normalized by the sum of the book debt and the market value of equity; and TobinR refers to the sum of the market value of equity and the book debt, normalized by total assets. The *p*-values are in parentheses.

Table 7. Timer and nontimer characteristics.

	Timers	Nontimers		Timers	Nontimers
	Maturity			***Cash***	
Mean	2610	2543	Mean	0.099	0.097
Median	1836	1839	Median	0.066	0.064
p-value	0.834		p-value	0.962	
	Price			***Capex***	
Mean	99.752	99.720	Mean	0.024	0.023
Median	99.795	99.807	Median	0.019	0.019
p-value	0.890		p-value	0.899	
	Volume			***Ebitda***	
Mean	989,479	1,228,032	Mean	0.067	0.057
Median	775,000	850,000	Median	0.056	0.045
p-value	0.473		p-value	0.135	
	Yield			***Size***	
Mean	5.006	4.766	Mean	12.142	12.203
Median	5.104	4.834	Median	12.504	12.749
p-value	0.036		p-value	0.154	
	Rating			***Tangibility***	
Mean	5.17	4.48	Mean	0.182	0.145
Median	5	5	Median	0.170	0.102
p-value	0.023		p-value	0.005	
	Yield Spread			***LeverageR***	
Mean	1.077	1.364	Mean	0.490	0.516
Median	0.829	0.948	Median	0.570	0.565
p-value	0.021		p-value	0.741	
				TobinR	
			Mean	0.597	0.510
			Median	0.380	0.343
			p-value	0.295	

Maturity refers to the days to maturity of the bond; Industry refers to the industry of the firm issuing the bond; Price is the offering price at which the issue was originally sold, as a percentage of par; Volume is the par value of debt initially issued, in million dollars; Yield is the yield to maturity at the time of issuance, as a percentage of par; Rating is the mean rating category assigned by S&P, Moody's, and Fitch; and Yield spread is the difference between the yield of the benchmark Treasury issue and the issue's offering yield. Cash refers to cash and short-term investment accounts, normalized by total assets; CapExp refers to capital expenditures, normalized by total assets; Ebitda refers to operating income before depreciation, normalized by total assets; Size refers to the log of total assets; Tangibility refers to the sum of property, plant and equipment and inventories, normalized by total assets; LeverageR refers to book debt, normalized by the sum of the book debt and the market value of equity; and TobinR refers to the sum of the market value of equity and the book debt, normalized by total assets.

Figure 1. Yield spreads in the subsequent three years after the issuance.
This Figure shows the time evolution, from the issuance date (date 0) and 36 months after, of the average yield spread for the corporate bonds in two subsamples: the bonds issued when market liquidity is high (Timers) and the bonds issued in moments of low market liquidity (Nontimers).

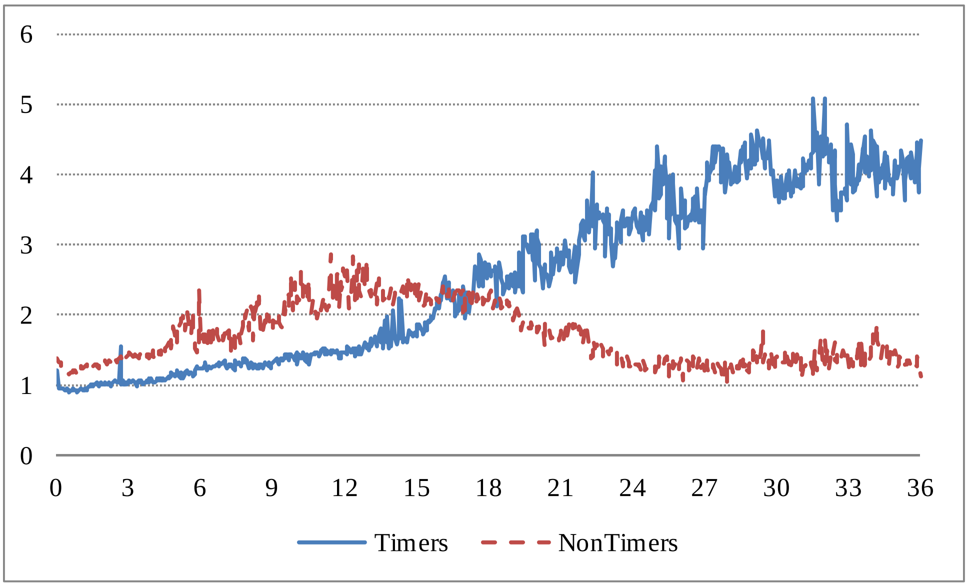

Figure 2. Aggregate Amihud and Bao illiquidity measures. Corporate bond market.

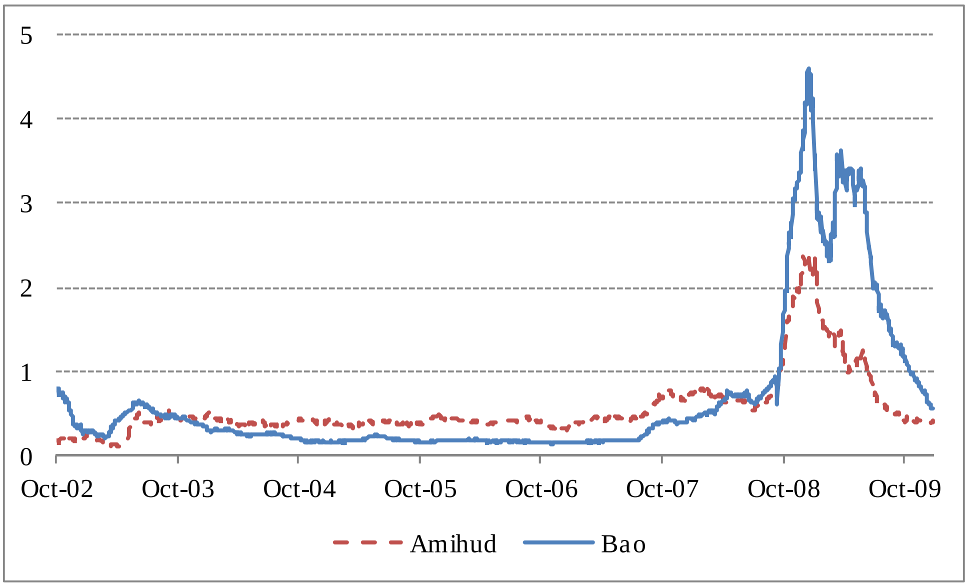

Figure 3. Bao and Amihud illiquidity measures by rating.
Median values for all corporate bonds in each rating class.

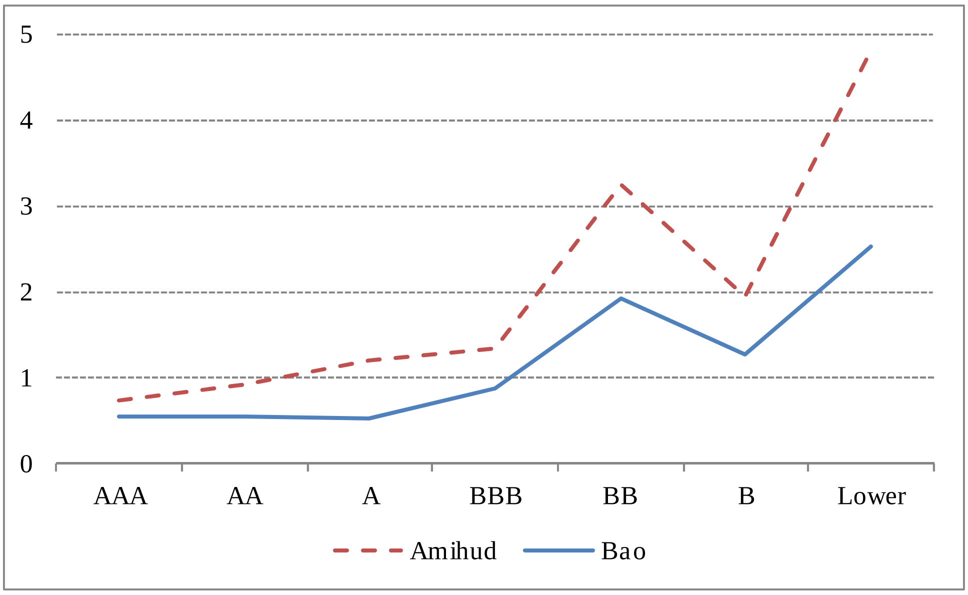

Figure 4. Aggregate Amihud and Bao illiquidity measures. Stock market.