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Impact of Relative Liquidity of Stocks and Bonds on the Financing and Investment Decisions of a Firm

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Impact of Relative Liquidity of Stocks and Bonds on the Financing and Investment Decisions of a Firm

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Abstract

The dissertation consists of two essays. The first essay investigates if market illiquidity is a significant determinant of capital structure decisions. We hypothesize that firms would likely compare the illiquidity of two sources of external funding at a given point in time and issue the one with lower illiquidity. Therefore, if the level of illiquidity is a key driver of firms' capital structure decisions in that year, the higher the level of stocks illiquidity, the more of its financing needs are satisfied by the issuance of debt, and the higher the level of bonds illiquidity, the less of its financing needs are satisfied by the issuance of debt. We find that illiquidity of the two sources of external funding affects significantly the capital structure decisions of U.S. firms over the sample period 2003-2018. Specifically, the coefficient of relative bonds illiquidity is negative, large, and strongly significant regardless of leverage measurement, and the coefficient of relative stocks illiquidity is positive, large, and strongly significant regardless of leverage measurement.

The second essay investigates if markets illiquidity is a significant determinant of investment decisions. We argue that an increase in investment opportunities due to an increase in bonds liquidity is for the decrease of the firm's cost of capital and the decrease in its issuance cost. With a lower cost of capital and a higher ability to issue securities, firms are able to undertake more investment opportunities. We find that bonds and stocks illiquidity affect significantly the investment decisions of U.S. firms over the sample period 2003-2018. Specifically, the coefficients of bonds and stocks illiquidity are negative, large, and strongly significant regardless of investment measurement. Also, we find the effect of bonds illiquidity is more pronounced for financially constrained firms using different financial constraints measures.

Keywords: Capital structure, Investment opportunities, stocks illiquidity, bonds illiquidity

Chapter one
Impact of Relative Liquidity of Stocks and Bonds on the Financing decisions

1. Introduction and hypotheses development

Market frictions like bonds and stocks illiquidity increase the cost of debt and stock issuance. However, illiquidity may not necessarily occur simultaneously. Consequently, firms would likely compare the illiquidity of two sources of external funding at a given point in time and issue the one with lower illiquidity. If such behavior persists in firms' decision to raise money externally, we should find a firm's capital structure decision to be an accumulation of past financing decisions, similar to the market timing theory, contradicting the trade-off theory. In this essay, we empirically test this proposition. The main objective of this paper is to investigate the effect of market friction of bonds illiquidity on leverage while taking into account the other main market friction, stock illiquidity.

Illiquidity or trading costs are critically considered in many investment and financial decisions. Amihud and Mandelson (1986) define illiquidity as the cost of immediate execution since the offer price comprises a buying premium and the bid price includes a sale discount. They indicate that a natural measure of illiquidity is the spread between the bids and asks prices.

1.1 Market timing theory of leverage

Market timing theory of leverage hypothesizes that security issuance decisions depend on market performance. Managers, aiming to maximize shareholders wealth, have the ability to identify the times when issuing security is less costly. Baker and Wurgler (2002) suggest that capital structure is the result of mangers' efforts to time the market. The variation of adverse selection costs across firms or across time would induce firms to issue equity when book-to-market or adverse selection is low. In fact, Anton Miglo (2010) indicates that the evidences provide a support to the market timing theory in that managers postpone securities issuance until the market conditions enhanced.

Illiquidity makes securities' issuance costly because it is a reflection of the frictions in the trading environment and is a major determinant of risk. Many papers find that bonds with similar characteristics and high illiquidity would show greater yield spreads. Also, theoretical work by Merton (1987) and O'Hara (2003) suggest that illiquidity is priced in the market. In addition, Amihud (2002) and Pastor and Stambaugh (2003) among others find that illiquidity is a major price

factor in the market. Chen et al. (2007) find that illiquidity is priced in firm's bonds yield spreads. Constantinides (1986) and Lo et al (2004) argue that market illiquidity decreases investors' ability to hedge risk, leading investors to demand a premium, which would consequently increase the cost of external financing.

Also, illiquidity makes securities' issuance costly because it is an indication of high adverse selection. Bagehot (1971) proposes a distinction between informed traders hoping to gain from their advantageous information in trading with the uninformed traders. Easley and O'Hara (1987) develop a model of the bids-asks spread, which has a positive correlation with information asymmetry and asset value uncertainty. Market proxies of adverse selection are based on the notion that market illiquidity is a function of three main components: order processing, inventory, and adverse selection. The idea here is that an increase in illiquidity works as a compensation for dealing with informed traders and rises with the degree of adverse selection. Easley et al. (1996, 1997), and Easley, Hvidkjaer, and O'Hara (2004) show that adverse selection measured by either the bid-ask spread or trading volume is a significant factor in determining market liquidity.

A number of statistical models were developed to proxy for an asset's liquidity. Some models try to make inference from the autocovariance of consecutive asset returns like Roll's (1984) and Boa, pan and Wang (BPW, hereafter) (2011). Others try to make inference based on the interaction between trading volume and asset returns like the price impact measure of Amihud (2002).

The market timing theory of leverage suggests that the presence of variation of adverse selection costs across firms would induce firms to issue securities when adverse selection is low. Also, the pecking order theory of leverage by Myers and Majluf (1984) proposes that asymmetric information affects firms' preferences of funding sources. It states that firms prefer internal finance, but if external finance is required, firms issue debt first and issue equity as the last resort. However, Halov and Heider (2004) claim that the traditional pecking order is a unique case of adverse selection. When the adverse selection is related to the firm value, the standard pecking order is applicable and firms prefer to issue debt instead of equity. However, when the adverse selection is related to firm's risk, firms prefer to issue equity instead of debt. Thus, the preference for external debt or external equity depends on whether adverse selection is related to value or risk.

Therefore, high market illiquidity is an indication of the increase in market's risk and in adverse selection, and hence would cause securities' underpricing and higher issuance costs. Butler et al (2005) provide evidence that there is a negative correlation between investment bank fees and stock liquidity. Also, Lipson and Mortal (2009) investigate the correlation between stocks liquidity

and equity issuance, and find that firms with high stocks liquidity have lower issuance costs, and therefore they use more funding through the issue of shares; consequently, firms end up with lower levels of leverage. Corwin (2003) finds that underpricing in seasoned equity offerings is negatively correlated with some measures of market liquidity. In addition, Hong and Stein (2007) by using disagreement models show that illiquidity is positively associated to underpricing. Therefore, based on the market timing theory of leverage, the security issuance decision when market exhibits high illiquidity is disadvantageous for firms and shareholders wealth since illiquidity increases the issuance cost.

In fact, transactions costs are essential in the academic debate about firms' capital structure. Jalilvand and Harris (1984), Auerbach (1985), Shyam-Sunder and Myers (1995), Opler and Titman (1994) and others cite transactions costs as the reason for firms to delay adjusting their leverage ratios and thus cause a deviation from their target ratios. Also, Huang and Ritter (2009) show that firms' choice among equity and public debt is related to the relative cost of issuance. Moreover, Graham and Harvey (2000) observe that firms take transactions costs into their consideration when making debt issuance decisions especially among small firms. Similarly, Titman and Wessels (1988) observe that small firms use comparatively little debt and cite this as evidence that transaction costs decrease debt issuance among small firms.

Moreover, Bharath et al (2009) find that information asymmetry measured by stocks illiquidity is a significant factor in determining capital structure decisions, as argued by the pecking order theory. Also, Faulkender and Petersen (2005) show that firms with more access to bonds market, as measured by having a debt rating, have significantly more leverage.

However, these studies do not directly test for the association between bonds illiquidity and leverage ratios or include both markets liquidities in the same model. Graham (2000) argues that some firms are significantly below the optimal leverage ratio and missing the opportunity to increase their value by adding more debt and hence decreasing their tax payments. The assumption here is that firms are willingly deciding to leave money on the table. However, another justification is that firms are incapable of increasing their leverage due to market frictions like illiquidity. Therefore, investigating if financial markets' illiquidity influences corporate behavior is important since market imperfections play a big role in determining the financing and investment decisions of firms.

To sum up, trade-off theory suggests that firms rebalance their capital structure with a goal to maintain optimal capital structure. However, pecking order theory does not recognize optimal capital structure and asserts that financing behavior follows a pecking order. Also, market timing

theory argument suggests that leverage is the cumulative result of past financing decisions (issuing stocks when prices are high) and this effect is permanent. Therefore, pecking order and market timing theory are inconsistent with the trade-off theory and do not assume optimality. Market timing theory is also inconsistent with the Pecking Order theory in that the firms do not go for debt financing before they issue stock financing.

Our suggestion is that firms' financing decision follows the following path: firms exploit their internal fund initially, inconsistent with the trade-off but consistent with the first part of the pecking order that firms prefer internal financing to external financing; then when doing external financing, firms examine the illiquidity of the bonds market versus the illiquidity of the stocks market, and issue the one with less illiquidity, inconsistent with both trade-off and pecking order, and more in line with timing market theory. Consequently, the relative importance of external financing's illiquidity has an opposing effect of firm's leverage ratio. An increase in bonds illiquidity relevant to stock illiquidity, has a negative influence on leverage since it increases stock issuance (the denominator). While an increase in stocks illiquidity relevant to bonds illiquidity, has a positive influence on leverage since it increases bonds issuance (the numerator).

Therefore, the higher the degree of relative illiquidity of a given type of security, the greater is the firm's incentive to issue the other type, all else held constant. Thus, we hypothesize the following:

Hypothesis a. An increase in the level of the relative firm's bonds illiquidity, the less of its financing needs are met by the issuance of debt.

Hypothesis b. An increase in the level of the relative firm's stocks illiquidity, the more of its financing needs are met by the issuance of debt.

1.2 Effect of different firm's financial constraints

More financially constrained firms would have a high-pronounced effect of bonds illiquidity. The relaxation of financial constraints means that firms have more internal funds or easier excess to equity market, which consequently makes the bonds market and its imperfections irrelevant. Conversely, firms with more financially constraints will benefit more from the bonds liquidity, as it makes it easier for them to borrow externally. Thus, we expect the effect of bonds illiquidity is to be more pronounced on financially constrained firms due to the limited access for other external capital.

To capture the effect of financial constraints and to reassure that our main results are not

driven by the choice of a single variable, we use firm size, Kaplan and Zingales (1997)'s index (KZ index, hereafter), following Fazzari et al., (1988), Almedia et al., (2004), and Alhassan et al. (2017). On an annual basis, we rank firms by the financial constraint variable into four quartiles. Then, we create a dummy variable that takes one if the firm is assigned in the top quartile and zero otherwise. This dummy represents firms in the highest quartile. We will test the hypothesis by adding to the base specification the financial constraint dummy interacted with the bonds illiquidity variable. A significant coefficient would indicate that illiquidity is more relevant for firms with greater financial constraints.

The first financial constraint is firm size. Almedia et al. (2004) argue that small firms are more vulnerable to capital market imperfections since they are less known. Beck et al. (2008) show evidence that there is a difference in funding between firms based on their size, making small firms more susceptible to financial constraints. Therefore, small firms should be more sensitive to bonds illiquidity. An interacted dummy between illiquidity and small firms is added to the base regression, and it should be significant and negative as evidence that the effect of illiquidity is bigger and more effective for small firms since they have less access to capital.

KZ index is introduced by Kaplan and Zingales (1997) and has been used to proxy financial constraints in many related studies (Almeida et al (2004); Alhassan et al. (2017); and others). The KZ index is constructed from the following equation:

KZ=-1.002 FCF+0.283 Qratio+3.139 Leverage –39.368 Dividend -1.315 Cash.

Therefore, the interaction variable should be negative and significant, indicating a higher sensitivity form the financially constrained firms to the effect of illiquidity.

Therefore, the effect of bonds illiquidity is more pronounced on financial constrained firms due to the limited access for external capital.

2. Data

We use annual data from 2003-2018. Our sample includes all nonfinancial firm observations in the Compustat database between 2003 and 2018. We end up with 1,176 firms. We employ S&P's credit rating to classify firms, where firms rated BBB – or higher are investment-grade firms and firms rated BB+ or lower are below- investment-grade firms.

We estimate a fixed effect panel model, following the standard approach popular in many previous papers. The use of panel data analysis allows us to better control for firm heterogeneity and reduce the issue of multicollinearity of explanatory variables. Also, lagged time periods are used since the leverage is not carried out immediately.

The equation is based on the assumption that supply and demand factors are the two main determinants of the desired level of leverage. In the absence of supply frictions, only demand factors like firm size explain differences in the firms' leverage ratios. However, supply frictions as bonds and stocks illiquidity may affect firm decisions to issue debt.

$$\text{Leverage}_{i\tau} = a + b_1 \text{ Bonds Illiquidity}_{i\tau} + b_2 \text{ Stocks Illiquidity}_{i\tau} + b_i \text{ Control variables} + \varepsilon_{i\tau}$$

2.1 Dependent variable measure

The definition of the dependent variable, the firm leverage, is dependent on the objective of analysis. For example, as Rajan and Zingales (1995) point out, the relevant measure of leverage according to agency problems of debt (Jensen and Meckling (1976) and Myers (1997)) is the debt to firm value because the theory relates to the firm past financing.

Also, defining leverage as the ratio of total liabilities to total assets is widely used and it provides a reasonable indication of firm's value in case of liquidation. However, this measure does not indicate firm's probability of default in the nearby future. Also, it may overstate the amount of leverage since it includes items that are not used for financing purposes. Therefore, defining leverage as the ratio of long debt to total assets might mitigate the issue of overstating leverage and give a good indication of the likelihood of default.

In addition, Rajan and Zingales (1995) argue that a more appropriate definition of leverage is by the ratio of total debt to total assets. However, this measure contains measurement error since it includes assets that are counterbalance by specific non-debt items. Also, a suitable measure of leverage is the ratio of total debt to capital because it includes the effects of past financing decisions.

We also add two measures of leverage, which is the debt issuance and the net issuance,

which is the difference between debt issuance and debt reduction.

As we can infer, each ratio contains measurement error. However, the biasedness is mitigated by the using of all of theses leverage ratio measures.

2.2 Bonds liquidity measures

We construct many proxies for bonds liquidity using TRACE data. The first 3 measures are defined similar to Dick-Nielsen et al. (2012).

The Amihud illiquidity ratio is computed using high-frequency transaction data from TRACE, and is defined as the daily average of absolute returns divided by the trade size in millions of consecutive transactions, as $\sum_{J=1}^{N_t} \frac{\frac{|P_j - P_{j-1}|}{P_{j-1}}}{Q_j}$.

Also, Roll (1984) suggests that the effective bid-ask spread can be measured using return autocovariance. It is computed in this paper over a 21-day rolling interval (ending on day t) within fiscal year as $2\sqrt{-\mathrm{cov}\,(\Delta P_t - \Delta P_{t+1})}$. The daily auto covariance is more likely to be positive for heavily traded stocks, so when we encounter a positive autocovariance, we make it zero. It is applied to daily data based on the assumption that the daily closing price is likely to be similar for bids and asks prices.

In addition, a proxy for roundtrip costs is the bid-ask spread, which is not available in TRACE before November 2008. An alternative measure of transaction costs, proposed by Feldhutter (2010), is calculated using unique roundtrip trades (URT). The spread is defined as $\frac{P\ Max - P\ Min}{P\ Max}$. A daily estimate is the average of roundtrip costs on that day for different volumes, and then we average them to get the yearly measure.

Similar to Roll (1984), Boa, pan and Wang (2011) develop illiquidity measure, γ, defined as the negative of the autocovariance of the returns as $-\mathrm{cov}\,(\Delta P_t - \Delta P_{t+1})$.

2.3 Control variables

A number of control variables, which have been identified by previous papers are employed as potential explanatory factors affecting capital structure. Rajan and Zingales (1995), after surveying literatures on factors driving leverage, end up with four main determinants, which are specifically, tangibility of assets, market-to-book ratio as a proxy for investment opportunities, firm size, and profitability. They conclude that these factors consistently appear correlated with leverage in

previous studies.

Therefore, following Rajan and Zingales (1995), our main explanatory variables are size, tangibility, Tobin's Q, and profitability.

The first control variable is the size defined as the logarithm of sales. The relation between leverage and size is ambiguous. If the size is viewed as an inverse proxy for the probability of bankruptcy, this can have a positive effect on the supply of debt. However, size might increase the outside investors' preferences for equity relative to debt. Rajan and Zingales (1995), Graham et al (1998), Hovakimain et al (2001), and Bharath et al (2009) find that leverage is positively correlated with size. An increase in size would decrease risk, increase diversification, and lower the probability of distress and its expected costs. Bigger size firms may also have lower issuance costs due to the economies of scale. In fact, Titman and Wessels (1988) observe that small firms use comparatively little debt and cite this as evidence that transaction costs decrease debt issuance among small firms.

The second control variable is tangibility, defined as property, plant, and equipment to assets. An increase in tangible assets would lower the cost of financial distress since a higher proportion of tangible assets retain more value in liquidation and serve as collateral; and it also decreases the agency costs of debt like assets shifting. Therefore, tangibility increases lenders willingness to provide loans, and consequently leverage should be higher. Rajan and Zingales (1995), Faulkender and Petersen (2005), and Bharath et al (2009) find a positive significant relation between leverage and tangibility.

The third control variable is Tobin's Q used as a proxy for growth opportunities, and defines as the ratio of market value of assets to book value of assets, as suggested by Myers (1977). Myers (1977) argues that firms with high future growth expectations should use a greater amount of equity financing. Rajan and Zingales (1995), Faulkender and Petersen (2005), and Bharath et al (2009) find a negative significant relation between leverage and Tobin's Q.

The forth control variable is profitability, measured as the ratio of net profit to revenue. There are contradictory theoretical suggestions on the effects of profitability on leverage. The pecking order theory by Myers and Majluf (1984) suggests a negative relation since firms prefer internal financing to resorting to the external market. Also, firms might use their profitability to decrease debt, and thus have lower leverage. However, Jensen (1986) suggests that debt is used as an effective corporate control mechanism to force firms to pay out free cash flow. Also, suppliers of debt are more willing to lend firms with high profitability. In fact, Rajan and Zingales (1995), Faulkender and Petersen (2005), and Bharath et al (2009) find more profitable firms have lower

leverage.

Therefore, the final model is:

Equation (1): $\text{Leverage}_{i\tau} = a + b_1 \text{ bonds illiquidity}_{i\tau} + b_2 \text{ stocks illiquidity}_{i\tau} + b_3 \text{Tangibility}_{i\tau} + b_4 \text{ Tobin's q}_{i\tau} + b_4 \text{size}_{i\tau} + b_5 \text{ Profitability}_{i\tau} + \varepsilon_{i\tau}$

Table 1 Descriptive Analysis

Panel A presents the means, medians, and standard deviations for each variable included in the study. We take the log of Amihud measure plus one to avoid outliers. Roll (1984) defined as the square root of negative autocovariance computed over a 21-day rolling interval within fiscal year. Boa, pan and Wang (2011) defined as the negative of the autocovariance of the returns. Relative spread is max-min spread relative to an estimate of max price. Tobin's q is computed as the sum of market value of equity and book value of debt (total market value) divided by total assets. Leverage is defined as long-term debt divided by total assets. Profit is defined as net earning scaled by the beginning revenue. Panel B shows the pairwise Pearson's correlation between variables included in the study. For each correlation coefficient, the table reports the level of the statistical significance. The superscripts a, b, and c refer to 1%, 5% and 10% statistical significance level, respectively.

Panel A: Summary statistics							
Variable	Mean	Median	S.D	Variable	Mean	Median	S.D
Bonds illiquidity				Stocks illiquidity			
Amihud	.0003 [a]	.0022	.0143	Amihud	0.0125	0.0002	0.81
Roll	.0121 [a]	.0056	.0699	Roll	.0095	.0074	.0084
BPW	.0073 [b]	0	.2669	BPW	.00006	.00001	.0011
Relative spread	.0083 [a]	.0060	.0078	Relative spread	.0224	.0193	.0117
	Control variables			Control variables			
Size	8.869	8.847	1.47	Tobin's q	1.083	.8492	.9359
Leverage	.2316	.212	.1517	Tangibility	.5631	.4592	.5173
FCF	.2229	.189	.1946	Net profit	.054	.0489	.0682

Table continued

Panel B: Whole Sample

Variable	Amihud	Roll	BPW	Relative spread	Amihud stocks	Roll stocks	BPW stocks	Relative spread stocks	Size	Leverage	Net profit	Tobin's q	Tang.
Amihud	1												
Roll	.028 [a]	1											
BPW	.26 [a]	.557 [a]	1										
Relative spread	-.0003[a]	.005	-.005	1									
Amihud stocks	.0049	.001	-.001	.0003	1								
Roll stocks	.007	.037 [a]	-.0005	.016 [b]	.0965 [a]	1							
BPW stocks	-.000	.005	-.0003	.0017	.0112	.6610 [a]	1						
Relative spread stocks	.0094	.092 [a]	.017 [b]	.023[a]	.0476 [a]	.396 [a]	.026 [a]	1					
Size	-.031 [a]	-.066 [a]	-.029 [a]	-.0108	-.0261 [a]	-.1195 [a]	-.0085	-.3383	1				
Leverage	-.018 [b]	.0015	.001	-.0072	.0077	.0417[a]	-.002	.1907 [a]	-.2595 [a]	1			
Net profit	.0085	-.0085	.0015	-.0014	-.0340 [a]	-.089 [a]	.0194 [a]	-.3198	.2709 [a]	-.1080 [a]	1		
Tobin's q	.0254 [a]	-.0020	-.0012	-.0076	-.0056	-.055 [a]	-.010	-.1236 [a]	-.1026[a]	-.0206 [b]	.5363 [a]	1	
Tangibility	-.0059	.0202 [b]	.0073	.0813 [a]	-.0053	.0252 [a]	-.0059	.1662 [a]	-.0056	.1779 [a]	-.1126 [a]	-.1316 [a]	1

Panel A presents summary statistics associated with illiquidity measures for stocks and bonds markets and other control variables. It shows the means, medians, standard deviations for each variable included in the study. There are no substantial differences between the whole sample and a subsample restricted to investment-bond firms. The medians are similar to the means suggesting little skewness in liquidity distribution. As expected, it seems that volatility of illiquidity measured by standard deviation is higher in the stocks market than the bonds market. Comparing the bonds illiquidity measures and stocks illiquidity measures shows inconsistency in terms of which market exhibit the highest illiquidity. The reason for that as we mentioned above is that these measures exhibit inconsistency among them and do not capture all illiquidity aspects. The inconsistency between illiquidity measures is apparent in the correlation results between them on panel B. However, most of illiquidity measures show that bonds market is more liquid. The relative decrease of bond illiquidity comparing to stocks illiquidity is because adverse selection is not a major concern in bond markets and is more important in individual stocks due to idiosyncratic shocks, as Chordia et al (2003) point out.

Panel B presents summary statistics for correlations between variables included in the study. The most important result is the apparent low correlation between the two markets illiquidity. Chordia et al (2003) find that there is a little correlation in liquidity between the two markets. Also, Campbell and Ammer (1993) find that the unconditional correlation between stock and bonds returns is low. They argue that stocks and bonds covariance should be low since the only common factor is interest rate, which has low variability. Moreover, as suggested by Borensztein and Gelos (2003) individual investors' herding behavior that typically causes higher correlations in stocks

market is unlikely to be a factor in bond market due to the high concentration of institutional investors who are less susceptible to herding behavior.

However, many papers indicate that there are common factors that drive both markets causing a covariance between the two markets. Innovations and trading activity might cause an interaction between stocks and bonds market liquidity and a shift in portfolios between the two markets. A negative information shock in stocks might cause investors to substitute safe assets for risky one or to substitute illiquid assets for more liquid one. Fleming et al (1998) show that volatility affects both markets, which can affect liquidity in both markets. Also, Chordia et al (2003) find that innovation in one market increases the spreads in both markets. However, the innovation is not necessary affecting both markets equally or on the same magnitude. Chordia et al (2003) find that monetary easing has only a significant positive effect on stocks liquidity during crisis periods.

Beber et al. (2009) observe that illiquidity differs based on the bonds maturities and find a stronger correlation between illiquidity of stocks and short-term bonds. Similarly, Goyenko and Ukhov (2009) find a liquidity connection between stocks and treasury bonds returns that is more pronounced for short-term maturities.

David and Veronesi (2013) and Campbell et al (2013) show that covariance of stocks and treasuries bonds returns turned from being positive before 2000 to being negative after that. They offer an explanation for the changing sign, which is the role of inflation especially during recessions. High expected inflation causes a positive covariance between stocks and bonds and vice versa. During the financial crisis, bonds market provided insurance against severe adverse economic conditions. In addition, Connolly et al (2005) find that the covariance negativity increases in a period of high stocks volatility and argue that the explanation is the investors seeking safety in bonds market. Also, Campbell et al (2014) offer another explanation to the time variation in the covariance, which is the response to monetary policy changes and the change in risk aversion, particularly in bad times.

However, papers trying to explain the relation between bonds and stocks illiquidity using firms' level data are scarce. Nieto and Rodriguez (2015) try to narrow this gap by employing bond transaction prices from TRACE and find that the correlations between individual bonds and stocks returns are small and time variant. They also find that the correlation is negative with systematic firm risk, and positive with idiosyncratic risk.

We try to investigate the causality between the two markets illiquidity for all measures. The Panel VAR-Granger causality Wald tests in Table 2 mostly indicate inconsistent results. Amihud's

(2002) bonds illiquidity measure strongly negative Granger causes stocks illiquidity. However, using the spread measure, the causality is reversed. The stocks illiquidity measured by relative spread strongly positively Granger causes bonds illiquidity. Also, there is no bidirectional causality between the two markets using Roll or BPW. Interestingly, when we investigate the causality between the two markets illiquidity during the financial crisis. The Amihud's (2002) bonds illiquidity measure strongly positively Granger causes stocks illiquidity. And the stocks illiquidity measured by relative spread strongly negatively Granger causes bonds illiquidity. Therefore, the signs are flipped.

Table 2 Panel vector autoregresssion

Table states the expected sign for each independent variable. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Regressor	Dependent Variable in VAR	
	Amihud	S. Amihud
Amihud	.0624 [a]	-.0650 [a]
S. Amihud	-.0081	1.213 [a]
	Roll	S. Roll
Roll	.1831	.0011
S. Roll	.9767	.6757
	Spread bonds	Spread stocks
Spread bonds	.0738 [c]	.000
Spread stocks	27.91 [a]	.977 [a]
	BPW bonds	BPW stocks
BPW bonds	.0453	.0000
BPW stocks	12.82	.3576

3. Main Findings

In this section, we provide a detailed discussion of the results from the regressions analyses. We begin with the results from the fixed effect panel models. Later, we show the findings for the role of financial constraints on the leverage and liquidity relation.

As previously outlined, we estimate Equation (1) on an annual basis where we include firms' dummies to capture the heterogeneity across firms and to ameliorate the endogeneity issue. Also, based on the main hypothesis, the bonds illiquidity coefficient should be negative and significant, indicating that an increase in bonds illiquidity would cause a decrease in leverage by the firm. Also, the stocks illiquidity coefficient is positive and significant, indicating that an increase in stocks illiquidity would cause an increase in leverage by the firm.

All tables show the results of coefficients, R-squares, number of observations, and expected sign for each variable. For each table, we report the results of 5 models where we include different bonds illiquidity measures. To individually test the null hypothesis that the independent variable coefficients are equal zero, we report the subscripts a, b, c referring to 1%, 5%, and 10% statistical significance levels, respectively. We use Huber-White corrected standard errors when computing the p-values to account for the possible presence of heteroskedasticity. The results are the same when we use robust standard errors corrected for firm-level clustering.

In Table 3, where the dependent variable is leverage proxied by 6 measures, it appears that there is a significant negative relation between leverage measures and bonds illiquidity measures in the prior year. It shows statistically significant coefficients at the 5% level or higher. Thus, more bonds illiquid firms choose a lower level of leverage. Also, the economic magnitude of bonds illiquidity effect is meaningful. The consistency among the different measures of bonds illiquidity is apparent except for relative spread, which shows a higher magnitude. Also, the results show that there is a significant positive relation between leverage measures and stocks illiquidity measure in the prior year. It shows statistically significant coefficients at the 5% level or higher. Thus, firms with high stocks illiquidity choose a higher level of leverage. Also, the economic magnitude of stocks illiquidity effect is meaningful since it is higher than the bonds illiquidity effect. In fact, it seems that the stocks illiquidity effect is the highest among all explanatory variables.

The results of control variables are consistent with prior studies. Leverage is positively related to size at 1% level, except for leverage measured by debt issuance and net issuance where it shows less significant results. The positive relation between leverage and size is consistent with the

assumption that an increase in size would decrease risk, increase diversification, and lower the probability of distress and its expected costs. Also, leverage is positively related to tangibility at 1% level. It has similar significance and magnitude as the size. The positive relation is expected since tangible assets would work as a collateral to lower the cost of financial distress, and would decrease the agency costs of debt like assets shifting. Profitability is significant and has a negative effect on all measures of leverage at 1%. It has the highest magnitude among independent variables after stocks illiquidity variable. This correlation is consistent with the pecking order theory suggestion that the relation between profit and leverage should be negative since firms prefer internal financing to debt. Also, firms might use their earnings to pay off debt, and thus have lower leverage.

On the other hand, Tobin's Q shows significant positive relation with all leverage measures except for leverage measured by debt to market which exhibits a negative relation. Myers (1977) argues that firms expecting high future growth should use a greater amount of equity financing and thus has less leverage. In addition, the negative relation is a result of high-growth firms attempts to time the market via equity issuance, consistent with timing market theory suggestion by Baker and Wurgler (2002). However, Chen and Zhao (2006) show that firms with high market-to-book ratios raise more debt as a result of their high profitability and low borrowing costs. They show that Tobin's Q for the majority of firms is significant and positively related to the leverage ratio. In fact, the positive relation is consistent with our sample, which is based on investment firms where the agency cost is less sever due to the high concentration of institutional investors, profitability is high and borrowing costs is low comparing to below-grade firms. So, we should observe a positive relation between leverage and market-to-book ratio within this sample.

Table 3 Fixed panel Regressions of Leverage

This table reports annual regressions of equation: Leverage= α + β Bonds illiquidity+ β stocks illiquidity + β Tangibility+ β size+ β Tobin's q+ β Profitability + ε. The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Total liability to total assets					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0302 [a]	-.0330 [a]	-.7142 [a]	-.0104
Stocks illiquidity	+	.7126 [a]	.7159 [a]	.4760 [a]	.6322 [a]
Size	+	.0399 [a]	.0398 [a]	.0384 [a]	.0425 [a]
Tangibility	+	.0608 [a]	.0607 [a]	.0613 [a]	.0736 [a]
Profitability	-	-.2566 [a]	-.2569 [a]	-.2565 [a]	-.2874 [a]
Tobin's Q	-/+	.0205 [b]	.0209 [b]	.01942 [b]	.0134 [c]
R2		0.0549	0.0558	0.0578	0.0709
OBS		4,128	4,128	4,128	3,695

Table Continued

Dependent Variable: long debt to total assets					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0527 [a]	-.0241 [b]	-.6349 [a]	.0042 [a]
Stocks illiquidity	+	.1000 [c]	.0055 [c]	-.5538 [b]	-.7518[a]
Size	+	.0413 [a]	.0405 [a]	.0422 [a]	.0429[a]
Tangibility	+	.0576 [a]	.0569 [a]	.0576 [a]	.0568[a]
Profitability	-	-.2644 [a]	-.3053 [a]	-.3061 [a]	-.2792[a]
Tobin's Q	-/+	.0136 [b]	.01454 [c]	.01475 [b]	.0060
R2		0.0711	0.0853	0.0898	0.0792
OBS		3,663	4,112	4,110	4,092

Dependent Variable: long debt to market value					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.1527 [a]	-.0437	-1.437	-.0165 [a]
Stocks illiquidity	+	2.142 [b]	5.417 [a]	3.995	5.249 [a]
Size	+	.0961 [a]	.0912 [a]	.0914 [a]	.0905 [a]
Tangibility	+	.0780	.0751	.0510	.0734
Profitability	-	-1.720 [b]	-1.513 [c]	-1.237 [c]	-1.514 [c]
Tobin's Q	-/+	-.1347 [a]	-.1324 [a]	-.1435 [a]	-.1319 [a]
R2		0.1326	0.2172	0.1920	0.2144
OBS		4,141	3,672	3,245	3,640

Dependent Variable: Total liability to Capital					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0319 [a]	-.0377 [a]	-.6574 [b]	-.0153 [a]
Stocks illiquidity	+	.9970 [c]	.9916 [c]	1.064 [c]	.9940 [c]
Size	+	.0452 [a]	.0450 [a]	.0435 [a]	.0452 [a]
Tangibility	+	.0703 [a]	.0700 [a]	.0703 [a]	.0699 [a]
Profitability	-	-.2618 [a]	-.2621 [a]	-.2615 [a]	-.2623 [a]
Tobin's Q	-/+	.0203 [b]	.0208 [b]	.0194 [b]	.0205 [b]
R2		0.0628	0.0640	0.0652	0.0631
OBS		3,785	3,785	3,785	3,773

Dependent Variable: Debt issuance					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0978 [a]	-.0239 [c]	-1.031 [b]	-.0123 [a]
Stocks illiquidity	+	.0081 [c]	.0081 [c]	.0076 [c]	.0075 [c]
Size	+	.0144 [b]	.0144 [b]	.0126 [c]	.0132 [c]
Tangibility	+	.0393	.0394	.0406 [c]	.0384
Profitability	-	-.1507 [a]	-.1512 [a]	-.1482 [a]	-.1525 [a]
Tobin's Q	-/+	.0360 [a]	.0360 [a]	.0338 [a]	.0391 [a]
Leverage	-	-.1536 [b]	-.1544 [a]	-.1625 [b]	-.1427 [b]
R2		0.0421	0.0419	0.0455	0.0452
OBS		4,127	4,127	4,127	4,093

Dependent Variable: Net Issuance					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0116 [a]	-.0175 [b]	-.3471 [c]	-.0029 [a]
Stocks illiquidity	+	.0036 [c]	.0047 [b]	.0050 [c]	.0045 [b]
Size	+	.0010	.0081 [c]	.0074 [c]	.0078 [c]
Tangibility	+	.0213 [b]	.0233 [b]	.0241 [b]	.0223 [b]
Profitability	-	-.2046 [b]	-.0173	-.0200	-.0200
Tobin's Q	-/+	.0356 [a]	.0254 [a]	.0242 [a]	.0252 [a]
Leverage	-	-.1842 [a]	-.1988 [a]	-.1979 [a]	-.2044 [a]
R2		0.1337	0.0815	0.0821	0.0823
OBS		3,966	3,874	3,874	3,842

When dealing with bonds market, the firms can be classified into high-investment-grade firms, and below-investment-grade firms. Several papers indicate a different behavior of liquidity between the two grades firms. Dick-Nielsen et al (2012) show that illiquidity increased during the subprime crisis and is more pronounced and less persistent for below-investment-grade bonds. In addition, Bessembinder et al. (2016) suggest that below-investment-grade bonds are more dependence on market liquidity as a result of their high exposure to asymmetric information. Kisgen and Strahan (2010) and Bessembinder et al. (2016) point out that institutional investors and insurance companies are usually required to only invest into investment-grade firms. Also, Chen et al. (2007) find that bonds illiquidity has a significant positive increase on yield spreads and is more pronounced for junk bonds.

In addition, the effect of illiquidity on leverage is different across bonds grades. Lemmon and Roberts (2010) show that a shock to stocks liquidity has a significant impact on the financing and investment behavior of below-investment-grade firms. Below-investment-grade firms decrease their total net security issuances without substitution to alternative sources of financing such as equity or internal funds. Faulkender and Petersen (2005) show that a supply shift by having an access to bond market as measured by having a debt rating, have significantly increases leverage. Namin (2017) also show that there is an increase in liquidity around rating upgrades announcements and that high credit rating firms have relatively higher bonds liquidity, excluding the financial crisis period, and consequently have higher leverage.

Therefore, we repeat our initial analysis for the whole sample by including the below-investment-grade firms. The results show consistent results for the main variables with no material difference, that firms with high bonds illiquidity choose a lower level of leverage, and firms with high stocks illiquidity choose a higher level of leverage.

Interestingly, Tobin's Q shows significant negative relation with all leverage measures, in contrast to our initial results. This result is consistent with Myers (1977) argument that firms expecting high future growth should use a greater amount of equity finance and thus has less leverage, and is consistent with the argument of Baker and Wurgler (2002) that many high-growth firms actively time the market by equity issuance.

Table 4 Fixed panel Regressions of Leverage – Whole sample

This table reports annual regressions of equation: Leverage= α + β Bonds illiquidity+ β stocks illiquidity + β Tangibility+ β size+ β Tobin's q+ β Profitability + ε.The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Total liability to total assets					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0120 [c]	-.0299 [a]	-.1858 [a]	-.0025 [a]
Stocks illiquidity	+	.0015 [a]	.0015 [a]	2.338 [a]	.0015 [a]
Size	+	.0205 [b]	.0201 [b]	.0268 [a]	.0204 [b]
Tangibility	+	.0284	.0285	.0061	.0290
Profitability	-	-.0924 [c]	-.0934 [c]	-.1011 [a]	-.0923 [c]
Tobin's Q	-/+	-.0159 [b]	-.0162 [b]	.0059	-.0159 [b]
Rating up		-.0124	-.0121	-.0069	-.0123
R2		0.0175	0.0188	0.0400	0.0179
OBS		6,365	6,988	5,302	6,341

Dependent Variable: long debt to total assets					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0318 [a]	-.0121	-.3846 [b]	-.0013 [a]
Stocks illiquidity	+	.0011 [b]	.0011 [b]	.0012 [b]	.0012 [b]
Size	+	.0174 [b]	.0171 [b]	.0160 [c]	.0173 [b]
Tangibility	+	.0282 [b]	.0283 [c]	.0312 [b]	.0289 [c]
Profitability	-	-.1433 [a]	-.1432 [a]	-.1516 [a]	-.1515 [a]
Tobin's Q	-/+	-.0088	-.0089	.0026	.0031
Rating Up		-.0232 [b]	-.0231[b]	-.0258 [b]	-.0243 [b]
R2		0.0300	0.0302	0.0320	0.0287
OBS		6,365	6,365	6,356	6,334

Dependent Variable: Debt to market value					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.5249 [a]	-.4166 [c]	-.7089	-.0158
Stocks illiquidity	+	9.788 [b]	10.11 [b]	8.094 [c]	9.616 [b]
Size	+	.2163 [b]	.2111 [b]	.2305 [c]	.2201 [b]
Tangibility	+	-.0801	-.0758	-.0322	-.0833
Profitability	-	-1.236 [b]	-1.226 [c]	-1.306 [c]	-1.251 [c]
Tobin's Q	-/+	-.2683 [b]	-.2702 [b]	-.3173 [b]	-.2670 [b]
Rating Up		-.0030	.0015	.0078	.0033
R2		0.0071	0.0074	0.0060	0.0069
OBS		7,588	7,588	6,360	7,474

Dependent Variable: Total liability to Capital					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.2250 [b]	-.0368 [a]	-.2408 [a]	-.0171 [a]
Stocks illiquidity	+	.0016 [a]	.0013 [a]	.0013 [a]	.0013 [a]
Size	+	.0330 [a]	.0322 [a]	.0316 [a]	.0329 [a]
Tangibility	+	.0368 [c]	.0376 [c]	.0382 [c]	.0356 [c]
Profitability	-	-.1065 [b]	-.1079 [b]	-.1118 [b]	-.1031 [b]
Tobin's Q	-/+	.0047	.0044	.0039	-.0004
Rating Up		-.0111	-.0107	-.0120	-.0104
R2		.0148	.0163	.0158	0.0149
OBS		5,100	5,100	5,100	5,088

Table Continued					
Dependent Variable: Debt issuance					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0032 [a]	.0108	-.0337	.0008
Stocks illiquidity	+	.0024 [a]	.0024 [a]	.0024 [a]	.0024 [a]
Size	+	-.0049	-.0047	-.0051	-.0045
Tangibility	+	.0416 [a]	.0416 [a]	.0418 [a]	.0415 [a]
Profitability	-	-.2322 [b]	-.2322 [b]	-.2322 [a]	-.2328 [b]
Tobin's Q	-/+	.0320 [a]	.0320 [a]	.0319 [a]	.0321 [a]
Leverage	-	-.1129 [a]	-.1129 [a]	-.1127 [a]	-.1133 [a]
Rating		-.0092	-.0094	-.0093	-.0093
R2		.0419	.0420	0.0419	0.0422
OBS		6,351	6,351	6,351	6,329

Dependent Variable: Net Issuance					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0029	-.0215	-.4383 [a]	-.0042 [a]
Stocks illiquidity	+	.0007 [a]	.0007 [a]	.0007 [a]	.0007 [a]
Size	+	-.0117 [a]	-.0123 [a]	-.0136 [a]	-.0118 [b]
Tangibility	+	.0296 [c]	.0298[c]	.0326 [c]	.0301 [c]
Profitability	-	-.0969	-.0969	-.0973	-.0975
Tobin's Q	-/+	.0309 [a]	.0306 [a]	.0296 [a]	.0306 [a]
Leverage	-	-.1504 [a]	-.1503[a]	-.1479 [a]	-.1493 [a]
Rating		.0002	.0005	-.0005	.0005
OBS		6,159	6,159	6,159	6,138
R2		0.0639	0.0651	0.0692	0.0660

Next, we redefine the main independent variable by making a ratio of bonds illiquidity to stock illiquidity. Since our main concern is to test the relative importance of illiquidity, we expect that an increase in bonds illiquidity relative to stock illiquidity would decrease the leverage.

In table 5, the ratio coefficient is negative and highly significant for the investment sample and for the whole sample. It shows negative correlation between the ratio and leverage measures, indicating that an increase in the ratio would decrease bonds financing.

The reported results are based on defining illiquidity based on Roll measure. However, when we define illiquidity based on other measures the results are similar in magnitude and significance.

Table 5 Fixed panel Regressions of Leverage-Relative illiquidity

This table reports annual regressions of equation: Leverage= α + β Log (Bonds illiquidity/ stocks illiquidity) + β Tangibility+ β size+ β Tobin's q+ β Profitability + ε. The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Leverage-Whole sample					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Log (ratio)	-	-0.0130 [a]	-0.0140 [a]	-0.0130 [a]	-0.0678 [a]
Size	+	-0.0034	0.0023	0.0010	0.0965 [b]
Tangibility	+	0.0022	0.0114	-0.0039	-0.1150
Profitability	-	-0.1059 [c]	-0.1046 [b]	-0.1391 [b]	-0.9255 [a]
Tobin's Q	-/+	-0.0080 [c]	-0.0065	-0.0113 [b]	-0.3865 [a]
R2		0.0611	0.0288	0.0698	0.0997
OBS		7,815	8,712	8,087	7,953

Table Continued					
Dependent Variable: Leverage-Investment bonds					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Log (ratio)	-	-0.0163 [a]	-0.0170 [a]	-0.0146 [a]	-0.0913 [a]
Size	+	0.0318 [a]	0.0348 [a]	0.0285 [a]	0.3171 [a]
Tangibility	+	0.0296	0.0336 [c]	0.0289	0.2323 [b]
Profitability	-	-0.2861 [a]	-0.2628 [a]	-0.2818 [a]	-0.9768 [a]
Tobin's Q	-/+	0.0146 [b]	0.0033	0.0141 [b]	-0.4203 [a]
R2		0.0954	0.1135	0.0833	0.1855
OBS		3,524	4,242	3,957	3,947

We also create a dummy that takes 1 if the ratio is above 1 and zero otherwise. A ratio that is more than 1 indicates an increase in bonds illiquidity relative to stock illiquidity, which will make bonds issuance more costly, and consequently decease the leverage. On the other hand, a ratio that is less than 1 indicates an increase in stocks illiquidity relative to bonds illiquidity, which will make stocks issuance more costly, and consequently increase the leverage.

In table 6, the independent variable defined as 1 when the ratio of bonds illiquidity to stock illiquidity is above 1 is negative and highly significant, indicating that an increase in bonds illiquidity relative to stock illiquidity deceases the leverage. On the other hand, a ratio that is less than 1 indicating that an increase in stocks illiquidity relative to bonds illiquidity is significantly positive.

Table 6 Fixed panel Regressions of Leverage- Relative illiquidity

This table reports annual regressions of equation: Leverage= α + β ratio above 1 + β Tangibility+ β size+ β Tobin's q+ β Profitability + ε. The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results assessed with (heteroskedasticity) robust standard errors corrected for firm-level clustering.

Dependent Variable: Leverage-Whole sample					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Ratio above 1	-	-0.0121 [a]	-0.01830 [a]	-0.0130 [a]	-0.0532 [b]
Size	+	0.0036	0.01093 [c]	0.0037	0.1004 [b]
Tangibility	+	0.0092	0.01344	0.0104	-0.0522
Profitability	-	-0.0969 [c]	-0.11806 [a]	-0.1146 [b]	-0.6589 [a]
Tobin's Q	-/+	-0.0164 [b]	-0.01516 [b]	-0.0154 [b]	-0.3776 [a]
R2		0.0541	0.0331	0.0640	0.0826
OBS		8,059	8,355	9,007	8,831

Dependent Variable: Leverage-Investment bonds					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Ratio above 1	-	-0.0210 [a]	-0.0242 [a]	-0.0234 [a]	-0.0793 [b]
Size	+	0.0368 [a]	0.0405 [a]	0.0332 [a]	0.3853 [a]
Tangibility	+	0.0683 [a]	0.0350	0.0587 [a]	0.2479 [b]
Profitability	-	-0.2730 [a]	-0.2753 [a]	-0.2789 [a]	-0.9720 [a]
Tobin's Q	-/+	0.0210 [a]	0.0169 [a]	0.0211 [a]	-0.4113 [a]
R2		0.0970	0.1054	0.0868	0.1603
OBS		3,554	4,014	3,860	4,292

Moreover, we get the median of leverage for each industry in each period. Then, we divide the sample to above or below the industry median and create an interacted dummy between firms who has a ratio below 1 and a dummy variable that indicates if the firm is above the industry median. What we want to show is that if a firm were having above the median leverage, they would not issue debt even though they have high stock illiquidity. The cost of adding more leverage to a high leverage firm outweighs stock illiquidity cost. The results are consistent with this suggestion. For all leverage measures, the interacted dummy is negative and highly significant. It indicates that high stock illiquidity firms do not issue debt if they are above the industry median. The results also imply that firms respect trade off policy, that is there is an optimal leverage, and thus firms may ignore the lower illiquidity principle when the leverage is high.

Table 7 Fixed panel Regressions of Leverage- Below ratio interacted with Median of leverage

This table reports annual regressions of equation: Leverage= α + β ratio above 1 + β ratio below 1* Leverage above industry median + β Tangibility+ β size+ β Tobin's q+ β Profitability + ε. The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Leverage-Whole sample					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Ratio below 1	+	0.0527[a]	0.0689 [a]	0.0381 [a]	0.1883 [a]
Ratio below 1*Lev. above median	-	-0.0692 [a]	-0.1018 [a]	-0.0478 [a]	-0.2647 [a]
Size	+	0.0009	0.0053	0.0037	0.0991 [c]
Tangibility	+	0.0979 [a]	0.0624 [a]	0.1002 [a]	-0.0594
Profitability	-	-0.4610 [a]	-0.1855 [a]	-.4542 [a]	-0.6339 [a]
Tobin's Q	-/+	-0.0011	-0.0056	-0.0218	-0.3688 [a]
R2		0.2286	0.1421	0.2224	0.2760
OBS		8,059	9,005	9,020	8,831

Dependent Variable: Leverage- Investment bonds					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Ratio below 1	+	0.0634 [a]	0.0717 [a]	0.0490 [a]	0.2138 [a]
Ratio below 1* Lev. above industry	-	-0.0656 [a]	-0.0787 [a]	-0.0440 [a]	-0.2037 [a]
Size	+	0.0305 [a]	0.0331 [a]	0.0272 [a]	0.3763 [a]
Tangibility	+	0.0601 [a]	0.0502 [a]	0.0455 [a]	0.2286 [b]
Profitability	-	-0.3199 [a]	-0.2718 [a]	0.3445 [a]	-0.9055 [a]
Tobin's Q	-/+	0.0219 [a]	0.0077	0.0126 [a]	-0.4030 [a]
R2		0.1929	0.2396	0.1431	0.1698
OBS		3,877	4,315	4,315	4,292

We also want to control for the current status of firms leverage and to show that the effect of relative illiquidity is not consumed by the leverage status of the firm**.**

First, running a regression with relative illiquidity, as dependent dummy variable, and over-levered as an independent variable do not yield any significant results.

Second, running another regression using leverage as a dependent continuous variable and both relative illiquidity and current leverage status as independent variables still yield significant results for our main variable. In fact, for all leverage measures, the relative illiquidity has a high negative coefficient and high p-value at 1%. The current leverage status is negative and significant. The results are not affected by restricting the sample to just high quality firms or the inclusion of the financial crisis.

Table 8 Fixed panel Regressions of Leverage - Median of leverage

This table reports annual regressions of equation: Leverage= α + β ratio above 1 + Leverage above industry median + β Tangibility+ β size+ β Tobin's q+ β Profitability + ε. The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Leverage-Whole sample					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Ratio above 1	-	-0.0127 [a]	-0.0170 [a]	-0.0134 [a]	-0.0538 [b]
Lev. above median	-	-0.0708 [a]	-0.0744 [a]	-0.0691 [a]	-0.3916 [a]
Size	+	0.0042	0.0085	0.0044	0.1044 [b]
Tangibility	+	0.0099	0.0149	0.0109	-0.0569
Profitability	-	-0.0867 [a]	-0.0865 [b]	-0.1042 [b]	-0.5922 [a]
Tobin's Q	-/+	-0.0126 [a]	-0.0080	-0.0117 [c]	-0.3534 [a]
R2		0.1663	0.2295	0.1673	0.3402
OBS		9,105	10,483	10,485	8,831

Dependent Variable: Leverage- Investment bonds					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
Ratio above 1	-	-0.0229 [a]	-0.0237 [a]	-0.0198 [a]	-0.0760 [b]
Lev. above median	-	-0.0495 [a]	-0.0519 [a]	-0.0514 [a]	-0.2752 [a]
Size	+	0.0360 [a]	0.0347 [a]	0.0302 [a]	0.3746 [a]
Tangibility	+	0.0592 [a]	0.0468	0.0275 [a]	0.2196 [b]
Profitability	-	-0.2579 [a]	-0.2530 [a]	-0.2459 [a]	-0.8467 [a]
Tobin's Q	-/+	0.0243 [a]	0.0124 [a]	0.0185 [a]	-0.3921 [a]
R2		0.1602	0.1602	0.1196	0.1830
OBS		3,860	4,304	4,304	4,292

In Table 9, we add to the base equation the financial constraint dummy interacted with the bonds illiquidity variable to capture the effect of financial constraints. We use firm size and Kaplan and Zingales (1997)'s index. On an annual basis, we rank firms by the financial constraints into four quartiles. Then, we create a dummy variable that takes one if the firm is assigned in the top quartile and zero otherwise.

The results of regressions show that more financially constrained firms have a more pronounced effect of bonds illiquidity.

Specifically, the results from the inclusion of the variable that represents the interaction between bonds illiquidity and a dummy for small firms are negative and statistically significant across all models. The significant negativity shows that small firms are more vulnerable to capital market

imperfections since they are less known and have less access to external market.

Similarly, the results from Kaplan and Zingales (1997)'s index interacted with bonds illiquidity are negative and significant across all models, indicating a higher sensitivity form the financially constrained firms to the effect of illiquidity, similar to the leverage effect.

These results are indicators of the robustness of our findings, which suggest that the effect of bonds illiquidity on leverage is more prominent in the more financially constrained firms.

Table 9 Fixed panel Regressions: Financial constraints

This table reports annual regressions of equation: leverage= α + β Bonds illiquidity+ β Bonds illiquidity* Financial constraint + β stocks illiquidity + β Tangibility+ β size + β Tobin's q+ β Profitability + ε.The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: long debt to market value-Small size				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0938	-.0145	-1.101 [c]
Bonds illiquidity * size	-	-.7394 [a]	-.0452 [b]	-4.867 [a]
Stocks illiquidity	+	3.235 [b]	3.201 [b]	3.240 [a]
Size	+	.0907 [a]	.0881 [a]	.0797 [a]
Tangibility	+	.1165 [b]	.1150 [b]	.1186 [a]
Profitability	-	-.8661 [a]	-.8656 [a]	-.8394 [a]
Tobin's Q	-/+	-.0432 [a]	-.0438 [a]	-.0374 [a]
R2		0.0807	0.0784	0.13
OBS		4,545	4,545	4,069
Dependent Variable: Leverage-Whole sample				
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets
Ratio above 1	-	-0.0147 [a]	-0.0144 [a]	-0.0139 [a]
Ratio above 1*size	-	-0.0192 [a]	-0.0187 [a]	-0.0189 [a]
Lev. above median	-	-0.0867 [a]	-0.1400 [a]	-0.0853 [a]
Size	+	0.0011	0.0056	0.0010
Tangibility	+	0.0949 [a]	0.0573 [a]	0.0963 [a]
Profitability	-	-0.4522 [a]	-0.1699 [a]	-0.4463 a
Tobin's Q	-/+	0.0001	-0.0033	0.0004
R2		0.2718	0.2547	0.2655
OBS		8,059	9,005	9,007
Dependent Variable: Leverage- Investment bonds				
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets
Ratio above 1	-	-0.0161 [a]	-0.0162 [a]	-0.0180 [a]
Ratio above 1* size	-	-0.0154 [a]	-0.0180 [a]	-0.0166 [a]
Lev. above median	-	-0.0543 [a]	-0.0974 [a]	-0.0753 [a]
Size	+	0.0294 [a]	0.0288 [a]	0.0197 [b]
Tangibility	+	0.0519 [a]	0.0354 [a]	0.0381 [a]
Profitability	-	-0.3520 [a]	-0.2445 [a]	-0.2969 [a]
Tobin's Q	-/+	0.0256 [a]	0.0092 [b]	0.0225
R2		0.1889	0.3560	0.2329
OBS		3,877	4,315	4,315

Table Continued

Dependent Variable: long debt to market value- Index				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.2108 [a]	-.0305 [b]	-1.250
Bonds illiquidity * Index	-	-2.609 [a]	-1.914 [b]	-3.267 [b]
Stocks illiquidity	+	4.960 [a]	4.339 [a]	4.134 [a]
Size	+	.0824 [a]	.0805 [a]	.0773 [a]
Tangibility	+	.1212 [a]	.0915 [b]	.0891 [b]
Profitability	-	-.8542 [a]	-.8018 [a]	-.7823 [a]
Tobin's Q	-/+	-.0415 [a]	-.0486 [a]	-.0482 [a]
R2		0.1156	0.0850	0.0852
OBS		4,069	3,182	3,182
Dependent Variable: Leverage-Whole sample				
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets
Ratio above 1	-	-0.0109 [a]	-0.0154 [a]	-0.0115 [a]
Ratio above 1* Index	-	-0.0105 [c]	-0.0103 [b]	-0.0088
Lev. above median	-	-0.0871 [a]	-0.1402 [a]	-0.0855 [a]
Size	+	0.0014	0.0050	0.0012
Tangibility	+	0.0958 [a]	0.0577 [a]	0.0971 [a]
Profitability	-	-0.4541 [a]	-0.1713 [a]	-0.4477 [a]
Tobin's Q	-/+	0.0002	-0.0034	0.0003
R2		0.2685	0.2524	0.2624
OBS		8,059	9,005	9,007
Dependent Variable: Leverage- Investment bonds				
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets
Ratio above 1	-	-0.0164 [a]	-0.0182 [a]	-0.0164 [a]
Ratio above 1* Index	-	-0.0221 [a]	-0.0205 [a]	-0.0221 [a]
Lev. above median	-	-0.0752 [a]	-0.0972 [a]	-0.0752 [a]
Size	+	0.0197 [b]	0.0281 [a]	0.0197 [b]
Tangibility	+	0.0371 [a]	0.0342 [a]	0.0371 [a]
Profitability	-	-0.3044 [a]	-0.2508 [a]	-0.3044 [a]
Tobin's Q	-/+	0.0229 [a]	0.0095 [b]	0.0229 [a]
R2		0.2263	0.3507	0.2263
OBS		4,315	4,315	4,315

4. Robustness

We do not confine our results to a specific measure of leverage or illiquidity and show that our results are robust for all measures. Also, we address the issue of heteroskedasticity and autocorrelation by using Huber-White corrected standard errors when computing the p-values and got robust standard errors corrected for firm-level clustering.

In this section, we also address different issues, specifically, endogeneity, stability over time, and the difference between investment and junk bonds in terms of liquidity.

4.1 Endogeneity

In all our models, we use fixed effect models, which as Lemmon et al. (2008) state make important differences in the estimated coefficients in leverage, because leverage is a level and not a change. Also, fixed effect models make important differences since one of the most common reasons for endogeneity in corporate finance is omitted variables as a result of the heterogeneity. In a setting aimed at understanding firm behavior, any time-invariant variable that are not observed in the data, such as unobservable technological differences across firms, could contribute to the presence of a fixed effect. Using fixed effect model in panel data can ameliorate this issue as suggested by Roberts and Whited (2013). We first check for statistical significance in differences between random and fixed effects with a standard Hausman test in which the null is random effects and the alternative is fixed effects, which shows that the appropriate model is the fixed effect.

4.1.1 Heckman (1976) test for sample selection bias

In addition, to address the endogeneity resulted from sample selection bias, Heckman (1976) introduced the Heckman model, a two-stage approach for data analysis. The results of the Heckman (1979) are not reported for brevity. The result show that Inverse Mills Ratio is insignificant, bonds illiquidity is negative with (-.0559) and significant at 5% level, and that stocks illiquidity is positive with (.0011) and significant at 1% level, suggesting that our findings are not affected by selection bias. We also get similar results when leverage is defined differently like by long debt to assets or liability to capital.

4.1.2 GMM Test

In addition, we estimate dynamic GMM regressions to address the endogeneity concerns. Particularly, we use the dynamic GMM estimator developed by Arellano and Bover (1995), and

Blundell and Bond (1998) to estimate the dynamic regression model. GMM estimator outweighs fixed-effects estimates because it allows current leverage to be influenced by previous realizations of past performance. Two lags of leverage are sufficient to capture the dynamic endogeneity. The main result of the GMM estimate still shows a negative effect of bonds illiquidity on leverage (-.0251) with a high significance at 1% and a positive significant effect of stocks illiquidity on leverage (.001). There is no substantial difference in employing different measures of leverage.

4.1.3 Granger causality

Moreover, we try to explicitly investigate the causality between the leverage and illiquidity for all measures using the Panel VAR-Granger causality Wald test. The results mostly indicate bonds illiquidity significantly Granger causes leverage, while leverage does not Granger cause bonds illiquidity. Interestingly, there is no significant causality between stocks illiquidity measure and leverage except for spread relative measure. It appears that the casualty tests are sensitive to how the leverage or illiquidity is measured. However, casualty tests are consistent whether we include financial crisis period or restrict the sample to investment-grade bonds.

Table 10 Panel vector autoregresssion- whole sample

Table states the expected sign for each independent variable where Leverage defined as long term debt to total assets. The p-values of the zero mean t-test are reported in parenthesis. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. Full definitions of the variables appearing in the table are provided in Table 1 Panel A. The results are robust standard errors corrected for firm-level clustering.

Regressor	Dependent in VAR		Regressor	Dependent in VAR	
	Amihud	Leverage		S.Amihud	Leverage
Amihud	.0528 [a]	-.0075 [b]	S.Amihud	.2226	.0006
Leverage	-.1139	.2730	Leverage	3.929	.2734
	Roll	Leverage		S.Roll	Leverage
Roll	.1999	-.0139 [c]	S.Roll	.4344 [a]	-.7928
Leverage	.5982	.5959 [a]	Leverage	-.0056	.3303
	Spread	Leverage		S.Spread	Leverage
Spread	.2004 [c]	-.5280 [c]	S.Spread	.709 [a]	- .24 [c]
Leverage	.0858	.3348	Leverage	.0508	.4752 [b]
	BPW	Leverage		S.BPW	Leverage
BPW	.0109	-.0017 [c]	S.BPW	-.0193	-.2065
Leverage	3.982	.2365	Leverage	-.0088	.2733

4.2 Stability over time

In this section, we test the stability of our main results over time since several studies document a change in market liquidity during the time of financial crisis. Friewald et al. (2012) and Dick-Nielsen et al. (2012) among others find that US corporate bonds liquidity significantly plummeted during the financial crisis in 2008. During the financial crisis, credit quality and liquidity's fall increase yield spreads, decrease investors' portfolio values, and increase firms' financing costs.

Therefore, considering the results of significant liquidity deterioration for corporate bonds during the financial crisis in 2008, we repeat our initial analysis for the same sample excluding the financial crisis period (2008) as in Friewald et al. (2012).

The results are not affected by the exclusion of financial crisis period, indicating a stability of our results through time, that there is a significant negative relation between leverage measures and bonds illiquidity measures, and that there is a significant positive relation between leverage measures and stocks illiquidity measure. Thus, firms with high bonds illiquidity choose a lower level of leverage, and firms with high stocks illiquidity choose a higher level of leverage. Also, control variables' results are consistent with the main analysis and prior studies.

In addition, we control for time effect by adding a dummy variable for each period in our sample and the results for bonds and stocks illiquidity are not affected.

4.3 Difference in leverage

To examine whether firms' response is to differences in illiquidity or to the current leverage situation. In other words, examining if illiquidity is related to the leverage status. Similar to (Bharath et al (2009)), we run the regression:

$\Delta Leverage_{i\tau} = a + b_1 \Delta Ratio_{i\tau} + b_2 \Delta Tangibility_{i\tau} + b_3 \Delta Qratio_{i\tau} + b_4 \Delta Log\ sales_{i\tau} + b_5 \Delta Profitability_{i\tau} + b_6 Leverage_{i\tau-1} + \varepsilon_{i\tau}$, where all variables are fiscal year-on-year changes of the level variables. Also, we include lagged leverage to control for the possibility of mean reversion in leverage in the literature.

The results show that a change in the extent of firm-level illiquidity has a negative significant effect on the changes in firms' leverage. Also, the lagged leverage indicates a mean reversion in leverage.

4.4 Exogenous shock-Financial Crisis

The implicit assumption in the previous results is that market illiquidity is exogenously determined. However, if there are variables, which we do not observe, that affect our main

independent variables, then our coefficient could be biased. To address this potential problem, we use financial crisis as purely exogenous variable.

As we mentioned, Friewald et al. (2012) and Dick-Nielsen et al. (2012) among others find that US corporate bonds liquidity significantly plummeted during the financial crisis in 2008. During the financial crisis, credit quality and liquidity's fall increase yield spreads, decrease investors' portfolio values, and increase firms' financing costs.

Therefore, considering the results of significant liquidity deterioration for corporate bonds during the financial crisis in 2008, we use financial crisis period in place of bonds illiquidity.

For all leverage measures, the financial crisis has a high negative effect and a high p- value at 1%. The current leverage status is negative and significant. The results ate not affected by restricting the sample to just high quality. In fact, the effect and significance of relative illiquidity and the financial crisis are similar.

Table 11 Fixed panel Regressions of Leverage- Financial Crisis

This table reports annual regressions of equation: Leverage (t+1)= α + β Financial crisis+ Leverage above industry median + β Tangibility+ β size+ β Tobin's q+ β Profitability + ε. The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 1 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Leverage-Whole sample					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
FC	-	-0.0192 [a]	-0.0187 [a]	-0.0196 [a]	-0.0748 [b]
Lev. above median	-	-0.0703 [a]	-0.0739 [a]	-0.0687 [a]	-0.3901 [a]
Size	+	0.0067	0.0120 [c]	0.0072	0.1166 [b]
Tangibility	+	0.0096	0.0154	0.0111	-0.0555
Profitability	-	-0.0906 [c]	-0.0897 [b]	-0.1076 [b]	-0.6057 [a]
Tobin's Q	-/+	-0.0142 [b]	-0.0095	-0.0133 [c]	-0.3601 [a]
R2		0.1620	0.1893	0.1612	0.1121
OBS		8,059	9,005	7,679	8,831

Dependent Variable: Leverage- Investment bonds					
Variables	Expected sign	Total liability to Capital	Long debt to total assets	Total liability to total assets	Debt to market value
FC	-	-0.0125 [a]	-0.0092 [a]	-0.0140 [a]	-0.0315
Lev. above median	-	-0.0497 [a]	-0.0530 [a]	-0.0512 [a]	-0.2755 [a]
Size	+	0.0451 [a]	0.0396 [a]	0.0374 [a]	0.4020 [a]
Tangibility	+	0.0606 [a]	0.0292	0.0316	0.2354 [b]
Profitability	-	-0.2661 [a]	-0.2465 [a]	-0.2491 [a]	-0.8630 [a]
Tobin's Q	-/+	0.0234 [a]	0.0118 [b]	0.0176 [a]	-0.3931 [a]
R2		0.1242	0.1377	0.1106	0.1804
OBS		3,554	3,861	4,304	4,292

5. Conclusion

We hypothesize that firms would likely compare the illiquidity of two sources of external financing at a given point in time and issue the one with lower illiquidity. Therefore, if the level of illiquidity is a key driver of firms' capital structure decisions in that year, the higher the level of stocks illiquidity, the more of its financing needs are satisfied by the issuance of debt, and the higher the level of bonds illiquidity, the less of its financing needs are satisfied by the issuance of debt.

Even after controlling for the firm characteristics previously found to determine observed capital structure, we find that illiquidity of the two sources of external funding affects the capital structure decisions of U.S. firms over the sample period 2003-2018. Specifically, the coefficient of bonds illiquidity is negative, large, and strongly significant regardless of leverage measurement, and the coefficient of stocks illiquidity is positive, large, and strongly significant regardless of leverage measurement. We also show that the relative importance of external financing's illiquidity has an opposing effect of firm's leverage ratio. An increase in bonds illiquidity relevant to stock illiquidity, has a negative influence on leverage since it increases stock issuance. While an increase in stocks illiquidity relevant to bonds illiquidity, has a positive influence on leverage since it increases bonds issuance. Also, both the sign and the significance of the coefficients for the conventional variables are consistent with previous literatures. We also address different issues like endogeneity, stability over time, and the difference between investment and junk bonds in terms of liquidity, and find that the main results are robust and consistent.

6. References

1. Abdulrahman M. Alhassan. (2017). Working paper. Corporate Future Investments and Stock Liquidity: Evidence from Emerging Markets
2. Amihud, Yakov & Mendelson, Haim. (1986). Asset Pricing and the Bid–Ask Spread. Journal of Financial Economics. 17. 223–249.
3. Avid, Alexander and Veronesi, Pietro, (2013), What Ties Return Volatilities to Price Valuations and Fundamentals?, Journal of Political Economy, 121, issue 4, p. 682 - 746,
4. Baker, M. and Wurgler, J. (2002), Market Timing and Capital Structure. The Journal of Finance, 57: 1-32.
5. Bao, J. , Pan, J. and Wang, J. (2011), The Illiquidity of Corporate Bonds. The Journal of Finance, 66: 911-946.
6. Bharath, Sreedhar & Pasquariello, Paolo & Wu, Guojun. (2009). Does Asymmetric Information Drive Capital Structure Decisions? Review of Financial Studies.
7. Bolton, P., & Freixas, X. (2000). Equity, Bonds, and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information. Journal of Political Economy, 108(2), 324-351.
8. Butler, A., Grullon, G., & Weston, J. (2005). Stock Market Liquidity and the Cost of Issuing Equity. The Journal of Financial and Quantitative Analysis, 40(2), 331-348.
9. Capital Structure Puzzle. Stewart C. Myers, 1983
10. Chen, Long & Lesmond, David & Zhanshun Wei, Jason. (2007). Corporate Yield Spreads and Bond Liquidity. Journal of Finance. 62. 119-149.
11. Chordia, T & Roll, R & Subrahmanyam, A. (2000). Commonality in liquidity. Journal of Financial Economics. 56. 3-28.
12. Chordia, T., Sarkar, A., & Subrahmanyam, A. (2005). An Empirical Analysis of Stock and Bond Market Liquidity. The Review of Financial Studies, 18(1), 85-129.
13. Corwin, S., Schultz, P. (2012). A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices. The Journal of Finance, 67(2), 719-759.
14. Dick-Nielsen, Jens and Feldhütter, Peter and Lando, David, Corporate Bond Liquidity Before and After the Onset of the Subprime Crisis (May 31, 2011). Journal of Financial Economics (JFE), Forthcoming.
15. Elmira Shekari Namin. (2017). Working paper. Credit Ratings and Corporate Bond Liquidity.
16. Faulkender, M., & Petersen, M. (2006). Does the Source of Capital Affect Capital Structure? The Review of Financial Studies,19(1), 45-79.
17. Fazzari, Steven & Glenn Hubbard, R & Petersen, Bruce. (1988). Financing Constraints and Corporate Investment. National Bureau of Economic Research, Inc, NBER Working Papers. 1.
18. Field, Laura Casares and Mkrtchyan, Anahit and Wang, Yuan, Bond Liquidity and Investment (May 15, 2018). Northeastern U. D'Amore-McKim School of Business Research Paper No. 3062841.
19. Gabrielsen, Alexandros & Marzo, Massimiliano & Zagaglia, Paolo. (2011). Measuring Market Liquidity: An Introductory Survey. SSRN Electronic Journal.
20. Gilson, S. C. (1997), Transactions Costs and Capital Structure Choice: Evidence from Financially Distressed Firms. The Journal of Finance, 52: 161-196.
21. Goyenko, R., & Ukhov, A. (2009). Stock and Bond Market Liquidity: A Long-Run Empirical Analysis. Journal of Financial and Quantitative Analysis, 44(1)

22. Graham, John R. and Harvey, Campbell, (2001), The theory and practice of corporate finance: evidence from the field, Journal of Financial Economics, 60, issue 2-3, p. 187-243
23. Graham, John. (1999). How Big Are the Tax Benefits of Debt?. The Journal of Finance.
24. Heck, Stephanie and Margaritis, D. and Muller, Aline, Liquidity Patterns in the U.S. Corporate Bond Market (January 2016).
25. Hong, Harrison, and Jeremy C. Stein. 2007. "Disagreement and the Stock Market." Journal of Economic Perspectives,21 (2): 109-128.
26. L. Lipson, Marc & Mortal, Sandra. (2009). Liquidity and Capital Structure. Journal of Financial Markets. 12. 611-644.
27. Lemmon, M., & Roberts, M. (2010). The Response of Corporate Financing and Investment to Changes in the Supply of Credit. The Journal of Financial and Quantitative Analysis, 45(3)
28. Lesmond, David & Trzcinka, Charles & Ogden, Joseph. (1997). A New Measure of Transaction Costs.
29. Long Chen, Xinlei Zhao, On the relation between the market-to-book ratio, growth opportunity, and leverage ratio, Finance Research Letters, Volume 3, Issue 4, 2006, Pages 253-266
30. M. Babajide Wintoki, James S. Linck, Jeffry M. Netter, Endogeneity and the dynamics of internal corporate governance, Journal of Financial Economics, Volume 105, Issue 3, 2012, Pages 581-606 1.
31. Michael R. Roberts and Toni Whited, (2013), Endogeneity in Empirical Corporate Finance, Handbook of the Economics of Finance, vol 2.
32. Miglo, Anton (2010): The Pecking Order, Trade-off, Signaling, and Market-Timing Theories of Capital Structure: a Review.
33. Muñoz, Francisco. (2013). Liquidity and firm investment: Evidence for Latin America. Journal of Empirical Finance. 20. 18–29.
34. Murray Z. Frank, Vidhan K. Goyal, Chapter 12 - Trade-Off and Pecking Order Theories of Debt.
35. Nicos Koussis, Spiros H. Martzoukos, Lenos Trigeorgis. August (2017). Corporate liquidity and dividend policy under uncertainty. Journal of Banking & Finance, Volume 81, Pages 221-235
36. Nieto, B. and Rodriguez, R. (2015), Corporate Stock and Bond Return Correlations and Dynamic Adjustments of Capital Structure. Journal of Business Finance & Accounting, 42: 705-746.
37. Noe, Thomas & Fang, Vivian & Tice, Sheri. (2009). Stock Market Liquidity and Firm Value. Journal of Financial Economics. 94. 150-169.
38. Rajan, R., & Zingales, L. (1995). What Do We Know about Capital Structure? Some Evidence from International Data. The Journal of Finance, 50(5), 1421-1460
39. Roll, R. (1984). A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market. The Journal of Finance, 39(4), 1127-1139. 1.
40. Van Ness, B., Van Ness, R., & Warr, R. (2001). How Well Do Adverse Selection Components Measure Adverse Selection? Financial Management, 30(3), 77-98.
41. Welch, I. (2004). Capital Structure and Stock Returns. Journal of Political Economy, 112(1), 106-131.

Chapter Two
Impact of Relative Liquidity of Stocks and Bonds on the Investment decisions

1. Introduction and hypotheses development

A central question in the finance literature is whether the firms respond to the market signals when making corporate decisions. In this study, we investigate whether bonds and stocks illiquidity affect firm investment decisions employing a US data set.

Illiquidity or trading costs are critically considered in many investment and financial decisions. Amihud and Mandelson (1986) define illiquidity as the cost of immediate execution since the offer price comprises a buying premium and the bid price includes a sale discount.

Numerous studies have established a link between financial markets and firms decisions. For example, Barro (1990) states that changes in stock prices have substantial effect on US investment decisions, even after controlling for cash flow variables. Likewise, Fang et al. (2009) investigate the relation between stock liquidity and firm performance. They show a positive relation between stock liquidity and firm performance measured by market to book ratio. The justifications of this positive relation are the increase in information content of market prices and the increase of performance-sensitivity of managerial compensation. In addition, Amihud and Mendelson (1986) argue that an improvement in stock liquidity would cause assets in place to be discounted at a lower cost of capital, leading to an increase in firm value.

Recently, Cheung et al. (2016) investigate the consequences of stock liquidity on firm value and corporate governance and find that stocks liquidity improves firm value, as measured by Tobin's Q and leads to corporate governance enhancement due to the increase of institutional ownership. Thus, the increase of market liquidity facilitates the entry of informed shareholders and relaxes firm's financial constraints. Another reason for the positive relation between market liquidity and investment is the decrease of financing cost due to the increase of liquidity. Hong and Stein (2007) by using disagreement models show that liquidity can be a proxy for the disagreement among investors generating a positive relationship between liquidity and investment.

Another explanation of the positive relation between liquidity and firm investment is liquidity premium hypothesis. Myers (1977) argues that firm value is consisted of both assets in place and future investment opportunities. An increase in bonds liquidity would lower the weighted average cost of capital (WACC), and hence expand the investment opportunity set. Since firms evaluate their future projects using WACC to determine the set of viable projects that are available

to undertake, a lower hurdle rate increases investment. Therefore, Amihud and Mendelson (1986) show that liquidity has a positive effect on growth by reducing the cost of capital used to discount firms' new investments.

Another effect of the increase in bonds liquidity is its increase of borrowing capacity since it decreases the debt's issuance cost and consequently expands firm's investment. Butler et al (2005) provide evidence that there is a negative correlation between investment bank fees and stock liquidity. In a similar works, Lipson and Mortal (2009) investigate the correlation between stocks liquidity and equity issuance and find firms with high stock liquidity have lower issuance costs.

Therefore, holding other factors constant, a firm's future investments increase in its bonds and stocks liquidity. The increase in investment opportunities due to the increase in market liquidity is due the decrease of the firm's cost of capital and the decrease in its issuance cost.

Hypothesis 1a. A higher level of a firm's bonds illiquidity would decrease firm's investment.

Hypothesis 1b. A higher level of a firm's stocks illiquidity would decrease firm's investment.

1.1 Effect of different firm's financial constraints

Similar to illiquidity, financial constraints are an imperfection in the market. Modigliani and Miller (1958) argue that market imperfections cause the supply of capital to be inelastic and affect firms' investment policy. Bolton and Freixas (2000) suggests a model in which risky firms are incapable of obtaining financing because of asymmetric information between firms and external investors. The implication here is that there are a heterogeneity among firms in their credit rationing, in that less financially healthy firms are more likely to be rationed than relatively healthier firms. Thus, we expect a different effect of illiquidity across different firms level. Munoz (2013) finds a positive relationship between trading volume and investment using a panel of Latin American firms. He also finds that this effect is greater for firms with higher financial constraints and larger investment opportunities. Lemmon and Roberts (2010) show that a shock to stock liquidity has negative significant impact on the financing and investment behavior of below-investment-grade firms.

Therefore, more financially constrained firms would have a high-pronounced effect of bonds illiquidity. The relaxation of financial constraints means that firms would have more internal funds or easier excess to equity market that consequently makes the bonds market and its imperfections irrelevant. Conversely, firms with more financially constraints will benefit more from bonds liquidity, as it makes it easier for them to borrow externally.

To capture the effect of financial constraints and to reassure that results are not driven by the choice of a single determinant, we use firm size, firm leverage, firm payout ratio and Kaplan and Zingales (1997)'s index (KZ index, hereafter), following Fazzari et al., (1988), Almedia et al., (2004), and Alhassan et al. (2017). We also add two other measures of financial constraints, which are stock illiquidity and below-investment bonds firms. On an annual basis, we rank firms by the financial constraints into four quartiles. Then, we create a dummy variable that takes one if the firm is assigned in the top quartile and zero otherwise. This dummy represents firms in the highest quartile. We will test the hypothesis by adding to the base specification the financial constraint dummy interacted with bonds illiquidity variable. A significant coefficient would show that liquidity is more relevant for firms with greater financial constraints.

The first financial constraint is the firm size. Almedia et al. (2004) argue that small firms are more vulnerable to capital market imperfections since they are less known. Beck et al. (2008) show evidence that there is a difference in funding between firms based on their size, making small firms more inclined to financial constraints. Therefore, small firms should be more sensitive to bond liquidity. An interacted dummy between illiquidity and big firms is added to the base regression, and it should be significant and positive as evidence that the effect of illiquidity is smaller for large firms showing that they are less affected by illiquidity since they have more access to capital.

Firm leverage ratio is another proxy for financial constraints since a high leverage ratio would lower firm's debt capacity and their ability to acquire additional finance. An interacted dummy between illiquidity and high leverage firms is added to the base regression, and it should be significant and negative, as evidence that the effect of illiquidity is greater for high leverage firms.

Payout Ratio is another proxy for financial constraints and one of the most prevalent in the literature. Firm's ability to pay dividend is an indication of its internal financing capacity. Fazzari et al. (1988) argue that financially constrained firms are more likely to have lower payout ratios. We define payout ratio as the dividends divided by income before extraordinary items. An interacted dummy between illiquidity and high payout firms is added to the base regression, and it should be significant and positive, as evidence that the effect of illiquidity is lower for high payout firms.

KZ index is introduced by Kaplan and Zingales (1997) and has been used to proxy for financial constraints in many related studies (Almeida et al., 2004, Alhassan et al. (2017), and others). Therefore, similar to the effect of leverage ratio, the interaction variable should be negative and significant, indicating a higher sensitivity form the financially constrained firms to the effect of illiquidity.

In addition, we use stock illiquidity as another measure of financial constraints. An interacted dummy between bonds illiquidity and a dummy representing firms with high stock illiquidity is added to the base regression, and it should be significant and negative, as evidence that the effect of illiquidity is greater for those firms.

Lastly, we use the sample of firms with junk bonds as another proxy for financial constraints. Dick-Nielsen et al (2011) show that bonds spread is low and persistent for investment-grade bonds while the effect is stronger but less persistent for below-investment-grade bonds. An increase in the spread means an increase in the bond risk and thus less accessibility to external market. An interacted dummy between illiquidity and firms with junk bonds is added to the base regression, and it should be significant and negative, as evidence that the effect of liquidity is greater for these firms.

Hypothesis 2. The effect of bonds illiquidity is higher on financially constrained firms due to the limited access for external capital.

2. Data

We use annual data from 2003-2018. Our sample includes all nonfinancial firm observations in the Compustat database between 2003 and 2018. We end up with 1,176 firms. We employ S&P's credit rating to classify firms, where firms rated BBB – or higher are investment-grade firms and firms rated BB+ or lower are below- investment-grade firms.

We estimate a fixed effect panel model, following the standard approach popular in many previous papers. The use of panel data analysis allows us to better control for firm heterogeneity and reduce the issue of multicollinearity of explanatory variables. Also, lagged time periods are used since the investment is not carried out immediately.

2.1. Dependent variable measure

Investment opportunity set which is not observable can be proxied by capital expenditures, which is observable. As Becker-Blease and Paul (2006) point out, capital expenditures reflect managerial ability to utilize current investment opportunities.

Also, we consider two additional alternative proxies for investment opportunities, acquisition expenses and book-to-market equity. Different investment measures represent different aspects of corporate investment decisions and allow us to achieve a more comprehensive analysis.

The first alternative proxy for investment opportunities is acquisition expense. Field et al (2014) point out that firms with higher bond liquidity will be more likely to undertake acquisitions, as liquidity reduces cost of debt and potential acquisitions are discounted at a lower hurdle rate. Harford and Uysal (2013) find that firms' access to debt markets by having a higher credit rating increases its likelihood of undertaking acquisitions.

The second alternative proxy for investment opportunities is book-to-market value of equity. Since high book-to-market indicates a low-growth (value) stock, and low book-to-market indicates a high-growth stock, a positive relation between book-to-market and illiquidity is consistent with a decrease in growth opportunities. Becker-Blease and Paul (2006) show a significant positive relation between book-to-market and the illiquidity ratio. A result that is consistent with an increase in investment opportunities as liquidity increases.

2.2. Bonds liquidity measures

We construct many proxies for bonds liquidity using TRACE data. The first 3 measures are defined similar to Dick-Nielsen et al. (2012).

The Amihud illiquidity ratio is computed using high-frequency transaction data from TRACE, and is defined as the daily average of absolute returns divided by the trade size in millions of consecutive transactions, as $\sum_{J=1}^{N_t} \frac{\frac{|P_j - P_{j-1}|}{P_{j-1}}}{Q_j}$.

Also, Roll (1984) suggests that the effective bid-ask spread can be measured using return autocovariance. It is computed in this paper over a 21-day rolling interval (ending on day t) within fiscal year as $2\sqrt{-\text{cov}\,(\Delta P_t - \Delta P_{t+1})}$. The daily auto covariance is more likely to be positive for heavily traded stocks, so when we encounter a positive autocovariance, we make it zero. It is applied to daily data based on the assumption that the daily closing price is likely to be similar for bids and asks prices.

In addition, a proxy for roundtrip costs is the bid-ask spread, which is not available in TRACE before November 2008. An alternative measure of transaction costs, proposed by Feldhutter (2010), is calculated using unique roundtrip trades (URT). The spread is defined as $\frac{P\,Max - P\,Min}{P\,Max}$. A daily estimate is the average of roundtrip costs on that day for different volumes, and then we average them to get the yearly measure.

Similar to Roll (1984), Boa, pan and Wang (2011) develop illiquidity measure, γ, defined as the negative of the autocovariance of the returns as $-\text{cov}\,(\Delta P_t - \Delta P_{t+1})$.

2.3. Control variables

A number of control variables, which have been identified by previous papers are employed as potential explanatory factors affecting investment decisions.

As in Lins et al (2005), Muñoz (2013), and Alhassan et al. (2017), our control variables include the firm leverage. An increase in leverage would lower the debt capacity and firm's ability to raise capital. Aivazian et al. (2005), Lins et al. (2005), Muñoz (2013), and Alhassan et al. (2017) and others show a negative relation between leverage and investments.

It also includes size as a proxy for production, calculated as the logarithm of revenues. It can be argued that an increase in production would increase the investment. Lins et al. (2005) and Alhassan et al. (2017) find a positive significant relation between size and investments.

In addition, we include Tobin's Q as a control variable, measured by the ratio of market to book value of firm assets. Since Tobin's Q reflects investment opportunities, it should be positive and significant. Chen and Zhao (2006) show that firms with higher market-to-book ratios have more

profitability and lower borrowing costs, which suggests that Tobin's Q is similar to profitability in its effect. Lins et al (2005), Polk and Sapienza (2009), Muñoz (2013), and Alhassan et al. (2017) find a positive significant relation between Tobin's Q and investments.

In addition, we include cash flow as a control variable, measured by the sum of earnings before interest, tax and deprecation minus dividends, scaled by the total assets. Farazzi et al. (1988) argue that firms' investment is positively related to their internal financing capability because external financing is costly. Lins et al. (2005), Almeida and Campello (2007), Muñoz (2013), and Alhassan et al. (2017) find a positive significant relation between CF and investments.

Therefore, our final model is:

Equation (1): $\text{Investment}_{i\tau} = a + b_1 \text{ bonds illiquidity}_{i\tau} + b_2 \text{ stocks illiquidity}_{i\tau} + b_3 \text{Size}_{i\tau} + b_4 \text{ FCF}_{i\tau} + b_4 \text{Leverage}_{i\tau} + b_5 \text{ Tobin's Q}_{i\tau} + \varepsilon_{i\tau}$

Lag time period is used since the investment is not carried out immediately. Based on the main hypothesis, the parameter β1 and β2 are negative and significant, indicating that an increase in illiquidity would cause a decrease in investment by the firm, because liquidity facilitates financing of investment. Also, by dividing firms according to their financial constraints, it should be observed that an increase in financial constraints would make firms more sensitive to illiquidity.

Table 12 Descriptive Analyses

Panel A presents the means, medians, standard deviations for each variable included in the study. We take the log of Amihud measure plus one to avoid outliers. Roll (1984) defined as the square root of negative autocovariance computed over a 21-day rolling interval (ending on day t) within fiscal year. Boa, pan and Wang (2011) defined as the negative of the autocovariance of the returns. Relative spread is max-min spread relative to an estimate of max price. Size is defined as log of revenues. Tobin's q is computed as the sum of market value of equity and book value of debt (total market value) divided by total assets. Leverage is defined as long-term debt divided by total assets. Profit is defined as net earning scaled by the beginning revenue. Panel B shows the pairwise Pearson's correlation between variables included in the study. For each correlation coefficient, the table reports the level of the statistical significance. The superscripts a, b, and c refer to 1%, 5% and 10% statistical significance level, respectively.

Panel A: Summary statistics							
Variable	Mean	Median	S.D	Variable	Mean	Median	S.D
Bonds illiquidity				Stocks illiquidity			
Amihud	.00031 [a]	.00227	.0143	Amihud	0.0125	0.0002	0.81
Roll	.0121 [a]	.0056	.0699	Roll	.0095	.0074	.0084
BPW	.0073 [b]	0	.266991	BPW	.00006	.00001	.0011
Relative spread	.0083 [a]	.006	.0078	Relative spread	.0224	.0193	.0117

Table Continued

Control Variables				Control Variables			
Size	8.869	8.847	1.47	Tobin's q	1.084	.8492	.9359
Leverage	.2316	.2129	.1517	Capital Expenditure	.0580	.0394	.0642
FCF	.2229	.1894	.1946	Net profit	.0201	.0398	.2496

Panel B: Whole Sample

Variable	Amihud	Roll	BPW	Relative spread	Amihud stocks	Roll stocks	BPW stocks	Relative spread stocks	Size	Leverage	FCF	Tobin's q	Cap.
Amihud	1												
Roll	.028 [a]	1											
BPW	.26 [a]	.557 [a]	1										
Relative spread	-.0003[a]	.005	-.005	1									
Amihud stocks	.0049	.001	-.001	.0003	1								
Roll stocks	.007	.037[a]	-.0005	.016 [b]	.0965 [a]	1							
BPW stocks	-.0000	.005	-.0003	.0017	.0112	.6610 [a]	1						
Relative spread stocks	.0094	.092 [a]	.017 [b]	.023 [a]	.0476 [a]	.396 [a]	.026 [a]	1					
Size	-.031 [a]	-.066 [a]	-.029 [a]	-.0108	-.0261 [a]	-.1195 [a]	-.0085	-.3383	1				
Leverage	-.018 [b]	.0015	.0010	-.0072	.0077	.0417[a]	-.0020	.1907 [a]	-.2595 [a]	1			
FCF	.0542 [a]	.0081	.0173 [c]	-.0424 [a]	-.0226 [b]	-.039 [a]	-.0063	-.1083 [a]	.156 [a]	-.1147 [a]	1		
Tobin's q	.0254 [a]	-.0020	-.0012	-.0076	-.0056	-.055 [a]	-.0100	-.1236 [a]	-.103 [a]	-.0206 [b]	.570 [a]	1	
Cap.	-0.004	-.007	-.005	-.0189 [a]	-.0049	.0022	-.0024	.0430 [a]	-.1126 [a]	-.0148	-.016 [c]	.1014 [a]	1

Panel A presents summary statistics associated with illiquidity measures for stocks and bonds markets and other control variables. It shows the means, medians, standard deviations for each variable included in the study. There are no substantial differences between the whole sample and a subsample restricted to investment-bond firms. The medians are similar to the means suggesting little skewness in liquidity distribution. As expected, it seems that volatility of illiquidity measured by standard deviation is higher in the stocks market than the bonds market. Comparing the bonds illiquidity measures and stocks illiquidity measures shows inconsistency in terms of which market exhibit the highest illiquidity. The reason for that as we mentioned above is that these measures exhibit inconsistency among them and do not capture all illiquidity aspects. The inconsistency between illiquidity measures is apparent in the correlation results between them on panel B. However, most of illiquidity measures show that bonds market is more liquid. The relative decrease of bond illiquidity comparing to stocks illiquidity is because adverse selection is not a major concern in bond markets and is more important in individual stocks due to idiosyncratic shocks, as Chordia et al (2003) point out.

Panel B presents summary statistics for correlations between variables included in the study. The most important result is the apparent low correlation between the two markets illiquidity. Chordia et al (2003) find that there is a little correlation in liquidity between the two markets. Also, Campbell and Ammer (1993) find that the unconditional correlation between stock and bonds returns is low. They argue that stocks and bonds covariance should be low since the only common factor is interest rate, which has low variability. Moreover, as suggested by Borensztein and Gelos (2003) individual investors' herding behavior that typically causes higher correlations in stocks market is unlikely to be a factor in bond market due to the high concentration of institutional investors who are less susceptible to herding behavior.

However, many papers indicate that there are common factors that drive both markets causing a covariance between the two markets. Innovations and trading activity might cause an interaction between stocks and bonds market liquidity and a shift in portfolios between the two markets. Fleming et al (1998) show that volatility affects both markets, which can affect liquidity in both markets. Also, Chordia et al (2003) find that innovation in one market increases the spreads in both markets. However, the innovation is not necessary affecting both markets equally or on the same magnitude. Chordia et al (2003) find that monetary easing has only a significant positive effect on stocks liquidity during crisis periods.

Beber et al. (2009) observe that illiquidity differs based on the bonds maturities and find a stronger correlation between illiquidity of stocks and short-term bonds. Similarly, Goyenko and Ukhov (2009) find a liquidity connection between stocks and treasury bonds returns that is more pronounced for short-term maturities.

David and Veronesi (2013) and Campbell et al (2013) show that covariance of stocks and treasuries bonds returns turned from being positive before 2000 to being negative after that. They offer an explanation for the changing sign, which is the role of inflation especially during recessions. High expected inflation causes a positive covariance between stocks and bonds and vice versa. During the financial crisis, bonds market provided insurance against severe adverse economic conditions. In addition, Connolly et al (2005) find that the covariance negativity increases in a period of high stocks volatility and argue that the explanation is the investors seeking safety in bonds market. Also, Campbell et al (2014) offer another explanation to the time variation in the covariance, which is the response to monetary policy changes and the change in risk aversion, particularly in bad times.

However, papers trying to explain the relation between bonds and stocks illiquidity using firms' level data are scarce. Nieto and Rodriguez (2015) try to narrow this gap by employing bond transaction prices from TRACE and find that the correlations between individual bonds and stocks returns are small and time variant. They also find that the correlation is negative with systematic firm risk, and positive with idiosyncratic risk.

We try to investigate the causality between the two markets illiquidity for all measures. The Panel VAR-Granger causality Wald tests in Table 13 mostly indicate inconsistent results. Amihud's (2002) bonds illiquidity measure strongly negative Granger causes stock illiquidity. However, using the spread measure, the causality is reversed. The stock illiquidity measured by relative spread strongly positively Granger causes bonds illiquidity. Also, there is no bidirectional causality between the two markets using Roll or BPW. Interestingly, when we investigate the causality between the two markets illiquidity during the financial crisis. The Amihud's (2002) bonds illiquidity measure strongly positively Granger causes stock illiquidity. And the stock illiquidity measured by relative spread strongly negatively Granger causes bonds illiquidity. Therefore, the signs are flipped.

Table 13 Panel vector autoregresssion - whole sample

Table states the expected sign for each independent variable. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Regressor	Dependent Variable in VAR	
	Amihud	S. Amihud
Amihud	.0624 [a]	-.0650 [a]
S. Amihud	-.0081	1.213 [a]
	Roll	S. Roll
Roll	.1831	.0011
S. Roll	.9767	.6757
	Spread bonds	Spread stocks
Spread bonds	.07383 [c]	.000
Spread stocks	27.91 [a]	.9775 [a]
	BPW bonds	BPW stocks
BPW bonds	.04534	.0000
BPW stocks	12.825	.3576

3. Main Findings

In this section, we provide a detailed discussion of the results from the regression analyses. We begin with the results from the fixed effect panel models. Later, we show the findings for the role of financial constraints on the leverage and liquidity relation.

As previously outlined, we estimate Equation (1) on an annual basis where we include firms' dummies to capture the heterogeneity across firms and to ameliorate the endogeneity issue. Also, based on the main hypotheses, the bonds and stocks illiquidity coefficients should be negative and significant, indicating that an increase in bonds and stock illiquidity would cause a decrease in investment by the firm.

All tables show the results of coefficients and R-squares from those fixed effect panel regressions, number of observations, and expected sign for each variable. For each table, we report the results of 5 models where we include different bonds illiquidity measures. To individually test the null hypothesis that the independent variable coefficients are equal zero, we report the subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. We use Huber-White corrected standard errors when computing the p-values to account for the possible presence of heteroskedasticity. The results are the same when we use robust standard errors corrected for firm-level clustering.

In Table 14, where the dependent variable is investment proxied by 4 measures. It appears that there is a significant negative relation between investment measures and bonds illiquidity measures in the prior year. It shows statistically significant coefficients at the 5% level or higher. Therefore, a firm's future investments increase in its bonds liquidity. Also, the consistency among the different measures of bonds illiquidity's magnitude is apparent except for relative spread, which shows a higher magnitude. Also, it shows that there is a significant negative relation between investment measures and stock illiquidity measure in the prior year. It shows statistically significant coefficients at the 5% level or higher. Thus, a firm's future investments increase in its stocks liquidity. Also, the economic magnitude of the stocks illiquidity effect is meaningful since it is higher than the bonds illiquidity effect. In fact, it seems that the stock illiquidity effect is the highest among all explanatory variables, and it has a higher effect than bonds illiquidity.

In terms of book-to-market, a measure to investment opportunities, the stock and bonds illiquidity show significant positive results. Thus, similar to Becker-Blease and Paul (2006) who find a significant positive relation between book-to-market and the stock illiquidity ratio, we find a

significant positive relation between book-to-market and the bonds and stocks illiquidity ratio. A result that is consistent with an increase in investment opportunities as liquidity increases.

The results of control variables are consistent with prior studies. Investment is positively related to size at a significant level. The positive relation between investment and size is consistent with assumption that size is a proxy for production and an increase in production would consequently increase the investment.

Also, leverage is negatively related to investment at a significant level except when the investment is measured by book to market. The negativity between investment and illiquidity is because leverage would lower the firm's debt capacity and firm's ability to raise capital.

The results show that free cash flow is significant and has a positive effect on all measures of investment. Consistent with Farazzi et al. (1988) argument that firms' investment is positively related to their internal financing capability because external financing is costly.

Tobin's Q or the ratio of the market value of assets to the book value of assets shows significant positve relation with all investment measures. Since Tobin's Q reflects investment opportunities, it should be positive and significant.

Table 14 Fixed panel Regressions of Future Investments

This table reports annual regressions of equation: Investment = α + β Bonds illiquidity+ β stocks illiquidity + β FCF+ β Leverage + β size+ β Tobin's q+ ε.The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 12 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Capital Expenditure scaled by net property plant and equipment					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.01811 [a]	-0.0162 [a]	-.5577 [a]	-.0059 [a]
Stock illiquidity	-	-.3168 [b]	-0.9673 [b]	-.7975 [b]	-.3178 [b]
Size	+	.0145 [a]	0.0145 [a]	.01242 [b]	.01455 [b]
FCF	+	.03561 [b]	0.0421 [a]	.04108 [b]	.0364 [a]
Leverage	-	-.06115 [a]	-0.0602 [a]	-.0572 [a]	-.0613 [a]
Tobin's Q	+	.01748 [a]	0.0160 [a]	.01487 [a]	.01754 [a]
R2		0.0119	.0148	0.0157	0.0119
OBS		3,984	3,986	3,986	3,972

Dependent Variable: Capital Expenditure scaled by total assets					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.01531 [a]	-.01357 [a]	-.2494 [a]	-.0015
Stock illiquidity	-	-.3133 [a]	-.3107 [a]	-.2376 [b]	-.3143 [a]
Size	+	.0035 [c]	.0036 [c]	.0028	.0035 [c]
FCF	+	.0337 [a]	.0345 [a]	.0335 [a]	.0338 [a]
Leverage	-	-.04387 [a]	-.0439 [a]	-.0427 [a]	-.0437 [a]
Tobin's Q	+	.0079 [a]	.0079 [a]	.0075 [a]	.0080 [a]
R2		0.0992	0.1016	0.1043	0.0994
OBS		4,140	4,140	4,140	4,126

Table Continued					
Dependent Variable: Book To market					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	+	1.491	.4378 [b]	14.17 [b]	.0883 [a]
Stock illiquidity	+	.2355 [a]	.1029 [c]	13.60 [b]	.1035 [c]
Size	+	.5676 [a]	.5256 [a]	.5975 [a]	.5282 [a]
FCF	-	-1.705 [a]	-.8258 [c]	-.8674 [b]	-.8356 [c]
Leverage	+	-.4955	.0664	-.0833	.0707
Tobin's Q	-	-.3117 [a]	-.3272 [a]	-.2345 [a]	-.3217 [a]
R2		0.0198	0.0167	0.0236	0.0165
OBS		3,310	4,256	4,761	4,241
Dependent Variable: Acquisition					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0566 [a]	-.0062 [a]	-.2423 [c]	-.006 [a]
Stock illiquidity	-	-.1892 [b]	-.1734 [a]	-.1331 [a]	-.1302 [a]
Size	+	-.01749 [a]	-.0127 [a]	--.0183 [a]	-.0171 [a]
FCF	+	.0556 [a]	.01913 [a]	.0521 [b]	.0527 [b]
Leverage	-	-.0422	-.0525 [a]	-.0495 [b]	-.0359 [c]
Tobin's Q	+	.0106 [a]	.0108 [a]	.0120 [a]	.01294 [a]
R2		0.0295	0.0264	.03333	0.0329
OBS		3,790	3,094	3,367	3,354

In Table 15, we add to the base equation the financial constraint dummy interacted with the bonds illiquidity variable to capture the effect of financial constraints. We use firm size, firm leverage, firm payout ratio, Kaplan and Zingales (1997)'s index, rating, and stock illiquidity. On an annual basis, we rank firms by the financial constraints into four quartiles. Then, we create a dummy variable that takes one if the firm is assigned in the top quartile and zero otherwise.

The results of regressions show that more financially constrained firms have a high-pronounced effect of bonds illiquidity, indicating that market imperfections have high effect on financially constrained firms.

Specifically, the results from the inclusion of the variable that represents the interaction between bonds illiquidity and a dummy for large firms are positive and statistically significant across all models. The significant positivity shows that large firms are less vulnerable to capital market imperfections since they are more known and have more access to external market. Also, the interaction variable between illiquidity and an indicator for high leverage firms is negative and statistically significant in all models, indicating that market imperfection is more pronounced for high leverage firms since it would lower firm's debt capacity and their ability to raise capital.

Similarly, the results from using high payout ratio as an indicator for financial constraints are consistent with the hypothesis that bonds illiquidity would have a low effect on firms with high internal finance capacity. The interaction between bonds illiquidity and a dummy for high payout ratio firms are positive and statistically significant across all models. Also, the results from Kaplan and Zingales (1997)'s index interacted with bonds illiquidity is negative and significant across all

models, indicating a higher sensitivity from the financially constrained firms to the effect of illiquidity, similar to the leverage effect.

Moreover, the results from the interaction between a dummy variable for firms with high stock illiquidity and bonds illiquidity measures are negative and significant across all measures, indicating that market imperfections represented by bonds illiquidity is more pronounced for firms suffering from high stock illiquidity. In addition, the results from the interaction between a dummy variable for firms with junk bonds and bonds illiquidity measures are negative and significant across all measures, indicating that market imperfections have higher effect on firms with below-grade bonds. Finally, these results are indicators of the robustness of our findings, which suggest that the effect of bonds illiquidity on investment is more prominent in the more financially constrained firms.

Table 15 Fixed panel Regressions: Financial constraints

This table reports annual regressions of equation: Investment= α + β Bonds illiquidity+ β Bonds illiquidity* Financial constraint + β stocks illiquidity + β Leverage + β size + β Tobin's q+ β FCF + ε.The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 12 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Capital Expenditure scaled by net property plant and equipment				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0544 [a]	-.0140 [a]	-.5104 [b]
Bonds illiquidity * size	+	.0442 [a]	.0264 [a]	.4619 [b]
Stock illiquidity	-	-.7525 [a]	-.7705 [a]	-.6124 [a]
Size	+	.0111 [b]	.0110 [b]	.0115 [b]
FCF	+	.0619 [a]	.0604 [b]	.0492 [b]
Leverage	-	-.0429 [b]	-.0433 [b]	-.0471 [a]
Tobin's Q	+	.0144 [a]	.0144 [a]	.0158 [a]
R2		0.0161	0.0167	0.0175
OBS		3,987	3,987	4,451
Dependent Variable: Capital Expenditure scaled by total assets				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0428 [a]	-.0104 [a]	-.2436 [a]
Bonds illiquidity * size	+	.0328 [a]	.0195 [a]	.2182 [a]
Stock illiquidity	-	-.3199 [a]	-.3324 [a]	-.2534 [a]
Size	+	-.0003	-.0004	.0002
FCF	+	.0656 [a]	.0645 [a]	.0593 [a]
Leverage	-	-.0165 [b]	-.0167 [b]	-.0170 [a]
Tobin's Q	+	.0061 [a]	.0062 [a]	.0065 [a]
R2		0.1118	0.1191	0.1071
OBS		4,134	4,134	4,620

Table Continued

Dependent Variable: Capital Expenditure scaled by net property plant and equipment

Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0203 [a]	-.0165 [a]	-.2485
Bonds illiquidity * leverage	-	-.2648 [a]	-.0163 [c]	-1.0227 [b]
Stock illiquidity	-	-.5919 [a]	-.7475 [a]	-.5378 [a]
Size	+	.0240 [a]	.0112 [b]	.0120 [b]
FCF	+	.0517 [b]	.0621 [a]	.0500 [b]
Leverage	-	-.0329 [c]	-.0431 [b]	-.0368 [b]
Tobin's Q	+	.0173 [a]	.0143 [a]	.0157 [a]
R2		0.0201	0.0163	0.0177
OBS		4,038	3,987	4,451

Dependent Variable: Capital Expenditure scaled by total assets

Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0114 [b]	-.0122 [a]	-.1345 [b]
Bonds illiquidity * leverage	-	-.0045 [a]	-.0101 [b]	-.3012 [b]
Stock illiquidity	-	-.3666 [a]	-.3167 [a]	-.2226 [a]
Size	+	-.0013	-.0002	.0003
FCF	+	.0695 [a]	.0658 [a]	.0598 [a]
Leverage	-	-.0200 [a]	-.0166 [b]	-.0138 [b]
Tobin's Q	+	.0066 [a]	.0061 [a]	.0064 [a]
R2		0.1291	0.1138	0.1058
OBS		3,667	4,134	4,620

Dependent Variable: Capital Expenditure scaled by net property plant and equipment

Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.8731 [a]	-.0126 [b]	-.5404 [b]
Bonds illiquidity * payout	+	.8642 [a]	.0175 [a]	.5667
Stock illiquidity	-	-.7992 [a]	-.9087 [a]	-.9018 [b]
Size	+	.0257 [a]	.0103	.0277 [a]
FCF	+	.0043	.0431 [c]	.0255
Leverage	-	-.1178 [a]	-.1161 [a]	-.1069 [b]
Tobin's Q	+	.0152 [a]	.0143 [a]	.0151 [a]
R2		0.0232	0.0205	0.0223
OBS		3,945	3,978	3,579

Dependent Variable: Capital Expenditure scaled by total assets

Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.3171 [b]	-.0110 [a]	-.2949 [a]
Bonds illiquidity * payout	+	.3076 [b]	.0143 [b]	.1834 [c]
Stock illiquidity	-	-.3843 [a]	-.4194 [a]	-.2710 [a]
Size	+	.0008	-.0049 [b]	-.0054 [a]
FCF	+	.0370 [a]	.0333 [a]	.0509 [a]
Leverage	-	-.0445 [a]	-.0414 [a]	-.0322 [a]
Tobin's Q	+	.0064 [a]	.0060 [a]	.0055 [a]
R2		0.1125	0.1216	0.1311
OBS		4,126	4,128	4,134

Dependent Variable: Capital Expenditure scaled by net property plant and equipment

Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0098 [c]	-.0148 [b]	.4580
Bonds illiquidity * Index	-	-1.238 [a]	-.5515 [b]	-.9041 [a]
Stock illiquidity	-	-.7864[a]	-.7536 [a]	-.9062 [a]
Size	+	.0255 [a]	.0237 [a]	.0110
FCF	+	.0319	.0320	.0425 [b]
Leverage	-	-.1169 [a]	-.1193 [a]	-.1112 [b]
Tobin's Q	+	.0139 [a]	.0141 [a]	.0152 [a]
R2		0.0237	0.0241	0.0215
OBS		3,965	4,046	3,978

Table Continued

Dependent Variable: Capital Expenditure scaled by total assets				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0199 [a]	-.0118 [a]	-.0928
Bonds illiquidity * Index	-	-.9717 [a]	-.2259 [b]	-.2335 [b]
Stock illiquidity	-	-.3915 [a]	-.3775 [a]	-.3513 [b]
Size	+	-.0047 [c]	-.0011	-.0050 [c]
FCF	+	.0356 [a]	.0363 [a]	.0352 [a]
Leverage	-	-.0429 [a]	-.0445 [a]	-.0408 [a]
Tobin's Q	+	.0062 [a]	.0063 [a]	.0059 [a]
R2		0.1165	0.1155	0.1182
OBS		4,084	4,128	4,084

Dependent Variable: Capital Expenditure scaled by net property plant and equipment				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0125	-.0089	-.0639
Bonds illiquidity* Stock illiquidity	-	-1.317 [c]	-.0229 [a]	-.6177 [c]
Stock illiquidity	-	-.8557 [a]	-.8419 [a]	-.5527 [a]
Size	+	.0190	.0083	.0189
FCF	+	.0535 [c]	.0928 [a]	.0523 [c]
Leverage	-	-.1239 [a]	-.1108 [a]	-.1200 [a]
Tobin's Q	+	.01465	.0122 [a]	.0143 [a]
R2		0.0228	0.0226	0.0234
OBS		4,047	3,979	4,047

Dependent Variable: Capital Expenditure scaled by total assets				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0207 [a]	.0016	-.0424
Bonds illiquidity* Stock illiquidity	-	-1.153 [c]	-.0180 [a]	-.2409 [b]
Stock illiquidity	-	-.4110 [a]	-.3503 [a]	-.2719 [a]
Size	+	-.0061 [a]	-.0014	-.0047
FCF	+	.0319 [a]	.0538 [a]	.0344 [a]
Leverage	-	-.0401 [a]	-.0452 [a]	-.0415 [a]
Tobin's Q	+	.0057 [a]	.0061 [a]	.0061 [a]
R2		0.1218	0.1202	0.1190
OBS		4,128	4,130	4,128

Dependent Variable: Capital Expenditure scaled by net property plant and equipment				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.2280	-.0059 [b]	-.5599 [b]
Bonds illiquidity* Rating	-	-.0230	-.03179 [c]	-.9500 [b]
Stock illiquidity	-	-.4868 [b]	-.3374 [b]	-.1686
Size	+	-.0123	-.0056	-.0171 [b]
FCF	+	-.0362	-.1632	-.0794
Leverage	-	-.0609 [a]	-.0520 [c]	-.0592 [a]
Tobin's Q	+	.0217 [a]	.0770 [c]	.0714 [c]
R2		0.0165	0.0452	0.0390
OBS		5,592	7,811	7,805

Dependent Variable: Capital Expenditure scaled by total assets				
Variables	Expected sign	Amihud	Roll	Relative Spread
Bonds illiquidity	-	-.0135 [a]	-.0001	-.3684 [b]
Bonds illiquidity * Rating	-	-.0093 [a]	-.0176 [c]	-.1180 [b]
Stock illiquidity	-	-.2953 [a]	-.3117 [a]	-.2356 [a]
Size	+	-.0068 [a]	-.0062 [a]	-.0047 [b]
FCF	+	.0216 [b]	.0374 [a]	.0490 [a]
Leverage	-	-.0289 [a]	-.0201 [a]	-.0287 [a]
Tobin's Q	+	.0085 [a]	.0077 [a]	.0048 [a]
R2		0.0699	0.0727	0.0934
OBS		8,186	9,367	6,782

4. Robustness

We do not confine our results to a specific measure of leverage or illiquidity and show that our results are robust for all measures. Also, we address the issue of heteroskedasticity and autocorrelation by using Huber-White corrected standard errors when computing the p-values and got robust standard errors corrected for firm-level clustering.

In this section, we also address different issues, specifically, endogeneity, stability over time, and the difference between investment and junk bonds in terms of liquidity.

4.1. Endogeneity

In all our models, we use fixed effect models, which make important differences in the estimation of coefficients. Also, fixed effect models make important differences since one of the most common reasons for endogeneity in corporate finance is omitted variables as a result of the heterogeneity. In a setting aimed at understanding firm behavior, any time-invariant variable that are not observed in the data, such as unobservable technological differences across firms, could contribute to the presence of a fixed effect. Using fixed effect model in panel data can ameliorate this issue as suggested by Roberts and Whited (2013).

4.1.1. Heckman (1976) test for sample selection bias

In addition, to address the endogeneity resulted from sample selection bias, Heckman (1976) introduced the Heckman model, a two-stage approach for data analysis. The results of the Heckman (1979) are not reported for brevity. The result show that that Inverse Mills Ratio is insignificant, bonds illiquidity is negative with (-.01270) and significant at the 10% level, and stocks illiquidity is negative with (-.0087) and significant suggesting that our findings are robust. We also get similar results when investment is defined as capital expenditure scaled by total assets.

4.1.2. GMM Test

In addition, we estimate dynamic GMM regressions to address the endogeneity concerns. We use the dynamic GMM estimator. Two lags of investment are sufficient to capture the dynamic endogeneity. The main result of the GMM estimate still shows a negative effect of bonds illiquidity on investment (-.0078) at 5% significance and a negative effect of stocks illiquidity on investment (-.01615) at 1% significance. There is no substantial difference in employing different measures of investment like capital expenditure scaled by total assets.

4.1.3. Granger causality

Moreover, we try to explicitly investigate the causality between the investment and bonds and stocks illiquidity for all measures using the Panel VAR-Granger causality Wald test. The results mostly indicate bonds illiquidity significantly Granger causes investment, while investment does not Granger cause bonds illiquidity. Interestingly, there is no significant causality between stocks illiquidity measure and investment except for spread relative measure. It appears that the casualty tests are sensitive to how the investment or illiquidity is measured. However, casualty tests are consistent whether we include financial crisis period or restrict the sample to investment-grade bonds.

Table 16 Panel vector autoregresssion- whole sample

Table states the expected sign for each independent variable where investment is Capital Expenditure scaled by net property plant and equipment. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Regressor	Dependent in VAR		Regressor	Dependent in VAR	
	Amihud	Investment		S.Amihud	Investment
Amihud	.0080 [a]	.0021 [a]	S.Amihud	.3004	.0045
Investment	-.0145	.5188 [a]	Investment	.01417	.5311 [a]
	Roll	Investment		S.Roll	Investment
Roll	.3946	.0042	S.Roll	.3691 [a]	-.0949
Investment	.0757	.6424 [a]	Investment	-.0245	.6517 [a]
	Spread	Investment		S.Spread	Investment
Spread	.1667 [c]	-.2833 [a]	S.Spread	.6796 [a]	-.3376 [a]
Investment	-.0175	.4818 [a]	Investment	-.0185	.5401 [a]
	BPW	Investment		S.BPW	Investment
BPW	.1998 [a]	.00009 [a]	S.BPW	-.020	.02843
Leverage	.0534	.64474 [a]	Investment	-.0076	.5427 [a]

4.2. Stability over time

In this section, we test the stability of our main results over time since several studies document a change in market liquidity during the time of financial crisis. Friewald et al. (2012) and Dick-Nielsen et al. (2012) among others find that US corporate bonds liquidity significantly plummeted during the financial crisis in 2008. During the financial crisis, credit quality and liquidity's fall increase yield spreads, decrease investors' portfolio values, and increase firms' financing costs. Also,

Therefore, considering the results of significant liquidity deterioration for corporate bonds during the financial crisis in 2008, we repeat our initial analysis for the same sample excluding the financial crisis period (2008) as in Friewald et al. (2012).

The results are not affected by the exclusion of financial crisis period, indicating stability of our results through time. The results show a significant negative relation between investment measures and bonds and stocks illiquidity measures. Thus, firms with high bonds and stocks illiquidity choose a lower level of investment. In addition, we control for time effect by adding a time trend and the results for bonds and stock illiquidity are not affected.

4.3. Stability across samples: difference between investment and junk bonds

When dealing with bonds market, the firms can be classified into high-investment-grade firms, and below-investment-grade firms. Several papers indicate a different behavior of liquidity between the two grades firms. Dick-Nielsen et al (2012) show that illiquidity increased during the subprime crisis and is more pronounced and less persistent for below-investment-grade bonds. In addition, Bessembinder et al. (2016) suggest that below-investment-grade bonds are more dependence on market liquidity as a result of their high exposure to asymmetric information. Kisgen and Strahan (2010) and Bessembinder et al. (2016) point out that institutional investors and insurance companies are usually required to only invest into investment-grade firms. Also, Chen et al. (2007) find that bonds illiquidity has a significant positive increase on yield spreads and is more pronounced for junk bonds.

Therefore, we repeat our initial analysis for the whole sample by including the below-investment-grade firms. The results show consistent results for the main variables with no material difference, that firms with high bonds and stocks illiquidity choose a lower level of investment. However, the significance of stocks and bonds illiquidity coefficients is less. Also, defining the investment as book to market shows inconsistent results. More importantly, the sign and significance of size and tangibility in general are inconsistent with our initial results.

Table 17 Fixed panel Regressions of Future Investments – whole sample

This table reports annual regressions of equation: Investment = α + β Bonds illiquidity+ β stocks illiquidity + β FCF+ β Leverage + β size+ β Tobin's q+ ε.The table states the expected sign for each independent variable. Full definitions of the variables appearing in the equation above are provided in Table 12 Panel A. The subscripts a, b, c refer to 1%, 5%, and 10% statistical significance levels, respectively. The results are robust standard errors corrected for firm-level clustering.

Dependent Variable: Capital Expenditure scaled by net property plant and equipment					
Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0080 [c]	-.0287	-.3023	-.0004 [a]
Stock illiquidity	-	-.2260 [c]	-.2998 [c]	-.2967	-.2122
Size	+	-.0087	-.0146	-.0146	-.0115
FCF	+	-.1502	-.1406	-.1464	-.0582 [a]
Leverage	-	-.0612 [c]	-.0743 [a]	-.0732 [a]	.0776 [a]
Tobin's Q	+	.0779 [c]	.0668 [a]	.0665 [a]	.0776 [c]
Rating Up		.0039	-.0013	-.0018	.0069
R2		.0474	.0407	.0408	.0418
OBS		6,955	8,246	8,246	6,868

Table Continued

Dependent Variable: Capital Expenditure scaled by total assets

Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0043 [c]	-.0031	-.0563 [c]	-.0002 [a]
Stock illiquidity	-	-.0724 [c]	-.0718 [c]	-.084 [b]	-.0766 [c]
Size	+	-.0049 [b]	-.0049 [b]	-.0046 [b]	-.0033
FCF	+	.0434 [a]	.0434 [a]	.0434 [b]	.0474 [b]
Leverage	-	-.0261 [a]	-.0261 [a]	-.0299 [a]	-.0268 [b]
Tobin's Q	+	.0089 [a]	.0089 [a]	.0098 [a]	.0097 [a]
Rating Up		.0014	.0014	.0004	.0013
R2		0.0614	0.0615	0.0659	0.0675
OBS		7,591	7,591	6,985	6,261

Dependent Variable: Book To market

Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	+	1.496 [b]	-2.009	40.64	-.1237
Stock illiquidity	+	95.09	102.7 [c]	17.48	87.35
Size	+	.6569	.6105	.4518	.4227
FCF	-	1.885	1.484	23.66 [c]	1.540
Leverage	+	24.96 [c]	19.63	20.04 [c]	20.53 [c]
Tobin's Q	+	-.6688	-.6883	-.7965	-.8129
Rating Up		1.428 [c]	1.213 [c]	.9888	1.001
R2		0.0081	0.0075	0.0073	0.0078
OBS		6,360	7,587	6,966	8,140

Dependent Variable: Acquisition

Variables	Expected sign	Amihud	Roll	Relative Spread	BPW
Bonds illiquidity	-	-.0225 [c]	-.0082 [a]	-.0723 [b]	-.0013 [a]
Stock illiquidity	-	-.1449 [b]	-.1463 [b]	-.1985 [a]	-.1374 [b]
Size	+	-.0170 [a]	-.0172 [a]	-.0149 [a]	-.0169 [a]
FCF	+	.0140 [b]	.0141 [b]	-.0381 [a]	.0153 [b]
Leverage	-	-.0556 [a]	-.0559 [a]	.0075 [a]	-.0570 [a]
Tobin's Q	+	.0116 [a]	.0115 [a]	.0272 [a]	.0112 [a]
Rating Up		.0071 [c]	.0071 [c]	.0043	.0063
R2		0.0311	0.0316	0.0276	0.0302
OBS		5,032	5,032	7,167	4,938

5. Conclusion

Employing bonds and stocks illiquidity models developed by the market microstructure literature, we investigate if markets illiquidity is a significant determinant of investment decisions.

We hypothesize that, ceteris paribus, a firm's future investments increase in its bonds and stocks liquidity. We hypothesize that an increase in investment opportunities due to an increase in bonds liquidity is for the decrease of the firm's cost of capital and the decrease in its issuance cost. We also hypothesize that firms with more financially constraints will benefit more from the bonds liquidity, as it makes it easier for them to borrow externally. Thus, we expect the effect of bonds illiquidity to be more pronounced on financially constrained firms due to the limited access for other external capital.

The results show that, even after controlling for the firm characteristics that determine investment decisions, bonds and stock illiquidity affect the investment decisions of U.S. firms significantly over the sample period 2003-2018. Specifically, the coefficients of bonds and stocks illiquidity are negative and strongly significant regardless of investment measurement. Also, both the sign and the significance of the coefficients for the conventional variables are consistent with previous literatures.

Also, we find the effect of bonds illiquidity is more pronounced for financially constrained firms using different financial constraints measures.

We also address different issues like endogeneity, stability over time, and the difference between investment and junk bonds in terms of liquidity, and find that the main results are robust and consistent.

6. Reference

1. Abdulrahman M. Alhassan. (2017). Working paper. Corporate Future Investments and Stock Liquidity: Evidence from Emerging Markets
2. Amihud, Yakov & Mendelson, Haim. (1986). Asset Pricing and the Bid–Ask Spread. Journal of Financial Economics. 17. 223–249.
3. Bao, J. , Pan, J. and Wang, J. (2011), The Illiquidity of Corporate Bonds. The Journal of Finance, 66: 911-946.
4. Bao, J., Pan, J., & Wang, J. (2011). The Illiquidity of Corporate Bonds. The Journal of Finance, 66(3), 911-946.
5. Bharath, Sreedhar & Pasquariello, Paolo & Wu, Guojun. (2009). Does Asymmetric Information Drive Capital Structure Decisions?. Review of Financial Studies.
6. Bolton, P., & Freixas, X. (2000). Equity, Bonds, and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information. Journal of Political Economy, 108(2), 324-351.
7. Butler, A., Grullon, G., & Weston, J. (2005). Stock Market Liquidity and the Cost of Issuing Equity. The Journal of Financial and Quantitative Analysis, 40(2), 331-348.
8. Chen, Long & Lesmond, David & Zhanshun Wei, Jason. (2007). Corporate Yield Spreads and Bond Liquidity. Journal of Finance. 62. 119-149.
9. Chordia, T & Roll, R & Subrahmanyam, A. (2000). Commonality in liquidity. Journal of Financial Economics. 56. 3-28.
10. Chordia, T., Sarkar, A., & Subrahmanyam, A. (2005). An Empirical Analysis of Stock and Bond Market Liquidity. The Review of Financial Studies, 18(1), 85-129.
11. Corwin, S., & Schultz, P. (2012). A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices. The Journal of Finance, 67(2), 719-759.
12. Elmira Shekari Namin. (2017). Working paper. Credit Ratings and Corporate Bond Liquidity.
13. Faulkender, M., & Petersen, M. (2006). Does the Source of Capital Affect Capital Structure? The Review of Financial Studies,19(1), 45-79.
14. Fazzari, Steven & Glenn Hubbard, R & Petersen, Bruce. (1988). Financing Constraints and Corporate Investment. National Bureau of Economic Research, Inc, NBER Working Papers. 1.
15. Field, Laura Casares and Mkrtchyan, Anahit and Wang, Yuan, Bond Liquidity and Investment (May 15, 2018). Northeastern U. D'Amore-McKim School of Business Research Paper No. 3062841.
16. Gabrielsen, Alexandros & Marzo, Massimiliano & Zagaglia, Paolo. (2011). Measuring Market Liquidity: An Introductory Survey. SSRN Electronic Journal.
17. Graham, John. (1999). How Big Are the Tax Benefits of Debt?. The Journal of Finance.
18. Hong, Harrison, and Jeremy C. Stein. 2007. "Disagreement and the Stock Market." Journal of Economic Perspectives,21 (2): 109-128.
19. L. Lipson, Marc & Mortal, Sandra. (2009). Liquidity and Capital Structure. Journal of Financial Markets. 12. 611-644.
20. Lemmon, M., & Roberts, M. (2010). The Response of Corporate Financing and Investment to Changes in the Supply of Credit. The Journal of Financial and Quantitative Analysis, 45(3)
21. Lesmond, David & Trzcinka, Charles & Ogden, Joseph. (1997). A New Measure of Transaction Costs.

22. Muñoz, Francisco. (2013). Liquidity and firm investment: Evidence for Latin America. Journal of Empirical Finance. 20. 18–29.
23. Nicos Koussis, Spiros H. Martzoukos, Lenos Trigeorgis. August (2017). Corporate liquidity and dividend policy under uncertainty. Journal of Banking & Finance, Volume 81, Pages 221-235
24. Noe, Thomas & Fang, Vivian & Tice, Sheri. (2009). Stock Market Liquidity and Firm Value. Journal of Financial Economics. 94. 150-169.
25. Rajan, R. G. and Zingales, L. (1995), What Do We Know about Capital Structure? Some Evidence from International Data. The Journal of Finance, 50: 1421-1460.
26. Roll, R. (1984). A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market. The Journal of Finance, 39(4), 1127-1139.
27. Van Ness, B., Van Ness, R., & Warr, R. (2001). How Well Do Adverse Selection Components Measure Adverse Selection? Financial Management, 30(3), 77-98.
28. Welch, I. (2004). Capital Structure and Stock Returns. Journal of Political Economy, 112(1), 106-131.

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