THE IMPACT OF STOCK MARKET LIQUIDITY ON CORPORATE FINANCE DECISIONS

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Abstract

In this thesis I examine whether stock market frictions affect corporate financing behavior. In a simple model of firm valuation I show how the costs of illiquidity, if investors require to be compensated for them by higher returns, should affect the capital structure of the firm. I predict that the degree of illiquidity associated with the firm's stock should influence the target leverage and capital structure adjustments the firm undertakes. To identify the impact of stock market frictions on corporate financing I use liquidity measures proposed by empirical asset pricing literature as proxies for transaction costs faced by investors and relate them to corporate capital structures. My empirical results confirm that financing behavior is influenced by the illiquidity of the firm's stock. In particular, I find that liquidity affects the dynamic capital structure decisions. Faced with the need to attract new capital, less liquid firms are more likely to issue debt. Market imperfections thus do play a role in determining a firm's financing choice.

Key words: liquidity, price impact, capital structure, leverage, debt-equity choice

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Introduction

While liquidity is regarded in the asset pricing literature as a characteristic of a security with a negative effect on expected returns, it can also be viewed as a firm's attribute which affects its cost of issuing capital. If liquidity is priced on the market and investors are willing to accept lower returns from more liquid stocks, managers should consider the liquidity of their stock as well when making decisions about raising and allocating capital. In other words, a reasonable hypothesis is that the liquidity of firm's equity is an additional factor that determines company's choice of optimal capital structure. The negative relation between liquidity and return translates into lower cost of equity capital for the company and makes equity financing relatively cheaper. Does this suggest that, all other factors held constant, more liquid firms can be expected to employ more equity relative to debt when optimizing their financial structure?

The objective of this work is to analyze the existence of this link between stock market liquidity and financing decisions of the company. I do so by considering a simple model with exogenous transaction costs and trading horizons, in which the value maximization is the primary objective of the firm. I then develop the positive relation between the illiquidity of the equity and the optimal amount of debt suggested in this simple framework into two empirical questions. To test the hypotheses I estimate static and dynamic models of capital structure on the sample of publicly traded US companies.

First, I examine if more illiquid on the stock market firms tend to have larger debt-to-assets ratios. The idea is that illiquid stocks are heavily discounted by investors, which makes debt financing relatively more attractive for less liquid firms. Consistent with my first hypothesis, the estimated association between leverage and illiquidity is positive, even after accounting for unobserved heterogeneity and serially correlated errors.

Next, I analyze propensity of companies to use debt or equity for the capital structure adjustments. I hypothesize that firms take into account their own liquidity on the market when issuing capital. Consistent with my prediction the results show that firms with higher illiquidity of their stock are more likely to raise capital via debt increases.

I also perform a number of robustness checks to address the concern that the documented evidence is specific to particular measure, sample or estimation methods that I consider.

Overall, the results support the idea that stock market imperfections affect financing of the company. Consistent with the first hypothesis I find that companies with less liquid stock tend to employ higher levels of debt relative to equity, although this result does not prove to be robust to all the sensitivity checks I perform. Furthermore, I find strong support for the second hypothesis, which suggests that liquid firms should be more likely to turn to equity rather than to debt at the time the firm needs to raise capital.

The remainder of this work is organized as follows. In Chapter 1, theoretical explanations of sources of liquidity are summarized, and literature which considers effects of liquidity costs on the corporate financing is reviewed. Chapter 2 presents a simple theoretical argument to identify the relationship between liquidity and leverage and outlines the empirical design. Chapter 3 defines the sample, describes the variables under consideration, and provides an overview of the data. In Chapter 4 I present and analyze the main empirical findings and provide robustness tests. Chapter 5 concludes.

1 Literature review

There is by now a growing literature that relates liquidity to asset pricing (see e.g. Acharya and Pedersen (2005) for a detailed review). The cornerstone of it is provided by theoretical papers which explain what the possible sources of illiquidity are and how it affects asset prices. Empirical studies of the connection between the two support the existence of the liquidity effect: investors do seem to require an additional return on illiquid security. More recent evidence suggests that there are consequences of this effect for corporate finance policies.

1.1 Sources of illiquidity

While there are many different frameworks designed to understand how illiquidity can arise and how it affects asset prices, I discuss three streams of this literature: strategic models of information asymmetry, models of inventory risk, and exogenous transaction costs.

A. Asymmetric information

The main idea behind the asymmetric information literature is that different agents have different (possibly superior) information about the fundamental value of an asset and this creates adverse selection problem in the fashion of Akerlof (1970). The market maker faces the risk of trading with the informed trader who is willing to buy when her signal is high, and eager to sell when her signal is low. Given that the market maker always loses when trading with the informed counterparty, what induces her to trade at all is the presence of uninformed traders.

Glosten and Milgrom (1985) show that this logic gives rise to the bid-ask spread as an informational phenomenon. In the setting they consider, a competitive market maker needs to behave strategically in a way that would protect her from informed trading, and she does so by quoting the bid and ask prices prior to sequential arrival of investors. The first determinant of the spread is the market maker's estimate of the fundamental value. With time, as she learns more from the order flow, the spread shrinks. Secondly, the bid-ask spread is greater if there are more informed traders on the market (higher probability of informed trading).

The alternative analysis of informational asymmetry in a completely opposite market structure is provided by Kyle (1985). In his model competitive market makers face the demand of a single insider and random noise traders, and have to set the price only after observing the aggregate order flow. To protect herself from losing money on informed trading the market maker will set the price equal to the expected value of the asset plus an extra charge (discount) per unit of aggregate demand. Kyle shows that the price sensitivity to order flow, which captures the degree of illiquidity of the asset, is proportional to the ratio of the amount of noise trading to the amount of private information the insider is expected to have. In this sense, the Kyle's price impact in the same way as bid-ask spread rises from the market makers' incentive to compensate themselves for adverse selection risk they face, and measures the illiquidity resulting from such incentive.

Based on the theoretical discussion of the asymmetric information literature, the bid-ask spread and the price impact of trades are employed by empirical literature as measures of liquidity of an asset.

B. *Illiquidity coming from inventory risk*

Another way to capture the essence of market liquidity is by introducing a mismatch between the arrival of buyers and sellers. Grossman and Miller (1988) present a model where liquidity of the market is determined by the difference between costs of providing immediacy through market maker's continuous presence in the market and benefits from the demand for immediacy which arises due to the exogenous liquidity event faced by the trader. They show that for a given cost of being a market maker, assets with more variability of price changes and, hence, carrying more inventory risk, have higher negative covariance between successive price changes. Their results suggest that the asset is more liquid in equilibrium, when the autocorrelation in its rates of return in lower. This relationship between trading activities and serial correlation of stock returns is further studied in Campbell, Grossman and Wang (1993). Their model suggests that price changes accompanied by high volume will tend to be reversed, because they are supposedly coming from exogenous selling pressure of noise traders, whereas this will be not the case for price changes on low-volume days, which are more likely to be caused by arrival of public information about the asset value.

The measure of liquidity which is related to this stream of literature was introduced in fact even earlier by Roll (1984). He suggested that the amount of compensation required by market maker can be inferred from the sequence of price changes. In particular, higher trading costs induce higher negative serial dependence in successive price changes. Therefore, the Roll's measure of illiquidity is calculated based on the observed autocovariance of security price changes.

C. *Exogenous trading cost literature*

Illiquidity can also derive from exogenous trading costs associated with trading. Brokerage fees, order-processing costs and transaction taxes lower the returns realized by investors, and, therefore, need to be taken into account when valuing the asset. The literature on transaction costs treats illiquidity as the exogenous and inherent feature of financial markets. In their early work, Amihud and Mendelson (1986) present a model of return-spread relation which shows that the expected asset return is increasing in bid-ask spread and this relationship is concave due to different holding periods of investors. The presence of investors, who are ready to hold the asset for longer, and, hence expect to incur less of selling-buying costs, mitigates the additional return required as a compensation for the illiquidity. In the model of Amihud and Mendelson (1986) the per-share cost of selling the security is assumed to remain constant over time, and therefore the returns offered by securities are adjusted only for the level of illiquidity cost. I use the simplified version of their model to derive empirical prediction about the relation between liquidity and financing of the company.

1.2 Implications for corporate finance

In Section 1.1 we saw how liquidity arises due to different market frictions and how these frictions ultimately affect prices and returns. A particular empirical prediction of these theories is that comparing two stocks, which can be otherwise considered identical, the stock which can be traded quickly and at low cost will have a lower required return. This low required return implies a low cost of capital to the firm. Therefore, the issue of illiquidity as a market friction that influences price formation has a direct implication for the corporate financing.

Interestingly, the idea that stock market liquidity impacts the debt-equity choice fits into each of the two competing theories of capital structure (see Harris and Raviv (1991) for a review). In the framework of trade-off theory the firm evaluates the costs and benefits of the two financing options and chooses the capital structure such that the total cost of capital is minimized. The higher cost of capital for the less liquid firm makes debt more advantageous than equity, and should lead to relatively higher usage of debt. The alternative pecking order theory of capital structure seems to fit liquidity equally well in its predictions. It suggests that asymmetric information problems rather than cost-benefit analysis explain the capital structure of the firm. Investors know that managers have superior information about the prospects of the company they run and can explore this information on the market by issuing overpriced stock or by insider trading activities. Therefore, the market discounts the value of new and existent shares which induces the managers to resort to equity issuance only as a last option after exploring other, cheaper financing alternatives. As we have seen, one indication of illiquidity is a price impact: how prices react to the volume of the trade. On the one hand, the issue of the stock is an announced event and, hence, should have negligible price impact as we would expect the market to be ready to absorb the sale. This is the case when we think the issue to be information-free. The asymmetric information concerns of investors, in the fashion advocated by pecking order theory, are in place in case of regular, expected trading as well. Therefore, liquidity, to the extent that it can proxy for information asymmetry associated with the stock, should be an important determinant of company's capital structure.

There are so far only few works that relate liquidity to capital structure. Lipson and Mortal (2008) and Frieder and Martell (2006) investigate the relationship without trying to relate it to any of the afore-mentioned theories. Lipson and Mortal (2008) find that firms whose equity can be regarded as more liquid tend to have lower levels of debt. Their simple univariate analysis shows that firms grouped in quintiles according to book value of assets, and then within each size group divided into liquidity quintiles reveal a clear inverse and monotonic relation between liquidity and leverage. After controlling for other factors which are likely to influence capital structure choice of the firm, the authors still document a significant negative relation between leverage and measures of liquidity in the cross-section and also at the time of financing decision. Frieder and Martell (2006) perform a similar but more general investigation. They explore the idea of reverse causality from leverage to equity liquidity, and, hence treat these variables as jointly determined. On the one hand, increased leverage can reduce the information asymmetries between manager and investors, as the former (being responsible for meeting the necessary debt payments) is forced to make better investment decisions. If this is the case, we would expect the positive relationship between leverage and liquidity. On the other hand, by borrowing more the company becomes more risky in the eyes of potential investors, which means reduced liquidity. Frider and Martell find that increased debt is accompanied with decreased spreads (their measure of illiquidity), which is in line with Jensen

(1986). Then, controlling for the endogenous relationship between leverage and liquidity, the authors show that liquidity is a significant negative determinant of leverage.

Bharath et al. (2006) try to capture the adverse selection component of the liquidity measures suggested in the literature and relate it to the idea behind the pecking order model. They extract a common factor underlying different groups of liquidity measures, which infer the asymmetric information content of the stock from the observed serial covariance properties of returns, price impact of trading volume, or by estimating structural models of the likelihood of information-based trades. Their results show that the cross-sectional variation in information asymmetry index across firms is indeed related to the cross-sectional variation of their financing decisions.

The alternative way of looking at the same issue is suggested by Butler, Grullon and Weston (2005). In their work they test whether stock market liquidity matters for the fees investment banks charge for underwriting the issue of new stock. Their results indicate that this is indeed the case, which means that due to illiquidity of its stock the company bears a direct cost of raising equity capital.

Although my work is not the first attempt to examine the effect of stock liquidity on capital structure decisions, it differs from and contributes to the existing research in a number of ways. As a first step toward a fuller and less ad hoc analysis of the problem, I start with a formalized relationship between illiquidity cost and the firm value to derive predictions about its impact on the optimal amount of debt financing employed by the company. Moreover, by addressing the econometric problems which accompany the estimation of the hypothesized relation I demonstrate that the results are sensitive to estimation techniques, which implies that the evidence presented by the previous research mainly operating with simple pooled ordinary least squares regressions should be treated with caution.

2 Hypotheses development

In this chapter I turn to theory to formalize the hypothesized links between liquidity of firm's stock and its financing decisions and use the result to suggest two empirical predictions.

2.1 A simple model

I derive the effect of liquidity on the financial policy of the firm in the simplest set up. To describe the relation between the liquidity and asset prices I consider a special case of Amihud and Mendelson's (1986) model discussed in Acharya and Pedersen (2005). In this model an investor who buys an asset which promises to be costly to resell afterwards will take this into account when valuing this asset. And since she knows that all the subsequent buyers and sellers will follow the same logic, the whole perpetuity of the future transaction costs needs to be accounted for in the price.

In particular, I consider a simple overlapping generations (OLG) economy in discrete time. The economy is composed of risk neutral individuals who live for two periods and infinitely existing firm. The firm finances itself by equity and debt. Equity is illiquid due to exogenous transaction costs, while debt is perfectly liquid. Agents are born of two types: creditors (bondholders) and investors (stockholders), and both can borrow and lend at the risk free rate, r.

The timing is as follows: at time t agent buys a share/bond; at t+1 she receives a dividend/coupon payment and sells a share/bond. Selling shares involves a transaction cost, whereas bonds are perfectly liquid. The firm generates cash flow X each period, which is independently and identically distributed with mean $\overline{X}$. The firm also needs to pay interest payments R, a fixed proportion of the employed debt. The distribution of X is assumed to be such that the firm is able to cover its interest payments in each period, i.e. bankruptcy risk is not modeled. In addition, the firm has to pay corporate taxes t. After interest and after tax payment available to shareholders equals to (1-t)(X-R).

To express the market value of equity, V_e, I use the following logic. An agent who buys a share at time t and has to sell it the next period is realizing an expected return of $(1\text{-}t)(\overline{X}\text{-}R)+P(1\text{-}S)$. S ($0 \leq S < 1$) is a relative trading cost, as in Amihud and Mendelson (1986); P is the per share price. Since the agent would buy an arbitrarily large amount of shares if the price would be lower than the discounted expected return and shortsell an arbitrarily large amount if the price is higher, the price of the firm's equity must be equal to:

$$P=\frac{(1\text{-}t)(\overline{X}\text{-}R)+P(1\text{-}S)}{1+r},$$

and from this

$$P=\frac{(1\text{-}t)(\overline{X}\text{-}R)}{r+S}. \tag{1}$$

The price is equal to the present value of the expected cash flow, discounted at the gross return (r+S). Under the assumption of unit interval of equity issued, the market value of equity equals price, $V_e=P$.

The debt is perfectly liquid and assumed to be fully secured, which means that the upper bound of the firm's debt capacity is given by the tangibility of its assets (collateral): $\tau A \geq V_d+R$ Interest payments on debt are assumed to be set such that bonds are being sold at par value. The value of the firm's debt for creditor in each period is equal to:

$$V_d=\frac{V_d+R}{1+r},$$

and from this

$$V_d = \frac{R}{r}. \tag{2}$$

This expression intuitively suggests the present value of debt is equal to the capitalized value of the stream of interest payments.

The market value of the firm is the sum of the market value of its debt and market value of its equity:

$$V = V_e + V_d,$$

substituting (1) and (2) we get:

$$V = \frac{(1-t)(\overline{X}-R)}{r+S} + \frac{R}{r}. \tag{3}$$

The firm maximizes its value by choosing the optimal financial policy. The variable that determines the financial policy of the firm is R (the interest rate paid to bond holders is kept fixed, so the amount of coupon payments defines the amount of debt issued). To find the level of R (contractual coupon payments on debt), which maximizes the total value of the firm the following derivative needs to be evaluated:

$$\frac{\partial V}{\partial R} = -\frac{1-t}{r+S} + \frac{1}{r} \geq 0.$$

As long as the tax rate is positive and the transaction costs are greater or equal to zero the derivative is strictly positive, $\frac{\partial V}{\partial R} = \frac{rt+S}{(r+S)r} > 0$, which means that the value of the firm increases in the amount of debt employed, i.e. optimal R^* equals to its maximum as determined by $\tau A \geq V_d + R$.

Since the main focus is on the link between liquidity and capital structure rather than on the closed form solution of optimal debt level, I discuss only the comparative statics analysis with respect to S. The results are summarized in Proposition 1.

Proposition 1. The effect of transaction costs on firms financing can be viewed through the following channels:

(i) Differentiating the optimal leverage with respect to S suggests that the optimal level of leverage is increasing in transaction costs:

$$\frac{\partial\left(\frac{V_d}{V}\right)}{\partial S}=\frac{(1\text{-t})(\bar{X}\text{-}R^*)}{[(1\text{-t})(\bar{X}\text{-}R^*)r+R^*(r+S)]^2}>0. \tag{4}$$

(ii) Differentiating the FOC for the maximum with respect to S yields that the marginal effect of additional unit of debt on the firm's value is increasing in transactions cost:

$$\frac{\partial^2 V}{\partial R \partial S}=\frac{1\text{-t}}{(r+S)^2}>0. \tag{5}$$

2.2 Testable hypotheses

The basic messages of the Proposition 1 are that the value-maximizing leverage level is increasing in transaction cost associated with trading firm's equity and the additional unit of debt is more attractive for the firm for which this cost is higher. Intuitively, for a high relative transaction cost investors require high return for equity, which induces the firm to shift its financing to debt. Based on Equations (4) and (5) I generate two hypotheses about liquidity and financing behavior of the firm.

Hypothesis 1: Firms with less liquid stock tend to have higher debt ratios.

The intuition is that illiquid stocks are discounted by investors, who require higher returns for holding illiquid security. In the model, the price of the more illiquid stock is discounted at the higher rate. This makes debt financing relatively more attractive for less liquid firms. Empirical evidence is expected to show that differences in the capital structures of firms can be attributed to differences in liquidity of their equity, and that less liquid firms tend to be more levered.

> *Hypothesis 2:* Firms take into account liquidity of their stock when adjusting their capital structure.

The chosen level of leverage reflects the static aspect of the company's capital structure and is the cumulative outcome of the initial financial structure followed by necessary increases and reductions of capital. Therefore the second hypothesis focuses on the dynamics of the financial decision. In particular, it suggests that, conditional on the decision to raise capital and choosing between debt and equity, companies with more liquid stock are more likely to issue equity.

It is worth noting that I focus only on the debt-equity dilemma which accompanies capital raising activity of the company. Modeling the capital reductions in a similar fashion is not instructive, because the company does not have the option to turn to the market and repurchase equity instead of paying down debt. In the case of repurchases and illiquidity costs associated with them, the firm faces the equity vs. dividend tradeoff (payout policy) rather than equity vs. debt tradeoff (financing).

2.3 Empirical specification

The econometric approach I use to test the hypotheses stated above is similar to the one suggested by Hovakimian et al. (2001) and subsequently used by Korajczyk and Levy (2003), Hovakimian et al. (2004), and Brav (2009), who also examine the relation between firm characteristics, target leverage and choice of financing instrument. I suggest that firm's financing decisions can be described by the following two equations:

$$\left(\frac{D}{A}\right)^{*}_{it} = \alpha + \beta ILLIQ_{it-1} + \mathbf{x}'_{it-1}\boldsymbol{\gamma} + \varepsilon_{it} \qquad (6)$$

$$\Pr(\Delta D_{it} = 1) = F\left[\alpha + \beta ILLIQ_{it-1} + \mathbf{x}'_{it-1}\boldsymbol{\gamma} + \varepsilon_{it}\right] \qquad (7)$$

The first equation defines the optimal debt-to-assets ratio chosen by the firm in year t as a function of firm characteristics and illiquidity of the firm's stock. The second describes the firm's expected issue choice (1 for debt and 0 for equity). The coefficient of interest in both cases is β, which captures the importance of the firm's liquidity on the stock market in determining future levels of leverage and optimal adjustment decisions.

A couple of things need to be mentioned regarding these models. First, since I estimate Eq. (6) based on actual data the assumption is that the firm's observed leverage ratio equals its optimal target plus a measurement error which is not correlated with the explanatory variables. Second, to test the Hypothesis 2 (Eq. (7)) I transform the continuous variable (net debt/equity issues) into a binary one which allows me to focus on the choice of the financial instrument rather than on the amount of issue. Third, liquidity measure and control variables are lagged one period in both models. The reason is that contemporaneous relation between the left and right hand side variables is very likely to suffer from endogeneity and reverse causality problems. Moreover, lagging independent variables avoids using information which is not yet in the information set of the company and allows me to interpret the coefficients as marginal effects of a particular determinant on the target level or chosen adjustment of debt-to-assets ratio.

3 Data

3.1 Sample selection

To test empirically how the stock market frictions affect corporate finance I use a sample of publicly traded US companies. The data comes from two sources. Annual liquidity estimates, end of year price per share, end of year market capitalization, and stock exchange codes come from datasets constructed by Joel Hasbrouck and available on his web-page.[1] In this data firms are observed a number of times, not necessarily through the whole duration of the study, which makes the panel not balanced. The unbalanced structure of the panel can be an issue if the attrition problem biases the estimates. But I argue that in my data these concerns are ignorable in a sense that data is missing for random reasons, which are unlikely to correlate with the error term in the regression specifications. Balance sheet, income statement and cash flow statement information comes from Datastream.[2] The information from the two sources is matched according to the company name and ticker symbol, which is an alphabetic symbol assigned to each security by an exchange.

To be included in the final sample observations must satisfy the following criteria: a) the company is not financial or utility firm (SIC codes 6000 through 6999 and 4900 through 4999 respectively); b) asset size is greater than $1 million; c) leverage is between 0% and 100%. These selection criteria are common to capital structure research (See, e.g. Fama and French (2002)). In addition, since liquidity measures are calculated for the calendar year, whereas accounting data corresponds to financial year of the company, and these time periods are not the same for some firms in the sample, in the regression analysis I limit the sample to those companies for which the

[1] http://pages.stern.nyu.edu/~jhasbrou/Research/GibbsEstimates2006/Liquidity%20estimates%202006.htm
[2] The data was extracted from the Datastream Advance with Worldscope database during my studies at the Katholieke Universiteit Leuven using on campus access via the Library of Business and Economics

time dimensions of liquidity and financial information overlap. These criteria generate a sample of 22,490 firm-year observations covering the 1992-2005.

3.2 Variable definition

A. Liquidity measure

As a primary measure which is meant to capture market's perception of the company's stock I use Amihud (2002) price impact. It is calculated from daily prices and volumes and averaged over each year:

$$\text{ILLIQ}=\text{Average}\left(1000000*\frac{|\text{Return}_t|}{\text{Price}_t*\text{Volume}_t}\right).$$

This measure captures the daily price response following one dollar of trading volume and is based on Kyle's concept of a market beset by informational asymmetry and price sensitivity to order flow arising from it (Kyle, 1985).

For the rest of the discussion it is important to remember that ILLIQ is a measure of firm's illiquidity on the stock market: firms which stock is traded at higher cost are characterized by higher values.

Other measures used to check the robustness of the main results are the following:

1. Effective spread (Roll)

$$\text{Roll}=\begin{cases} 2\sqrt{-\text{Cov}(\Delta P_t,\Delta P_{t-1})} & \text{if } \text{Cov}(\Delta P_t,\Delta P_{t-1})<0, \\ 0 & \text{if } \text{Cov}(\Delta P_t,\Delta P_{t-1})\geq 0. \end{cases}$$

Roll measure is a spread proxy calculated from the low frequency data using a method of moments estimation. Roll measures the so called effective spread, the difference between trading and quoted prices actually faced by investors, which does not necessarily equal to the quoted spread.

2. Effective spread (Gibbs)

This measure is developed by Joel Hasbrouck using the Bayesian estimation of the Roll model (Hasbrouck, 2004). The problem with Roll's measure is that quite often the serial covariance of price changes appears to be positive. To overcome it more elegantly than by simply assigning zero value to positive observations, Hasbrouck (2004) suggests a Markov chain Monte Carlo estimator, Gibbs sampler, which as he argues is preferable not only computationally but also analytically.

3. Proportion of zero return days (Zeros)

This measure was suggested by Lesmond, Ogden and Trzcinka (1999) and is calculated as follows:

$$\text{Zeros} = \frac{\text{Number of days with zero returns}}{\text{Number of days with non-missing price observations in the year}}.$$

In the model the authors present, the occurrence of zero returns is viewed as evidence that transaction costs exceed the benefits from desired trades, and is suggested as another measure of illiquidity.

B. *Financing activity measures*

The baseline indicator of firms financing activity is book leverage (D_{it}/A_{it}). Following Fama and French (2002), I compute it as a ratio of liabilities (plus preferred stock and less deferred taxes and investment tax credit) to book value of assets.

Another group of financing variables is meant to reflect the ongoing financing activities. To determine when a change in capital has taken place I follow Hovakimian et al. (2001) and define positive changes in equity debt which are greater or equal to 5% of the beginning of period total assets as net equity/debt issuances. Change in equity is calculated as the difference between sale of common and preferred stock and purchase of common and preferred stock. Change in debt is the sum of the long-term debt issuance less long-term debt reduction, plus changes in current debt.

C. Controls

The control variables I consider are mainly those suggested by Fama and French (2002). They include measures of firm size, profitability, investment opportunities, asset tangibility, and non-debt tax shields. Logarithm of total assets is employed as a measure of size. Pretax income is used as a measure of the profitability of assets in place, market-to-book ratio of assets and capital expenditures as proxies of investment opportunities. Information about property, plant and equipment serves as a rough proxy for asset tangibility. Depreciation expenses serve as proxies for non-debt tax shields, which imply less need for interest deduction from taxable profits which accompany debt financing. All these measures are standardized by the firm's book value of assets. To control for the tax advantage of debt I use effective tax rate, calculated as total tax paid by the firm divided by taxable income. In addition to these rather conventional variables employed in corporate structure research, I use the industry mean value of leverage. Frank and Goyal (2004) suggest that industry mean debt ratio is a good proxy for a number of factors: uniqueness, regulation, intangibility; which are important in determining the firm's capital structure. Definitions of all accounting variables employed in the study are presented in the Table 1 in the Appendix.

3.3 Summary statistics

Table 2 reports summary statistics separately for firms with high and low illiquidity levels. The firms are classified as more or less liquid comparing to the average illiquidity in the year. The level of ILLIQ exhibits a clear right-skewness (median below the mean), therefore from here onwards I use log-transformation of it to avoid any considerable impact of outliers.

There are two observations worth noting. First of all, the summary statistics provides no apparent support of the stated hypotheses. Less liquid firms are also less levered and less often engaged in both equity and debt issues. At the same time the table reveals considerable differences between the more liquid and less liquid firms. While high- and low-liquidity firms seem to be quite similar in terms of tangibility of their assets and capital expenditures, the more liquid firms are considerably larger in size, more profitable, and have higher market-to-book values.

Table 2. Summary statistics for total sample and across low- and high-liquidity firms

	All sample				Low Liquidity				High Liquidity			
	Mean	Median	Std. Dev.	Obs.	Mean	Median	Std. Dev.	Obs.	Mean	Median	Std. Dev.	Obs.
Ln(ILLIQ)	-2.82	-2.89	3.27	22,490	-0.13	-0.30	1.98	11,006	-5.40	-5.24	1.89	11,484
Leverage,%	43.60	43.16	22.40	22,490	42.44	40.85	22.87	11,006	44.72	45.36	21.89	11,484
Net equity issuers, %	15.95	0.00	36.61	19,338	15.79	0.00	36.47	9,307	16.09	0.00	36.75	10,031
Net debt issuers, %	20.81	0.00	40.60	19,338	19.72	0.00	39.79	9,307	21.82	0.00	41.31	10,031
Assets, millions of dollars	2,500	188	16,973	22,490	201	61	1,452	11,006	4,704	738	23,499	11,484
Market-to-book	3.06	1.52	25.09	22,490	1.95	1.26	3.51	11,006	4.11	1.78	34.90	11,484
Capital expenditures, %	6.53	4.24	7.47	22,490	6.39	3.69	8.26	11,006	6.67	4.73	6.63	11,484
Profitability, %	-1.57	4.96	31.43	22,490	-7.52	2.08	36.30	11,006	4.14	7.45	24.60	11,484
Tangible assets, %	27.51	20.72	23.00	22,490	26.54	19.10	23.35	11,006	28.45	22.25	22.62	11,484
Depreciation, %	5.45	4.41	6.70	22,490	5.90	4.57	6.89	11,006	5.01	4.28	6.48	11,484
Effective tax, %	25.08	30.00	73.59	22,472	20.06	3.51	50.81	10,992	29.89	33.72	89.90	11,480
Price per share, dollars	20.67	13.63	31.27	22,490	9.58	6.15	19.03	11,006	31.31	25.13	36.56	11,484

4 Empirical results

I split my empirical analysis into four parts which present tests of the hypotheses suggested in Chapter 2 and explore the robustness of obtained results. In the first section, I examine the relation between liquidity and the level of leverage using panel regression analysis. In the third, I investigate the role of stock market liquidity in the choice of financial instrument conditional on the decision to raise capital.

4.1 Hypothesis 1: Liquidity and level of leverage

I begin with a simple test of Hypothesis 1, which predicts that firms with more liquid stock are expected to have lower levels of leverage. I estimate the equation by pooled OLS, allowing for year and industry specific effects. All regressions include a constant, industry and year dummies, which are not reported. Two-digit SIC codes are incorporated to capture industry-specific component of financing choices. The p-values in parentheses are based on standard errors adjusted for clustering at the firm level. Columns 1 and 2 of Table 3 report the results of regression without controls and with firm size as the only control. In Columns 4 and 5 I incorporate two sets of control variables. The first set consists of the variables suggested by Fama and French (2002) and commonly used in capital structure research. It includes proxies for size (volatility), investment opportunities, profitability, and tangibility. Column 5 adds two variables which control for tax optimizing considerations of the company. Since interest payments reduce the firm's taxable profit the high level of tax burden should motivate the company to employ more debt relatively to equity financing. On the other hand, depreciation expenses are in part substitutes for the debt tax shields. The last control, industry leverage, is included in order to further mitigate the problem of omitted variables.

The industry mean debt ratio should capture the factors that determine the target debt ratio of the firm and are possibly related to liquidity.

Table 3. Leverage regression (pooled OLS)

	(1)	(2)	(3)	(4)	(5)
Illiquidity_{t-1}	-0.0056	0.0365	0.0327	0.0323	0.0319
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size $_{t-1}$		0.0844	0.0777	0.0803	0.0797
		(0.000)	(0.000)	(0.000)	(0.000)
Market-to-book $_{t-1}$				0.0004	0.0004
				(0.010)	(0.010)
Capital expenditures $_{t-1}$				0.0510	0.0581
				(0.203)	(0.147)
Profitability $_{t-1}$				-0.0983	-0.0920
				(0.000)	(0.000)
Tangible assets $_{t-1}$				0.1188	0.1105
				(0.000)	(0.000)
Depreciation $_{t-1}$					0.0816
					(0.228)
Effective tax $_{t-1}$					-0.0009
					(0.685)
Industry leverage $_{t-1}$					0.4261
					(0.000)
Year effects	No	No	Yes	Yes	Yes
Industry effects	No	No	Yes	Yes	Yes
Adj. R-squared	0.007	0.223	0.261	0.285	0.288
Obs.	19,338	19,338	19,338	19,105	18,978

Note: The table reports regression coefficients from pooled panel OLS; the p-values reported in parentheses are based on White period standard errors (robust to arbitrary serial correlation and time-varying variances in the disturbances). The dependent variable is book leverage. Independent variables are lagged one period.

Table 3 shows that there is indeed a significant positive relationship between the illiquidity measure and debt-to-assets ratio, which means that other things being equal more illiquid firms rely less on equity financing, which results in their higher levels of leverage. In the first column the coefficient is negative, but once the firm size is controlled for it turns to positive and remains such with inclusion of the rest of the controls. This is very intuitive, because illiquidity is strongly correlated with the firm size which is at the same time an important determinant of the firm's debt capacity; therefore the specification in Column 1 suffers from the omitted variable bias of the downward direction.

To obtain a better understanding of economic magnitudes, note from Table 2 that the standard deviation of ln(ILLIQ) in the sample is 3.27. Thus the impact of a one-standard deviation shock to illiquidity is predicted to alter the leverage ratio by 0.1043 or 10.43% ($0.0319 \times 3.27 = 0.1043$). When compared to the standard deviation of leverage in the sample (22.40%), this effect is quite substantial.

The sign of the illiquidity coefficient is of main interest but as an aside it is also interesting to look at the pattern of the coefficients on the control variables. Their signs, magnitude and significance are in line with the previous capital structure research. Larger firms with more investment opportunities, lower profits to finance them and high proportion of tangible assets which can be used as collateral are predicted to employ more debt relative to equity in their capital structure. The non-debt and debt tax shields have unexpected signs, but are insignificant. Industry leverage is significant and has intuitive sign. A company is predicted to employ more debt relative to equity if such is the tendency in the industry.

In Table 4 I exploit the panel structure of the data to further test the basic result. There are two potential problems with estimating the leverage regression specified by Eq. (6). First of all, as emphasized by the recent corporate finance literature (see Lemmon et al. (2008)) the leverage ratios are found to have a significant time-invariant component which is likely to be correlated with traditional explanatory variables employed in determinants of leverage regressions. For instance, Lemmon et al. (2008) show that initial capital structure chosen by a company plays an important role in explaining future values of leverage. Moreover, the authors advocate the necessity to account for unobserved heterogeneity in leverage for the reasons that have long motivated firm fixed effects specifications in investment and production function regressions: differences in reputation, managerial behavior, market power, and technology. Second problem is the presence of serial correlation which arises in regressions explaining the level of leverage and ignoring which can lead to greatly underestimated standard errors.

Table 4. Leverage regression (FE and FD)

	Fixed Effects		First Differencing	
Variable	(1)	(2)	(3)	(4)
Illiquidity $_{t-1}$	0.0149	0.0141	0.0030	0.0031
	(0.000)	(0.000)	(0.006)	(0.005)
Firm size $_{t-1}$	0.0405	0.0402	0.0222	0.0221
	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-book $_{t-1}$	0.0000	0.0000	-0.0003	-0.0003
	(0.662)	(0.909)	(0.169)	(0.168)
Capital expenditures $_{t-1}$	0.0324	0.0429	0.0306	0.0352
	(0.328)	(0.203)	(0.271)	(0.206)
Profitability $_{t-1}$	-0.0637	-0.0648	-0.0049	0.0051
	(0.000)	(0.000)	(0.407)	(0.500)
Tangible assets $_{t-1}$	0.1298	0.1305	0.0482	0.0469
	(0.000)	(0.000)	(0.039)	(0.043)
Depreciation $_{t-1}$		-0.0008		0.0981
		(0.991)		(0.020)
Effective tax $_{t-1}$		0.0005		0.0002
		(0.723)		(0.829)
Industry leverage $_{t-1}$		0.3267		-0.0397
		(0.000)		(0.445)
Year effects	Yes	Yes	Yes	Yes
Industry effects	No	No	No	No
Firm effects	Yes	Yes	No	No
Adj. R-squared	0.735	0.737	0.012	0.013
Obs.	19,105	18,798	16,178	16,035

Note: The table reports regression coefficients from fixed effects and first differences estimation, the p-values reported in parentheses are based on White period standard errors (robust to arbitrary serial correlation and time-varying variances in the disturbances). The dependent variable is book leverage. Independent variables are lagged one period.

Taking into account the aforementioned concerns I estimate Eq. (6) using the following econometric techniques: fixed effects (within estimation) and first differences. Each of the techniques is applied to two specifications, in which two full sets of controls is employed. The two estimators address the problems outlined above in a different way. And one must take care with their interpretation. Fixed effects address concerns over omitted time-invariant unobserved factors which are likely to be correlated with other explanatory variables. Since the Hausman test strongly rejected the null about uncorrelated effects, I do not report the random effects estimation. Once firm-specific effects are included the serial correlation in error terms can be considerably reduced, but it might not be completely eliminated (Cameron and Trivedi (2005)). Therefore the standard errors in the fixed effects regression are adjusted for serial correlation at the firm level (panel-robust inference). First differences estimator offers an alternative way to deal with individual specific effects, and in addition, addresses concerns over serially correlated errors.

The results in Table 4 show that the estimated parameters are indeed sensitive to model specification. Nevertheless, they suggest that there is a positive relationship between the illiquidity measure and chosen level of leverage, highly significant in both the fixed effects estimation the first differencing model.

4.2 Robustness of Hypothesis 1 results

In this section I explore the robustness of my results. In particular, I change different aspects of the estimation design such as measures used to proxy stock market illiquidity, the composition of the sample, and the estimation method.

Table 5 shows how the results carry over to the three other measures of liquidity. In the first two models, pooled OLS and fixed effects, the estimated coefficients for two bid-ask measures (Roll and Gibbs) and proportion of zero returns are of positive sign and significant. That is, the more illiquid a firm is in terms of spread proxies or no-return days, the higher the debt-to-asset ratio it ends up with. The first differencing results are less unanimous: only proportion of zero return days gives significant result.

Table 5. Alternative liquidity measures in leverage regressions

	Pooled OLS with industry and time effects	Fixed effect	First differences
	(1)	(2)	(3)
Ln(1+Roll)	2.5673	0.7102	0.2051
	(0.000)	(0.000)	(0.108)
Ln(Gibbs)	0.0449	0.0159	0.0034
	(0.000)	(0.000)	(0.078)
Zeros	0.5433	0.1427	0.0483
	(0.000)	(0.000)	(0.010)

Note: The table reports the illiquidity coefficients from the three specification discussed in 4.1 with the full set of controls, the p-values reported in parentheses are based on White period standard errors (robust to arbitrary serial correlation and time-varying variances in the disturbances).

In Table 6 I explore if my results are sensitive to the sample composition. In particular, I reestimate the main equations without outlying observations which could drive the results. To do so I require the end of year share price of the company to be not less than 1 dollar, and further get rid of the firms with market-to-book ratios of more than 10 (the criterion used in Baker and Wugler (2002)). These criteria make the sample more representative in a way that very illiquid cheap stocks and extremely liquid fashion stocks are eliminated. The main question is whether eliminating these observations, which constitute only 5% of the sample and for which the univariate statistics shows the link between liquidity and leverage to be very strong, would change the results.

The results from the first differencing model in column 3, which I consider to be the most convincing in the presence of estimation issues outlined above suggest the coefficient on the illiquidity remains significant at the 5% significance level. In fact, the magnitude of the coefficient remained almost the same as for the full sample.

Table 6. The main regression for the restricted sample

Variable	Pooled OLS (1)	Fixed Effects (2)	First Differencing (3)
Illiquidity$_{t-1}$	0.0335	0.0141	0.0024
	(0.000)	(0.000)	(0.026)
Firm size $_{t-1}$	0.0836	0.0406	0.0218
	(0.000)	(0.000)	(0.000)
Market-to-book $_{t-1}$	0.0008	0.0003	-0.0002
	(0.000)	(0.063)	(0.234)
Capital expenditures $_{t-1}$	0.0878	0.0541	0.0438
	(0.033)	(0.117)	(0.116)
Profitability $_{t-1}$	-0.0874	-0.0728	0.0019
	(0.000)	(0.000)	(0.790)
Tangible assets $_{t-1}$	0.1048	0.1383	0.0532
	(0.000)	(0.000)	(0.023)
Depreciation $_{t-1}$	0.0624	-0.0488	0.0751
	(0.396)	(0.534)	(0.075)
Effective tax $_{t-1}$	-0.0005	0.0008	0.0005
	(0.815)	(0.619)	(0.392)
Industry leverage $_{t-1}$	0.4379	0.3562	-0.0256
	(0.000)	(0.000)	(0.632)
Year effects	Yes	Yes	Yes
Industry effects	Yes	No	No
Firm effects	No	Yes	No
Adj. R-squared	0.302	0.749	0.013
Obs.	18,131	18,131	15,369

Note: The table reports regression coefficients from the three specifications discussed in 4.1 with the full set of controls. The sample excludes 1,111 observations with price less than 1 dollar and market-to-book greater than 10. The p-values reported in parentheses are based on White period standard errors (robust to arbitrary serial correlation and time-varying variances in the disturbances). The dependent variable is book leverage.

In Table 7 I employ the Arellano-Bond GMM estimator, which handles the time-series correlation in dependent variable by estimating the dynamic panel model (lagged dependent variable) on the first differenced data. There are two reasons why I would like to control for past level of leverage. The first reason is the already mentioned problem of serially correlated error structure caused by high degree of autocorrelation in leverage. In addition, there are reasons to worry about reverse causality and omitted variable bias. As Amihud and Mendelson (2008) point out, higher level of debt employed by the company makes its equity more risky for existing and potential investors, which results in wider spreads and higher price-impact costs. To address the reverse causality concerns up to this point I have used lagged independent variables specification. This research design mitigates the endogeneity concerns but does not really solve the problem in case of dynamic adjustment of dependent variable. Failing to control for current level of leverage which is positively correlated with next period leverage (in addition to correlation due to unobserved heterogeneity) and supposedly positively correlated with current period illiquidity measure might bias the coefficient on illiquidity.

Table 7. Dynamic panel specification of leverage regression

Illiquidity $_{t-1}$	0.0052
	0.1835
Firm size $_{t-1}$	0.0256
	(0.000)
Market-to-book $_{t-1}$	-0.0003
	(0.207)
Capital expenditures $_{t-1}$	0.0493
	(0.173)
Profitability $_{t-1}$	0.0517
	(0.000)
Tangible assets $_{t-1}$	-0.0667
	(0.062)
Depreciation $_{t-1}$	0.1882
	(0.000)
Effective tax $_{t-1}$	0.0006
	(0.464)
Industry leverage $_{t-1}$	-0.3182
	(0.000)
Lagged dependent variable	0.4522
	(0.000)
Obs.	16,100

Note: The table reports the regression coefficients for the Arellano-Bond 1-step estimator from model with one period lagged dependent variable and cross-section fixed effects. The p-values reported in parentheses are based on White period standard errors which account for time-series structure in the disturbances. The dependent variable is book leverage.

The results of Table 7 suggest that once the lagged dependent variable is included in the model the impact of stock market illiquidity on the chosen levels of leverage is of the positive direction but no longer statistically significant. This result of dynamic panel estimation is at odds with the rest of the evidence. However, it is worth noting that adding dynamics to a model completely changes the interpretation of the equation. With the lagged leverage in the regression we condition on the entire history of the independent variables and the estimated coefficients represent the effect of new information (Green (2007)). Thus the insignificant coefficient on the illiquidity measure suggests that new information about illiquidity in time t-1, not captured in the past leverage level, does not have significant impact on the next period leverage. This means the absence of the short run effect but does not necessarily disprove the evidence of long run (overall) effect found in the models discussed up to this point, which considered the full set of information about past illiquidity and related it to the observed outcome of capital structure.

The sensitivity analysis of Hypothesis 1 results suggests that the estimation presented in Section 4.1 about liquidity affecting the leverage ratio are relatively robust to alternative measures of liquidity and exclusion of outlying observations but not to lagged dependent variable specification.

4.3 Hypothesis 2: Capital structure adjustments

In this section I discuss the results from estimation of Eq. (7) for companies which initiate a net equity or debt issue of at least 5% of the book value of their assets. The Hypothesis 2 suggests that liquidity consideration influence capital structure adjustments in a way that illiquidity impacts the choice of the form of financing rather than the amount of capital raised. In order to focus on the stock liquidity as a determinant of the choice between the two options I consider only the firm-years in which companies raised a considerable amount of rather debt or equity, excluding firms which performed dual issues or were inactive.

Table 8 reports the results of linear probability and logit models of the choice of the form of financing. The set of control variables includes the determinants of leverage that I used earlier when estimating Eq. (6), the firm's pre-issue debt-to-assets ratio and the share price in the year of issue. The results in columns 3 and 4 are from the same specification augmented with time and industry fixed effects.

Table 8. Debt vs. equity choice

	OLS	Logit	OLS	Logit
Variable	(1)	(2)	(3)	(4)
Illiquidity $_{t-1}$	0.0481	0.2559	0.0370	0.2594
	(0.000)	(0.000)	(0.000)	(0.000)
Size $_{t-1}$	0.1470	0.8257	0.1376	0.8964
	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-Book $_{t-1}$	0.0000	-0.0060	-0.0001	-0.0029
	(0.818)	(0.647)	(0.650)	(0.717)
Capital Expenditures $_{t-1}$	0.1489	0.7074	0.1263	0.5195
	(0.104)	(0.207)	(0.163)	(0.371)
Profitability $_{t-1}$	0.3002	3.0996	0.2190	2.8515
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility $_{t-1}$	0.1829	0.8070	0.2141	1.1827
	(0.000)	(0.000)	(0.000)	(0.000)
Pre-issue leverage	0.0007	-0.2018	-0.0650	-0.3807
	(0.983)	(0.242)	(0.058)	(0.034)
Ln(Price)$_t$	-0.0612	-0.4776	-0.0695	-0.5376
	(0.000)	(0.000)	(0.000)	(0.000)
Year effects	No	No	Yes	Yes
Industry effects	No	No	Yes	Yes
Adj./Pseudo R-squared	0.270	0.249	0.325	0.287
Obs.	5,712	5,712	5,712	5,712
Obs. with Dep=0	2,398	2,398	2,398	2,398
Obs. with Dep=1	3,314	3,314	3,314	3,314

Note: The table reports regression coefficients from linear probability model with the p-values based on White period standard errors (robust to arbitrary serial correlation and time-varying variances in the disturbances) and logit model with p-values based on Huber/White standard errors. The dependent variable is binary: 1 for debt issues and 0 for equity issues higher than 1% of the beginning of period total assets. Independent variables (except for price) are lagged one period.

The coefficient estimates for illiquidity measure are significantly positive in all regressions, suggesting that more illiquid firms are less likely to choose equity issues as the financial instrument of attraction of new capital. This result is consistent with my second hypothesis. Company which experiences illiquidity shock that moves it from the lowest illiquidity decile in the sample (most liquid) to the highest (least liquid) is predicted to be 30% more likely to issue debt.

Other results are as follows. The firm's size, profitability and tangibility are significant determinants of probability to issue debt rather than equity. Smaller firms with less potential collateral are on average more likely to turn to the stock market. Higher past profitability, as we have seen in the level of leverage regression, means that firm has a tendency to have low debt-equity ratio. And according to the results in Table 5, these firms are more likely to increase leverage via debt issues. The coefficient on pre-issue leverage ratio is negative and significant suggesting that highly leveraged firm is more likely to raise capital via equity issues. As expected, low stock price motivates the company to choose debt.

4.3 Robustness of Hypothesis 2 results

The sensitivity analysis discussed in this section repeats the one performed in 4.2: other illiquidity measures, restricted subsample, and the estimation method. Therefore, I do not repeat the discussion of each of the tests, but focus on the outcomes. In addition, I check if the results are sensitive to the cut-off point at which firms are defined as issuing equity or debt.

The estimates from the Table 9 show that the Hypothesis 2 test is sensitive to the measure of illiquidity. While coefficients on Roll, and proportion of zero returns are of expected sign and significant, using Gibbs measure yields insignificant result.

Table 9. Alternative liquidity measures in debt-equity choice regressions

	Linear probability model	Logit
Ln(1+Roll)	2.8532	15.2213
	(0.000)	(0.000)
Ln(Gibbs)	-0.0099	-0.0394
	(0.375)	(0.505)
Zeros	0.9676	4.9928
	(0.000)	(0.000)

Note: The table reports the illiquidity coefficients from specifications discussed in 4.3 with the set of controls including time and industry effects, the p-values reported in parentheses are based on White period (for LPM model) or Huber/White (for logit) standard errors.

Table 10 shows the reestimated equations for the restricted sample. The binary choice results remain intact, confirming the significant impact of liquidity on the probability of debt issuance.

Table 11 reports the results of dynamic panel model which allows the next period issue decision to be induced directly by the previous period choice in addition to the correlation across time due to unobserved heterogeneity. I have in part accounted for the state dependence of issue decisions by controlling for past leverage. And results in Table 11 show that accounting for past issue decision has a negligible effect on the estimated relation. The illiquidity estimates remain significant at the 5% significance level.

Finally, I show that the results from binary choice models are not sensitive to the exact cut-off point of 5% which is used to determine when a change in capital structure has occurred. Now the issuance of debt or equity is defined as having taken place if the net change in equity or debt, scaled by beginning of period book value of assets, is greater than 3% or 7%. Table 12 provides similar results to those in Table 8.

Table 10. Debt-equity choice regression for the restricted sample

Variable	LPM	Logit
Illiquidity $_{t-1}$	0.0435	0.1420
	(0.000)	(0.000)
Size $_{t-1}$	0.1512	0.7189
	(0.000)	(0.000)
Market-to-Book $_{t-1}$	-0.0009	-0.1916
	(0.126)	(0.000)
Capital Expenditures $_{t-1}$	0.0747	0.6752
	(0.435)	(0.252)
Profitability $_{t-1}$	0.2723	3.0359
	(0.000)	(0.000)
Tangibility $_{t-1}$	0.2640	1.0543
	(0.000)	(0.000)
Pre-issue leverage	-0.0473	-0.4679
	(0.174)	(0.012)
Ln(Price)$_t$	-0.0774	-0.5381
	(0.000)	(0.000)
Year effects	Yes	Yes
Industry effects	Yes	Yes
Adj./Pseudo R-squared	0.290	0.283
Obs.	5,391	5,391
Obs. with Dep=0	2,175	2,175
Obs. with Dep=1	3,216	3,216

Note: The table reports regression coefficients from the models discussed in 4.3 with the set of controls including time and industry effects. The sample excludes 1,111 observations with price less than 1 dollar and market-to-book greater than 10. The p-values reported in parentheses are based on White period (for LPM model) or Huber/White (for logit) standard errors.

Table 11. Dynamic panel specification of the debt-equity choice regression

Illiquidity $_{t-1}$	0.0603
	(0.035)
Firm size $_{t-1}$	-0.0464
	(0.283)
Market-to-book $_{t-1}$	0.0006
	(0.519)
Capital expenditures $_{t-1}$	0.5565
	(0.043)
Profitability $_{t-1}$	-0.0572
	(0.043)
Tangible assets $_{t-1}$	0.0387
	(0.789)
Pre-issue leverage	-1.1343
	(0.000)
Ln(Price)	-0.1054
	(0.000)
Lagged dependent variable	-0.0626
	(0.598)
Obs.	3,779

Note: The table reports regression coefficients for the Arellano-Bond 1-step estimator from model with one period lagged dependent variable and cross-section fixed effects. The p-values reported in parentheses are based on White period standard errors which account for time-series structure in the disturbances. The dependent variable is binary: 1 for debt issues and 0 for equity issues higher than 1% of the beginning of period total assets.

Table 12. Debt vs. equity choice for alternative definitions of capital issues

	Logit model	
Variable	3% cut-off point	7% cut-off point
Illiquidity $_{t-1}$	0.2798	0.1845
	(0.000)	(0.000)
Size $_{t-1}$	0.9068	0.7981
	(0.000)	(0.000)
Market-to-Book $_{t-1}$	-0.0018	-0.0215
	(0.794)	(0.518)
Capital Expenditures $_{t-1}$	0.2834	0.4913
	(0.611)	(0.413)
Profitability $_{t-1}$	2.7941	2.9280
	(0.000)	(0.000)
Tangibility $_{t-1}$	1.3766	1.0367
	(0.000)	(0.000)
Pre-issue leverage	-0.0250	-0.3629
	(0.882)	(0.058)
Ln(Price)$_t$	-0.5564	-0.5252
	(0.000)	(0.000)
Year effects	Yes	Yes
Industry effects	Yes	Yes
Adj./Pseudo R-squared	0.282	0.275
Obs.	6,845	4,844
Obs. with Dep=0	2,897	2,119
Obs. with Dep=1	3,948	2,725

Note: The table reports regression coefficients from linear probability model with the p-values based on White period standard errors (robust to arbitrary serial correlation and time-varying variances in the disturbances) and logit model with p-values based on Huber/White standard errors. The dependent variable is binary: 1 for debt issues and 0 for equity issues higher than 3% or 7%of the beginning of period total assets. Independent variables (except for price) are lagged one period.

The sensitivity analysis suggests that, as supposed by Hypothesis 2, illiquidity considerations affect the choice of the form of financing, and this conclusion is relatively robust to the altered specifications and composition of the sample.

5 Conclusions

Theoretical studies of asset pricing with frictions have provided a framework in which one can think about the influence of market imperfections on security pricing. Empirical researchers have been successful in capturing these frictions in a number of illiquidity measures and relating them to the prices of financial assets. At the same time these empirical facts have been interpreted only with respect to the investors and their trading activities. However, a stock is not only a financial asset which can be traded on the market but also a tool of financing policy for the company which issues it. The fact that the required rate of return on the equity and, hence, the firm's cost of capital is affected by the liquidity of the firm's shares means that stock market frictions are important for corporate finance.

The focus of this study has been on stock liquidity and financing decisions of the company. Guided by a simple intuition I connected liquidity considerations of investors to the capital structure of the company and suggested that firms less liquid on the market should be more leveraged and more likely to raise capital via debt financing comparing to their liquid peers.

I derive empirical conclusions from two sets of regression. First, I analyzed the liquidity as additional determinant of the debt-to-asset ratio of the firm. The hypothesis was that differences in capital structures of firms can be attributed to differences in liquidity of their equity: companies which stock is not liquid on the market suffer from higher cost of equity and optimally tend to be more levered. Next, binary choice regressions analyzing the choice between debt financing and equity financing have been considered. I abstracted from the amount of the net issuing activity and examined only the choice of the form of financing at the time of significant capital structure adjustments that impact leverage.

The results suggest that less liquid firms tend to be more levered and are more likely to raise capital with debt. Examining the determinants of firm's debt in the static framework I found that more illiquid firms have statistically and economically lower leverage ratios. Even if new information about stock market liquidity is not an important predictor of observed debt ratios as suggested by dynamic panel model, in the model of capital adjustment choice I show that firms do take into account both the entire history and news on cost of issuing an illiquid equity when making their financing decisions. This suggests that stock liquidity affects the relative attractiveness of equity vs. debt on the margin. When firms decide to raise a significant amount of new capital, their choice between equity and debt depends on the illiquidity. Less liquid firms are more likely to issue debt. This effect is observed even after other determinants suggested by the literature have been controlled for.

To summarize, the evidence I presented in this thesis supports the hypothesis that stock market imperfections play an important role for corporate finance. They are of particular importance when firms adjust their capital structure. The results are consistent with managers being concerned about cost of equity capital for the firm and incorporating these concerns in their decisions.

This work contributes to understanding of the motives and considerations that explain corporate finance decisions. Investors are concerned about how quickly and costless they can trade the stock, as suggested by higher returns which accompany illiquid securities. This paper shows that these concerns carry on to the real economy through corporate decision-making consequences. Besides financing, another link from stock market to company's internal policy can be made regarding payout and investment decisions. All things being equal, higher liquidity of the company's stock should encourage managers to explore the tax advantage of equity repurchases. In addition, since financing and investment are linked, it is naturally to suppose that liquidity affects the company's investment decisions as well. Future corporate finance research would benefit from taking into account liquidity costs and risks faced by investors to ensure correct inferences in empirical tests meant to explain the observed corporate behavior.

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Appendix

Table 1. Variable definitions

Variable	Units	Definition
Book Assets	Millions	The total value of assets reported on the Balance Sheet
Book Leverage	%	Liabilities minus deferred taxes and investment tax credit, plus preferred stock (scaled by total value of book assets).
Capital Expenditures	%	Cash outflow or the funds used for investment in the company's property, plant and equipment, excluding amounts arising from acquisitions (scaled by total assets)
Change in debt	Millions	Issuance of long term debt minus long term debt reduction, plus changes in current debt (the net change in short-term borrowings and/or current maturities of long-term debt).
Change in equity (Net stock issues)	Millions	Sale of common and preferred stock minus purchase of common and preferred stock
Depreciation and Amortization	%	Non-cash charges for obsolescence and wear and tear on property, allocation of the current portion of capitalized expenditures, and depletion charges (scaled by total value of book assets)
Effective taxes rate	%	The ratio of positive total income taxes to pretax income if taxable income is positive. In case of loss or tax refund from the government the value of zero is assigned.
Market-to-book	Units	End of year market capitalization, computed as end of year stock price times shares outstanding and scaled by book value of assets
Pretax income	Millions	Sum of operating and non-operating income before provisions for income taxes and minority interest.
Price	Dollars	End of year price per share.
Property, Plant and Equipment	%	The cost, less accumulated depreciation, of tangible fixed property used in the production of revenue (scaled by total assets).