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On Capital Structure and the Liquidity of a Firm's Stock

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Abstract

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Prior capital structure literature has only touched on a causal relation between liquidity and leverage (i.e., liquidity affects leverage). We use a two-stage least squares analysis to explore the notion that these variables are jointly determined. Consistent with the idea that debt forces managers to make better investment decisions, we find that as leverage increases, equity bid-ask spreads decrease. Using the fitted values from our first-stage regression, results from the second-stage regression further imply that as liquidity decreases, leverage increases, which is consistent with the notion that managers rely on debt financing when the cost of equity financing increases. While controlling for the endogenous relationship between spreads and leverage greatly reduces the impact of spreads on leverage, results from our analysis suggest that a one standard deviation increase in spreads results in a 3% increase in leverage. Not only do our results add to the understanding of the complex relationship between capital structure and liquidity, they also shed light on the determinants of leverage and bid-ask spreads.

1 Introduction

Capital structure decisions have been a focal point of the corporate finance literature, and in an effort to explain capital structure, researchers have run a lengthy "horse race" between the pecking order and tradeoff models. But, Fama and French (2005) write that "both the tradeoff model and the pecking order model have serious problems. Thus, it is probably time to stop running empirical horse races between them as stand-alone stories for capital structures." In this paper, we consider a different determinant of capital structure: equity liquidity. While variables such as size, growth opportunities, profitability, and even measures of information asymmetry have been used to explain leverage, equity liquidity has been largely ignored. Weston, Butler, and Grullon (2005) show that the liquidity of a firm's equity affects the ease with which a company can raise external capital via a stock offering. Thus, it seems obvious that liquidity could directly affect a firm's capital structure, and the fact that it has received little attention as an explanatory variable is somewhat surprising.

Relative to investors, managers have superior information about their firm's investment opportunities and issue stock when it is overvalued; security prices therefore fall upon issuance since investors are wary of an information asymmetry problem (Myers (1984)). But, an infinitely liquid stock has willing buyers and sellers ready to trade and trades free of any price impact, so (as Baker and Stein (2004) suggest) managers can reduce this negative price impact that accompanies an issuance by issuing equity when liquidity is high. Indeed, Graham and Harvey (2001) find that market timing plays an important part in CFO financing decisions and that low adverse selection costs accompany "hot markets" when equity offerings are substantial (see also Korajczyk, Lucas, and McDonald (1992) and Alti (2005)). Weston, Butler, and Grullon (2005) further suggest the cost of issuing equity is lower for a highly liquid stock. Though these studies have focused on equity issuance, taken together, these empirical results suggest that a stock's liquidity will alter a firm's capital structure because managers have an incentive to raise money by issuing equity rather than debt when liquidity is high.[1] In fact, Lipson and

[1]Arguably, narrower spreads may also facilitate access to debt markets. But since debt has a fixed income stream and is accompanied by less adverse selection, the effect of liquidity on raising debt (vis-a-vis equity) should be smaller. Additionally, one might wonder why we do not consider debt liquidity as well. We discuss this question in Section 1.

Mortal (2006) examine the cross sectional relation between capital structure and liquidity and find that liquidity explains an economically significant part of that cross section. At the same time, there is good reason to believe that liquidity could be affected after capital restructuring. For instance, following leveraged buyouts, performance improvements are fairly predictable (Shleifer (1997)), especially since debt can reduce agency costs. A reduction in agency costs between manager and shareholders also mitigates information asymmetry, which increases liquidity.[2] In this paper, we examine how a stock's equity liquidity impacts a company's leverage. We also consider that the relationship between liquidity and capital structure may be endogenous. We not only show that capital structure affects liquidity but, even after taking into account the bi-directional relationship, liquidity has a significant impact on leverage.

To determine the causality between leverage and liquidity, we first explore the effect of leverage on bid - ask spreads (our proxy for liquidity). We then use an instrumental variables approach and perform two-stage least-squares estimation to capture the effect of liquidity on leverage. Based on a panel of all NYSE firms with Trades and Automated Quotations (TAQ), CRSP, and COMPUSTAT coverage from 1988-1998, we find that capital structure *does* influence liquidity. Specifically, as leverage increases, spreads decrease (liquidity increases). In line with Jensen (1986), this result indicates that debt reduces agency costs or, put differently, managers who are responsible for meeting interest and principal payments of debt are forced to choose positive net present value projects. This finding is also consistent with the idea put forth in Amihud and Mendelson (1989) that managers' capital structure decisions reflect their concern that illiquidity reduces value. Our second result indicates that *after* accounting for the effect of leverage on liquidity, liquidity is a significantly negative determinant of leverage, which suggests that firms with smaller spreads are more likely to issue equity than debt to raise money. As compared to running a single stage regression of leverage on spreads, controlling for the endogenous relationship between leverage and liquidity significantly mutes the role that liquidity plays in determining leverage. Specifically, our analysis suggests that a one standard deviation increase in spreads results in just over a 3% increase in leverage. Though an effect of 3%

[2]As will be discussed, equity bid-ask spreads (our measure of liquidity) have three components: inventory carrying costs, order processing costs, and adverse selection costs. When information asymmetry is reduced, the adverse selection component of the spread (as well as the entire spread) is decreased, and liquidity increases.

is approximately 1.5% lower than when endogeneity is not considered, 3% is economically important and represents approximately one-twelfth of the average firm's leverage. Our result accords with the notion that managers issue equity when the chance of a negative price impact is relatively low, i.e., when spreads are narrow and liquidity is high (Baker and Stein (2004)).

The remainder of the paper is organized as follows. Section 2 discusses the importance of liquidity on firm value, and motivates and describes our hypotheses. Section 3 describes the data and introduces the empirical analysis. Results are given in Section 4. Robustness checks are presented in Section 5, and Section 6 concludes.

2 Motivation and Hypotheses

2.1 Relevant literature

Amihud and Mendelson (1986) suggest that firms have an incentive to choose corporate policy that makes their securities more liquid because liquidity increases firm value.[3] Amihud and Mendelson (1989) further note that managers who are concerned about increasing the liquidity of their firm's financial claims can do so through corporate policies such as going public, voluntary disclosure, and distributing ownership among a wider base of shareholders. The fact that increases in liquidity through such corporate decisions can increase value suggests that increases in liquidity can also lower the cost of capital. Indeed, Weston, Butler, and Grullon (2005) find that a) investment banks charge lower fees to firms with more liquid equity and b) the time to complete a seasoned equity offering decreases with a firm's equity liquidity.

To further appreciate the impact liquidity can have on a firm's cost of capital, consider extant market microstructure literature which documents the effect of illiquidity on expected equity returns. Theoretical asset pricing models suggest that uninformed traders who trade against informed investors require higher rates of return for relatively illiquid securities. Amihud and Mendelson (1986), for example, suggest a liquidity premium,

[3]Surveys such as Baker and Pettit (1982) find that managers care about the liquidity of their firm's stock because an increase in liquidity lowers transaction costs and increases value (see also Wan (2001)).

wherein higher transaction costs of less liquid stocks are associated with higher required rates of return and, therefore, a higher cost of capital. They claim that investors with long holding periods can gain by holding high-spread assets because, net of trading costs, they earn a higher expected return.[4] Specifically, they find that a 1% increase in bid-ask spread is accompanied by a .21% increase in monthly risk-adjusted excess return. Brennan and Subrahmanyam (1996) and Brennan, Chordia, and Subrahmanyam (1998) are two empirical studies that suggest decreases in liquidity result in a higher cost of capital. The former article documents that both fixed and variable costs of trading (reflected in the bid-ask spread) are associated with a significant return premium, and the latter posits that a one standard deviation increase in dollar volume implies a decrease in excess return of 0.11% per month for NYSE stocks. Pastor and Stambaugh (2003) find that stocks with greater exposure to *market-wide* liquidity changes require higher expected returns. Together, these studies suggest that investors are willing to pay more for assets with higher liquidity and require compensation for bearing costs of illiquidity. Given the economic impact of liquidity on firm value (Amihud and Mendelson (1988)), we explore whether this effect is large enough to affect leverage choice. By way of lowering flotation costs, liquidity adds value to a firm (Weston, Butler, and Grullon (2005)). This finding implies that higher liquidity allows for more frequent visits to capital markets. Based on the notion that corporate policy can influence liquidity (presented in Amihud and Mendelson (1986)), we also provide evidence that a company's capital structure influences its equity's liquidity. Further, hinging on the idea that a firm's cost of equity (and therefore its cost of capital) is at least partially determined by the liquidity of its shares, we show that even after accounting for the impact that capital structure has on liquidity, liquidity plays a significant role in determining a firm's leverage.

Arguably, narrower spreads may also facilitate access to debt markets. But since debt has a fixed income stream and is accompanied by less adverse selection, the effect of liquidity on raising debt (vis-a-vis equity) should be smaller. Further, private correspondence with the Executive Director of Fixed-Income Sales at Morgan Stanley Dean Witter indicates that most outstanding debt is not exchange traded, and for the debt that is, there is no bid or offer. Additionally, it is not uncommon for firms to issue debt to a few institutions that plan to "buy and hold" (rather than trade) the issue. Finally, stocks

[4] The spread is the difference between the bid and ask prices.

are, on average, held for about one year (Barber and Odean (2000)) whereas one would expect that bonds are held longer-term. Thus, it does not appear that bond liquidity is nearly as important of a determinant as is equity liquidity in raising external funds.

2.2 Hypotheses

Section 2.1 suggests that the liquidity of a firm's stock affects the ease with which a firm can raise external capital, and our ultimate goal is to understand the impact that liquidity has on leverage. Amihud and Mendelson (1988) note that forming a portfolio of securities does not eliminate liquidity risk (even if it is idiosyncratic) since an investor pays transaction costs on every trade. Thus, investors will pay more for more liquid assets. Because of the impact that liquidity has on a firm's expected cost of equity and firm value (Amihud and Mendelson (1986)), managers have an incentive to change their capital structure decisions in order to increase their stock's liquidity. Hence, to properly analyze the role that liquidity plays in determining capital structure, we first need to understand how leverage affects liquidity (measured by bid-ask spread).

The first hypothesis that we explore is that increases in debt increase the firm's financial burden (for example, interest payments) and the riskiness of the firm, which results in reduced liquidity. A firm with a large amount of debt relative to the size of its equity, *ceteris paribus*, puts its equity holders at greater risk. Put differently, since equity holds the residual claim to a firm's cash flows, shareholders face more uncertainty as debt levels increase. Additionally, high leverage may cause managers (with minimal equity share) to select less risky investments and not make value-maximizing decisions. Investors have diminished interest in trading or holding such a stock, and this causes the market maker to set wider spreads.[5,6] Frieder and Subrahmanyam (2005) find a negative relationship between leverage and institutional holdings, which are positively related to liquidity (Dennis and Weston (2001)). By way of its effect on institutional holdings, leverage may have an indirect, negative effect on liquidity. Further, traditional accounting measures such as the current ratio, among others, suggest that firms with greater debt are simply less liquid;

[5] Since this risk is idiosyncratic, investors will not be compensated with higher required returns.

[6] Low volume stocks make it difficult for market makers to achieve their target inventory levels, so market makers set wider spreads for such stocks as compensation.

such illiquidity may spill over to the firm's equity:

Hypothesis 1A *Issuing debt increases the interest burden and the riskiness of a firm and therefore reduces liquidity.*

To the contrary, there is reason to believe that liquidity may increase with leverage. Increased default risk that accompanies high leverage may cause mangers to make better investment decisions since bankruptcy may lead managers to lose control and reputation benefits (Grossman and Hart (1986)). Additionally, after leveraged buyouts (LBOs), improvements that occur are fairly predictable, especially since debt overhang can reduce agency costs (Shleifer (1997)). Kaplan (1989) provides evidence that LBOs that subsequently go public increase operating performance and value, and Bhagat, Shleifer, and Vishny (1990) suggest that the increase in profitability that accompanies an LBO is related to a reduction of agency costs. Decreased agency costs between manager and shareholder would also reduce information asymmetry, and thereby increase liquidity. These arguments give rise to a competing, alternative hypothesis. It may be the case that as firms take on more debt, managers who must meet interest payments are forced to make more efficient investment decisions. Essentially, this reduces information asymmetry problems between investors and managers, which results in increased liquidity (reflected in narrower spreads).

Hypothesis 1B *Increased debt forces managers to make better investment decisions thereby reducing information asymmetry between managers and investors and, thus, increasing the liquidity of the firm's stock.*

Moving away from the idea that capital structure plays a role in determining liquidity, our third hypothesis addresses the reverse causality: that liquidity affects capital structure. Because investors are willing to pay more for more liquid stocks, and because illiquidity is associated with a higher cost of capital and therefore a lower firm value, we explore whether changes in the liquidity of a firm's stock affect the firm's optimal capital structure. Finally, because a firm's ability to absorb a share issue will influence management's incentives to issue equity, we hypothesize that greater liquidity results in lower leverage:

Hypothesis 2 *A firm's equity liquidity is negatively related to leverage because firms with more liquid equity find it more attractive to issue equity relative to other financing options.*

The pecking order theory (Myers (1984)) predicts that firms will issue equity as a last resort. Fama and French (2005), however, find that over two-thirds of large firms issue equity during their sample period. Models such as Fama and French (2002), among others, test the idea of a pecking-order theory, wherein firms should issue equity when there is less information asymmetry (i.e., liquidity is high or spreads are small) since there will be less of a discount on new issues.[7] The assumption underlying Hypothesis 3 is that narrow spreads are associated with low information asymmetry (or a lower probability of informed trading as in Easley, Kiefer, O'Hara, and Paperman (1996)) and high liquidity (Kyle (1985)). One possibility is that liquidity is also relevant in the debt market, in which case the prediction about leverage would be indeterminant. Nonetheless, liquidity is much less relevant in the debt (vis-a-vis the equity) market since a) most outstanding debt is not exchange traded, b) for the debt that is, there is no bid or offer, and c) it is not uncommon for firms to issue debt to a few institutions that plan to "buy and hold" (rather than trade) the issue.

Lipson and Mortal (2006) claim that more liquid firms are likely to choose equity over debt when raising money, but they do not account for the effect that leverage has on liquidity. As discussed above, if a firm has high levels of debt, the incentive to hold equity may be lower because the equity is, all else equal, riskier.[8] Additionally, if leverage reduces liquidity, the shareholder base may be further diminished since liquidity traders allocate their demands to the stocks where they face the lowest transaction costs (Huddart, Hughes, and Brunnermeier (2002)). This will further reduce liquidity. The aforementioned studies underscore the importance of isolating the effects of liquidity on capital structure from those of capital structure on liquidity.

[7]Dierkens (1991) links lower adverse selection costs to lower costs of equity issuance. See also Korajczyk, Lucas, and McDonald (1991), Reinganum (1990), Amihud, Lauterbach and Mendelson (1997), Amihud (2002), Easley and O'Hara (2002), and Easley, Hvidkjaer, and O'Hara (2002).

[8]See Frieder and Subrahmanyam (2005) who find a negative relationship between leverage and institutional holdings.

3 Data

3.1 The Data

In previous theoretical and empirical market microstructure literature (see, for example, Kyle (1985) and Chordia, Roll, and Subrahmanyam (2002), respectively), quoted and effective spreads represent the liquidity of a financial asset. We use these variables, defined next, as proxies for liquidity. Spreads compensate a dealer for order processing costs (Roll (1984)), inventory carrying costs (Demsetz (1968)), and adverse selection costs of trading with investors who may have superior information (Copeland and Galai (1983)). The *quoted* spread (the price at which the market-maker is willing to sell less that at which he is willing to buy) is a transaction cost for traders who require immediacy in terms of execution. However, there are certain instances where transactions occur within the quoted spread. For example, market-makers may be slow to update their quotes, they may wish to rebalance their own inventory and do this by "bettering" existing quotes, or they may wish to provide discounts to customers who they believe are trading for reasons other than private information. Thus, we focus our analysis on *effective* spreads, those spreads at which transactions actually occur. Our measure of spreads are determined by actual trades and quotes from the ISSM and TAQ databases. Though these data limit our sample to NYSE stocks from 1988-1998, they allow us to *directly* measure the costs of trading, as opposed to using, for instance, the method proposed by Roll (1984) wherein the spread is deduced from price data. We use annual average daily spreads in our regressions.

3.1.1 Determinants of Spreads

To examine the role that leverage plays in determining liquidity, we consider known determinants of effective spreads. First, spreads are highly persistent so we control for lagged spreads in our regressions. We also control for size and volatility (Roll (1984)), volume (Easley and O'Hara (1987)), and institutional holdings (Dennis and Weston (2001)). Size is measured as the log of market capitalization (the number of shares outstanding multiplied by share price at the end of the year), and volatility of returns is defined as annual variance of daily returns, which are obtained from CRSP. Trading volume data are obtained from TAQ. Annual institutional holdings are obtained from Standard & Poor's (S&P). As in Chordia, Roll, and Subrahmanyam (2001, 2002) and Chordia and Subrahmanyam (2004), our spread data are obtained from daily transactions from the NYSE TAQ database. We eliminate stocks with prices less than $1.00 and all financial and utility firms (SIC codes between 4900 and 4999 and between 6000 and 6999).

Because leverage is considered a measure of the likelihood of financial distress, we explore whether firms with higher leverage have lower equity liquidity. Equity holders are subordinate to bond holders in the event of default; thus, highly levered firms are riskier for equity holders. We use market value of leverage as our leverage variable for three reasons. First, liquidity (measured here by spreads) is largely an equity market phenomenon. Second, book value has been referred to as a "plug number that equalizes both sides of the balance sheet" (p. 511, Welch (2006)). Third, recent research (Flannery and Rangan (2006), Fama and French (2002), among others) has focused on market-value of leverage ratios. In line with Baker and Wurgler (2002), we take the following steps to compute market value of leverage. We define book value of equity as total assets less liabilities less preferred stock plus deferred taxes and debt (COMPUSTAT data item 6 - 181 - 10 + 35 + 79); book value of debt is simply total assets less book value of equity. Market value of equity is the product of COMPUSTAT data items 25 and 199, and market value of assets is total assets less book equity plus market equity. From here, we obtain our measure of market leverage by dividing book debt by market value of assets. Consistent with previous literature, we eliminate observations for firms with market leverage falling in the upper 0.5% of our sample distribution. All data are annual to ensure the maximum possible number of observations.

3.1.2 Determinants of Leverage

To best examine the impact of spreads on leverage, we need to control for known determinants of leverage. In our equations using market leverage as the dependent variable, we include return on assets (henceforth, ROA) which represents profitability as an independent variable (Baker and Wurgler (2002) and Fama and French (2002)). More profitable firms have access to more cash, which not only reduces the need for debt but also helps to pay it off, predicting a negative relationship between ROA and debt (Myers (1984)). ROA is defined as earnings before interest and taxes (the sum of COMPUSTAT data items 15, 16, and 18) divided by book value of assets (data item 6). We also include size, defined here by the log of the book value of assets (data item 6). We predict a positive relationship between size and leverage. Since firms may be more tempted to issue equity when markets are overvalued, we also control for market-to-book, defined as the ratio of market value of assets to total assets (and predict a negative relation between market-to-book and leverage). We follow Baker and Wurgler (2002) and define market-to-book as the ratio of total assets less book value of equity plus market value of equity to total assets.

Leverage may also be affected by the stability of cash flows. A volatile revenue stream will make the lender more risky and therefore may affect the ability or incentives of the company to issue debt. Thus, we also account for the volatility of cash flows (defined as the rolling variance of quarterly cash flows (data item 21) over a five year window). We include research and development (R & D) expenditures (data item 46) and a dummy variable for firms that report R & D (Titman and Wessels (1988)) to capture any non-linear effects that R & D might have on leverage. We predict that firms with R & D need more external financing so, all else equal, have higher leverage.[9]

Table 1, Panel A presents summary statistics for the variables we consider. The total number of observations is just over 5000 firm-years (we have leverage data on 605 firms and spread data on 738 firms). From the first row, we see that the average effective spread is 0.136, with a standard deviation of 0.037. Quoted spreads are, as expected, slightly larger (0.208) with a standard deviation of 0.056. Effective spreads should be smaller because transactions often occur within the quoted spread. Neither measure of spreads displays skewness. The average firm in our sample has a market capitalization of 691 million dollars. Size in terms of assets averages 2.18 billion and is highly skewed with a large standard deviation: 3.6 billion. Average return volatility over the period is 0.44%. Volume averages 186,200 shares. Institutions hold, on average, 53.7% of publicly traded stock. Market leverage is 38.6% on average. Market-to-book has a mean of 1.63 (this relatively high value is likely an artefact of the sample period). ROA has a mean

[9] Alternatively, since R & D is often intangible, it may be more easily financed with equity, possibly resulting in a negative relation between R & D and leverage.

of approximately 9.51%, and volatility of cash flows averages 24.2 million dollars, with a standard deviation of 39.48. Firms spend, on average, 67.8 million dollars on R & D expenses, or just over 3% of their total assets.

Specific trends are notable from Table 1, Panel B, which gives year-by-year averages of our variables. First, effective spreads decrease monotonically from an average of 0.181 in 1988 to 0.105 in 1998. This difference is statistically significant. Quoted spreads follow a similar pattern. Chordia, Roll, and Subrahmanyam (2001) note that there was a particularly large drop in quoted spreads in June 1997 when the minimum tick size was reduced from one-eighth to one-sixteenth on the NYSE. Perhaps a result of the decrease in trading costs, volume rises by more than 100%: from an average of 133,000 shares in 1988 to 308,000 in 1998. Institutional holdings also increase over the period (from an average of approximately 48% in 1988 to nearly 61% in 1998).

Table 2 presents pairwise correlations for the variables we use in our analysis. The strongest correlations are those between spreads and size (measured by both assets and market capitalization) and spreads and volume (respective correlations are -0.16, -0.11 and -0.29), confirming that large and actively traded stocks are more liquid. The correlation between spreads and volatility is significantly positive: 0.28, which accords with the idea that volatility of returns as a risk measure is associated with higher spreads. Institutional holdings are negatively related to spreads, consistent with the idea that institutions prefer to hold more liquid stocks.

More relevant to this study, market leverage is positively correlated with size measured by assets (0.13). This well-known result suggests that large firms with more assets to offer as collateral have lower default risks since bankruptcy costs would be a smaller portion of their capital (Titman and Wessels (1988)). Market leverage is significantly negatively correlated with profitability ($\rho = -0.45$). The correlation between R & D as a percentage of total assets and leverage is also significantly negative, -0.25, which accords with the notion that since R & D is an intangible, it is more easily financed with equity. Predictably, size and volume are both positively correlated with institutional holdings.

While the univariate correlations are useful in leading us to the most appropriate determinants of spreads and leverage, they provide little insight on the relationship between spreads and leverage, and provide no insight on the direction of the effect. Thus, in the remainder of the paper we perform two-stage least squares multivariate regression analysis and focus our attention on understanding the relationship between spreads and market leverage.

3.2 Regression Specification

We propose the following firm-level fixed effects (system of) equations, wherein we not only assume that the liquidity of a firm's equity affects the firm's capital structure but also that a firm's leverage influences its liquidity:

$$SPREAD_t = \gamma_t + \delta_1 * LEV_t + \delta_2 * \sigma^2_{R_t} + \delta_3 * ROA_t + \delta_4 * ln(MKTCAP_t)$$

$$+\delta_5 * VOL_t + \delta_6 * INST_t + \delta_7 * SPREAD_{t-1} + \eta_{1,t} \quad (1)$$

and

$$LEV_{t+1} = \alpha_{t+1} + \beta_1 * LEV_t + \beta_2 * SPR\hat{E}AD_t + \beta_3 * ROA_t + \beta_4 * \sigma^2_{CF_t} + \beta_5 * SIZE_t + \beta_6 * MTB_t$$

$$+\beta_7 * INST_t + \beta_8 * RD_t + \beta_9 * RD/ASSETS_t + \eta_{2,t+1}, \quad (2)$$

where LEV is market leverage, σ^2_R is annual return variance, ROA signifies return on assets, MKTCAP is market capitalization, VOL represents volume, INST denotes institutional holdings, SPREAD represents effective spreads,[10] σ^2_{CF} measures volatility of cash flows, SIZE is the log of the book value of assets, MTB is the market-to-book ratio, RD is a dummy that equals 1 if a firm does any R & D and zero otherwise, RD/Assets is R & D as a proportion of total assets, and η_1 and η_2 are error terms. Note that the first equation is contemporaneous, while the second is not. We examine the next period (time $t + 1$ instead of time t) in the second equation since it takes firms time to adjust their capital structure.

[10] In the second equation, $SPR\hat{E}AD$ represents the fitted value of effective spread.

We first estimate the spread equation (Equation 1) for our panel of firms. Prior literature (discussed above) indicates that liquidity may influence leverage, but our method allows us to determine if leverage also influences liquidity or, put differently, if these variables are bi-causal. Because our measure of liquidity is bid-ask spread which is inversely related to liquidity, Hypothesis 1A predicts $\delta_1 > 0$ and Hypothesis 1B predicts $\delta_1 < 0$. After estimating Equation 1, we use the coefficients from it to generate a predicted value of spreads and use that estimate in the second equation (i.e., we use the fitted values as instruments for spreads). We then estimate β_2. Hypothesis 2 suggests $\beta_2 > 0$. Our goal is to test whether the role that leverage plays in determining liquidity has any relevance for the role that liquidity plays in determining leverage. We run this set of equations using effective and quoted spreads. Later in the paper, as a robustness check on our notion of liquidity, we also examine other indicators of a stock's ability to absorb a new share issue.

4 Results

As indicated above, because we believe leverage impacts spreads, we first employ firm-level fixed effects to regress spreads on market leverage,[11] while controlling for lagged spreads, return volatility, size, profitability, volume, and institutional holdings. Results are presented in the second column of Table 3. Most pertinent to this study, market leverage is significantly and negatively related to effective spreads (t-statistic = -4.83). The fact that increases in leverage decrease spreads (increase liquidity) is consistent with the notion proposed in Jensen (1986), wherein debt forces managers to be more disciplined and thereby reduces information asymmetry between borrowers and lenders. This is reflected in narrower spreads (i.e., the component of the bid-ask spread relating to adverse selection is reduced). Despite the fact that more debt adversely affects equity holders in two ways (there is a higher probability of default since more debt is accompanied by an increased interest burden and, given a default, additional debt causes the value of

[11] A Hausman test strongly rejects the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as those estimated by the consistent fixed effects estimator. The test therefore supports the use of a fixed effects estimator. Further, to control for the presence of heteroscedasticity and/or serial correlation we use the robust asymptotic variance matrix estimator proposed by Arellano (1987) and Woolridge (2002), which is particularly suitable in a case like ours when the length of the time series is small relative to the number of cross-sections in the panel.

the residual claim represented by equity to decrease), it appears that for the firms in our sample the benefits of increasing leverage more than offset the costs. This result is consistent with Hypothesis 1B. Additionally, the significantly positive coefficient on lagged spreads ($t = 7.13$) suggests that effective spreads are highly persistent. Other postulated variables are also significant determinants of spreads. For example, volume is negatively related to spreads ($t = -5.71$), as is size ($t = -13.25$). These results accord with evidence found in Easley and O'Hara (1987), who suggest not only that large firms are more liquid, but there is more trading activity in liquid firms. Volume may be high in liquid stocks because transaction costs are lower.[12] Our first-stage regression also suggests that spreads are positively and significantly related to volatility. Variance of returns is a measure of risk, and this risk is negatively correlated with liquidity. The R^2 for this regression is 49%.[13] A primary reason for such a large R^2 is the dependence of spreads on lagged spreads. Yet, even with the persistence in spreads, leverage has an incremental effect on liquidity. Because spreads contain elements that are not related to information asymmetry (i.e., order processing and inventory carrying costs), we perform an unreported analysis that considers the effect of the probability of informed trading (PIN, Easley, Kiefer, O'Hara, and Paperman (1996)), a measure of information asymmetry, on leverage. We find a significantly negative relationship: as leverage increases, PIN decreases (t = -4.34).[14] This result is also consistent with the idea that increased leverage decreases information asymmetry.

We now explore the impact of effective spreads on market leverage, while controlling for other postulated determinants of market leverage. We use the estimates from the first-stage regression in regression 2, which features leverage as the dependent variable. That is, we use the predicted value of spreads from our first regression and give it the role of an independent variable in the second equation. Results for this regression are presented in the third column of Table 3.

[12] Of course, the relationship between liquidity and volume is bi-directional, and as volume increases liquidity increases and spreads fall. Also worth noting is that Easley, Kiefer, O'Hara, and Paperman (1996) suggest that the probability of an information based trade is lower in actively traded stocks (thus market makers need not set spreads as wide for these stocks), and Madhavan and Smidt (1991) suggest that it is easier for market makers to maintain their target inventories if a stock is actively traded.

[13] Although we include additional lags of MTB and RD/Assets in our regressions, eliminating them from the specification does not alter our results.

[14] Results are available upon request.

Given the persistence of leverage (Welch (2004)), an important variable to include in our equation is lagged market leverage. Controlling for the previous year's leverage allows us to determine whether spreads have an incremental effect beyond that of lagged leverage. Consistent with Welch (2004), market value of leverage is highly sticky (the coefficient on lagged leverage is approximately 0.5). Other control variables also take their expected signs: for example, size is positively correlated with leverage ($t = 6.59$).[15] Market-to-book, which we include as a measure of growth opportunities, has a negative sign (t = -2.96), and lagged market-to-book is positively (but only marginally) related to market leverage. The coefficient on the R & D dummy variable is significantly negative, indicating that firms that undertake R & D have, on average, lower leverage. As mentioned above, firms that engage in R & D often have more intangibles and may find it easier to use equity financing. The coefficient on R & D as a proportion of total assets is insignificant, as is the coefficient on profitability.

Besides indicating a bi-directional impact of leverage and liquidity on each other, our results suggest that effective spreads positively predict market leverage, which is consistent with Hypothesis 2. Specifically, the coefficient is 0.841, and the t-statistic is 4.41. This suggests that a one-standard deviation increase in spreads results in approximately a 3% increase in our leverage variable ($0.03 \approx 0.841 * 0.037$). This result is consistent with the evidence found in Weston, Butler, and Grullon (2005) that the cost of and time to complete SEOs are reduced for firms with higher liquidity, or put differently, that equity financing is more expensive for more illiquid firms. Our finding further accords with the idea that when equity financing is expensive, firms turn to debt financing. Although one might wonder if narrower equity spreads also make it easier for firms to access debt markets (see Faulkender and Petersen (2005)), since debt has a fixed income stream, there is less of an adverse selection for debt, so the effect should be smaller. Additionally, as discussed in Section 1, debt liquidity does not appear to play as important of a role as does equity liquidity in raising external funds.

[15]We use size as measured by market capitalization in the spreads equation and size as measured by book value of assets in the leverage equation since extant literature has explained spreads with market capitalization and leverage with book value of assets. Nonetheless, our results are qualitatively unchanged if we use the same variable in both equations.

Two points about our regression specification should be mentioned. One of the obvious concerns with time series estimation is the existence of time series persistence, namely unit root processes. Woolridge (2002) shows that in the case of a fixed number of time periods and a large cross-section, however, unit root processes are not a concern because of the asymptotics assumed (p. 175). Another potential problem is that there may be an omitted variable that affects the right and left hand side variables which would result in serially correlated errors in a panel setup. To check this, we assume that the errors follow an AR(1) process ($\eta_t = \rho * \eta_{t-1} + e_t$, where η is the residual from Equation 2) and we generate a series of residuals using pooled OLS. We then run another pooled regression that includes the lagged residuals: $LEV_t = \beta * X_{t-1} + \rho * \eta_{t-1} + e_t$, where X represents all of our right hand side variables. A simple t-test shows that $\hat{\rho}$ is not significant.

Note that Odders-White and Ready (2006) find that firms with greater measures of adverse selection have poorer credit ratings, which would suggest as spreads increase, leverage would decrease because it is relatively more costly to issue. While distinct from the evidence presented in their paper, our findings are not inconsistent with Odders-White and Ready (2006). Overall, our results support the idea that when their equity is liquid, firms issue *proportionally* more stock than debt, since they can do so without incurring large costs (Baker and Stein (2004)).[16] Indeed, Myers (1984) recognizes that transaction costs may be higher for equity than for debt. The R^2 for the second stage regression is 27%. Though we show that liquidity affects capital structure, our result is also not inconsistent with Bharath, Pasquariello, and Wu (2006) who find that only under certain conditions does information asymmetry affect capital structure. Unlike their study which examines measures of information asymmetry, our analysis focuses on spreads, or actual transaction costs faced by investors, which also include order processing and inventory carrying components.[17]

[16] It is worth noting that in an especially bad market, it is easier for firms to be completely shut out of the debt market than the equity market, which would be inconsistent with our result. However, this point is moot since our sample period is a boom period.

[17] Given the debate on whether market or book leverage is the correct measure of debt (see, for example, Welch (2004)), we repeat our analysis using book leverage. As anticipated, the results using this variable are not as strong. Our analysis focuses on how stock liquidity affects capital structure, and stock liquidity is an equity market phenomenon (see Brennan and Subrahmanyam (1996)). Thus, we maintain that the result we document in this paper should relate primarily to market leverage, and not to book leverage.

We now examine the same regressions using quoted, rather than effective, spreads. These results are presented in the fourth and fifth columns of Table 3. The results using quoted spreads are similar to those using effective spreads. In particular, volatility, profitability, size, and volume retain the same signs. Looking at the effect of leverage on quoted spreads, the results suggest that leverage is negatively related to quoted spreads, as it is to effective spreads. The coefficient of leverage on quoted spreads, however, is slightly larger. This result is consistent with Kyle (1985), who associates narrow spreads with higher liquidity and lower information asymmetry. The R^2 for this regression is 62%, 13% higher than it is for the effective spread regression. A possible explanation is that quoted spreads are set by the market maker and are not subject to the same trading idiosyncracies that impact effective spreads.

In the second-stage equation for quoted spreads, the control variables again take the same signs and similar significance as in the effective spread equation: market-to-book and the R & D dummy variable have significantly negative coefficients, while the coefficient on size is significantly positive ($t = 5.71$). As is the case for Equation 1, the signs of the coefficients on quoted spreads are the same as those on effective spreads. The significantly positive coefficient, 0.301, suggests that quoted spreads are significantly positively related to market leverage ($t = 3.69$). Note that in this case, a one standard deviation increase to quoted spreads only (but still significantly) increases leverage by just over 1.6%. We would not expect the effect of quoted spreads on leverage to be as large as that of effective spreads on leverage since effective spreads are the transaction costs that market participants actually face. The R^2 for this regression is 27%. Concisely put, even after controlling for known determinants of leverage, and accounting for the effect that capital structure has on liquidity, spreads seem to be an important player in determining capital structure.

5 Robustness Checks

Welch (2004) shows that stock returns are an important determinant of debt ratios and Welch (2006) notes that changes in the market value of equity tend to come from price changes, rather than from changes in the number of outstanding shares. Mechanically, firms that have experienced recent value increases have lower debt ratios, and managers do little to move back to target debt ratios.[18] Thus, our previous results that suggest that leverage decreases as liquidity rises may simply be uncovering the mechanical effect that price appreciation has on leverage. We address this concern by controlling for price on the right hand side of our equations.[19] As shown in Table 4, price is significantly negatively related to leverage ($t = -1.95$), consistent with Welch (2004). Yet, even after controlling for price, the coefficient on effective spreads remains a significantly positive 0.952, indicating that an increase in spreads causes an incremental increase on leverage. (Unreported results available upon request confirm that our findings also hold using return instead of price as an independent variable.)

The primary goal of this paper is to control for the endogeneity between spreads and leverage, and in Table 3, we show a bi-directional effect between leverage and liquidity using a two-stage approach where we first determine the effect of leverage on spreads and then use the estimates from that regression to determine how spreads impact leverage. We now re-estimate only the leverage regression using a variable that is positively correlated with liquidity, but should be uncorrelated with a firm's leverage as a dependent variable. In particular, we regress leverage on a "split" dummy variable that takes on the value 1 if the stock has split in the previous year, and 0 otherwise. Because a stock split has the potential to attract new investors by making the share price more affordable, it can also increase shareholder base and liquidity. For example, a May, 2005 press release from Impress Group claimed the purpose of their stock split was to "facilitate investment in the Company, increase the number of shares in circulation, and expand its shareholder base." At the same time, a split should affect neither the firm's fundamentals nor its leverage. Thus, we examine a regression of market leverage on splits. If increased liquidity does lower the need for leverage as we claim above, we would expect the coefficient on our split variable to be negative. Indeed, as shown in Table 5, the coefficient on splits is significantly negative (-0.021, with a t-statistic of -3.50). These results further suggest that increases in liquidity decrease the need for leverage. In unreported results available upon request, we also confirm that our findings hold using only turnover, defined as dollar volume divided by shares outstanding, as an instrument for liquidity.

[18]This accords with survey evidence provided by Graham and Harvey (2001) that executives only minimally care about transaction costs or rebalancing leverage ratios when equity values change.

[19]Since we use leverage which is a stock variable as opposed to change in leverage which would be a flow variable, we control for this effect with price, rather than returns.

We also re-run our Table 3 regressions including industry dummies. In the spread equation, market leverage remains significantly negative with a coefficient of -0.022 and a t-statistic of -4.83. In the leverage equation, the coefficient on spreads (0.309) retains its sign and significance ($t = 3.20$). Because with the significant drop in spreads in 1997, we also repeat the analysis excluding 1998.[20] The results are qualitatively similar to those including 1998. (For the first-stage regression, the coefficient on leverage is -0.02 with a t-statistic of -3.66. For the second-stage regression, the coefficient on effective spreads is 1.02, with a t-statistic greater than 7.) Results for both of these regressions are available upon request.

In Table 6, we present results to our regressions from Table 3, but employ interest rates to capture time variation in leverage effects. The interest rate we use is the US Benchmark yield from Datastream, which is the rate on the on-the-run 30 year bond. We see that this variable comes in significantly positive. Though this is a bit surprising, the coefficient is only 0.003, which is not economically significant. In this regression, the coefficient on leverage in the effective spread equation is still significantly negative (-0.018), with a t-statistic of -3.63. The coefficient on effective spreads in the leverage equation is slightly larger than before and remains significantly positive, both statistically and economically. Specifically, the coefficient is 0.864 ($t = 4.42$) which suggests that a one standard deviation increase in spreads would result in just over a 3.2% increase in leverage. The fact that 3% represents approximately one-twelfth of the average firm's leverage indicates that the effect of liquidity on leverage is economically significant. Results regarding quoted spreads are qualitatively similar and are available upon request.

Another point worth mentioning rests on the premise of our analysis: when liquidity is low (or spreads are large), it is too costly for firms to issue equity to fund their investments. However, if firms use internal equity rather than resort to external financing for these projects, our rationale for why firms eschew equity financing when spreads widen may seem questionable. Thus, we perform the analysis including a measure of internal capital in the regressions. We define internal capital as the ratio of retained earnings to common equity (COMPUSTAT data36/data60). When we include this ratio in our regressions, both quoted and effective spreads remain negatively influenced by leverage, and leverage

[20] Eliminating 1998 from the sample also alleviates the concern that is difficult to disentangle a "hot market" effect from a significant increase in volume.

continues to be positively influenced by spreads. Specifically, the right hand side of Table 6 shows that market leverage is neither statistically nor economically significantly related to retained earnings (the coefficient is -0.045). The table also shows that the coefficient on effective spreads increases from 0.841 in the original specification to 0.903 in this regression. The t-statistic on fitted effective spreads in the leverage equation increases to 4.70. Thus, the possibility that firms primarily use internal equity to finance their investments does not affect our results.[21]

As our focus is on how a company's stock's liquidity (and therefore ability to absorb a new issue) influences the firm's capital structure, we next employ other variables that capture the "tradeability" of a firm's stock in the face of a new issue. Given our hypothesis that managers issue equity when the market is most liquid and can absorb, with minimal price impact, the negative signal of a new issue (managers think the stock is overpriced), we select analyst coverage and number of shares outstanding as proxy variables for liquidity. Respective results are presented in Tables 7 and 8. Again, because there may be bi-directional effects, we perform the first-stage regressions and then use the fitted values in the second-stage regressions.

We now motivate our choice of variables: if information asymmetry and the cost of issuing equity are low, a firm may choose to issue equity over debt to raise money, which, all else equal, reduces leverage. Recall that a perfectly liquid stock trades free of any price impact, and that managers (who have better information about their firm than investors) will issue when their stocks are overpriced. The signaling effect of this suggests that, without perfect liquidity, agency concerns will on average cause a firm's stock price to fall upon that firm issuing equity. Before issuing shares, it is important to determine how easily the market can absorb the new issue.

We predict a positive relationship between analyst coverage and leverage for two reasons. First, we hypothesize that banks likely feel safer in lending to a firm with wider analyst coverage. Second, all else equal, firms with greater analyst coverage should be less able to absorb new issues: if firms have greater coverage, investors should be more

[21]This result is in accordance with Bharath, Pasquariello, and Wu (2006) who find (contrary to the pecking order theory) that firms prefer to issue external debt over using internal funds. One might note that the fact that there are several ways to issue stock that avoid information asymmetry problems (e.g., stock options) is also not inconsistent with our results.

aware of the information effect of a new issue. In other words, we believe analysts will tune their clients into the negative signal that often accompanies (the news of) an equity issuance.

Our results for the regressions using analyst coverage are as follows. First, the coefficients on profitability and volatility are as expected: profitability has a significantly positive effect on analyst coverage and return volatility has a negative effect. More relevant to this study, leverage has a significantly negative effect on analyst coverage. As leverage increases, analyst coverage decreases (t = -7.99). This result is consistent with the ideas that analysts choose which stocks to cover based on client interest and, all else equal, large shareholders (in particular, institutions) have less interest in holding stocks with higher leverage (Frieder and Subrahmanyam (2005)). As in the previous analysis, in our second-stage regression, because of the influence that leverage has on analyst coverage, we use the predicted values of analyst coverage from the first-stage regression to understand the impact that analyst coverage has on leverage. From Table 7, we see that as analyst coverage increases, leverage increases. The coefficient is 0.313 and the t-statistic is 3.34. The R^2 for this regression is 26%. This result accords with the idea that firms with lower analyst following are better able to absorb an equity issue, as we hypothesized.

We also claim that, all else equal, firms with more shares outstanding will absorb new issues with less price impact than firms with fewer outstanding shares. For a new issue of a given size, the price impact on any one share is lower because there is a wider base over which to spread the impact. Even though the overall effect of a negative price response (price change multiplied by shares outstanding) may be the same despite the number of shares outstanding for a given firm, many shareholders only care about the impact on their shares, rather than the overall impact on market capitalization. Results from the first-stage regression indicate that market leverage has a positive impact on the number of outstanding shares. On the flip side, when we evaluate the effect of number of shares on leverage, we find that the coefficient is -0.146, accompanied by a marginally significant t-statistic of -1.67 (see Table 8). The R^2 for this regression is 27%. Thus, after controlling for other determinants of leverage, as the number of outstanding shares increases, percent debt decreases. This is consistent with our hypothesis that firms issue equity when the market can more readily absorb the issuance–in this case when there are more shares over which to diffuse the impact.

6 Conclusion

This paper explores the relation between capital structure and market liquidity, with a specific focus on the endogeneity between leverage and spreads. Because liquidity affects firm value (Amihud and Mendelson (1986)) and can play a role in determining a firm's expected return on equity, it may also affect a firm's optimal capital structure since a firm's cost of equity impacts its overall cost of capital. In analyzing the role liquidity plays in determining leverage, we investigate whether leverage first plays a role in determining spreads. Indeed, our analysis supports the idea that the influence of these variables on each other is bi-directional.

We control for postulated determinants of spreads to determine the effect that leverage has on liquidity. We then use the estimate of liquidity from this first-stage regression, along with other independent variables, to examine the role that liquidity plays in determining leverage. Data on a panel of all NYSE firms over 1988-1998 uncovers at least two interesting empirical results. First, increases in leverage increase liquidity, consistent with the idea that debt forces managers to make better investment decisions (as per Jensen (1986)), thereby reducing agency costs between managers and investors, and resulting in more liquid equity (Kyle (1985)). We further find that increases in spreads cause managers to eschew equity financing and turn to debt financing. This is consistent with the idea put forth in Baker and Stein (2004) who note that it is more expensive to issue equity under these conditions because a new issue would have a larger price impact. Finally, as compared to running a single-stage regression of leverage on spreads, controlling for the endogenous relationship between leverage and liquidity significantly mutes the role that liquidity plays in determining leverage. Specifically, in our analysis, a one standard deviation increase in spreads results in just over a 3% increase in leverage, which is approximately 1.5% lower than when endogeneity is not considered. The fact that 3% represents approximately one-twelfth of the average firm's leverage indicates that the impact of liquidity on leverage is economically significant.

We conclude that (after controlling for the impact that leverage has on spreads) leverage increases when transaction costs are high and equity is expensive to issue. Results from robustness checks using analyst coverage and number of shares outstanding as alternative measures of the market's ability to absorb new issues with minimal price impact lend credence to our hypothesis: leverage is lower when equity liquidity is relatively high. Further, our results are robust to accounting for internal equity. The results documented in this paper relate primarily to the cross-sectional relationship between leverage and liquidity. Future research might focus on the relationship between liquidity and speed of convergence to a target leverage ratio, as per Flannery and Rangan (2006). To our knowledge, this is the first study that analyzes the bi-directional relation between liquidity and capital structure. We believe that the fusion of corporate finance with market microstructure is fertile ground for new research.

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Table 1: Summary Statistics

Table 1, Panel A presents summary statistics for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998. Effective and quoted spreads (ESPR and QSPR, respectively) are the annual averages of daily spreads, σ_r^2 is the annual volatility of daily returns, size is total assets, ROA is EBIT / Total assets, volume is the number of shares traded expressed in thousands (vol), institutional ownership (Inst) is the percentage of common shares outstanding held by a investment companies, banks, insurance companies, college endowments, and 13F money managers. Market leverage (MLev) is book debt divided by market value of assets, market capitalization (Mcap) is computed multiplying the number of shares at the end of the calendar year times the stock price at that time and is expressed in millions of dollars, σ_{cf}^2 is computed as the 5-year roll over volatility of quarterly cash flows in millions of dollars, market-to-book is computed as in Baker and Wurgler (2002) and R&D/Total assets is the proportion of R&D (item 46) to total assets (item 6). Panel B reports year-by-year summary statistics.

Panel A

Variable	Obs.	Mean	Std. Dev.	Min	Max
ESPR	5063	0.1358	0.0370	0.0594	0.8866
QSPR	5063	0.2081	0.0559	0.0693	1.2331
σ_R^2	5063	0.44%	0.46%	0.02%	11.98%
Size	5063	2,183	3,617	12	30,719
ROA	5062	9.51%	9.80%	−65.34%	60.92%
Vol	5063	186.2	320.4	0.606	6037.3
Inst	5055	53.7%	20.4%	0.00%	98.4%
MLev	5063	38.57%	20.09%	0.80%	97.40%
MCap	5063	691.26	5.38	4.49	64,353.72
σ_{cf}^2	4819	24.22	39.48	0.20	393.42
MTB	5063	1.63	0.91	0.40	11.20
R&D	5063	67.8	163.8	0.00	1,417
R&D / Total assets	5063	3.36%	4.37%	0.00%	47.74%

Panel B

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
N	407	385	406	421	450	469	486	509	516	530	484
ESPR	0.1809	0.1510	0.1414	0.1475	0.1434	0.1374	0.1328	0.1281	0.1275	0.1158	0.1045
QSPR	0.2470	0.2316	0.2351	0.2327	0.2260	0.2223	0.2097	0.1963	0.1930	0.1672	0.1536
σ_R^2	0.36%	0.43%	0.50%	0.42%	0.43%	0.38%	0.39%	0.39%	0.43%	0.50%	0.58%
Size	1,974	2,055	2,173	2,127	2,072	2,006	2,201	2,336	2,366	2,248	2,347
ROA	11.37%	10.32%	9.40%	7.98%	8.45%	7.78%	9.85%	10.16%	10.58%	10.07%	8.62%
Vol	133.0	123.4	130.8	135.4	127.1	146.3	164.7	217.9	239.3	267.6	308.0
Inst	4.79%	5.00%	4.98%	5.07%	5.13%	5.38%	5.65%	5.72%	5.41%	5.74%	5.88%
MLev	40.47%	40.52%	45.38%	40.31%	38.61%	36.69%	38.46%	37.35%	35.66%	34.12%	39.38%
MCap	507.50	523.60	441.88	575.17	597.11	664.87	679.56	790.66	934.41	1072.41	899.69
σ_{cf}^2	24.01	23.04	24.15	23.23	22.27	21.11	22.27	25.44	26.18	25.56	28.07
MTB	1.37	1.45	1.37	1.58	1.61	1.68	1.59	1.68	1.75	1.91	1.78
R&D	73.2	67.0	72.5	74.1	68.9	64.6	67.9	67.2	67.9	62.9	62.3
RD/Assets	3.36%	3.52%	3.64%	3.62%	3.66%	3.58%	3.32%	3.20%	3.12%	3.02%	3.06%

Table 2: Correlations

Table 2 presents correlations for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998. Effective and quoted spreads (ESPR and QSPR, respectively) are the annual averages of daily spreads, σ_R^2 is the annual volatility of daily returns, size is total assets, ROA is EBIT / Total assets, volume is the number of shares traded expressed in thousands (vol), institutional ownership (Inst) is the percentage of common shares outstanding held by a investment companies, banks, insurance companies, college endowments, and 13F money managers. Market leverage (MLev) is book debt divided by market value of assets, market capitalization (Mcap) is computed multiplying the number of shares at the end of the calendar year times the stock price at that time and is expressed in millions of dollars, σ_{cf}^2 is computed as the 5-year roll over volatility of quarterly cash flows in millions of dollars, market-to-book is computed as in Baker and Wurgler (2002) and R&D/Total assets is the proportion of R&D (item 46) to total assets (item 6). P-values are in parentheses.

	ESPR	QSPR	σ_R^2	Size	ROA	Vol	Inst	MLev	MCap	σ_{cf}^2	MTB	R&D	RD/Assets
ESPR	1.000												
QSPR	0.888	1.000											
	(0.000)												
σ_R^2	0.283	0.298	1.000										
	(0.000)	(0.000)											
Size	−0.162	−0.155	0.146	1.000									
	(0.000)	(0.000)	(0.000)										
ROA	0.164	0.202	0.175	0.059	1.000								
	(0.000)	(0.000)	(0.000)	(0.000)									
Vol	−0.285	−0.328	0.158	0.465	0.068	1.000							
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)								
Inst	−0.058	0.006	0.162	0.210	0.176	0.202	1.000						
	(0.000)	(0.656)	(0.000)	(0.000)	(0.000)	(0.000)							
MLev	−0.111	−0.136	−0.180	0.093	−0.458	−0.141	−0.151	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
MCap	−0.126	−0.095	0.255	0.644	0.393	0.509	0.475	−0.369	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
σ_{cf}^2	−0.178	−0.185	0.139	0.839	0.082	0.551	0.193	0.045	0.600	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)				
MTB	0.007	0.026	0.235	0.022	0.478	0.254	0.143	−0.624	0.455	0.078	1.000		
	(0.636)	(0.061)	(0.000)	(0.118)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
RD	−0.091	−0.089	0.155	0.607	0.080	0.423	0.152	−0.090	0.497	0.526	0.162	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
RD/Assets	−0.050	−0.037	0.017	−0.035	−0.112	0.144	0.058	−0.246	0.055	−0.018	0.213	0.364	1.000
	(0.000)	(0.008)	(0.223)	(0.014)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.215)	(0.000)	(0.000)	

Table 3: Regressions

Table 3 shows estimates from a two-stage OLS regression model with controls for firm fixed effects. Results pertaining to the 2-stage estimation using effective spreads are in the left hand side of the table, while those using quoted spreads are given on the right. In the second stage regression $ESPR_{lag}$ ($QSPR_{lag}$) represents the fitted value of effective (quoted) spreads obtained from the first-stage regression. The sample includes observations for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998. ESPR is the effective spread and is the annual average of daily effective spreads, QSPR is the quoted spread and is the annual average of daily quoted spreads, σ^2_R is the annual volatility of daily returns, size is total assets, ROA is EBIT / Total assets, volume is the number of shares traded expressed in thousands, institutional ownership (Inst) is the percentage of common shares outstanding held by a investment companies, banks, insurance companies, college endowments, and 13F money managers. MLev is market leverage and is book debt divided by market value of assets, market capitalization (MCap) is computed multiplying the number of shares at the end of the calendar year times the stock price at that time and is expressed in millions of dollars, σ^2_{cf} is computed as the 5-year roll over volatility of quarterly cash flows in millions of dollars, market-to-book (MTB) is computed as in Baker and Wurgler (2002) and R&D/Total assets is the proportion of R&D (item 46) to total assets (item 6). We do not report the constant, and absolute value of t-statistics are shown in parentheses.

	$ESPR_t$	$MLev_{t+1}$	$QSPR_t$	$MLev_{t+1}$
$ESPR_{lag}$	0.448	0.841		
	(7.13)	(4.41)		
$MLev_t$	−0.022	0.481	−0.043	0.493
	(4.83)	(13.07)	(3.60)	(13.06)
$\sigma^2_{R_t}$	0.412		0.365	
	(5.73)		(3.46)	
ROA_t	0.026	−0.038	0.033	−0.029
	(4.39)	(1.31)	(4.69)	(1.02)
$\sigma^2_{cf_t}$		−0.005		−0.005
		(0.93)		(0.98)
MTB_t		−0.014		−0.015
		(2.96)		(2.96)
MTB_{t-1}		0.008		0.007
		(1.91)		(1.62)
RD_t		−0.113		−0.118
		(2.05)		(2.13)
$RD/Assets_t$		0.112		0.103
		(0.80)		(0.73)
$RD/Assets_{t-1}$		−0.259		−0.254
		(2.01)		(1.96)
$Size_t$		0.051		0.044
		(6.59)		(5.71)
$Inst_t$	0.134	0.030	0.290	0.059
	(4.20)	(0.15)	(6.16)	(0.29)
$QSPR_{lag}$			0.627	0.301
			(9.64)	(3.69)
$MCap_t$	−0.012		−0.023	
	(13.25)		(8.30)	
Vol_t	−9.775		−16.648	
	(5.71)		(6.59)	
Observations	3,989	3,021	3,989	3,021
No. Firms	738	605	738	605
R-squared	0.49	0.27	0.62	0.27

Table 4: Regressions II

Table 3 shows estimates from a two-stage OLS regression model with controls for firm fixed effects. Results pertaining to the second stage of the 2-stage estimation using effective spreads are in the left hand side of the table, while those using quoted spreads are given on the right. In the second stage regression $ES\hat{P}R_{lag}$ ($QS\hat{P}R_{lag}$) represents the fitted value of effective (quoted) spreads obtained from the first-stage regression. The sample includes observations for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998, and variables are defined as in 3. P_t is data199 from Compustat. The constant is omitted. Absolute value of t-statistics are shown in parentheses.

	$MLev_{t+1}$	$MLev_{t+1}$
$ES\hat{P}R_{lag}$	0.952	
	(4.41)	
$Mlev_t$	0.478	0.487
	(13.08)	(13.20)
ROA_t	−0.032	−0.025
	(1.06)	(0.80)
MTB_t	−0.011	−0.014
	(2.37)	(2.98)
MTB_{t-1}	0.009	0.008
	(2.00)	(1.69)
RD_t	−0.112	−0.116
	(10.60)	(11.98)
$RD/Assets_t$	0.139	0.131
	(0.80)	(0.76)
$RD/Assets_{t+1}$	−0.286	−0.282
	(2.21)	(2.17)
$Size_t$	0.056	0.045
	(4.62)	(3.99)
$Inst_t$	0.265	0.222
	(0.96)	(0.80)
$QS\hat{P}R_{lag}$		0.327
		(3.65)
P_t	−0.013	−0.006
	(1.95)	(1.00)
Observations	3039	3039
No. Firms	610	610
R-squared	0.27	0.26

Table 5: Single-Stage Regressions

Table 5 shows estimates from a regression of market leverage on the variables in Table 3, as well as on a dummy variable for whether a stock split in the previous year (Split). The sample includes observations for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998. ESPR is the effective spread and is the annual average of daily effective spreads, QSPR is the quoted spread and is the annual average of daily quoted spreads, σ_R^2 is the annual volatility of daily returns, size is total assets, ROA is EBIT / Total assets, volume is the number of shares traded expressed in thousands, institutional ownership (Inst) is the percentage of common shares outstanding held by a investment companies, banks, insurance companies, college endowments, and 13F money managers. MLev is market leverage and is book debt divided by market value of assets, market capitalization (MCap) is computed multiplying the number of shares at the end of the calendar year times the stock price at that time and is expressed in millions of dollars, σ_{cf}^2 is computed as the 5-year roll over volatility of quarterly cash flows in millions of dollars, market-to-book (MTB) is computed as in Baker and Wurgler (2002) and R&D/Total assets is the proportion of R&D (item 46) to total assets (item 6). Results pertaining to effective spreads are in the left hand side of the table, while those for quoted spreads are given on the right. The constant is omitted; absolute value of t-statistics are shown in parentheses.

	$MLev_{t+1}$		$MLev_{t+1}$
$ESPR_{lag}$	0.964	$QSPR_{lag}$	0.355
	(4.98)		(4.12)
$MLev_t$	0.495	$MLev_t$	0.493
	(16.18)		(16.02)
ROA_t	−0.031	ROA_t	−0.023
	(1.07)		(0.76)
$\sigma^2_{cf_t}$	−0.004	$\sigma^2_{cf_t}$	−0.004
	(0.56)		(0.62)
MTB_t	−0.011	MTB_t	−0.013
	(2.46)		(2.92)
MTB_{t-1}	0.008	MTB_{t-1}	0.007
	(1.77)		(1.50)
RD_t	−0.108	RD_t	−0.113
	(11.84)		(13.71)
$RD/Assets_t$	0.156	$RD/Assets_t$	0.141
	(0.90)		(0.82)
$RD/Assets_{t+1}$	−0.303	$RD/Assets_{t+1}$	−0.293
	(2.35)		(2.27)
$Size_t$	0.052	$Size_t$	0.045
	(4.75)		(4.16)
$Inst_t$	0.113	$Inst_t$	0.146
	(0.42)		(0.53)
$Split_t$	−0.021	$Split_t$	−0.019
	(3.50)		(3.02)
Observations	3039	Observations	3039
No. Firms	610	No. Firms	610
R-squared	0.28	R-squared	0.27

Table 6: Alternative Specification

Table 6 shows estimates from a two-stage OLS regression model with controls for firm fixed effects. In the second stage regression $ESPR_{lag}$ represents the fitted value of effective spreads obtained from the first-stage regression. The sample includes observations for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998. ESPR is the effective spread and is the annual average of daily effective spreads, QSPR is the quoted spread and is the annual average of daily quoted spreads, σ_R^2 is the annual volatility of daily returns, size is total assets, ROA is EBIT / Total assets, volume is the number of shares traded expressed in thousands, institutional ownership (Inst) is the percentage of common shares outstanding held by a investment companies, banks, insurance companies, college endowments, and 13F money managers. MLev is market leverage and is book debt divided by market value of assets, market capitalization (MCap) is computed multiplying the number of shares at the end of the calendar year times the stock price at that time and is expressed in millions of dollars, σ_{cf}^2 is computed as the 5-year roll over volatility of quarterly cash flows in millions of dollars, market-to-book (MTB) is computed as in Baker and Wurgler (2002) and R&D/Total assets is the proportion of R&D (item 46) to total assets (item 6). Rate is the value of the on-the-run 30 year bond. IntEq is computed as retained earnings (item 36) over market value of assets. The constant is omitted; absolute value of t-statistics are given in parentheses.

	$ESPR_t$	$MLev_{t+1}$		$ESPR_t$	$MLev_{t+1}$
$ESPR_{lag}$	0.495	0.864	$ESPR_{lag}$	0.495	0.903
	(12.41)	(4.42)		(12.41)	(4.70)
$MLev_t$	−0.018	0.491	$MLev_t$	−0.018	0.549
	(3.63)	(15.56)		(3.63)	(13.77)
$\sigma^2_{R_t}$	−0.247		$\sigma^2_{R_t}$	−0.247	
	(0.43)			(0.43)	
ROA_t	0.024	−0.039	ROA_t	0.024	−0.043
	(5.64)	(1.31)		(5.64)	(1.44)
$\sigma^2_{cf_t}$		−0.004	$\sigma^2_{cf_t}$		−0.004
		(0.65)			(0.54)
MTB_t		−0.012	MTB_t		−0.008
		(2.55)			(1.69)
MTB_{t-1}		0.008	MTB_{t-1}		0.008
		(1.70)			(1.75)
RD_t		−0.110	RD_t		−0.118
		(10.96)			(9.03)
$RD/Assets_t$		0.145	$RD/Assets_t$		0.148
		(0.84)			(0.85)
$RD/Assets_{t+1}$		−0.281	$RD/Assets_{t+1}$		−0.276
		(2.17)			(2.13)
$Size_t$		0.054	$Size_t$		0.050
		(4.79)			(4.55)
$Inst_t$	0.093	0.105	$Inst_t$	0.093	0.086
	(2.86)	(0.39)		(2.86)	(0.32)
$MCap_t$	−0.010		$MCap_t$	−0.010	
	(7.15)			(7.15)	
Vol_t	−13.744		Vol_t	−13.744	
	(3.83)			(3.83)	
$Rate_t$		0.003	$IntEq_t$		−0.045
		(1.23)			(1.82)
Observations	7401	3039	Observations	7401	3039
No. Firms	1344	610	No. Firms	1344	610
R-squared	0.43	0.27	R-squared	0.43	0.28

Table 7: Analyst Following as an Alternative Liquidity Measure

Table 7 shows estimates from a two-stage OLS regression model with controls for firm fixed effects. In the second stage regression $IBES_{lag}$ represents the fitted value of analyst following obtained from the first-stage regression. The sample includes observations for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998. IBES is the number of analysts following a company and is obtained from I.B.E.S., σ^2_R is the annual volatility of daily returns, size is total assets, ROA is EBIT / Total assets, volume is the number of shares traded expressed in thousands, institutional ownership (Inst) is the percentage of common shares outstanding held by a investment companies, banks, insurance companies, college endowments, and 13F money managers. MLev is market leverage and is book debt divided by market value of assets, market capitalization (MCap) is computed multiplying the number of shares at the end of the calendar year times the stock price at that time and is expressed in millions of dollars, σ^2_{cf} is computed as the 5-year roll over volatility of quarterly cash flows in millions of dollars, market-to-book (MTB) is computed as in Baker and Wurgler (2002) and R&D/Total assets is the proportion of R&D (item 46) to total assets (item 6). The constant is omitted; absolute value of t-statistics are given in parentheses.

	$IBES_t$	$MLev_{t+1}$
$IBES_{lag}$	0.669	0.313
	(48.85)	(3.34)
$MLev_t$	−0.048	0.483
	(7.99)	(14.19)
$\sigma^2_{R_t}$	−0.147	
	(1.12)	
ROA_t	0.034	0.021
	(5.51)	(0.59)
$\sigma^2_{cf_t}$		−0.014
		(1.99)
MTB_t		−0.014
		(3.11)
MTB_{t-1}		0.004
		(0.79)
RD_t		−0.118
		(2.00)
$RD/Assets_t$		0.136
		(0.82)
$RD/Assets_{t-1}$		−0.242
		(3.78)
$MCap_t$	−0.001	
	(0.77)	
$Inst_t$	0.015	−0.046
	(0.38)	(0.16)
$Size_t$		0.037
		(3.78)
Vol_t	−4.32	
	(1.33)	
Observations	6799	2753
No. Firms	1291	574
R-squared	0.51	0.26

Table 8: Shares Outstanding as an Alternative Liquidity Measure

Table 8 shows estimates from a two-stage OLS regression model with controls for firm fixed effects. In the second stage regression $\#Shares_{lag}$ represents the fitted value of number of shares outstanding obtained from the first-stage regression. The sample includes observations for all firms with information in TAQ, CRSP and COMPUSTAT from 1988 to 1998. # shares is COMPUSTAT data item 25 and represents the number of shares outstanding, σ^2_R is the annual volatility of daily returns, size is total assets, ROA is EBIT / Total assets, volume is the number of shares traded expressed in thousands, institutional ownership (Inst) is the percentage of common shares outstanding held by a investment companies, banks, insurance companies, college endowments, and 13F money managers. MLev is market leverage and is book debt divided by market value of assets, market capitalization (MCap) is computed multiplying the number of shares at the end of the calendar year times the stock price at that time and is expressed in millions of dollars, σ^2_{cf} is computed as the 5-year roll over volatility of quarterly cash flows in millions of dollars, market-to-book (MTB) is computed as in Baker and Wurgler (2002) and R&D/Total assets is the proportion of R&D (item 46) to total assets (item 6). The constant is omitted; absolute value of t-statistics are given in parentheses.

	$\#Shares_t$	$MLev_{t+1}$
$\#Shares_{lag}$	0.862	−0.146
	(26.72)	(1.67)
$MLev_t$	0.019	0.553
	(3.85)	(14.28)
$\sigma^2_{R_t}$	1.671	
	(3.03)	
ROA_t	−0.009	0.017
	(2.43)	(0.54)
MTB_t		−0.010
		(2.53)
MTB_{t-1}		−0.005
		(0.77)
RD_t		−0.109
		(2.11)
$RD/Assets_t$		0.157
		(0.92)
$RD/Assets_{t-1}$		−0.256
		(1.67)
$MCap_t$	0.009	
	(5.89)	
$Size_t$		0.030
		(3.43)
Observations	6903	2934
No. Firms	1301	601
R-squared	0.66	0.27