Asset Liquidity, and Stock Liquidity

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Abstract

We study the relation between asset liquidity and stock liquidity. Our model shows that the relation may be either positive or negative depending on parameter values. Asset liquidity improves stock liquidity more for firms which are less likely to reinvest their liquid assets, i.e., firms with less growth opportunities and financially constrained firms. Empirically, we find a positive and economically large relation between asset liquidity and stock liquidity. Consistent with our model, the relation is more positive for firms which are less likely to reinvest their liquid assets. Our results also shed light on the value of holding liquid assets.

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1 Introduction

An asset is liquid if it can be converted into cash quickly and at a low cost.[1] This definition applies both to real assets and to financial assets. Recent years have seen a secular increase in both stock liquidity and asset liquidity as measured by the level of cash on the firm's balance sheet (Chordia, Roll, and Subrahmanyam (2007) and Foley et al. (2007)). Furthermore, during the recent financial crisis, there was a decline in the liquidity of the assets of financial firms (such as mortgage backed securities) and in the liquidity of their stock.[2] An interesting question that arises is whether these two trends are related. More generally, is there a relationship between the liquidity of the firm's assets and the liquidity of financial claims on the assets? By addressing this question we highlight how corporate finance decisions can affect stock liquidity.

We argue that the balance sheet equivalence between the value of assets and liabilities/equity may not carry over to their respective liquidities. We formalize this point in a model that shows how managerial investment decisions can affect stock liquidity by converting liquid assets into illiquid ones. In our model, a firm has assets composed of cash, an illiquid project, and a growth option. The manager decides on the optimal allocation of cash between investment in the growth option and payment of dividends. A more productive growth option implies more investment, but firm financial constraints may limit the amount of investment. Reflecting frictions associated with raising external capital, we assume that the returns to investment are higher when financed with internal cash. The liquidity of the firm's stock is determined in a market similar to that in Kyle (1985). Managerial investment decisions affect the uncertainty of future cash flows, and consequently stock liquidity as measured by Kyle's lambda (the sensitivity of prices to order flow).

[1] This definition dates back to Keynes (1930, p. 67) who considered one asset as more liquid than another "if it is more certainly realizable at short notice without loss".

[2] See Boehmer, Jones, and Zhang (2009) for some evidence of lower stock liquidity for financial firms during the crisis period, even after short sale constraints were removed.

Our first result shows that the relationship between asset liquidity – the proportion of cash on the firm's balance sheet – and stock liquidity can be either positive or negative depending on parameter values. On the one hand, more cash lowers valuation uncertainty associated with assets-in-place, and improves stock liquidity. On the other hand, more cash also implies more future investments, since returns to investment of internal cash are higher. This leads to greater uncertainty about future assets and hence lower stock liquidity. Thus, our model highlights how the relation between asset liquidity and stock liquidity depends on the tendency of the firm to invest. The relation is more positive (or less negative) for firms that are less likely to convert liquid assets into uncertain investments: firms with fewer growth opportunities and those that are financially constrained.

We next turn to empirically testing the model's predictions. While our theoretical measure of stock liquidity is Kyle's lambda, there is no unanimity in the literature on how to empirically measure stock liquidity. In our tests we employ four alternative measures of stock liquidity: the illiquidity measure proposed by Amihud (2002), the implicit bid-ask spread proposed by Roll (1984) as estimated by Hasbrouck (2009), the effective bid-ask spread calculated from intra-day data, and the Pastor-Stambaugh measure (Pastor and Stambaugh (2003)).[3] While stock liquidity is determined on a daily basis, measures of asset liquidity are only recorded periodically. Hence, in our tests we use annual averages of the four stock liquidity measures.

To measure asset liquidity, we sort the firm's assets based on their liquidity and assign liquidity scores between zero and one to each asset class. We then calculate a weighted liquidity score for the firm using the book value or market value of the different assets on the firm's balance sheet as weights. Finally, we normalize this weighted score by the lagged value of total assets of the firm. This approach to measuring asset liquidity is similar to Berger

[3]The Pastor-Stambaugh measure is likely to be a noisy proxy for the liquidity of individual stocks (see p. 679 of Pastor and Stambaugh (2003)). We use it here to highlight the robustness of our results. We obtain similar results when we use the proportion of zero return days proposed by Lesmond, Ogden and Trzcinka (1999) as an alternative measure of stock liquidity.

and Bouwman (2008). Using this approach we come up with four alternative measures of asset liquidity that vary based on the liquidity scores assigned to the different assets.

In our first set of tests we estimate the time-series and cross-sectional relation between asset liquidity and stock liquidity. These tests help understand which among the two effects identified by our model dominates empirically. We use a panel data of all Compustat firms during the time period 1962-2005. In our main tests, we employ a model with time and firm fixed effects to understand how deviations in asset liquidity and stock liquidity for individual firms from their sample average values are related. Our results indicate that after controlling for known determinants of stock liquidity, there is a positive, robust, and economically significant relationship between the alternative measures of asset liquidity and those of stock liquidity. For example, for a firm with median level of stock liquidity, one standard deviation increase in asset liquidity results in a 15.7% decrease in Amihud's illiquidity measure. This relation is present in different industries and in different time periods. Using the Fama-MacBeth approach we also find a strong, positive relationship between asset liquidity and stock liquidity in the cross-section. Thus, our empirical analysis shows that, on average, the balance sheet relation between asset liquidity and stock liquidity does hold. Improvements in asset liquidity decrease the uncertainty related to assets-in-place more than they increase the uncertainty about future investments. Moreover, asset liquidity appears to be a strong empirical determinant of stock liquidity.

The second prediction of our model is that the relation between asset liquidity and stock liquidity should be less positive for firms with more growth opportunities. Using market to book ratio and capital expenditure to identify growth firms, we find that the relation between asset liquidity and stock liquidity is indeed less positive for firms with more growth opportunities.

To further explore how the relation between asset liquidity and stock liquidity relates to investment decisions, we carry out an event study around seasoned equity offerings (SEOs).

Masulis, Eckbo, and Norli (2000) document an increase in stock liquidity following an SEO. An SEO leads to an immediate inflow of cash and an increase in asset liquidity. Our model predicts that the increase in stock liquidity following the SEO will be lower for firms that invest the proceeds as compared to those that retain the proceeds as cash. Consistent with this prediction, we find that the change in stock liquidity in the post-SEO period is positively related to the fraction of the SEO proceeds the firm retains as cash at the end of the year.

We next test the prediction that the relation between asset liquidity and stock liquidity is more positive for financially constrained firms. Following prior literature we use firm size, the presence of credit ratings, and the probability of default to proxy for the presence of financial constraints. Consistent with our prediction, we find that the relation between asset and stock liquidity is more positive for small firms, firms without credit ratings, and firms with above median probability of default. Overall our empirical analysis offers significant support for our model predictions.

In a frictionless Modigliani-Miller (MM) world where returns to investments are independent of the source of finance, growth opportunities will not affect the relation between asset liquidity and stock liquidity. Our evidence to the contrary is consistent with the technology assumption in our model. Furthermore, the results provide new evidence supporting the importance of financial frictions for firm investment decisions. Unlike traditional tests of financial frictions, our tests do not rely on correctly modeling firm investments.

A final implication of the relation between asset liquidity and stock liquidity that we document is for the value of liquid assets on the firm's balance sheet. Indeed, the effect of high cash balances in improving stock liquidity is a hitherto unknown benefit of cash. If the improvements in stock liquidity that result from an increase in asset liquidity lead to higher firm value (e.g. by reducing the firm's cost of capital or by reducing the costs of providing managerial incentives), then asset liquidity should be valuable for firms. This is especially so for firms with an illiquid stock as improvements in stock liquidity are more likely for such firms. To test this prediction we use the methodology in Faulkender and Wang (2006) and estimate the value of corporate cash holdings for firms with more and less liquid stock. Consistent with our prediction, we find that an increase in corporate cash holding is more valuable for firms with less liquid stock. As compared to a firm with above median stock liquidity, a $1 increase in cash holdings is worth twelve cents more for a firm with below median stock liquidity.

The rest of the paper is organized as follows. In the next two sections, we describe our theoretical model and derive the main empirical predictions on the basis of this model. Section 4 describes our data, and our measures of stock and asset liquidity. Section 5 discusses empirical tests of the model while Section 6 discusses implications for value. Section 7 concludes.

2 Model

In this section we develop a simple model that highlights the relation between asset liquidity, future investments, and stock liquidity. The key feature of the model is that stock liquidity today depends on both the structure of the firm's assets today, and on the expectations regarding future investments.

There are three dates 0, 1, and 2. At date 0, we consider a firm with assets-in-place whose value is normalized to \$1. The assets comprise of cash of value $\$\alpha$ and a project of value $\$[1-\alpha]$, ($\alpha \in [0,1]$). We refer to α as the "asset liquidity" of the firm. Each dollar of the project will return $\tilde{x}$ units of cash at date 2, where $\tilde{x} = \mu_x + \tilde{\varepsilon}_x$, and $\tilde{\varepsilon}_x \sim N\left(0, \sigma_x^2\right)$.

At date 1, the manager decides on the allocation of the cash between an interim dividend and a new project. We assume that the manager's objective is aligned with that of the current shareholders of the firm. Let $\gamma \geq 0$, represent the fraction of the cash invested in the new project and $1-\gamma$ the fraction of cash that is paid out as dividends. Note that $\gamma > 1$

indicates investment in excess of the cash available with the firm at date 0. This will happen if the firm raises outside finance to invest in the project (similar to Miller and Rock (1985)).

The output from investing a dollar amount $\alpha\gamma$ in the project is given by the stochastic production function

$$\tilde{y} = k\alpha h(\gamma)(1+\tilde{\varepsilon}_y), \quad (1)$$

where $\tilde{\varepsilon}_y \sim N(0, \sigma_y^2)$ is an unexpected shock to production. Thus, the expected output from the project is $k\alpha h(\gamma)$. We assume that $h(\cdot) > 0$, $h'(\cdot) > 0$, and $h''(\cdot) < 0$.

Note that the expected output is concave in the fraction of cash invested in the project, γ. In other words, the marginal returns to investment depend on the source of finance. Marginal returns are higher if the firm has a high cash balance and uses a part of it to invest in the project – instances when γ is low – as compared to when the firm raises external finance to invest in the project – instances when γ is high. This is a departure from a MM world, and we use this assumption to capture the presence of costs of raising external finance in a reduced form. These costs reduce the marginal returns from investing outside cash.

We also assume that $h'(0) = \infty$, implying that some positive investment is optimal. Parameter $k > 0$ measures productivity. A higher k indicates higher marginal productivity at all investment levels, and thereby captures better growth opportunities. We let the correlation between $\tilde{\varepsilon}_x$ and $\tilde{\varepsilon}_y$ be $\rho \geq 0$.[4] At date 2 a liquidating dividend is paid to the equity holders. All agents are risk-neutral and the risk free interest rate is zero.

At date 0, the firm's stock is traded in a market *á la* Kyle (1985). Specifically, there are three types of traders: an insider, noise traders, and a market-maker. We assume that the insider knows the actual realizations of both $\tilde{\varepsilon}_x$ and $\tilde{\varepsilon}_y$.[5] Noise traders are uniformed and trade an exogenous amount distributed according to $\tilde{u} \sim N(0, \sigma_u^2)$, where $\tilde{u}$ is uncorrelated

[4] We limit ρ to non-negative values as we believe that better represents reality. Our results continue to hold for negative values of ρ as long as it is larger than some lower bound.

[5] Our results are robust to assuming that the insider obtains a partially informative signal about $\tilde{\varepsilon}_x$ and $\tilde{\varepsilon}_y$. We assume perfect knowledge to limit the complexity of the analysis.

with either $\tilde{x}$ or $\tilde{y}$. The market-maker observes the total order flow (both informed and uninformed), but cannot distinguish between the two. As in Kyle (1985), we assume that the market-maker sets a price equal to the expectation of firm value conditional on the observed order flow. The insider trades to maximize his profit, using the noise traders to hide his trades.

We solve the model backwards restricting attention to equilibria, where as in Kyle (1985), both the market-maker and the insider use linear strategies. At date 1 the manager optimally decides on the allocation of cash between interim dividend and investment. Expected firm value as a function of the fraction of cash invested in the new project, γ, is

$$V(\gamma) \equiv (1-\alpha)\mu_x + k\alpha h(\gamma) + \alpha(1-\gamma). \tag{2}$$

The first term represents the expected cash flow from the existing project. The second and third terms represent the expected cash flows from the new project, and the interim dividend respectively. Thus, the manager's problem is:

$$\max_{\gamma \geq 0} V(\gamma).$$

The first order condition implies that the optimal proportion of cash invested is

$$\gamma^* = h'^{-1}\left(\frac{1}{k}\right). \tag{3}$$

The second order condition is satisfied due to the concavity of $h(\cdot)$. Firms with better investment opportunities invest a higher proportion of their cash:

$$\frac{\partial \gamma^*}{\partial k} = -\frac{1}{k^2 h''\left(h'^{-1}\left(\frac{1}{k}\right)\right)} > 0. \tag{4}$$

Consider now the trading in the firm's shares at date 0. Both the market-maker and the insider anticipate the optimal investment/payout decision of the manager at date 1. As a result, the expected firm value is $V(\gamma^*)$. The variance of the firm value at time 0 is given by

$$\sigma_0^2 \equiv (1-\alpha)^2 \sigma_x^2 + \alpha^2 k^2 h (\gamma^*)^2 \sigma_y^2 + 2\alpha (1-\alpha) kh (\gamma^*) \sigma_x \sigma_y \rho. \tag{5}$$

The first term reflects the variability of the value of the assets-in-place. The second term reflects the variability of the expected investment, taking into account the optimization of the manager. Finally, the third term reflects the contribution of the correlation between the value of the current and future project. In equilibrium, the market-maker uses a linear pricing function with slope equal to Kyle's lambda (λ). That is, lambda measures the price impact per $1 of order flow, and is a conventional measure of stock illiquidity. Applying the results in Kyle (1985), we have:

$$\lambda = \frac{1}{2} \frac{\sigma_0}{\sigma_u}, \tag{6}$$

where unlike in Kyle's original model, σ_0 is endogenous and given by (5). As usual, λ is large when σ_0 is large in comparison to σ_u. That is, when variations in fundamentals are large relative to variations in noise trading.

Our first result illustrates how asset liquidity is related to stock liquidity in our model.

Proposition 1. *The relation between asset liquidity and stock liquidity can be either positive or negative. Higher asset liquidity is associated with higher stock liquidity (lower λ) if and only if $\alpha < \hat{\alpha}$, where*

$$\hat{\alpha} \equiv \frac{\sigma_x^2 - kh(\gamma^*) \sigma_x \sigma_y \rho}{\sigma_x^2 + k^2 h (\gamma^*)^2 \sigma_y^2 - 2kh(\gamma^*) \sigma_x \sigma_y \rho},$$

and γ^* is given by (3).

All proofs are presented in the Appendix. An increase in α has two conflicting effects on the variance of the firm's cash flows, σ_0. First, a higher α corresponds to a higher proportion of cash within assets-in-place, contributing to a reduction in σ_0. However, a higher α also implies that the manager has more internal cash to invest in the project. Since returns to investment are higher for internal cash, this implies more investment. This contributes to an increase in σ_0. As long as α is small enough (smaller than $\hat{\alpha}$), the first effect dominates, and an increase in α translates into higher stock liquidity. Once α becomes sufficiently large, the second effect dominates and an increase in α lowers stock liquidity.

We next turn to study how the relation between asset liquidity and stock liquidity varies in the cross-section. Our focus is on studying how variations in growth opportunities, financial constraints, and correlation in asset returns affect this relationship. For this analysis we first restrict attention to the case where $\alpha \leq 0.5$.[6] The results when $\alpha > 0.5$ are identical under some additional parameter restrictions. We discuss this further at the end of the section.

Recall that a higher k indicates a higher marginal productivity at all investment levels, and hence better growth opportunities.

Proposition 2. *The relation between asset liquidity and stock liquidity is less positive (or more negative) for firms with more growth opportunities (higher k).*

To understand the intuition for this result it is useful to consider the firm as a portfolio of assets-in-place and a new project. An increase in growth opportunities (higher k) affects the volatility of this portfolio (σ_0) in three ways. First, for a given α, a firm with higher k obtains a higher expected output for every dollar invested in the new project. Second, from (4), higher k implies that a larger fraction of the cash balance is invested in the project (higher γ^*). Third, the increase in the investment in the new project from a higher k increases the contribution of the correlation term to the volatility of the portfolio.[7] Thus, these three effects reinforce each other, leading to an increase in σ_0 relative to σ_u, thereby reducing stock liquidity.

Note that this result depends critically on our assumption that returns to investment

[6] This corresponds to assuming that the majority of the firm's assets are not perfectly liquid. Such an assumption is consistent with our data, where cash and marketable securities on average constitute 14.2% of book value of total assets.

[7] An increase in project size will lead to an increase in the correlation term only if $\alpha < 0.5$. As we discuss later when $\alpha > 0.5$, this effect is reversed.

are concave in γ. In the neoclassical world of MM, the production function is concave in $\alpha\gamma$ rather than in γ. In such a scenario, the optimal level of investment, and thereby the uncertainty associated with future investment are unaffected by the amount of cash held by the firm. Thus, growth opportunities do not affect the relation between asset liquidity and stock liquidity. Empirical tests of Proposition 2 can hence serve as validation of our technology assumption.

We next consider the effect of financial constraints on the relation between asset liquidity and stock liquidity. Our assumption of differential returns to investment of internal vs external cash can be considered as representing costs of raising external finance. Still, to better highlight the comparative statics of the presence of financial constraints, we model such constraints by assuming that there exists a $\hat{\gamma} > 0$ such that $\gamma \leq \hat{\gamma}$. This can be interpreted as representing a precautionary savings motive for financially constrained firms or a hard constraint on the amount of external finance that a firm can raise. Note that a firm that faces binding financial constraints will have $\gamma^* = \hat{\gamma}$. Thus, in general, the optimal investment level is given by

$$\gamma^* = \min\left(\hat{\gamma}, h'^{-1}\left(\frac{1}{k}\right)\right). \tag{7}$$

The following proposition derives the effect of financial constraints on the relation between asset liquidity and stock liquidity.

Proposition 3. *The relation between asset liquidity and stock liquidity is more positive (or less negative) for financially constrained firms.*

Intuitively, a binding upper bound on γ^* means that for a constrained firm, a lower proportion of each additional dollar of cash is invested in a new project, reducing the total volatility of the firm, σ_0. Thus, the relation between asset liquidity and stock liquidity is more positive.

We now discuss the robustness of our results when $\alpha > 0.5$, i.e., when cash and other liquid assets dominate the balance sheet of the firm. In this case we find that Propositions 2 and 3 still apply subject to an additional parameter restriction, which, among other things, depends on the structure of the production function.[8] The intuition for the additional restriction is as follows. When $\alpha > 0.5$, the new project is likely to be "big" relative to assets-in-place. In such a situation, an increase in the size of the new project resulting from an increase in k, will lead to a *reduction* in the contribution of the covariance term to the volatility of the firm cash flows. This happens because the covariance term is maximized at $\alpha = 0.5$. The other two effects discussed under Proposition 2 are unaffected. The parameter restriction ensures that the covariance effect does not dominate the other two effects.

Finally, the following proposition discusses how the relation between asset liquidity and stock liquidity depends on ρ, the extent of correlation between the cash flows from assets-in-place and new projects.

Proposition 4. *If $\alpha < 0.5$ ($\alpha > 0.5$), the relation between asset liquidity and stock liquidity is more (less) positive for firms with a low (high) ρ.*

When $\alpha < 0.5$, the covariance between the assets-in-place and the new project makes the relation between asset liquidity and stock liquidity less positive. Since the covariance term is increasing in ρ, it follows that the relation between asset liquidity and stock liquidity is more positive for firms with a low ρ. A similar logic applies in the case when $\alpha > 0.5$.

[8] For example, it can easily be verified using Equation (A3) in the Appendix that Proposition 2 continues to hold when $\alpha > 0.5$ as long as

$$\rho \leq \frac{4\alpha k h\left(\gamma^*\right)^2 \sigma_y^2 + 4\alpha k^2 h\left(\gamma\right) h'\left(\gamma^*\right) \frac{d\gamma^*}{dk}}{2\left(2\alpha - 1\right)\sigma_x \sigma_y \left(h\left(\gamma^*\right) + k h'\left(\gamma^*\right)\frac{d\gamma^*}{dk}\right)}.$$

3 Empirical Implications

In this section, we describe the main empirical implications of our model. From Proposition 1 we know that the relation between asset liquidity and stock liquidity can be either positive or negative. While a higher proportion of liquid assets on the balance sheet reduces the uncertainty regarding assets-in-place, it also facilitates more future investment, thereby increasing the level of uncertainty. These two effects influence stock liquidity in opposite directions. In our empirical analysis we test to see which effect dominates.

Proposition 2 implies that the relation between asset liquidity and stock liquidity is less positive for firms with more growth opportunities. We use firm capital expenditures and market to book ratios to proxy for the level of growth opportunities. Our first prediction is:

Prediction 1. *The relation between asset liquidity and stock liquidity is less positive for firms with high capital expenditures and high market to book ratios.*

As a further test of how managerial investment decisions affect the relation between asset liquidity and stock liquidity, we study the changes in stock liquidity following instances of firm financing. Say, when a firm raises finance through a SEO, the cash infusion is likely to result in high cash balances relative to total assets and hence high asset liquidity. However, if the manager is expected to invest the cash in projects and growth opportunities, then despite the high asset liquidity, there is likely to be a lot of uncertainty regarding future value. The rationale of our model suggests that the improvement in stock liquidity following firm financing depends on the future utilization of the proceeds.

Prediction 2. *The improvement in stock liquidity following financing depends on the extent to which the proceeds are retained as cash.*

Proposition 3 shows that the relation between asset liquidity and stock liquidity is more positive for firms that face constraints in raising external finance. We use firm size and the presence of credit ratings to identify constrained firms. Smaller firms and firms without credit rating are more likely to face constraints in raising external finance. Furthermore, firms that are closer to financial distress are not only likely to face constraints in raising external finance, but they are also likely to be subject to an underinvestment problem (Myers (1977)).[9] For such firms as well we expect the relation between asset liquidity and stock liquidity to be more positive. We proxy for firm financial distress using a modified version of the Merton-KMV expected default probability as first proposed in Bharath and Shumway (2008). Thus our third prediction is:

Prediction 3. *The relation between asset liquidity and stock liquidity will be more positive for financially constrained firms, in particular for smaller firms, firms without credit ratings, and for firms with higher default likelihood.*

4 Data and Liquidity Measures

To test our predictions we construct a sample that spans 1962-2005. Our analysis focuses on annual firm level data for all Compustat firms. We obtain data for three measures of stock liquidity from Joel Hasbrouck's website. We use TAQ data to construct one of our stock liquidity measures. We complement these data with daily stock returns and trading volume from CRSP and annual firm financial data from Compustat. Finally, we use the SDC database to identify SEOs. Apart from availability of liquidity measures and financial information in Compustat, we also limit our sample to firms with book value of assets higher than $5 million and with a minimum of two years of financial data. These restrictions ensure that very small firms do not disproportionately influence our results.

We use four popular measures of stock liquidity. The first one is the illiquidity measure

[9] An alternative view emphasizes agency conflicts when firms are in financial distress, and argues that asset liquidity may give managers of such firms greater discretion. Managers may be able to sustain inefficient operations by liquidating the assets (see DeAngelo, DeAngelo, and Wruck (2002)). Our empirical tests will help distinguish this view from the one described in the text.

proposed by Amihud (2002). Since the raw Amihud measure is highly skewed, we use the square root version of the raw measure in our empirical analysis. For every stock in our sample and for every year it is calculated as:

$$Illiq_{i,t} = \frac{1}{N_{i,t}} \sum_{j=1}^{N_{i,t}} \sqrt{\frac{|R_{i,j}|}{Vol_{i,j} \cdot P_{i,j-1}}}$$

where $N_{i,t}$ is the number of trading days for stock i during year t, $R_{i,j}$ is the return on day j, $Vol_{i,j}$ is trading volume in millions of shares, and $P_{i,j-1}$ is the closing stock price. *Illiq* is a price impact measure. It captures the stock return per one million dollars of trading volume. This measure is constructed along the lines of Kyle's (1985) 'lambda,' with the important difference of using volume instead of signed order flow. We obtain the annual average *Illiq* measure for all the stocks in our sample from Joel Hasbrouck's website.

Our second measure of stock liquidity is the implicit bid-ask spread, s, first proposed in Roll (1984). This measure is calculated as the square root of the negative daily autocorrelation of individual stock returns. i.e.

$$s_{i,t} = \sqrt{-Cov(R_{i,j}, R_{i,j-1})}.$$

Roll shows that this measure proxies for half of the bid-ask spread assuming that the fundamental value of the security is fixed through time and order flow is identically and independently distributed. Since the autocorrelation of stock returns is often positive, this measure is not well defined in many cases. To overcome this problem, Hasbrouck (2009) introduces a Gibbs sampler estimate of Roll's measure. Hasbrouck finds that the Gibbs estimator has a correlation of 0.965 with daily effective trading costs estimated from TAQ data. We use this Gibbs sampler estimate for our empirical analysis. We obtain data on this measure as well from Joel Hasbrouck's website.

Our third measure of stock liquidity is the annual average effective bid-ask spread, *Spread*, calculated from intra-day TAQ data. The bid and ask prices are identified from the intra-day transaction data. The effective bid-ask spread for any trade is equal to the ratio of the absolute difference between the trade price and the mid-point of the associated quote and the trade-price. The effective spread is then averaged over the year to obtain *Spread*. This data on the average effective spread is obtained from the web site of the University of Vanderbilt's Center for Research on Financial Markets and is available to us only for the sub-period 1994-2006.

Our final measure of stock liquidity is the Pastor-Stambaugh measure, *PS-Gamma*. This measure was first proposed by Pastor and Stambaugh (2003). The rationale for this measure is that if a stock is illiquid, then large buy or sell volumes are likely to move prices. Such temporary price movements are likely to be reversed subsequently. Thus for illiquid stocks, large buy (sell) volumes are likely to result in subsequent negative (positive) returns. Following this logic, Pastor and Stambaugh (2003) propose regressing daily stock returns on lagged stock returns and lagged signed volume, where the sign of lagged volume is the same as the sign of lagged stock return. The coefficient on signed volume, which on average is expected to be negative, is a measure of stock liquidity. We obtain data on this measure at annual frequencies from Joel Hasbrouck's website where higher values of *PS-Gamma* indicate a more illiquid stock. To obtain reasonable coefficients, we normalize *PS-Gamma* by multiplying with thousand.

Our main independent variable is a measure of asset liquidity. We assign liquidity scores between zero and one to all the assets on a firm's balance sheet based on their level of liquidity. We then calculate a weighted asset liquidity score using the book value of the different assets as weights and normalize by the lagged value of total assets. Using this approach we come up with four alternative measures of asset liquidity. These measures differ in terms of the liquidity score assigned to the balance sheet items.

Our first measure of asset liquidity assigns a liquidity score of one to cash and equivalents and a score of zero to all other assets of the firm. Formally, our first *Weighted Asset Liquidity* (*WAL*) measure for firm i in year t is given by

$$\text{WAL-1}_{i,t} = \frac{\text{Cash \& Equivalents}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 1 + \frac{\text{Other Assets}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 0.$$

Thus, effectively, *WAL-1* is the proportion of cash and equivalents to the firm's lagged total assets. Clearly, this measure leaves out a lot of information, as it presumes that all assets other than cash and equivalents are perfectly illiquid. Nevertheless, this measure is useful because it best captures the parameter α in our model.

While cash and equivalents are perfectly liquid, non-cash current assets (CA) are semi-liquid. That is, they can be converted to cash relatively quickly and at a low cost. Thus, for our second measure of asset liquidity, we assign a liquidity score of one-half to non-cash current assets. Our second *WAL* measure is,

$$\text{WAL-2}_{i,t} = \frac{\text{Cash \& Equivalents}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 1 + \frac{\text{Non Cash CA}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 0.5 + \frac{\text{Other Assets}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 0.$$

Non-current assets can broadly be divided into tangible and intangible assets. Tangible assets such as property, plant, and equipment are more liquid than intangible assets such as growth opportunities and goodwill. Following this logic we calculate our third measure by assigning a liquidity score of one for cash, three-quarters for non-cash current assets, one half for tangible fixed assets, and zero for the rest. We calculate tangible fixed assets as the difference between the book value of total assets and the sum of current assets, and book value of goodwill and intangibles.[10] This gives rise to our third *WAL* measure,

$$\begin{aligned}\text{WAL-3}_{i,t} = {} & \frac{\text{Cash \& Equivalents}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 1 + \frac{\text{Non Cash CA}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 0.75 \\ & + \frac{\text{Tangible Fixed Assets}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 0.5 + \frac{\text{Other Assets}_{i,t}}{\text{Total Assets}_{i,t-1}} \times 0.\end{aligned}$$

[10] We obtain book values of goodwill and intangibles from Data204 and Data33 in Compustat.

We construct our fourth and final measure of asset liquidity to capture the liquidity of both assets-in-place and growth options. We construct the *Market Weighted Asset Liquidity* measure (MWAL), by assigning a liquidity score of one to cash and equivalents, three-quarters to non-cash current assets, one half to tangible fixed assets, and zero to the rest. We calculate tangible fixed assets as the difference between the book value of total assets and the sum of current assets and goodwill. We normalize this weighted score by the lagged market value of total assets to obtain:

$$\begin{aligned} \text{MWAL}_{i,t} = & \frac{\text{Cash \& Equivalents}_{i,t}}{\text{Market Assets}_{i,t-1}} \times 1 + \frac{\text{Non Cash CA}_{i,t}}{\text{Market Assets}_{i,t-1}} \times 0.75 \\ & + \frac{\text{Tangible Fixed Assets}_{i,t}}{\text{Market Assets}_{i,t-1}} \times 0.5 + \frac{\text{Other Assets}_{i,t}}{\text{Market Assets}_{i,t-1}} \times 0. \end{aligned}$$

Note that *MWAL* assigns a liquidity score of zero to growth options. Since we normalize the measure by the market value of assets – which is likely to include growth options – ceteris paribus, *MWAL* will be lower for firms with a higher proportion of growth options.[11]

We use additional independent variables to account for firm and market characteristics that are likely to affect stock liquidity. All the variables are defined in Appendix B. We control for firm size, which is an important determinant of stock liquidity using *Log(Market capitalization)*, for the extent of growth opportunities using *Market to book*, and *Capital expenditure*. We also control for firm performance using return on assets, *ROA*, and using the annual buy and hold abnormal return during the previous year, *BHAR*. Firms with more transparent earnings and firms with better disclosure policies are also likely to be associated with higher stock liquidity (Diamond and Verrecchia (1991), Bhattacharya, Desai, and Venkataraman (2007)). In most of our specifications we employ firm fixed effects and this is likely to control for time invariant differences across firms in disclosure policies. In addition, we control for the quality of a firm's earnings using the level of discretionary

[11]We calculate the market value of assets as the sum of the book value of assets and the market value of equity less the book value of equity.

accruals normalized by lagged value of total assets, *Discretionary accruals*.[12] Finally, we control for stock return volatility, *Log(Volatility)*.

Table I presents summary statistics for the key variables in our sample. To reduce the effects of outliers, all our variables are winsorized at the 1% level. The median value of *Illiq* in our sample is 0.285. Average Roll's estimate of the half spread is about 1% implying an average relative spread during the entire sample period of approximately 2%. Consistent with this, the average effective half spread as estimated from the TAQ data, *Spread* is about 0.9%. Recall that this measure is estimated only for the sub-period 1994-2006. The average value for *PS-Gamma* is 0.01.

The mean value of *WAL-1* of 0.142 implies that on average book value of cash constitutes about 14.2% of the value of previous year's total assets. The average market capitalization of equity in our sample is $1637.8 million, whereas the median is $146.35 million. The average market to book ratio of equity in our sample of 2.29 is comparable to other studies. The average default probability of our sample firms is 6% while the 90^{th} percentile is 21.3% (Not reported in the table). This ensures sufficient variation in default probability in our sample. Firms in our sample have an average return on assets of 11.5%, and experience an average annual buy and hold abnormal return of 4.9%. The average abnormal return is positive because our requirements of a minimum book value of total assets of $5 million, and availability of more than two years of data tilts the sample towards the better performing firms. About 20.9% of firms in our sample have long term credit rating from S&P. The average daily stock volatility in our sample is 3.2%.

[Table I goes here]

Table II presents the correlations among the key variables in our analysis. As expected, the four measures of stock liquidity are positively correlated with each other. Among the

[12] The reported results use the signed discretionary accruals. The results are similar when using the absolute value of the discretionary accruals instead (not reported).

book value based asset liquidity measures, while *WAL-1* is negatively correlated with all four measures of stock illiquidity, the pattern with the other two is mixed. Both *WAL-2* and *WAL-3* are negatively correlated with two out of the four measures of stock illiquidity. *MWAL* on the other hand is unconditionally positively correlated with the measures of stock illiquidity. The three book value based measures of asset liquidity are highly correlated with each other. *MWAL* is less correlated with the other measures, especially with *WAL-1*. This is because a large fraction of the variation in *MWAL* is from changes in the market to book ratio as can be seen from the correlation between *MWAL* and *Market to book* of -.408.[13] Many of our control variables are also significantly correlated with the stock illiquidity measures, justifying the need to include them in the regressions.

[Table II goes here]

5 Empirical Results

5.1 The Basic Effect

We begin our empirical analysis by testing whether on average there is a positive or negative relation between asset liquidity and stock liquidity. To do this we estimate panel models with both firm fixed effects and time effects as follows:

$$Y_{i,t} = \alpha + \beta X_{i,t} + \gamma \text{Controls}_{i,t} + \mu_i + \mu_t + \epsilon_{i,t}. \tag{8}$$

Here $Y_{i,t}$ is one of the four measures of stock liquidity for firm i during year t, $X_{i,t}$ is one of the four asset liquidity measures, μ_i are firm fixed-effects, and μ_t are year dummies. The control variables are *Log(Market capitalization)*, *Capital expenditure*, *Market to book*, *ROA*,

[13]Since a lot of variation in our market value measure is driven by changes in market value of equity, we put more weight on the results with our book value measures.

BHAR, *Log(Volatility)*, and *Discretionary accruals*. We use standard errors that are robust to heteroskedasticity and clustered at the firm level.[14]

In Table III we estimate the average relation between asset liquidity and stock liquidity in our sample. We employ the sixteen different combinations of asset liquidity and stock liquidity measures. Since all four measures of stock liquidity are in fact measures of stock illiquidity, the sign of the relation between asset and stock liquidity is opposite to the sign of the coefficient.

In Panel A the dependent variable is either *Illiq* or *s*. Columns (1)-(4) have *Illiq* as the dependent variable and correspond to the four different measures of asset liquidity: *WAL-1*, *WAL-2*, *WAL-3*, and *MWAL*. The coefficients on *all* four measures are negative and significant. Furthermore, the results are economically significant. For example, for a firm with a median level of stock liquidity, a one standard deviation increase in *WAL-1* reduces *Illiq* by 15.7%. Similarly, one standard deviation increase in *MWAL* reduces *Illiq* by 11.9% for a firm with a median level of stock illiquidity. Note that the R^2 in all our regressions are high because of the use of firm fixed effects.

All our control variables are significant and indicate that, smaller firms, firms with high market to book ratio, less discretionary accruals (weakly), firms that do not undertake large capital expenditures, firms with low levels of profitability and abnormal stock returns and those with more volatile stock have less liquid stock.

In Columns (5)-(8) we repeat our estimation with Roll's measure as the dependent variable and obtain results consistent with those in the earlier columns. Here again we find that an increase in the proportion of liquid assets in the firm's balance sheet increases stock liquidity. The results are also economically significant. For example, the estimate in Column (5) indicates that for a firm with median level of stock liquidity, a one standard deviation

[14]Since stock liquidity is correlated across stocks at a point in time, in alternative empirical specifications, we repeat our tests clustering standard errors at the year level and obtain results similar to the ones reported. Alternatively, we also tried clustering standard errors both at the firm and year level, but given the large number of fixed effects in our specifications, the estimates failed to converge.

increase in *WAL-1* improves stock liquidity by 9.8%. In Panel B we repeat the estimation using the *Spread* and *PS-Gamma* as the dependent variables. The results are similar to the ones in the previous panel.

The results in Table III provide strong support for a positive average relation between asset liquidity and stock liquidity. This indicates that in our sample the effect of higher asset liquidity in increasing the liquidity of assets-in-place outweighs its effect of reducing the liquidity of future assets.[15,16]

To see if and how the relation between asset liquidity and stock liquidity changes with time, in unreported tests, we split our sample into four sub-periods, 1962-1975, 1976-1985, 1996-1995, and 1996-2005, and repeat our estimates. Our results indicate a positive association between asset liquidity and stock liquidity in all but the first sub-period. Furthermore we find that the relation becomes more positive in the latter sub-periods. To conserve space, we do not report these results, but they are available upon request.

[Table III goes here]

Since we employ firm fixed effects in all our specifications, the correlations that we document are between deviations in asset liquidity and stock liquidity from their average value for an individual firm in our sample. Does the same relation between asset liquidity and stock liquidity hold in the cross-section as well? To answer this question, in Table IV, we employ the Fama-Macbeth approach. We conduct annual cross-sectional regressions of stock liquidity on measures of asset liquidity and the full set of control variables, and report the average

[15]In unreported tests we divide our sample firms into three broad industry groups, *Financial services* (firms with SIC code 6000-6999), *Utilities* (firms with SIC code 4000-4999) and *Industrials* (firms with SIC code 2000-3999) and repeat our tests in the sub-samples. We find that asset liquidity and stock liquidity are positively related within all three industry groups. There is some evidence that the relation is strongest among industrial firms.

[16]To ensure that across industry differences in the level of cash balance does not bias our results, we repeat our tests replacing *WAL-1* with *Abnormal WAL-1*, where *Abnormal WAL-1* as the difference between the firm's *WAL-1* and the median *WAL-1* of all firms in the same three digit SIC code industry during the year. Our results indicate a positive association between stock liquidity and *Abnormal WAL-1*.

coefficients along with the standard errors. Since stock liquidity is quite persistent, we adjust for autocorrelation by correcting the reported standard errors. To do this, we follow Fama and French (2002) and Cooper, Gulen, and Schill (2008), and multiply the standard errors of the average parameters by $\sqrt{\frac{1+\rho}{1-\rho}}$, where ρ is the first-order autocorrelation of annual parameter estimates. To conserve space we suppress the coefficients on the control variables. The results in Panel A and B of Table IV are consistent with a positive relation between asset liquidity and stock liquidity in the cross-section. We find that twelve of the sixteen coefficients are negative and statistically significant. The coefficient estimates are in some cases larger than the estimates in Table III.

[Table IV goes here]

In summary, asset liquidity and stock liquidity are positively related both across time and in the cross-section. This suggests that the observed *WAL-1* in our sample is lower than $\hat{\alpha}$ (Proposition 1). The magnitude of the effect is also large. Since asset liquidity and stock liquidity are likely to be endogenous, one concern with our estimates is of omitted variable bias. Say firms with growth opportunities may have high asset liquidity and stock liquidity. If we do not adequately control for growth opportunities, our estimates are likely to be biased. To see if our results are robust to partially controlling for endogeneity, we employ the linear Generalized Method of Moments (GMM) estimator proposed by Arellano and Bond (1991). This procedure uses lagged values to instrument for asset liquidity and estimates the regression using the GMM procedure. We find that our results are robust to using this procedure. This indicates that the positive correlation between asset liquidity and stock liquidity is not driven by omitted variables bias.[17]

[17] We thank Christopher Baum for suggesting this test.

5.2 Growth Opportunities and the Relation Between Asset Liquidity and Stock Liquidity

Having established a positive average relation between asset liquidity and stock liquidity, we now turn to test *Prediction 1*: the relation between asset liquidity and stock liquidity is less positive for firms with more growth opportunities.

In Panel A of Table V we use capital expenditure to identify firms with growth opportunities. We divide our sample into firms with above and below median capital expenditure each year and repeat our tests in the two sub-samples. To conserve space, we only report the results for Amihud's stock illiquidity measure. Similar results obtain for the other three stock liquidity measures. While our specification is similar to the one we employ in Table III, we suppress the coefficients on the control variables other than *Log(Market capitalization)* to conserve space.

One way to test *Prediction 1* is to repeat the estimation of (8) after including an interaction term between the measures of asset liquidity and a dummy variable that identifies firms with high capital expenditure. *Prediction 1* would imply a positive coefficient on the interaction term. Instead of employing such a procedure, we repeat the estimation of (8) on two sub-samples of firms with high and low capital expenditure, and test to see if the coefficient on the asset liquidity measure is different across the two sub-samples. Our methodology is a more general way of estimating interaction effects, because we do not constrain the coefficients on the control variables to be the same for firms with high and low capital expenditures. Thus our procedure is equivalent to estimating the interaction effect after including a full set of interaction terms for all the control variables including the fixed effects.[18] We employ this procedure for its generality.

[18]To test if the relation between asset liquidity and stock liquidity is significantly different across the two subsamples, we estimate a single equation with a full set of interaction terms between all the independent variables and a dummy variable that identifies firms with above median capital expenditure and test if the coefficient on the asset liquidity interaction term is significantly different from zero. We present the results of the test in the row titled Δ *Coef* in the tables.

The results in Column (1) and (2) indicate that *WAL-1* has a more positive relation with stock liquidity for firms with below median capital expenditure (-.279) in comparison to firms with above median capital expenditure (-.200). The row titled Δ *Coef* shows that the coefficients across the two sub-samples are significantly different from each other. Qualitatively similar differences obtain from comparing Columns (3) to (4), (5) to (6) and (7) to (8).[19]

In Panel B of Table V we repeat the analysis using the firm's market to book ratio to proxy for the extent of growth opportunities. Since firms with a high market to book ratio (above median) are likely to have more growth opportunities, following *Prediction 1*, we expect asset liquidity to have a less positive effect on stock liquidity for such firms. Consistent with our prediction, the results in Column (1) and (2) of Panel B show that *WAL-1* has a more positive relation with stock liquidity for firms with low market to book ratio. From Δ *Coef.* we find that the coefficients are significantly different from each other across the two sub-samples. In Columns (3)-(8) we repeat our estimates successively with *WAL-2*, *WAL-3*, and *MWAL*. All the results, except for the ones with *MWAL*, show a significantly more positive effect of asset liquidity on stock liquidity for firms with low market to book ratio.

[Table V goes here]

We now proceed to tests of *Prediction 2*. To recall, *Prediction 2* suggests that the improvement in stock liquidity following firm financing should be greater if the firm retains a larger fraction of the issue proceeds as cash. To test the prediction, we focus on seasoned equity offerings (SEOs), and relate the change in stock liquidity in the post issue period to

[19]Since the normal level of capital expenditure may differ across industries, we perform additional tests to ensure that our results are not simply capturing across industry differences in the relation between asset liquidity and stock liquidity. To do this, we repeat our tests in subsamples of firms with positive and negative *Abnormal capital expenditure*, where *Abnormal capital expenditure* measures the difference between the firm's capital expenditure and the median capital expenditure of all firms in the same three digit SIC code industry during the year. Consistent with our reported results we find that the relation between asset liquidity and stock liquidity is less positive in the subsample of firms with positive abnormal capital expenditure. The results are available upon request.

the fraction of issue proceeds that the firm retains as cash.

We obtain a sample of SEOs from SDC with issue date during the period 1970-2006 and with non-missing and positive values for number of primary shares offered, issue proceeds and issue price. We also confine the sample to SEOs with a minimum size of $10 million. We combine the SEO data with CRSP and COMPUSTAT to obtain stock price information during the pre- and post-issue period and firm financial data. This procedure results in a sample of 5756 SEOs.

The summary statistics for the key variables for this SEO sample is provided in Panel A of Table VI. The average size of the issue in our sample is $117.8 million and this constitutes about 31% of the book value of total assets as of the end of the previous year. We use daily stock return data to calculate *Illiq* during the pre- and post-issue period. $Illiq_{-30,0}$ ($Illiq_{-60,0}$) is Amihud's illiquidity measure estimated during the thirty days (sixty days) prior to the SEO while $Illiq_{15,45}$ ($Illiq_{15,75}$) represents a similar measure estimated during the thirty days (sixty days) following the SEO. In calculating the illiquidity measures for the post-issue period, we ignore the fifteen day period immediately following the SEO to avoid any bias due to abnormal trading immediately following the SEO. Stock liquidity significantly improves after the SEO. This is evident from the fact that $Illiq_{15,45}$ and $Illiq_{15,75}$ are smaller than $Illiq_{-30,0}$ and $Illiq_{-60,0}$ respectively. This result is consistent with the finding in Masulis, Eckbo, and Norli (2000). *Fraction retained* is the ratio of the difference in cash balance between the end of the financial year immediately following and immediately before the SEO to the total SEO proceeds. We use this as a measure of the amount of the SEO proceeds that the firm retains as cash by the end of the year. We find that firms on average retain 42% of the SEO proceeds as cash by the end of the year of the SEO.

We use a model similar to (8) to estimate how the change in stock liquidity in the post-SEO period is related to the fraction of the SEO proceeds that the firm retains as cash. Since our analysis here is cross-sectional, we do not employ firm fixed effects. Our main dependent variable for this analysis is either $\Delta Illiq_{30}$ or $\Delta Illiq_{60}$, where $\Delta Illiq_{30}$ is $Illiq_{15,45}$ - $Illiq_{-45,0}$ and $\Delta Illiq_{60}$ is $Illiq_{15,75}$ - $Illiq_{-60,0}$. The main independent variable is *Fraction retained*. Note that in relating the change in stock liquidity in the immediate post-issue period to the fraction of cash retained – which is only known in the future – we implicitly assume that the market rationally anticipates the amount of cash the firm is going to retain and reacts accordingly. We control for the stock liquidity in the pre-issue period, *Market to book*, *Log(Market capitalization)*, and *ROA*.

In Column (1) of Panel B we have $\Delta Illiq_{30}$ as the dependent variable and find that the coefficient on *Fraction retained* is negative and significant. This is consistent with *Prediction 2*. In Column (2) we repeat our estimation with $\Delta Illiq_{60}$ as our dependent variable and obtain similar results. In Column (3) we repeat our estimation after dropping the SEOs that happen within a period of two months before the year end. We do this to avoid any overlap between the time period we use to calculate the post-issue illiquidity measures and the date we use to calculate the cash balance. This test is consistent with the notion that the change in stock liquidity in the post-issue period is related to the amount of cash that the firm is *expected* to retain by the end of the year.

The results in all the specifications show that the change in stock liquidity in the post issue period is positively related to the fraction of the issue proceeds that the firm retains as cash. In Column (4) we repeat our estimation after including an interaction term *Fraction retained* $\times$ *Proceeds/*TA_{t-1} to see if the change in stock liquidity in the post-issue period is greater for firms that conduct a larger SEO in comparison to firm size and retain a larger fraction of the issue. The results indicate that it is indeed the case.

[Table VI goes here]

5.3 Financing Constraints and the Relation Between Asset Liquidity and Stock Liquidity

In this section we perform tests of *Prediction 3* which suggests that the relation between asset liquidity and stock liquidity should be more positive for firms that face external finance constraints. We use three proxies to identify constrained firms. Our first proxy is firm size. Based on prior literature, we expect smaller firms to face greater constraints in raising external finance as compared to larger firms. In Panel A of Table VII, we classify firms into those with below and above median book value of total assets and repeat our estimation of (8) in the two sub-samples. Our results indicate that an increase in asset liquidity has a much greater effect on stock liquidity for firms with below median size in comparison to firms with above median size. For example, from Columns (1) and (2) one can see that the effect of asset liquidity on stock liquidity is more positive by a factor of more than eight for small firms. Similar results hold for the other asset liquidity measures.

In Panel B of Table VII we use the presence of credit ratings as a measure of financial constraints. Firms with credit ratings are likely to be more transparent and have more options when it comes to raising external finance. The results in Columns (1) and (2) indicate that, consistent with our prediction, an increase in *WAL-1* has more than twice the effect on stock liquidity for firms without credit ratings as compared to firms with credit ratings (-.103 in comparison to -.221). In Columns (3) and (4) we repeat our estimates using *WAL-2*, in Columns (5) and (6) we use *WAL-3* and obtain similar results. Our results with *MWAL* suggest no significant difference in the relation between asset liquidity and stock liquidity for rated and unrated firms.

Finally in Panel C we measure the extent of financial distress in a firm and classify firms in financial distress as facing greater constraints in raising external finance. We use the Merton-KMV measure of the expected default likelihood as a proxy for financial distress. We estimate this measure using a methodology similar to that in Bharath and Shumway

(2008). We outline the methodology in Appendix C. We distinguish between firms whose expected default probability is above and below the sample median. The results in Columns (1) and (2) of Panel C show that *WAL-1* has almost twice the effect on stock liquidity for firms with high default probability in comparison to firms with low default probability (-.276 in comparison to -.154). We also find that the coefficients are statistically different from each other. In Columns (3)-(8) we repeat our estimates successively using *WAL-2*, *WAL-3*, and *MWAL* and find that in all cases asset liquidity improves stock liquidity more for firms that are closer to default.

[Table VII goes here]

6 Value of Asset Liquidity

In our final set of tests, we estimate the value implications of the relation between asset liquidity and stock liquidity that we uncover. Our results so far show that an increase in asset liquidity is accompanied by an improvement in stock liquidity. Prior research in market microstructure shows that an increase in stock liquidity may increase firm value either by reducing the cost of capital (Amihud and Mendelson (1986)) or by enabling design of better incentive contracts (Holmstrom and Tirole (1993)). If the improvements in stock liquidity that result from an increase in asset liquidity lead to higher firm value, then asset liquidity will likely be more valuable for firms with an illiquid stock.

To test this prediction we use the methodology in Faulkender and Wang (2006) and estimate the value of corporate cash holdings for firms with more and less liquid stock. In brief, their methodology involves regressing annual size and book-to-market adjusted abnormal stock returns on changes in cash balance and a set of control variables. The control variables include the initial cash balance, $Cash_{t-1}$, changes in *Profits*, *Non cash assets*, *R&D*, *Interest*, *Dividends* and the level of *Leverage* and a variable that measures the net financing raised by the firm during the year, *Net financing*. We define all the variables in Appendix B.

In Column (1) of Table VIII we repeat the estimation of Faulkender and Wang (2006) for comparison. The coefficient on Δ *Cash* is an estimate of the value of the marginal dollar of cash. The results in Column (1) show that in our sample, a dollar of cash is worth seventy-six cents for the average firm. This estimate is very close to the seventy-five cents estimated by Faulkender and Wang (2006). In Column (2) we repeat the estimates after including firm and year fixed effects, with winsorized variables and after confining the sample to firms for which we have data on *Illiq* for the previous year. We include the last criteria because the sample in the subsequent Columns is confined to such firms. The results in Column (2) indicate that one $ of cash is worth eighty-one cents on average. In Columns (3) & (4) we divide our sample into firms with above and below median stock liquidity – as measured by *Illiq* – and repeat the estimation in the two subsamples. Faulkender and Wang (2006) show that cash is more valuable for smaller firms that may face greater external financial constraints. Since smaller firms are also likely to have illiquid stock, we need to control for firm size in our estimation. We do this by dividing our sample into market capitalization deciles and identifying high and low liquidity firms within the deciles. This ensures that the median market capitalization of firms in both the high- and low-liquidity sub-samples are the same. Our results in Column (3) & (4) of Table VIII show that consistent with our conjecture, an additional dollar of cash is more valuable for firms with less liquid stock. The row titled Δ *Coef.* indicates that a dollar of cash is worth twelve cents more for firms with below median stock liquidity.[20] In Columns (5) and (6) we further control for access to external finance, by limiting our sample to firms without long term bond rating. Our results again show that cash is more valuable for firms with below median stock liquidity.

[Table VIII goes here]

[20] In unreported tests we find our estimates robust to estimating a single regression on the full sample with an interaction term *High Illiq* $\times$ Δ *Cash*.

7 Conclusion

In this paper we study the balance sheet of liquidity: the relation between the liquidity of the firm's assets and the liquidity of financial claims on the assets, thereby linking corporate finance decisions to stock liquidity. Our model highlights that the relation may be either positive or negative depending on parameter values. Greater asset liquidity reduces uncertainty regarding valuation of assets-in-place, but it also increases future investments and the associated uncertainty. The model departs from the perfect MM world by assuming that the source of capital affects investment decisions. As a result, the model shows that asset liquidity improves stock liquidity more for firms which are less likely to reinvest their liquid assets: firms with less growth opportunities, financially constrained firms and firms with low correlation between assets-in-place and new projects.

Empirically, we find a positive and economically large relation between asset liquidity and stock liquidity. Consistent with our model, the relation is more positive for firms with low growth opportunities and for financially constrained firms. The results hold both in the time series, and in the cross section, and are reinforced by an event study.

The relation between asset liquidity and stock liquidity also has value implications. Indeed, the effect of high cash balance in improving stock liquidity is a hitherto unknown benefit of cash. We find that an increase in corporate cash holding is significantly more valuable for firms with less liquid stock.

Finally, our analysis linking corporate finance to stock liquidity has further implications, the empirical study of which is beyond the scope of this paper. One example is the result that the relation between asset liquidity and stock liquidity is more positive for firms with low correlation between assets-in-place and new projects. The second is commonality in stock liquidity. We show that the relation between asset liquidity and stock liquidity depends strongly on investment opportunities. Such opportunities co-vary at the industry, economy and global level. This suggests that stock liquidity may have a common component not only at the market level, but also at the industry and global level. Another example of an implication is the long-term stock under-performance after firm financing. The improvement in stock liquidity following such financing – as highlighted by our results– is likely to reduce the liquidity risk premium for the stock which in turn is likely to reflect as under-performance based on the ex ante risk characteristics.

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Appendix A: Proofs

Proof of Proposition 1: Recall that λ is a measure of stock illiquidity. Thus, $\frac{\partial\lambda}{\partial\alpha} \leq 0$ means that higher asset liquidity is associated with higher stock liquidity. Differentiating (6) with respect to α we have:

$$\frac{\partial\lambda}{\partial\alpha} = \frac{1}{2\sigma_u} \cdot \frac{\partial\sigma_0^2}{\partial\alpha}. \tag{A1}$$

Since $\sigma_u > 0$, $\frac{\partial\lambda}{\partial\alpha} \leq 0$ is equivalent to $\frac{\partial\sigma_0^2}{\partial\alpha} \leq 0$. Differentiating (5) with respect to α we obtain:

$$\frac{\partial\sigma_0^2}{\partial\alpha} = -2(1-\alpha)\sigma_x^2 + 2\alpha k^2 h(\gamma^*)^2 \sigma_y^2 + 2(1-2\alpha) kh(\gamma^*)\sigma_x\sigma_y\rho. \tag{A2}$$

Thus $\frac{\partial\sigma_0^2}{\partial\alpha} \leq 0$ iff

$$\alpha\left(\sigma_x^2 + k^2 h(\gamma^*)^2 \sigma_y^2 - 2kh(\gamma^*)\sigma_x\sigma_y\rho\right) \leq \sigma_x^2 - kh(\gamma^*)\sigma_x\sigma_y\rho.$$

or,[21]

$$\alpha \leq \frac{\sigma_x^2 - kh(\gamma^*)\sigma_x\sigma_y\rho}{\sigma_x^2 + k^2 h(\gamma^*)^2 \sigma_y^2 - 2kh(\gamma^*)\sigma_x\sigma_y\rho} \equiv \hat{\alpha}.$$

QED.

Proof of Proposition 2: Differentiating (A2) with respect to k we obtain:

$$\begin{aligned}\frac{\partial^2\sigma_0^2}{\partial k\partial\alpha} &= 4\alpha kh(\gamma^*)^2\sigma_y^2 + 4\alpha k^2 h(\gamma^*) h'(\gamma^*)\frac{\partial\gamma^*}{\partial k} \\ &\quad + 2(1-2\alpha)\sigma_x\sigma_y\rho\left(h(\gamma^*) + kh'(\gamma^*)\frac{d\gamma^*}{dk}\right).\end{aligned} \tag{A3}$$

Using (4), this expression is clearly positive for $\alpha \leq \frac{1}{2}$. Consequently, $\frac{\partial^2\lambda}{\partial k\partial\alpha} > 0$. Since λ is a measure of stock illiquidity, this means that the relation between asset liquidity and stock liquidity is weaker (less positive or more negative) for firms with higher values of k (higher growth opportunities). QED.

Proof of Proposition 3: Since γ^* is higher for an unconstrained firm and since $h(\cdot)$ is increasing in γ the second term in (A2) is larger for an unconstrained firm as opposed to a constrained firm. Similarly, since $\alpha \leq 0.5$, and $\rho \geq 0$, the third term is also larger for an unconstrained firm. Hence $\frac{\partial\sigma_0^2}{\partial\alpha}$ is smaller for a constrained firm as compared to an unconstrained firm. QED.

Proof of Proposition 4: Differentiating (A2) with respect to ρ we obtain:

$$\frac{\partial^2\sigma_0^2}{\partial\rho\partial\alpha} = 2(1-2\alpha) kh(\gamma^*)\sigma_x\sigma_y. \tag{A4}$$

[21] Note that

$$\sigma_x^2 + k^2 h(\gamma^*)^2 \sigma_y^2 - 2kh(\gamma^*)\sigma_x\sigma_y\rho > 0,$$

and hence dividing by this term does not reverse the inequality.

Thus, $\frac{\partial^2 \sigma_0^2}{\partial \rho \partial \alpha}$ is clearly positive (negative) for $\alpha < 0.5$ ($\alpha > 0.5$). QED.

Appendix B: Description of Variables

- *Abnormal:* Size and book to market adjusted abnormal stock return.
- *BHAR:* Buy-and-hold annual abnormal stock return. It is the difference between the annual return on the firm's stock to the return on the value weighted portfolio of all NYSE, Amex, and Nasdaq stocks.
- *Capital expenditure:* Ratio of a firm's capital expenditures (Data128) to lagged total assets (Data6). When Data128 is missing, this variable is set to zero.
- *Cash:* Ratio of book value of cash over lagged market value of equity.
- *Default probability:* Expected Default Probability estimated using the approach in Bharath and Shumway (2008). See Appendix C.
- Δ *Cash:* Ratio of change in the book value of cash over lagged market value of equity.
- Δ*Dividends:* Ratio of change in dividends over lagged market value of equity.
- Δ *Interest:* Ratio of change in interest expense over lagged market value of equity.
- Δ *Non cash assets:* Ratio of change in net assets, which is the difference between book value of total assets and book value of cash over lagged market value of equity.
- Δ *Profits:* Ratio of change in operating profits over lagged market value of equity.
- Δ *R&D:* Ratio of change in R&D expenditure over lagged market value of equity.
- *Discretionary accruals:* Measure of a firm's abnormal accruals originally proposed in Jones (1991) and modified to control for performance per Kothari et al. (2005).
- *Fraction retained:* Ratio of the change in cash balance between the year ending after the SEO to the year ending before the SEO deflated by the size of the SEO.
- *Illiq:* Square Root of average annual Amihud (2002) Illiquidity measure. Amihud's measure is the ratio of the absolute daily stock return and the daily dollar volume. Data for this variable was obtained from Hasbrouck's website.
- $Illiq_{-30,0}$: Average *Illiq* over thirty trading days prior to the SEO.
- $Illiq_{-60,0}$: Average *Illiq* over sixty trading days prior to the SEO.
- $Illiq_{15,45}$: Average *Illiq* over the period of fifteen to forty-five trading days following the SEO.
- $Illiq_{15,75}$: Average *Illiq* over the period of fifteen to seventy-five trading days following the SEO.
- *Leverage:* Book value of long term and short term debt over lagged market value of equity.
- *Log(Market capitalization):* Natural log of a firm's market value of equity (Data25*Data199).
- *Market to book:* The ratio of market value of equity to book value of equity.
- *MWAL:* Ratio of the sum of cash, 0.75 times the value of non-cash current assets and one half times the value of other tangible fixed assets, to lagged market value of total assets. We calculate market value of total assets as the sum of book value of total assets and market value of equity less book value of equity.

- *Net financing:* Ratio of net financing, which is the sum of equity issued and long term debt issued less shares repurchased and long term debt repurchased over lagged market value of equity.
- *Proceeds/TA:* The ratio of SEO proceeds to lagged book value of total assets.
- *PS-Gamma:* Annual Pastor and Stambaugh (2003) gamma coefficient obtain from Hasbrouck's website
- *s:* Gibbs sampler estimate of Roll's (1984) implicit measure of trading costs. Data for this variable was also obtained from Hasbrouck's website.
- *Rated:* A dummy variable that identifies firms with non-missing S&P Long-term credit rating in Compustat.
- *ROA:* Ratio of earnings before depreciation, interest, and taxes over lagged value of total assets.
- *Spread:* Average intra-day daily effective percentage bid-ask spread estimated from TAQ. The data on the effective spread was obtained from the web site of the University of Vanderbilt's Center for Research on Financial Markets and is available to us only for the sub-period 1994-2006.
- *WAL-1:* Ratio of the of cash and cash equivalents to lagged value of total assets.
- *WAL-2:* Ratio of the sum of cash and one half times the value of non-cash current assets, to lagged value of total assets.
- *WAL-3:* Ratio of the sum of cash, 0.75 times the value of non-cash current assets and one half times the value of other tangible fixed assets, to lagged value of total assets.
- *Volatility:* Standard deviation of a firm's stock returns over 60 months preceding the beginning of a current fiscal year.

Appendix C - Details of the calculation of modified Merton-KMV default probability

We calculate the expected default probability using the modified Merton-KMV procedure. This involves viewing the firm's equity as a call option on the underlying assets with a strike price equal to the book value of total debt. We use the Black-Scholes option pricing formula for European call options to estimate the default probability. The key parameters required to calculate the default probability are listed below. We first propose an initial value of the volatility of the firm's assets, σ_V, and use it along with the book value of total debt F, the market value of total assets V (the sum of the market value of equity and the book value of debt) and the risk free rate r and apply Equation (C1) to infer the market value of the firm's equity, E. We use the market value of the firm's equity along with the book value of total debt to estimate the market value of the firm's total assets at the end of every day during the previous year. We use these market values to calculate the log return on assets each day and use the return series to generate a new estimate for the volatility of the assets, σ_V and the expected return on the assets, μ. We iterate on σ_V in this manner until it converges (so the absolute difference in adjacent σ_Vs is less than 10^{-3}). We then calculate the expected default probability, *Default probability* using Equation (C3).

$$E = VN(d_1) - e^{-rT}FN(d_2), \tag{C1}$$

where E is the market value of the firm's equity and

$$d_1 = \frac{ln(V/F) + (r + 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}}, \tag{C2}$$

and d_2 is just $d_1 - \sigma_V\sqrt{T}$.

$$\text{Default probability} = N(-(\frac{ln(V/F) + (\mu - 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}}. \tag{C3}$$

- σ_V: Volatility of the firm's assets.
- μ: Expected return on the firm's assets.
- F: Book value of total debt.
- r: Risk free rate.
- V: Market value of total assets.
- T: Time to maturity (one year).
- E: Market value of the firm's equity.

Table I: Summary Statistics

This table reports the summary statistics of the key variables used in our analysis. All the variables are defined in Appendix B. The sample includes all firms with financial data in Compustat during the years 1962-2005. Effective Spread data is only for 1995-2006. All variables are winsorized at the first and the ninety-ninth percentile.

Variable	N	Mean	Median	Std. Dev.
Illiq	88360	0.579	0.285	0.754
s	88360	0.01	0.006	0.011
Spread	38086	0.009	0.006	0.008
PS-Gamma	88360	0.01	0	0.066
WAL-1	88360	0.142	0.065	0.196
WAL-2	88360	0.322	0.301	0.236
WAL-3	88360	0.664	0.64	0.237
MWAL	87563	0.507	0.501	0.237
Market capitalization	88360	1637.837	146.354	9889.643
Market to book	87562	2.292	1.559	2.72
Default probability	65580	0.06	0	0.15
Capital expenditure	87385	0.072	0.049	0.11
ROA	87710	0.115	0.126	0.157
BHAR	88227	0.049	0.02	0.478
Rated	88360	0.209	0	0.406
Disc. accruals	76245	0.069	0.045	0.084
Volatility	88360	0.032	0.028	0.019

Table II: Correlations

This table reports the correlations between the key variables used in our analysis. All variables are defined in Appendix B. The sample includes all firms with financial data in Compustat during the years 1962-2005. Effective Spread data is only for 1995-2006. All variables are winsorized at the first and the ninety-ninth percentile.

	Illiq	s	Spread	PS-Gamma	WAL-1	WAL-2	WAL-3	MWAL	Log(Market capitalization)$_{t-1}$
Illiq	1.000								
s	0.811	1.000							
Spread	0.830	0.884	1.000						
PS-Gamma	0.384	0.330	0.314	1.000					
WAL-1	-0.086	-0.007	-0.021	-0.028	1.000				
WAL-2	-0.020	0.051	0.066	-0.009	0.839	1.000			
WAL-3	-0.030	0.028	0.051	-0.009	0.636	0.791	1.000		
MWAL	0.280	0.194	0.266	0.077	0.041	0.201	0.414	1.000	
Log(Market capitalization)$_{t-1}$	-0.130	-0.134	-0.173	-0.032	-0.026	-0.057	-0.028	-0.135	1.000
Market to book$_{t-1}$	-0.158	-0.078	-0.122	-0.034	0.278	0.253	0.212	-0.408	0.161
Default probability	0.288	0.299	0.257	0.132	-0.100	-0.119	-0.167	0.025	-0.065
Capital expenditure	-0.048	-0.024	-0.017	-0.015	0.041	0.006	0.225	0.061	0.002
Rated	-0.331	-0.329	-0.413	-0.091	-0.205	-0.302	-0.207	-0.126	0.245
ROA	-0.139	-0.209	-0.184	-0.041	-0.297	-0.148	-0.015	0.034	0.105
BHAR$_{t-1}$	-0.119	-0.147	-0.139	-0.050	0.185	0.215	0.206	-0.098	0.012
Log(Volatility)$_{t-1}$	0.375	0.507	0.497	0.148	0.314	0.335	0.164	0.046	-0.155
Discretionary accruals	0.070	0.118	0.124	0.035	0.143	0.312	0.296	0.078	-0.055

	Market to book$_{t-1}$	Default probability	Capital expenditure	Rated	ROA	BHAR$_{t-1}$	Log(Volatility$_{t-1}$)
Market to book$_{t-1}$	1.000						
Default probability	-0.079	1.000					
Capital expenditure	0.075	-0.061	1.000				
Rated	-0.004	0.003	0.003	1.000			
ROA	-0.079	-0.175	0.101	0.144	1.000		
BHAR$_{t-1}$	0.196	-0.231	0.081	-0.032	0.079	1.000	
Log(Volatility)$_{t-1}$	0.089	0.331	-0.007	-0.364	-0.345	0.128	1.000
Discretionary accruals	0.110	0.057	0.105	-0.158	-0.093	0.083	0.225

Table III: Asset Liquidity and Stock Liquidity - Time Series Evidence

This table reports the results of the regression relating firm's asset liquidity to stock liquidity. Specifically, we estimate the panel OLS regression: $Y_{i,t} = \alpha + \beta X_{i,t} + \gamma Controls_{i,t} + \mu_i + \mu_t + \epsilon_{i,t}$, where $Y_{i,t}$ is a measure of stock liquidity for firm i during year t, $X_{i,t}$ is a measure of asset liquidity, μ_i are firm fixed-effects, and μ_t are year dummies. Y is *Illiq* in Columns (1)-(4) of Panel A, s in Columns (5)-(8) of Panel A, *PS-Gamma* in Columns (1)-(4) of Panel B, and *Spread* in Columns (5)-(8) of Panel B. All variables are defined in Appendix B. The sample includes all firms with financial data in Compustat during the years 1962-2005. Effective Spread data is only for 1995-2006. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

Panel A: Illiq & Roll's Measure (s)

	Illiq				Roll's Measure (s)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.228				-.003			
	(.018)***				(.0003)***			
WAL-2		-.278				-.004		
		(.016)***				(.0002)***		
WAL-3			-.200				-.003	
			(.011)***				(.0002)***	
MWAL				-.143				-.003
				(.020)***				(.0002)***
Log(Market capitalization)$_{t-1}$	-.213	-.216	-.217	-.228	-.002	-.002	-.002	-.002
	(.005)***	(.005)***	(.005)***	(.006)***	(.00006)***	(.00006)***	(.00006)***	(.00007)***
Discretionary accruals$_t$	-.086	-.003	-.005	-.091	-.0004	.0009	.001	-.0003
	(.028)***	(.029)	(.028)	(.028)***	(.0004)	(.0004)**	(.0004)**	(.0004)
Market to book$_{t-1}$	.010	.011	.011	.007	.0001	.0001	.0001	.00007
	(.001)***	(.001)***	(.001)***	(.001)***	(1.00e-05)***	(1.00e-05)***	(1.00e-05)***	(1.00e-05)***
Capital expenditure$_t$	-.161	-.142	-.091	-.154	-.003	-.003	-.002	-.003
	(.035)***	(.032)***	(.021)***	(.032)***	(.0005)***	(.0005)***	(.0003)***	(.0004)***
ROA$_t$	-.364	-.297	-.296	-.374	-.007	-.006	-.006	-.007
	(.026)***	(.027)***	(.026)***	(.027)***	(.0004)***	(.0004)***	(.0004)***	(.0004)***
Log(Volatility)$_{t-1}$	.237	.234	.233	.231	.007	.007	.007	.007
	(.012)***	(.012)***	(.012)***	(.012)***	(.0002)***	(.0002)***	(.0002)***	(.0002)***
BHAR$_{t-1}$	-.146	-.140	-.142	-.155	-.003	-.003	-.003	-.003
	(.005)***	(.005)***	(.005)***	(.005)***	(.00007)***	(.00007)***	(.00007)***	(.00007)***
Obs.	74795	74795	74795	74795	74795	74795	74795	74795
R^2	.78	.781	.781	.78	.772	.773	.773	.772

Panel B: Effective Bid-Ask Spread and Pastor-Stambaugh measure

	Effective Bid-Ask Spread (*Spread*)				Pastor-Stambaugh Measure (*PS-Gamma*)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.002				-.007			
	(.0002)***				(.002)***			
WAL-2		-.002				-.010		
		(.0002)***				(.002)***		
WAL-3			-.002				-.008	
			(.0001)***				(.001)***	
MWAL				-.002				-.004
				(.0002)***				(.002)
Log(Market capitalization)$_{t-1}$	-.002	-.002	-.002	-.002	-.006	-.006	-.006	-.007
	(.00006)***	(.00006)***	(.00006)***	(.00007)***	(.0005)***	(.0005)***	(.0005)***	(.0006)***
Discretionary accruals$_t$	-.0009	-.0002	-.0003	-.0008	-.0006	.003	.003	-.0009
	(.0003)***	(.0003)	(.0003)	(.0003)***	(.004)	(.004)	(.004)	(.004)
Market to book$_{t-1}$	.00006	.00006	.00006	.00003	.0006	.0006	.0006	.0005
	(1.00e-05)***	(1.00e-05)***	(1.00e-05)***	(1.00e-05)***	(.0001)***	(.0001)***	(.0001)***	(.0001)***
Capital expenditure$_t$	-.0009	-.0008	-.0006	-.0008	-.007	-.006	-.004	-.007
	(.0002)***	(.0002)***	(.0002)***	(.0002)***	(.002)***	(.002)***	(.002)*	(.002)***
ROA$_t$	-.004	-.003	-.003	-.004	-.014	-.011	-.011	-.015
	(.0003)***	(.0003)***	(.0003)***	(.0003)***	(.003)***	(.003)***	(.003)***	(.003)***
Log(Volatility)$_{t-1}$	.004	.004	.004	.004	.014	.014	.014	.014
	(.0002)***	(.0002)***	(.0002)***	(.0002)***	(.001)***	(.001)***	(.001)***	(.001)***
BHAR$_{t-1}$	-.001	-.001	-.001	-.001	-.006	-.005	-.005	-.006
	(.00005)***	(.00005)***	(.00005)***	(.00005)***	(.0006)***	(.0006)***	(.0006)***	(.0006)***
Obs.	31690	31690	31690	31690	74795	74795	74795	74795
R^2	.874	.874	.873	.873	.235	.235	.235	.235

Table IV: Asset Liquidity and Stock Liquidity - Cross-Sectional Evidence

This Table reports the results of Fama-Macbeth regressions relating firm's asset liquidity to stock liquidity. Specifically, we estimate annual OLS regression: $Y_{i,t} = \alpha + \beta X_{i,t} + \gamma Controls_{i,t} + \epsilon_{i,t}$, and report the average of the annual coefficients. $Y_{i,t}$ is a measure of stock liquidity for firm i during year t and $X_{i,t}$ is a measure of asset liquidity. Y is *Illiq* in Columns (1)-(4) of Panel A, s in Columns (5)-(8) of Panel A, *PS-Gamma* in Columns (1)-(4) of Panel B, and *Spread* in Columns (5)-(8) of Panel B. The specification is similar to the ones in Panel A and B of Table III. We suppress the coefficients of the control variables to conserve space. To adjust for autocorrelation, we correct the reported standard errors of the average parameters by multiplying with $\sqrt{\frac{1+\rho}{1-\rho}}$, where ρ is the first-order autocorrelation in yearly parameter estimates. The sample includes all firms with financial data in Compustat during the years 1962-2005. Effective Spread data is only for 1995-2006. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

Panel A: Illiq & Roll's Measure (s)

	Illiq				Roll's Measure (s)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.269 (.089)***				-.004 (.001)***			
WAL-2		-.279 (.129)***				-.005 (.002)***		
WAL-3			-.245 (.049)***				-.004 (.0009)***	
MWAL				-.019 (.035)				-.002 (.0007)***
Obs.	43	43	43	43	43	43	43	43

Panel B: Effective Bid-Ask Spread and Pastor-Stambaugh Measure

	Effective Bid-Ask Spread (*Spread*)				Pastor-Stambaugh Measure (*PS-Gamma*)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.004 (.0002)***				-.006 (.006)			
WAL-2		-.004 (.0006)***				-.017 (.004)***		
WAL-3			-.002 (.006)***				-.015 (.005)***	
MWAL				.0004 (.003)				-.0001 (.0002)
Obs.	12	12	12	12	43	43	43	43

Table V: Asset Liquidity and Stock Liquidity - Panel A: High vs Low capital expenditure firms

This table reports the results of the regression relating firm's asset liquidity to stock liquidity. Specifically, we estimate the panel OLS regression: $Y_{i,t} = \alpha + \beta X_{i,t} + \gamma Controls_{i,t} + \mu_i + \mu_t + \epsilon_{i,t}$, where $Y_{i,t}$ is a measure of stock liquidity for firm i during year t, $X_{i,t}$ is a measure of asset liquidity, μ_i are firm fixed-effects, and μ_t are year dummies. Y is *Illiq*. All variables are defined in Appendix B. To test if the coefficient on the measures of asset liquidity is significantly different across the two sub-samples, we estimate a single equation with a full set of interaction terms between all the independent variables and a dummy variable that identifies firms with above median capital expenditure and test if the coefficient on the asset liquidity interaction term is significantly different from zero. We present the results of the test in the row titled Δ *Coef*. The sample includes all firms with financial data in Compustat during the years 1962-2005. All variables are winsorized at the first and the ninety-ninth percentile. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

	High Cap. Ex.	Low Cap. Ex.	High Cap. Ex.	Low Cap. Ex.	High Cap. Ex.	Low Cap. Ex.	High Cap. Ex.	Low Cap. Ex.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.200 (.020)***	-.279 (.030)***						
WAL-2			-.228 (.018)***	-.322 (.026)***				
WAL-3					-.156 (.013)***	-.230 (.020)***		
MWAL							-.081 (.025)***	-.218 (.028)***
Log(Market capitalization)$_{t-1}$	-.173 (.006)***	-.255 (.008)***	-.176 (.006)***	-.260 (.008)***	-.176 (.006)***	-.262 (.008)***	-.181 (.007)***	-.282 (.009)***
Obs.	41818	32977	41818	32977	41818	32977	41818	32977
R^2	.806	.804	.806	.804	.806	.804	.805	.803
Δ Coef	.079 (.036)**		.094 (.032)***		.074 (.024)***		.137 (.037)***	

Table V: Asset Liquidity and Stock Liquidity - Panel B: High vs Low market to book firms

This panel reports the results of the regression relating firm's asset liquidity to stock liquidity with the sample split into firms with above and below median levels of market to book ratio. The dependent variable is *Illiq*. All variables are defined in Appendix B. To test if the coefficient on the measures of asset liquidity is significantly different across the two sub-samples, we estimate a single equation with a full set of interaction terms between all the independent variables and a dummy variable that identifies firms with above median market to book and test if the coefficient on the asset liquidity interaction term is significantly different from zero. We present the results of the test in the row titled Δ *Coef*. All variables are winsorized at the first and the ninety-ninth percentile. The sample includes all firms with financial data in Compustat during the years 1962-2005. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% (∗∗∗), 5% (∗∗) and 10% (∗) levels.

	High Mkt-Book	Low Mkt-Book	High Mkt-Book	Low Mkt-Book	High Mkt-Book	Low Mkt-Book	High Mkt-Book	Low Mkt-Book
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.185 (.015)***	-.339 (.045)***						
WAL-2			-.215 (.014)***	-.374 (.039)***				
WAL-3					-.158 (.010)***	-.233 (.027)***		
MWAL							-.177 (.024)***	-.186 (.028)***
Log(Market capitalization)$_{t-1}$	-.160 (.006)***	-.274 (.009)***	-.163 (.006)***	-.279 (.009)***	-.164 (.006)***	-.279 (.009)***	-.176 (.007)***	-.293 (.010)***
Obs.	37835	36960	37835	36960	37835	36960	37835	36960
R^2	.803	.809	.804	.809	.803	.809	.802	.809
Δ Coef	.154 (.047)***		.159 (.041)***		.075 (.029)***		.008 (.036)	

Table VI: Proceeds Retained in SEOs and Stock Liquidity

This table reports the results of tests relating post-SEO stock liquidity to the fraction of SEO proceeds retained by the firm. Panel A reports summary statistics for the key variables that we use in the tests. Panel B reports the results of the multivariate regressions. The dependent variable is a measure of the change in stock liquidity around the SEO. It is Δ $Illiq_{30}$ in Column (1) and Δ $Illiq_{60}$ in Columns (2)-(4), where $\Delta Illiq_{30}$ is $Illiq_{-30,0}$- $Illiq_{15,45}$ and $\Delta Illiq_{60}$ is $Illiq_{-60,0}$ - $Illiq_{15,75}$. In Column (3) the sample is confined to SEOs that happen more than two months before the financial year end. All variables are defined in Appendix B. The regression includes year fixed effects. All variables are winsorized at the first and the ninety-ninth percentile. The sample includes all SEOs from SDC database floated during the years 1970-2006, with a minimum size of $10 million, by firms with financial data in Compustat. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

Panel A: Summary Statistics

Variable	N	Mean	Min	Median	Max	Std. Dev.
Proceeds ($ Million)	5134	103.310	10.000	62.000	989.300	126.765
Proceeds/TA_{t-1}	4935	0.308	0.001	0.155	76.158	1.420
$Illiq_{-30,0}$	5134	0.173	0.012	0.096	1.502	0.235
$Illiq_{15,45}$	5134	0.111	0.012	0.075	0.750	0.116
$Illiq_{-60,0}$	5134	0.159	0.013	0.092	1.337	0.206
$Illiq_{15,75}$	5134	0.118	0.012	0.077	0.824	0.127
Market Capitalization ($ Million)	5065	1438	1.567	517.421	85499	3428.41
Fraction retained	4898	0.430	-2.628	0.198	5.991	1.017

Panel B: Proceeds Retained in SEOs and Stock Liquidity

	Δ $Illiq_{30}$	Δ $Illiq_{60}$		
	(1)	(2)	(3)	(4)
Fraction retained	-.002 (.0007)***	-.003 (.0007)***	-.002 (.001)	-.014 (.002)***
Proceeds/TA_{t-1}				.002 (.001)**
Fraction retained × Proceeds/TA_{t-1}				-.046 (.008)***
$Illiq_{-30,0}$	-.688 (.024)***			
$Illiq_{-60,0}$		-.553 (.028)***	-.715 (.036)***	-.564 (.028)***
Market to $book_{t-1}$	-.0001 (.0002)	.0001 (.0002)	-.0002 (.0003)	.0005 (.0002)**
ROA	-.024 (.005)***	-.023 (.006)***	-.025 (.005)***	-.027 (.006)***
Log(Market $capitalization)_{t-1}$	-.020 (.002)***	-.015 (.002)***	-.018 (.003)***	-.017 (.002)***
Obs.	4064	4064	2819	4064
R^2	.809	.694	.66	.698

Table VII: Asset Liquidity and Stock Liquidity Panel A: Small vs Large Firms

This table reports the results of the regression relating firm's asset liquidity to stock liquidity. Specifically, we estimate the panel OLS regression: $Y_{i,t} = \alpha + \beta X_{i,t} + \gamma Controls_{i,t} + \mu_i + \mu_t + \epsilon_{i,t}$, where $Y_{i,t}$ is a measure of stock liquidity for firm i during year t, $X_{i,t}$ is a measure of asset liquidity, μ_i are firm fixed-effects, and μ_t are year dummies. Y is *Illiq*. In Panel A we estimate the regression in sub-samples with above and below median book value of total assets. All variables are defined in Appendix B. To test if the coefficient on the measures of asset liquidity is significantly different across the two sub-samples, we estimate a single equation with a full set of interaction terms between all the independent variables and a dummy variable that identifies firms with above median book value of total assets and test if the coefficient on the asset liquidity interaction term is significantly different from zero. We present the results of the test in the row titled Δ *Coef*. The sample includes all firms with financial data in Compustat during the years 1962-2005. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% (∗∗∗), 5% (∗∗) and 10% (∗) levels.

	Large	Small	Large	Small	Large	Small	Large	Small
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.031	-.260						
	(.009)***	(.022)***						
WAL-2			-.059	-.314				
			(.010)***	(.020)***				
WAL-3					-.037	-.249		
					(.007)***	(.015)***		
MWAL							-.064	-.400
							(.014)***	(.026)***
Log(Market capitalization)$_{t-1}$	-.071	-.338	-.072	-.342	-.072	-.344	-.077	-.401
	(.003)***	(.007)***	(.003)***	(.007)***	(.003)***	(.007)***	(.004)***	(.009)***
Obs.	33818	40977	33818	40977	33818	40977	33818	40977
R^2	.784	.763	.784	.764	.784	.764	.784	.766
Δ Coef	.229		.255		.212		.336	
	(.024)***		(.022)***		(.017)***		(.029)***	

Table VII: Asset Liquidity and Stock Liquidity Panel B: Rated vs Not Rated Firms

This panel reports the results of the regression relating firm's asset liquidity to stock liquidity with the sample split into firms with and without short term credit rating. The dependent variable is *Illiq*. All variables are defined in Appendix B. To test if the coefficient on the measures of asset liquidity is significantly different across the two sub-samples, we estimate a single equation with a full set of interaction terms between all the independent variables and a dummy variable that identifies rated firms and test if the coefficient on the asset liquidity interaction term is significantly different from zero. We present the results of the test in the row titled Δ *Coef*. All variables are winsorized at the first and the ninety-ninth percentile. The sample includes all firms with financial data in Compustat during the years 1962-2005. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% (∗∗∗), 5% (∗∗) and 10% (∗) levels.

	Rated	Not Rated	Rated	Not Rated	Rated	Not Rated	Rated	Not Rated
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.103	-.221						
	(.027)***	(.020)***						
WAL-2			-.138	-.275				
			(.022)***	(.018)***				
WAL-3					-.090	-.212		
					(.015)***	(.013)***		
MWAL							-.235	-.237
							(.027)***	(.022)***
Log(Market capitalization)$_{t-1}$	-.085	-.260	-.087	-.264	-.087	-.264	-.105	-.291
	(.007)***	(.006)***	(.007)***	(.006)***	(.007)***	(.006)***	(.008)***	(.007)***
Obs.	14629	60166	14629	60166	14629	60166	14629	60166
R^2	.809	.779	.81	.78	.81	.78	.813	.78
Δ Coef	.119		.137		.121		.002	
	(.034)***		(.028)***		(.02)***		(.035)	

Table VII: Asset Liquidity and Stock Liquidity - Panel C: High vs Low default probability firms

This panel reports the results of the regression relating firm's asset liquidity to stock liquidity with the sample split into firms with above and below median default probability. We measure default probability using Bharath and Shumway (2008) methodology. The dependent variable is *Illiq*. All variables are defined in Appendix B. To test if the coefficient on the measures of asset liquidity is significantly different across the two sub-samples, we estimate a single equation with a full set of interaction terms between all the independent variables and a dummy variable that identifies firms with above median default likelihood and test if the coefficient on the asset liquidity interaction term is significantly different from zero. We present the results of the test in the row titled Δ *Coef*. The sample includes all firms with financial data in Compustat during the years 1970-2006. All variables are winsorized at the first and the ninety-ninth percentile. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% (∗∗∗), 5% (∗∗) and 10% (∗) levels.

	High default	Low default	High default	Low default	High default	Low default	High default	Low default
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WAL-1	-.276 (.036)***	-.154 (.019)***						
WAL-2			-.347 (.030)***	-.167 (.016)***				
WAL-3					-.242 (.022)***	-.111 (.011)***		
MWAL							-.301 (.031)***	-.025 (.020)
Log(Market capitalization)$_{t-1}$	-.282 (.009)***	-.118 (.005)***	-.286 (.009)***	-.121 (.005)***	-.286 (.009)***	-.122 (.005)***	-.316 (.010)***	-.119 (.006)***
Obs.	27601	29051	27601	29051	27601	29051	27601	29051
R^2	.795	.852	.796	.852	.796	.852	.796	.851
Δ Coef	-.122 (.041)***		-.180 (.034)***		-.131 (.025)***		-.277 (.037)***	

Table VIII: Asset Liquidity, Stock Liquidity, and the Value of Cash

This panel reports the results of the regression relating the abnormal stock return on a firm's stock to changes in cash balance. The dependent variable is *Abnormal*, the size and book to market adjusted abnormal stock return. All variables are defined in Appendix B. $\Delta Coef$ represents the difference between the coefficients on $\Delta Cash$ across the sub-samples with high- and low-stock liquidity. The sample includes all firms with financial data in Compustat during the years 1970-2001. We limit the sample till 2001 to be comparable to the sample in Faulkendar and Wang (2006). All variables are winsorized at the first and the ninety-ninth percentile. The standard errors are clustered at individual firm level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

	Size and Book to Market Adjusted Annual Return					
	All Firms		Low $Illiq_{t-1}$	High $Illiq_{t-1}$	Unrated Low $Illiq_{t-1}$	Unrated High $Illiq_{t-1}$
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Cash	.766	.811	.595	.715	.409	.860
	(.022)***	(.033)***	(.045)***	(.039)***	(.089)***	(.116)***
$Cash_{t-1}$	.270	.725	.580	.644	.582	.918
	(.013)***	(.031)***	(.038)***	(.037)***	(.109)***	(.121)***
Δ Profits	.543	.379	.285	.408	.217	.293
	(.014)***	(.016)***	(.021)***	(.022)***	(.051)***	(.058)***
Δ Non cash assets	.226	.141	.097	.157	.060	.089
	(.007)***	(.008)***	(.012)***	(.011)***	(.029)**	(.033)***
Δ R&D	.939	.194	.044	.311	-2.113	.297
	(.144)***	(.185)	(.237)	(.268)	(.695)***	(1.017)
Δ Interest	-1.156	-.768	-.492	-.807	-.228	.023
	(.045)***	(.056)***	(.078)***	(.072)***	(.227)	(.260)
Δ Dividends	3.933	1.711	1.245	2.219	.467	.439
	(.258)***	(.304)***	(.407)***	(.429)***	(.945)	(1.108)
Leverage	-.394	-1.059	-.744	-1.084	-.986	-1.409
	(.008)***	(.024)***	(.028)***	(.033)***	(.076)***	(.096)***
Net financing	-.002	.073	.018	.039	.010	-.099
	(.014)	(.018)***	(.023)	(.023)*	(.057)	(.062)
Const.	-.015	.235	.169	.274	-.376	-.321
	(.003)***	(.029)***	(.022)***	(.026)***	(.032)***	(.027)***
Obs.	80166	45811	17324	28487	3844	4635
R^2	.138	.359	.471	.462	.519	.541
Δ Coef			.120		.451	
			(.057)**		(.159)***	