Liquidity Dynamics Across Small and Large Firms

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Abstract

In this paper, we analyze cross-sectional heterogeneity in the time-series variation of liquidity in equity markets. Our analysis uses a broad time-series and cross-section of liquidity data. We find that average daily changes in liquidity exhibit significant heterogeneity in the cross-section; the liquidity of small firms varies more on a daily basis than that of large firms. A steady increase in aggregate market liquidity over the past decade is more strongly manifest in large firms than in small firms. Absolute stock returns are an important determinant of liquidity. We investigate cross-sectional differences in the resilience of a firm's liquidity to information shocks. We use the sensitivity of stock liquidity to absolute stock returns as an inverse measure of this resilience, and find that the measure exhibits considerable cross-sectional variation. Firm size, return volatility, institutional holdings, and volume are all significant cross-sectional determinants of this measure.

Liquidity is the grease that facilitates the smooth functioning of financial markets. A lack of liquidity is a form of friction (Stoll, 2000) that can have adverse effects on asset values, as demonstrated by Amihud and Mendelson (1986). Recent events such as the 1998 bond market crisis have heightened regulatory concerns about liquidity crises.[1] The study of liquidity is important, from a scientific as well as a practical standpoint.

Many studies of liquidity have documented that liquidity varies in the cross-section. Papers that focus on the cross-sectional determinants of liquidity include Benston and Hagerman (1974), Branch and Freed (1977), Stoll (1978), and Easley, Kiefer, O'Hara, and Paperman (1996). Of late, there has been interest in examining the time-series variation in market-wide liquidity; see Chordia, Roll, and Subrahmanyam (CRS) (2001).

While cross-sectional and time-series variations in liquidity have been analyzed in separate strands of literature, not much is known about how the time-series behavior of liquidity varies in the cross-section. There are sound reasons to study this issue. An immediate question is whether any trends in liquidity over the recent past are discernible uniformly in the cross-section. Another issue is whether the extent of day-to-day variation in liquidity differs across firms. A third question is whether there are cross-sectional differences in the ability of equity markets to provide liquidity when information shocks buffet the value of the security. That is, how resilient is liquidity to information flows that affect the value of the company?

The latter question raises the issue of how to measure the sensitivity of liquidity to information flows. Stock returns move both because of information as well as temporary price pressures; the second type of movement is reversible. Since daily stock returns exhibit extremely

[1] See the *Wall Street Journal*, "Illiquidity is Crippling the Bond World," (October 19, 1998) p. C1, "Illiquidity means it has become more difficult to buy or sell a given amount of any bond but the most popular Treasury issue. The spread between prices at which investors will buy and sell has widened, and the amounts in which Wall Street firms deal have shrunk across the board for investment grade, high-yield (or junk), emerging market and asset-backed

low serial correlation in our sample, we use the daily absolute return as a proxy for daily information flow, and use the sensitivity of liquidity to absolute returns as an inverse measure of the resilience of liquidity to information shocks. Inventory and asymmetric information arguments suggest that this resilience could be very different across firms with differing market capitalization and differing levels of trading activity. However, since there is no extant evidence on this issue, an empirical question of interest is whether the time-series sensitivity of liquidity to information varies significantly in the cross-section, and if so, what cross-sectional attributes capture the heterogeneity in this relationship.

Motivated by the above observations, we seek to document cross-sectional heterogeneity in the time-series variation of liquidity, and in the sensitivity of liquidity to daily stock price fluctuations.[2] Specifically we ask the following questions: (i) Are any trends in liquidity over the recent past discernible uniformly in both small and large stocks? (ii) Is the extent of day-to-day variation in liquidity uniform across all firms in the cross-section? (iii) How does the relation between liquidity and absolute stock returns vary in the cross-section? (iv) What firm-specific characteristics explain cross-sectional variation in this co-movement?

Apart from the straightforward goal of understanding more about the general topic of liquidity, our study has asset pricing implications. For instance, larger liquidity improvements for some firms relative to others imply a greater reduction in their costs of capital. In addition, knowing the determinants of the relation between liquidity and stock price movements can aid in the development of trading strategies; for example, stocks whose resilience to stock price

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bonds…**The sharp reduction in liquidity has preoccupied the Fed because it is the lifeblood of markets**." (emphasis added).

[2] In this paper, we do not attempt to shed explicit light on the inventory vs. asymmetric information hypotheses. That is an exercise which can be better conducted using transaction-by-transaction data. Our goal here is to present stylized facts on cross-sectional heterogeneity in daily liquidity variations; however, studies such as Glosten and Harris (1988) suggest that the inventory component is small at daily horizons. Further, while some important studies

movements is small imply higher trading costs during periods of important news announcements. From an academic standpoint, understanding the time-series relation as well as the cross-sectional relation between liquidity and stock price movements can help us gain a better understanding of why stock liquidity moves over time.

In our empirical analysis, we depart from the existing cross-sectional studies of liquidity by using a broad time-series and cross-section of liquidity data. Specifically, we use daily liquidity data on more than 1200 NYSE stocks over more than 2500 trading days; whereas most existing cross-sectional studies of liquidity (e.g., Benston and Hagerman (1974), Branch and Freed (1977), and Stoll (1978)) use data over an year or less for a relatively small sample of stocks. Our comprehensive sample allows us to enhance the reliability of our results, and, unlike existing studies, we study both the time-series and cross-section of liquidity.

We find that the increase in liquidity over the past decade, while manifest across the cross-section, is more pronounced for the larger stocks. Further, the daily liquidity of small firms is far more volatile than that of large firms. We also find that daily absolute returns are an important determinant of day to day variations in liquidity; in particular, spreads vary strongly and positively with absolute returns. This result obtains for returns computed using closing prices as well as the mid-point of the last bid and ask quotes during a day, so it is not an artefact of bid-ask bounce.[3] In addition, individual stock liquidity is also strongly and positively related to a five-day moving average of lagged absolute returns (where the latter variable, given volatility persistence, proxies for expected future volatility). After controlling for concurrent absolute

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have analyzed cross-sectional differentials in liquidity around specific events (see Goldstein and Kavajecz (2000) and Corwin and Lipson (2000)) our focus here is on long-term variations in liquidity across a multitude of events.

[3] We interpret the relation between liquidity and absolute returns as representing the resilience of liquidity to information flows, i.e., we take daily absolute returns as a measure of daily information flow. This interpretation is supported by the finding that daily returns exhibit virtually zero serial correlation, so that noise does not appear to be significant factor in daily returns; in addition, return variations due to changes in liquidity premia are related to signed, not absolute returns. See footnote 6 for a more detailed explanation.

stock returns and recent stock volatility, concurrent and recent market movements do not appear to be important in determining stock liquidity.

The co-movement between liquidity and absolute stock returns, an inverse measure of the resilience of a firm's liquidity to information shocks, exhibits considerable cross-sectional heterogeneity. We explore the cross-sectional determinants of this co-movement. Return volatility, stock market volume, and firm size strongly and negatively affect this relation. Variability of volume and the level of the stock price are positively related to this relation. Institutional holdings influence the relation negatively in large firms. In sum, the cross-sectional results demonstrate that the resilience of equity market liquidity to stock price movements is (ceteris paribus) greatest for large firms, firms with high trading volume, firms with high return volatility, and firms with low variability in trading activity. Greater institutional holdings are positively associated with this capacity in large firms.

The rest of the paper is organized as follows. Section I describes the data. Section II documents the time-series response of liquidity to absolute returns, and analyzes the cross-sectional determinants of the response coefficient. Section III concludes.

I. Data

The data sources are the Institute for the Study of Securities Markets (ISSM) and the New York Stock Exchange TAQ (trades and automated quotations). The ISSM data cover 1988-1992 inclusive while the TAQ data are for 1993-1998. We use only NYSE stocks to avoid any possibility of the results being influenced by differences in trading protocols.

A. Inclusion Requirements

Stocks are included or excluded during a calendar year depending on the following criteria:

- To be included, a stock had to be present at the beginning and at the end of the year in both the CRSP and the intraday databases.
- If the firm changed exchanges from Nasdaq to NYSE during the year (no firms switched from the NYSE to the Nasdaq during our sample period), it was dropped from the sample for that year.
- Because their trading characteristics might differ from ordinary equities, assets in the following categories were also expunged: certificates, ADRs, shares of beneficial interest, units, companies incorporated outside the U.S., Americus Trust components, closed-end funds, preferred stocks and REITs.
- To avoid the influence of unduly high-priced stocks, if the price at any month-end during the year was greater than $999, the stock was deleted from the sample for the year.

Intraday data were purged for one of the following reasons: trades out of sequence, trades recorded before the open or after the closing time, and trades with special settlement conditions (because they might be subject to distinct liquidity considerations). Our preliminary investigation revealed that auto-quotes (passive quotes by secondary market dealers) were eliminated in the ISSM database but not in TAQ. This caused the quoted spread to be artificially inflated in TAQ. Since there is no reliable way to filter out auto-quotes in TAQ, only BBO (best bid or offer)-eligible primary market (NYSE) quotes are used. Quotes established before the opening of the market or after the close were discarded. Negative bid-ask spread quotations, transaction prices, and quoted depths were discarded. Following Lee and Ready (1991), any quote less than five seconds prior to the trade is ignored and the first one at least five seconds prior to the trade is retained.

For each stock we define the following variables:

QSPR: the quoted bid-ask spread associated with the transaction.

RQSPR: the quoted bid-ask spread divided by the mid-point of the quote (in %).

ESPR: the effective spread, i.e., the difference between the execution price and the mid-point of the prevailing bid-ask quote.

RESPR: the effective spread divided by the mid-point of the prevailing bid-ask quote (in %).

DEPTH: the average of the quoted bid and ask depths.

$DEPTH: the average of the ask depth times ask price and bid depth times bid price.

COMP = RQSPR/$DEPTH: spread and depth combined in a single measure. COMP is intended to measure the average slope of the liquidity function in percent per dollar traded.

Our initial scanning of the intraday data revealed a number of anomalous records that appeared to be keypunching errors. We thus applied filters to the transaction data by deleting records that satisfied the following conditions:

1. QSPR >$5
2. ESPR/QSPR > 4.0
3. RESPR/RQSPR > 4.0
4. QSPR/PRICE > 0.4

These filters removed fewer than 0.02% of all transaction records. In addition, because we later document the relation between liquidity and absolute returns, days for which stock return data was not available from CRSP were dropped from the sample.

B. Summary Statistics

Panel A of Table 1 presents the cross-sectional averages of the liquidity measures in each year of our sample period, as well as for the entire sample. The variables are first averaged for each firm for each year, and then averaged cross-sectionally. As can be seen, the effective spread is lower than the quoted spread, because a large proportion of transactions take place within the spread. The table also indicates that the quoted and effective spreads have generally decreased over time during our sample period.[4] However, focusing on the cross-sectional standard deviation for the variables, we notice that the averages hide significant cross-sectional variation in liquidity, particularly in the depth and relative spread variables.

Panels B through E of Table 1 show the trend in the liquidity variables across size quartiles. As can be seen, both quoted and effective spreads have shown a steady decline across both small and large firms. For instance, the quoted (effective) spread for the smallest firms has declined from \$0.21 (\$0.16) in 1988 to \$0.18 (\$0.12) in 1998 and for the largest firms it has decreased from \$0.23 (\$0.17) to \$0.14 (\$0.09). The relative quoted and effective spreads have also declined significantly for all size quartiles but this could be the result of the dramatic increase in prices in the 1990s. For the smallest quartile of firms, depth has increased from an average of 6,114 shares in 1988 to 6,555 shares in 1996 and for the largest quartile of firms, depth has increased from an average of 6,778 shares in 1988 to 10,054 shares in 1996. The increasing trend in aggregate market liquidity, while manifest throughout the cross-section, is more pronounced for the largest stocks. This suggests that it is the largest stocks that have benefited more from technological innovations that have led to an increase in liquidity over time.

We next examine how day-to-day changes in liquidity vary in the cross-section. Panel A of Table 2 presents the summary statistics for the absolute daily changes in liquidity measures (in percentages). Changes in liquidity exhibit significant cross-sectional variation. For example, the average absolute daily change in the quoted spread is about 12% for quartile 4, which consists of

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[4] This is also pointed out in Chordia, Roll, and Subrahmanyam (2001), who look at time-series variation in *aggregate market* liquidity.

the largest firms, but as much as 23% for quartile 1, which consists of the smallest firms. The variability of absolute changes in the spread measures are also largest for small firms.

Panel B of this table presents the time-series averages of the cross-correlation in daily liquidity changes. Variations in the liquidity measures are highly correlated with each other; and changes in spread are negatively correlated with changes in depth. In addition, changes in quoted spread are positively correlated with changes in effective spread, viz., the correlation between DQSPR and DESPR is 0.19.

II. The Relation between Liquidity and Stock Volatility.

To this point, we have described cross-sectional heterogeneity in the daily level and day-to-day variation in liquidity. Motivated partially by the evidence in Chordia, Roll, and Subrahmanyam (2001) that stock market returns are the most important determinant of aggregate market liquidity, we now turn to the issue of whether there is cross-sectional heterogeneity in the relation between liquidity and stock price movements. In order to build up to the empirical analysis in Section II.B, we provide a simple theoretical setting in the following subsection.

A. Theoretical Background

Consider the following framework. A standard Kyle (1985)-type setting (e.g., Subrahmanyam 1991) indicates that the slope of the pricing schedule λ when the market maker is risk averse is given by

$$\lambda = \frac{R\upsilon_\delta}{4} + \sqrt{\frac{(R\upsilon_\delta)^2}{4} + \frac{n\upsilon_\delta}{(n+1)^2\upsilon_z}} \ , \qquad (1)$$

where ν_δ is the volatility of the asset value (δ being the asset's terminal payoff), R is the risk aversion of the market maker, ν_z is the volatility of noise trading, and n is the number of informed traders. Henceforth, we use λ as a theoretical proxy for the empirical liquidity measures we describe in the next section.

Define $K = R/4$ and $A \equiv n/[(n+1)^2 \nu_z]$. Then, the derivative of λ with respect to ν_δ is given by

$$\frac{d\lambda}{d\upsilon_\delta} = K + \frac{8K^2\upsilon_\delta + A}{\sqrt{4K^2\upsilon_\delta^2 + A\upsilon_\delta}} \ , \tag{2}$$

which is positive. From the above it follows that

$$\frac{d^2\lambda}{d\upsilon_\delta^2} = -\frac{A^2}{4\left(4K^2\upsilon_\delta^2 + A^2\right)^{\frac{3}{2}}} < 0 \ , \tag{3}$$

and

$$\frac{d^2\lambda}{d\upsilon_\delta d\upsilon_z} = -\frac{A^2\upsilon_\delta\upsilon_z}{4\left(4K^2\upsilon_\partial^2 + A^2\right)^{\frac{3}{2}}} < 0 \ . \tag{4}$$

Thus, the response of λ to ν_δ is positive but decreasing in ν_δ and ν_z. In other words, λ is concave in ν_δ, and the response of λ to ν_δ is decreasing in ν_z. An increase in ν_δ implies an increase in profit potential for informed traders as well as greater inventory risk and thus results in greater illiquidity. However, for progressively larger values of asset volatility, unit increases in asset volatility have increasingly smaller impacts on lambda. Further, for large values of the variance of noise trading, the adverse selection problem is small, so a marginal increase in ν_δ does not have much of an effect on illiquidity, but for small values of ν_z the opposite is true.

We use the above framework as a guide to our analysis.[5] Note that with normally distributed asset values, we have $\nu_\delta=(\pi/2)[E|\delta|]^2$, so that $E[|\delta|]$ is monotonically related to ν_δ. In order to keep the measures comparable across stocks, we use a scaled (dimensionless) estimate for $E[|\delta|]$. Thus, in Section II.B.1 to follow, we use the absolute return over a trading day as a proxy for the information flow ν_δ. Of course, a potential concern that the absolute return could be a temporary (reversible) price pressure unrelated to information flow. However, the average daily serial correlation in the cross-section of stocks during our sample period is close to zero (-0.021). This suggests that the bulk of daily return movements is due to information flows; which justifies the use of the absolute return as a proxy for ν_δ. In addition to the contemporaneous absolute return, we also use a moving average of lagged absolute returns over the past week as a proxy for the market maker's estimate of ν_δ. To control for market-wide changes in volatility, we use the absolute market return as well as the moving average of past five-day absolute market returns.

In our cross-sectional work in Section II.B.2, our goal is to identify the sources of cross-sectional variation in the sensitivity of liquidity to absolute returns. In this context, the second derivatives in (3) and (4) above can be interpreted as capturing the cross-sectional relation between the response of liquidity to new information (the first derivative) and cross-sectional proxies for ν_δ and ν_z. This interpretation allows us to test hypotheses regarding the sign of the

[5] The theory is meant to guide the interpretation of our results. We do not intend our empirical analysis to be interpreted as a test of the theory. A richer theoretical analysis would consider a dynamic setting with multiple securities, an exercise that is beyond the scope of this work. The empirical analysis can simply be viewed as the answer to the following questions of applied interest: Suppose the price of stock X is flat on a given day but falls by 5% on the next day. By how much can its liquidity be expected to change on the second day relative to the first? Further, what attributes of stock X allow one to characterize how its relation between liquidity and price movements differs from that for another stock Y?

second derivatives in equations (3) and (4). The specific proxies for v_δ and v_z that we use are described in Section II.B.2.

B. Empirical Analysis

B.1 Time-Series Regressions

We now document cross-sectional differences in the ability of a stock's liquidity to withstand information flows. As pointed out in the previous subsection, an inverse measure of this ability is the extent of co-movement between a stock's liquidity and contemporaneous absolute returns. To estimate this quantity, we run the following regression for each stock i:

$$X_{it} = \alpha_{0i} + \alpha_{1i}DABSRET_{it} + \alpha_{2i}DABL5RET_{it} + \alpha_{3i}DABSMRET_t + \alpha_{4i}DABL5MRET_t + \alpha_{5i}MX_t + \alpha_{6i}MX_{t-1} + \alpha_{7i}MX_{t+1} + \sum_{j=1}^{5} \alpha_{i7+j}X_{it-j} + \varepsilon_{it}\ , \qquad (6)$$

where

X_{it}: Proportional change in stock i's liquidity measure at date t. We consider percentage changes in quoted spread (DQSPR), relative quoted spread (DRQSPR), effective spread (DESPR), relative effective spread (DRESPR), depth (DDEPTH), dollar depth (D$_DEPTH) and the composite liquidity measure (DCOMP),

$ABSRET_{it}$: Absolute value of return for stock i on date t,

$DABSRET_{it}$: Change in the absolute value of the contemporaneous return for stock i across dates t-1 and t,

$DABL5RET_{it}$: Change in the cumulative absolute return for stock i over the past five days across dates t-1 and t, i.e., $ABSRET_{it-1} - ABSRET_{it-6}$,

$DABSMRET_t$: Change in the absolute value of the contemporaneous market return across dates t-1 and t,

$DABL5MRET_t$: Change in the cumulative absolute market return over the past five days across dates t-1 and t, i.e., $ABSMRET_{t-1}$ - $ABSMRET_{t-6}$,

MX_t: Equally-weighted market liquidity measure that corresponds to the dependent variable X,

ε_{it} : Error term which is assumed to follow an AR(1) process.

As argued earlier, the contemporaneous change in the daily absolute stock return, $DABSRET_{it}$, results from information shocks, and thus, reflects new information about a company. The regression coefficient associated with this variable captures the sensitivity of liquidity to stock price fluctuations, and is an inverse estimate of the resilience of stock's liquidity to information shocks.[6]

Since volatility is persistent,[7] the lagged change in absolute stock returns, $DABL5RET_{it}$, partially captures the market's assessment of stock return volatility this week as compared to that of last week, and thus proxies for changes in the market maker's estimate of inventory risk. Our theory suggests that the coefficient on $DABL5RET_{it}$ should also have a positive sign. This coefficient is an additional measure of the resilience of liquidity to stock price fluctuations. Since information shocks may be either stock-specific or economy-wide, we include $DABSMRET_t$ and $DABL5MRET_t$ as the market counterparts of the individual stock measures.

Our model also includes market-wide liquidity and five lagged values of liquidity changes; further, we assume an auto-regressive error structure. The five lags of liquidity

[6] The reader may wonder whether day to day returns contain a liquidity premium, which could result in a reverse causality whereby liquidity causes return fluctuations. However, we look at absolute returns, whereas the liquidity premium theory is one involving signed returns. Further, while infrequent liquidity crises could lead to stock market crashes, we find it implausible that day to day liquidity variations are an important factor in day to day return variation. The notion that returns mainly reflect information is supported by our earlier statement that day to day returns appear to follow a random walk in our sample; the serial correlation in these returns is virtually zero. Also, our results are robust to using closing quote-midpoints to calculate returns (see Section II.B.4 to follow), thus alleviating concerns about bid-ask bounce.

[7] The persistence of volatility is well-known (see, e.g., Bollerslev, Chou, and Kroner, 1992).

changes capture autocorrelation, and the market liquidity variables capture commonality as well as weekly seasonalities in aggregate market liquidity. The above equation is estimated separately for each firm in each year using a maximum likelihood estimation procedure.[8] The average adjusted R^2's in these regressions vary from 34% for regressions based on DQSPR to 15% for regressions of DCOMP.

Table 3 presents the annual cross-sectional averages for the coefficients α_1 through α_4,[9] as well as the averages sorted into size quartiles. Panels A and B report the averages for the coefficient on DABSRET (α_1). With the exception of regressions based on DDEPTH and D$_DEPTH, the average coefficient on DABSRET, α_1, is positive and statistically significant in the regressions. In addition, the vast majority of the coefficients on DABSRET are positive for all measures of liquidity except depth. The positive value suggests that spreads increase with the magnitude of absolute returns, i.e., liquidity is lower when the contemporaneous stock volatility is large. This is consistent with the theory in Section I, suggesting that new information, as proxied by stock price volatility, increases adverse selection risks and inventory risks faced by liquidity providers, and thus impacts spreads. The estimates are economically significant, suggesting, for example that a change in ABSRET of 0.1% changes spreads by about 20%.

In the regressions of DEPTH and $_DEPTH, α_1 tends to be insignificant in many years. The coefficient is negative during the years 1989-1993 and positive during 1994-1998. This suggests that stock price movements may impact liquidity mainly through spreads rather than depth. Alternatively, with an increase in return volatility and higher spreads, depth may actually increase for some stocks as the inside depth is wiped out or as investors submit more limit orders

[8] The results are qualitatively the same when OLS is used.

[9] For convenience, we drop the i subscripts on the coefficients in the discussion below.

instead of market orders in order to capture the bid-ask spread. Finally, α_1 is significantly positive in regressions of DCOMP (which combines depth and spread), but is positive for fewer firms in this regression than in the regressions based on spreads.

From Panel B, which reports the average coefficients sorted by size quartiles (firm size is computed as of the end of the previous year), we observe that the average coefficients in the spread regressions decrease monotonically across quartiles 2 to 4.[10] However, these averages are smaller for quartile 1 than for quartile 2. In addition, the percentage of firms with positive coefficients is lowest for quartile 1 and the standard errors in the spread regressions are the highest, suggesting that the coefficients for the smallest firms are estimated less precisely. Doubtless, these findings could be influenced by the low transaction frequency in small firms.

The coefficients for the depth measures are negative for the two largest quartiles and positive for the two smallest quartiles. This implies that for the smaller stocks, spreads and depth are both positively related to absolute returns. Again, limit order submissions may account for this finding. In particular, since smaller stocks have higher spreads, with an increase in volatility, it may become advantageous for investors to place limit orders instead of market orders in order to capture the bid-ask spread. The probability of executing a limit order is greater when the magnitude of stock price fluctuations is higher. Thus, for the small stocks, an increase in limit order submissions in response to greater stock price fluctuations may explain the positive coefficient in the regression of depth on absolute stock returns.

An alternative explanation for results for the depth regressions is as follows. For small stocks, depth at the inside quotes is likely to be small, so that as return volatility increases, the inside depth is more likely to be eliminated in response to incoming orders. Outside the inside quotes, depth may be higher so that we may see an increase in depth for the small stocks as volatility increases. For larger stocks, the inside depth may be larger and thus may not be completely eliminated in response to an increase in volatility. This may lead to a decrease in depth for the largest stocks as return volatility increases.

Overall, there is significant inter-quartile variation in the relation between liquidity and contemporaneous stock price movements. However, it remains an open question as to which firm characteristics (such as price, size, trading volume, etc.) drive this time-series relationship. This issue is addressed in the next subsection.

Panels C and D present the average coefficients from the regression of changes in liquidity on changes in the past moving average of absolute returns (α_2). Similar to Panel A, the coefficients are positive and highly significant for spread measures, but not for depth measures of liquidity. This indicates that increases in recent stock volatility also lead to higher spreads and thus lower liquidity. In Panel D, the coefficients for spread measures increase monotonically across quartiles. Further, as in Panel B, the coefficients appear to be noisiest for the smallest quartile of firms where the percentage of coefficients with positive values is the least.[11]

The above results establish a strong relationship between the spread measures of liquidity and contemporaneous stock price movements as well as stock volatility in the recent past. However, the coefficients from the depth regressions do not show a consistent pattern, and the proportion of positive coefficients is in the range of 40-60%; for this reason we do not focus on these coefficients in our cross-sectional analysis.

The results for the absolute market return (measured by the absolute value of the CRSP equally-weighted return), while not reported for brevity, indicate the following pattern. In

[10] Quartile 1 represents the smallest firms and quartile 4 the largest.
[11] The finding that the results for the contemporaneous absolute return (DABSRET) are similar to those for the past moving average of returns (DABL5RET) indicates that our results on the relation between liquidity and stock price movements are not an artefact of a spurious relation between spread and contemporaneous absolute returns caused

contrast to the results for α_1, the vast majority of the α_3 (the coefficient on DABSMRET) estimates tend to be only weakly significant. The sign for α_3 is not consistent across the years. Further, in all regressions, the proportion of firms with coefficients that are positive (or negative) is very close to 50%. Even when firms are sorted into quartiles, the proportion of firms with positive (or negative) coefficients (not reported for brevity), although often statistically significant, tend to be around 50%. The results for α_4 are similar. For all liquidity measures other than quoted spreads and relative quoted spreads, the coefficient on DABSMRET tend to be insignificant. This suggests that it is individual stock return volatility and not market return volatility that impacts the liquidity of a given stock. Hence, we do not consider DABSMRET in the cross-sectional analysis to follow.

B.2 Cross-sectional Determinants of the Response of Liquidity to Absolute Returns

The previous subsection documented cross-sectional heterogeneity in the extent of co-movement between liquidity and daily absolute stock returns, alternatively in the resilience of a liquidity to information shocks (for brevity we will henceforth use the term "response coefficient" for this co-movement). In this section, we explore whether firm-specific characteristics explain the cross-sectional variation in these response coefficients. That is, we try to identify variables which help explain why the ability of liquidity to withstand information shocks varies across firms. In particular, we attempt to isolate variables that are associated with the inventory and/or asymmetric information problems faced by market makers on the trading floor. First, we hypothesize that the smaller a firm, the larger the increase in adverse selection risks and inventory risks following information shocks, proxied by stock price movements. In addition,

by bid-ask bounce effects. The relation between liquidity and past absolute returns is unlikely to be caused by bid-ask bounce. Nevertheless, we examine the robustness of our results to the bid-ask bounce effect in Section B.4

market makers of small firms with a low supply of outstanding shares may have difficulty turning around their inventory. This suggests that, *ceteris paribus*, the liquidity of smaller firms should be more strongly associated with fluctuations in stock prices than those of larger firms. Hence, we include firm size as an explanatory variable in our cross-sectional analysis.

To obtain further guidelines for the choice of cross-sectional variables, we proceed as follows. As we pointed out earlier, we interpret the second derivative in the theoretical analysis of Section II.A as measuring how the relation between liquidity and stock price movements varies in the cross-section. The theory indicates that this response is decreasing in volatility of the asset value and the volume of uninformed trade (recall the sign of the second derivatives in equations (3) and (4)). In our cross-sectional analysis, we use proxies for these variables as well as other variables indicated by a priori intuition. Thus, we use a measure of return volatility measured over the prior calendar-year as a proxy for the asset variance v_δ. We also include share turnover because we expect that more volume would cause market makers to be less concerned about reversing their inventory. This variable also proxies for liquidity trading, v_z, as per Section II.A. However, the more volatile the trading activity, the more difficulty the market maker will have in predicting the arrival of reversing transactions and, hence, greater will be the inventory risk; based on this intuition we also include the volatility of share turnover.

The next two variables we consider are the price per share and the percentage of a firm's stock held by institutions. We include price per share to account for inadequate scaling of the response coefficients across low-price and high-priced firms. In addition, we conjecture that market makers have more reasons to be concerned about inventory if a greater proportion of stock is held by institutions as institutional orders tend to be larger. Thus, we include the institutional holdings variable.

Based on the above reasoning, the explanatory variables used in the cross-sectional analysis are as follows:

SIZE: market capitalization as of end of the previous year,

INSTPC: the percentage of the outstanding shares of a company held by institutions as of the end of the previous year,

PRICE: the closing stock price level as of the previous year,

STDRET: the volatility (standard deviation) of daily returns as of the previous year,

AVETURN: the average daily stock turnover (trading volume/number of shares outstanding) in the previous year, and

STDTURN: the standard deviation of daily turnover in the previous year.

Table 4 presents the summary statistics for these variables across all firms as well as across firms sorted into size quartiles. On average, institutions hold about 46% of the shares in our sample firms. This percentage, however, increases monotonically from the smallest quartile of firms, where the average institutional holding is 32%, to the largest quartile where the corresponding figure is 57%. The increase in institutional holdings across size quartiles is consistent with the preference of institutions to hold more stock in the larger firms. The average price of the shares varies from $10.61 for the smallest quartile to $48.48 for the largest quartile. Not surprisingly, the volatility of returns decreases across the size quartiles, while turnover increases across these groups. On average, 0.31% of the stocks for all firms are "turned-over" on each day of trading. To provide more perspective on cross-sectional variation in trading activity, we also provide statistics on the daily number of transactions across the size quartiles and for the entire sample (though we do not use this variable in our cross-sectional regressions). The pattern in the numbers for the average daily number of transactions, an alternative measure of trading activity, are similar to those for turnover. Specifically, for the median small firm, there are about

13 trades in a day. However, this number increases to about 177 for the median firm in the largest quartile. These indicate the existence of significant variation in the explanatory variables and trading activity across the size quartiles.

We now turn our attention to the cross-sectional regressions of the response coefficients estimated from our time-series regressions. Table 5 presents the Fama-Macbeth averages and t-statistics based on year by year cross-sectional regression of the time-series coefficient α_1 from the previous section on the above variables. For brevity, we only report results for the proportional spread measures and the composite measures; the results for the unscaled measures are similar. The averages are presented for regressions estimated across all firms and across firms in each of the size quartiles. Our variables explain between 5% and 26% of the cross-sectional variation in spread response to absolute returns; the explanatory power is lower for the COMP variable.

Many of our variables tend to be important in explaining the cross-sectional variation of the response coefficients. Consistent with equations (3) and (4) of Section I, STDRET, SIZE and AVETURN are all negatively and significantly related to the response coefficient for spreads and composite liquidity measure.[12] The coefficients are also economically significant; as an example, a one standard deviation change in STDRET changes the response coefficient by about 27%. Given the magnitudes of the response coefficients documented in the previous section, this is a substantial effect.

PRICE and STDTURN are positively related to the response coefficient. The response coefficient is decreasing in size and trading volume as measured by the turnover, suggesting that for larger firms and firms that have a higher trading volume, the impact of contemporaneous stock volatility on liquidity is smaller. Thus, the liquidity of larger stocks and stocks that have higher trading volumes, is more resilient to stock price movements than the liquidity of smaller stocks and stocks with lower trading volumes. This is consistent with the notion that it is the former category of stocks that are widely held and extensively followed. The response coefficient is also decreasing in return volatility. Thus, the liquidity of stocks that have higher return volatility exhibits a lower response to information shocks.

The impact of contemporaneous absolute returns on spreads is increasing with price and this impact decreases monotonically across size quartiles. A possible explanation for this result is as follows. Table 4 documents that smaller firms have lower stock prices. The tick size,[13] which represents the minimum institutionally mandated change in stock prices, is more likely to be binding for lower priced stocks. The response coefficient is then constrained by the tick size, especially for lower priced stocks. Thus, as price increases, the constraint will be less binding, and the impact of the stock price on the response coefficient should be higher. Furthermore, this response coefficient should decrease across size quartiles because as price increases across the size quartiles, the tick size becomes less binding.

The variability of turnover is positively related to the response coefficient for the spread. This result is consistent with the intuition that market maker inventory is riskier for stocks with more variable turnover, so that liquidity responds strongly to stock price movements for stocks with higher variability in trading activity.

The relation between the spread and absolute returns is insignificantly related to institutional holdings for the quoted spread, but positively for the proportional effective spread,

[12] It is well-known that volatility is *positively* related to the *level* of the bid-ask spread in the cross-section (see, e.g., Benston and Hagerman, 1974). However, as documented here, there is a *negative* relation between volatility and the *time-series response of spreads to absolute returns*.

[13] See Chordia and Subrahmanyam (1995) and Ball and Chordia (2000) for a detailed analysis of the tick size.

for the entire sample of firms. Focusing on the within quartile regressions, the largest two quartiles have a significantly negative relationship between the quoted spread's response coefficient and institutional holdings. This suggests that as the impact of stock price movements on quoted spreads increases in the largest quartiles, institutions can step up to supply liquidity because they hold more of the largest stocks and being well diversified they are in a position to profit from information shocks to a given stock.

The regression results for the composite liquidity measure tend to be qualitatively similar to those based on quoted spreads. This is not surprising, since the composite measure is based on quoted spreads and depth.

In sum, the cross-sectional results demonstrate that the resilience of a firm's equity market to information shocks is (ceteris paribus) greatest for firms with high market capitalization, trading volume, and return volatility, and low variability in trading activity. Larger institutional holdings are positively associated with this capacity in large firms.

B.4 Robustness checks

It is worth emphasizing that the Fama-Macbeth statistics reported for the regressions in Table 5 are based on only 11 years of data. Naturally, power in the tests is a concern with such a short sample period. The significance observed in the regressions in spite of this shortcoming reinforces our confidence in the results, and provides evidence of stability in the cross-sectional estimates across the years. In this section, we address two other concerns regarding our estimation procedure.

The first concern relates to the fact that we compute absolute returns using actual transaction prices, so that there is the possibility that the co-movement between spreads and absolute returns could be an artifact of bid-ask bounce, given that the component of return due to bid-ask bounce depends on the size of the bid-ask spread. To address this issue, we create a data-set of returns that is free of bid-ask bounce. In particular, we use a time series of the mid-point of the quoted bid-ask spread prevailing at the time of the last trade of the day to calculate the daily return for each stock.[14] We redid the regressions using this return series and found that the results in Tables 3 through 5 were qualitatively unaltered. These results are not reported for brevity but are available upon request.

A second concern regarding our results is that in the two-step procedure we have used thus far, the response coefficients are measured with error in the second stage cross-sectional regressions. But these response coefficients are the dependent variables in the cross-sectional regressions and as long as the estimation errors are not related to the firm characteristics in any systematic manner, the cross-sectional regression coefficients will not be biased. Nevertheless, to address this issue, we estimate a single panel regression using both time-series as well as cross-sectional data. The panel regression allows us to estimate, the response coefficient and the impact of the characteristic on the response coefficient in a single step.

The following regression is estimated across all firms and all days in the sample (i.e, 1988-1998), using the bid-ask bounce free return data:

$X_{it} = a_0 + a_1 DABSRET_{it} + a_2\, DABSRET_{it}*SIZE_{it} + a_3\, DABSRET_{it}*INSTPC_{it} + a_4$

$DABSRET_{it}*PRICE_{it} + a_5\, DABSRET_{it}*STDRET_{it} + a_6\, DABSRET_{it}*AVETURN_{it} + a_7$

$DABSRET_{it}*STDTURN_{it} + b_1 DABL5RETit + b_2\, DABL5RET_{it}*SIZE_{it} + b_3$

$DABL5RET_{it}*INSTPC_{it} + b_4\, DABL5RET_{it}*PRICE_{it} + b_5\, DABL5RET_{it}*STDRET_{it} + b_6$

[14] We do not use the closing bid-ask spreads because without any transaction, these spreads may be economically suspect. However, for the largest stocks, the closing bid-ask spreads are often also the spreads at which the last transaction of the day took place.

$DABL5RET_{it}*AVETURN_{it} + b_7\ DABL5RET_{it}*STDTURN_{it} + c_1DABSMRET_t +$

$$c_2DABL5MRET_t + c_3MX_t + c_4MX_{t-1} + c_5MX_{t+1} + \sum_{j=1}^{5} c_{5+j}\, X_{it-j} + \varepsilon_{it}\,,$$

where the variables are as defined earlier, except that individual stock returns are computed using the return dataset that is free of bid-ask bounce.

In the above regression, the coefficients on the interaction terms capture the sensitivity of the response coefficient to the relevant cross-sectional variable.[15] For example, the coefficient a_2 captures the cross-sectional relation between firm size and the time-series liquidity response to DABSRET. An advantage of this panel regression relative to the two-stage regressions used for Table 5 is that the panel regression can increase the power of the model by avoiding estimation errors which arise in the first step of the two-stage regressions.

The panel regression results are presented in Table 6.[16] Size, turnover, and return volatility are all negatively related to the response of liquidity to absolute returns, and the standard deviation of turnover is positively related to this response. Notice that the explanatory power is considerably higher for the quoted spread regressions than for the effective spread regressions; perhaps because effective spreads, especially for infrequently-traded stocks, are estimated noisily.[17] In general, however, the panel regressions support the central findings of Table 5.

III. Conclusion

A voluminous literature has explored the cross-sectional determinants of the spread. This line of literature treats liquidity essentially as a fixed property of a given stock. Yet, recent research

[15] The intercept a_0 corresponds to the intercept from the first-stage time-series regression, while the coefficients a_1 and b_1 corresponds to the intercept from the second stage cross-sectional regression.
[16] We also estimated the panel regression using returns computed from transaction prices. The results were qualitatively similar to those reported in Table 7.
[17] Panel regressions by size quartile, while not reported here for brevity, yielded results that were largely similar to those in Tables 5 and 6.

indicates that market-wide liquidity exhibits substantial intertemporal variation. This paper connects the cross-sectional and time-series studies of liquidity by taking a first step towards documenting cross-sectional heterogeneity in time-series variation in liquidity. We first examine whether there are differences across firms in recent liquidity trends as well as in daily fluctuations in liquidity. Next, we explore cross-sectional differences in the capacity of a firm's equity market to provide liquidity when information shocks affect the value of the stock. Low serial correlation in daily stock returns indicates that much of daily return movements are information-related, which justifies our use of daily absolute stock returns as a proxy for volatility.

We depart from existing cross-sectional studies of liquidity by using a comprehensive sample of more than 1200 stocks over more than 2800 days, and examining the cross-section and time-series of liquidity simultaneously. Our main results are as follows:

- Daily average liquidity changes exhibit considerable cross-sectional variation. Small firms tend to have greater proportional liquidity changes on average than large firms.
- The increase in aggregate market liquidity over the past decade has been more pronounced for large firms than for small firms.
- Daily absolute returns are an important determinant of daily variations in liquidity.
- We take the degree of co-movement between liquidity and absolute returns as an inverse measure of the resilience of a firm's liquidity to information shocks. Our cross-sectional analysis indicates that size, volume, and volatility are all negatively related to this co-movement coefficient; however, the volatility of volume is positively related to the co-movement.
- Institutional holdings are negatively related to the co-movement between liquidity and absolute stock returns. Our rationale for this result is that liquidity trades are more likely to

emanate from institutions in large companies, so that the liquidity of large stocks is better able to withstand large stock price fluctuations.

The results in the last two items above indicate that the resilience of a firm's equity market to stock price fluctuations is largest for firms with large market capitalization, trading volume, and return volatility, but small variability of trading volume. Larger institutional holdings are positively related to this resilience. These results help shed light on which types of firms are likely to be most costly to trade during periods of information arrival. They also shed light on the cross-sectional determinants of the heterogeneity in the time-series movements of liquidity across different types of stocks.

Our work suggests some interesting topics for future research. While we provide some theoretical analysis, a further exploration of the issues we address (e.g., in the context of a multi-security dynamic model) may be worthwhile. In addition, it may also be worthwhile to analyze the relation between liquidity and returns, and how this relation varies in cross-section. For instance, stock returns have been high during the 1990s, while liquidity has increased. Further, large firms have performed better than small firms, and their liquidity has increased more than that of small firms. It would be interesting to document how much of the greater price appreciation for large firms can be attributed to increases in their liquidity.

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Table 1: Average liquidity measures by year, 1988-1998

For each firm, liquidity measures are averaged within each year and within each year are averaged cross-sectionally. This table reports the cross-sectional mean and standard deviation for liquidity measures for each year as well as for all years combined. QSPR: the quoted bid-ask spread, RQSPR: the quoted bid-ask spread divided by the mid-point of the quote (in %), ESPR: the effective spread, i.e., the difference between the execution price and the mid-point of the prevailing bid-ask quote, RESPR: the effective spread divided by the mid-point of the prevailing bid-ask quote (in %), DEPTH: the average of the quoted bid and ask depths, $DEPTH: the average of the ask depth times ask price and bid depth times bid price, COMP = RQSPR/$DEPTH.

Panel A: All firms

YEAR		QSPR	RQSPR(%)	ESPR	RESPR(%)	DEPTH^{+}	$_DEPTH^{++}	COMP
1988	**Mean**	0.238	1.705	0.174	1.275	5.730	0.110	1.534
(n=1193)	**Std. Dev.**	0.079	1.895	0.062	1.523	8.456	0.116	7.088
1989	**Mean**	0.226	1.618	0.149	1.121	6.738	0.144	2.099
(n=1185)	**Std. Dev.**	0.080	2.126	0.053	1.650	9.413	0.156	15.970
1990	**Mean**	0.229	2.141	0.139	1.416	6.128	0.113	5.750
(n=1208)	**Std dev**	0.085	2.926	0.046	2.232	8.733	0.124	38.211
1991	**Mean**	0.226	2.044	0.145	1.397	6.088	0.119	5.315
(n=1255)	**Std. Dev.**	0.088	2.789	0.052	2.075	8.030	0.136	42.497
1992	**Mean**	0.221	1.775	0.143	1.212	6.565	0.139	2.691
(n=1311)	**Std. Dev.**	0.086	2.449	0.053	1.799	8.850	0.157	16.948
1993	**Mean**	0.221	1.492	0.139	0.988	6.703	0.154	1.709
(n=1392)	**Std. Dev.**	0.080	1.974	0.052	1.419	8.650	0.177	15.478
1994	**Mean**	0.210	1.361	0.136	0.919	6.586	0.148	1.077
(n=1466)	**Std. Dev.**	0.067	1.599	0.044	1.170	8.653	0.182	9.349
1995	**Mean**	0.196	1.302	0.130	0.904	7.539	0.175	1.056
(n=1495)	**Std. Dev.**	0.054	1.687	0.034	1.267	9.654	0.217	9.796
1996	**Mean**	0.193	1.173	0.130	0.823	7.140	0.174	0.749
(n=1545)	**Std. Dev.**	0.050	1.454	0.032	1.106	9.065	0.202	4.884
1997	**Mean**	0.171	0.948	0.120	0.688	5.450	0.146	0.718
(n=1548)	**Std. Dev.**	0.069	1.270	0.045	0.997	6.537	0.155	5.686
1998	**Mean**	0.159	0.914	0.109	0.637	3.662	0.098	0.672
(n=1444)	**Std. Dev.**	0.061	1.026	0.044	0.754	4.102	0.092	2.089
ALL YEARS	**Mean**	0.207	1.469	0.136	1.015	6.216	0.140	2.020
(n=15042)	**Std. Dev.**	0.077	2.010	0.050	1.508	8.364	0.164	19.200

$^{+}$ Thousands of shares
$^{++}$ $ millions

Table 1 (contd)
Panel B: Quartile 1

YEAR		QSPR	RQSPR(%)	ESPR	RESPR(%)	DEPTH[+]	$_DEPTH[++]	COMP
1988	**Mean**	0.212	3.623	0.158	2.775	6.114	0.028	5.308
(n=298)	**Std. Dev.**	0.063	2.884	0.048	2.351	10.724	0.020	13.561
1989	**Mean**	0.204	3.700	0.133	2.619	6.531	0.033	7.846
(n=296)	**Std. Dev.**	0.061	3.344	0.036	2.688	11.132	0.025	31.378
1990	**Mean**	0.202	5.115	0.122	3.462	5.895	0.022	22.115
(n=302)	**Std. Dev.**	0.066	4.505	0.036	3.604	10.375	0.017	74.337
1991	**Mean**	0.197	5.059	0.129	3.559	6.225	0.023	20.633
(n=314)	**Std. Dev.**	0.066	4.205	0.042	3.205	9.529	0.016	83.872
1992	**Mean**	0.202	4.317	0.134	3.022	6.512	0.027	10.131
(n=328)	**Std. Dev.**	0.061	3.788	0.040	2.831	10.953	0.023	32.844
1993	**Mean**	0.210	3.343	0.138	2.271	5.740	0.036	6.291
(n=348)	**Std. Dev.**	0.058	3.181	0.038	2.324	8.723	0.031	30.425
1994	**Mean**	0.210	2.886	0.139	2.007	5.400	0.035	3.789
(n=366)	**Std. Dev.**	0.053	2.566	0.034	1.901	7.874	0.025	18.541
1995	**Mean**	0.198	2.799	0.133	1.984	5.623	0.038	3.769
(n=374)	**Std. Dev.**	0.047	2.756	0.027	2.095	7.777	0.024	19.336
1996	**Mean**	0.195	2.571	0.133	1.844	6.555	0.043	2.620
(n=386)	**Std. Dev.**	0.047	2.323	0.031	1.801	10.359	0.030	9.524
1997	**Mean**	0.182	2.088	0.128	1.540	4.684	0.036	2.555
(n=387)	**Std. Dev.**	0.053	2.088	0.036	1.668	7.343	0.021	11.192
1998	**Mean**	0.177	1.940	0.123	1.370	3.198	0.028	2.215
(n=361)	**Std. Dev.**	0.063	1.548	0.044	1.163	6.011	0.014	3.722
ALL YEARS	**Mean**	0.198	3.324	0.134	2.348	5.638	0.032	7.501
(n=3760)	**Std. Dev.**	0.059	3.241	0.039	2.475	9.246	0.024	37.902

[+] Thousands of shares
[++] $ millions

Table 1 (contd)
Panel C: Quartile 2

YEAR		QSPR	RQSPR(%)	ESPR	RESPR(%)	DEPTH+	$_DEPTH++	COMP
1988	**Mean**	0.257	1.552	0.188	1.143	4.502	0.055	0.627
(n=299)	**Std. Dev.**	0.089	0.704	0.069	0.581	8.208	0.033	0.495
1989	**Mean**	0.253	1.410	0.164	0.949	5.561	0.072	0.446
(n=297)	**Std. Dev.**	0.107	0.841	0.068	0.705	10.495	0.049	0.393
1990	**Mean**	0.247	1.824	0.149	1.180	5.709	0.058	0.743
(n=302)	**Std. Dev.**	0.087	1.135	0.042	0.962	10.340	0.038	0.651
1991	**Mean**	0.244	1.657	0.155	1.094	4.994	0.061	0.708
(n=314)	**Std. Dev.**	0.073	0.991	0.040	0.781	8.274	0.040	1.150
1992	**Mean**	0.242	1.383	0.157	0.915	4.495	0.066	0.458
(n=328)	**Std. Dev.**	0.073	0.671	0.046	0.528	6.362	0.038	0.413
1993	**Mean**	0.240	1.285	0.153	0.834	5.060	0.075	0.370
(n=348)	**Std. Dev.**	0.060	0.608	0.038	0.457	8.358	0.046	0.399
1994	**Mean**	0.225	1.243	0.145	0.812	4.683	0.072	0.396
(n=366)	**Std. Dev.**	0.048	0.506	0.031	0.377	7.482	0.052	0.344
1995	**Mean**	0.208	1.196	0.137	0.814	6.058	0.081	0.328
(n=374)	**Std. Dev.**	0.045	0.630	0.026	0.524	10.451	0.055	0.323
1996	**Mean**	0.207	0.985	0.138	0.672	4.525	0.081	0.267
(n=387)	**Std. Dev.**	0.041	0.411	0.026	0.331	6.629	0.060	0.211
1997	**Mean**	0.180	0.823	0.126	0.585	3.914	0.072	0.233
(n=386)	**Std. Dev.**	0.047	0.393	0.032	0.318	5.359	0.037	0.237
1998	**Mean**	0.171	0.814	0.118	0.561	2.810	0.056	0.300
(n=361)	**Std. Dev.**	0.074	0.367	0.055	0.259	2.647	0.025	0.262
ALL YEARS	**Mean**	0.223	1.266	0.147	0.854	4.732	0.069	0.431
(n=3762)	**Std. Dev.**	0.075	0.750	0.048	0.588	7.974	0.045	0.523

+ Thousands of shares
++ $ millions

Table 1 (contd)
Panel D: Quartile 3

YEAR		QSPR	RQSPR(%)	ESPR	RESPR(%)	DEPTH+	$_DEPTH++	COMP
1988	**Mean**	0.252	1.051	0.181	0.759	5.528	0.112	0.198
(n=298)	**Std. Dev.**	0.079	0.573	0.062	0.485	8.614	0.065	0.189
1989	**Mean**	0.228	0.871	0.151	0.587	6.799	0.151	0.120
(n=296)	**Std. Dev.**	0.047	0.328	0.031	0.264	8.641	0.089	0.109
1990	**Mean**	0.242	1.049	0.146	0.659	5.439	0.106	0.207
(n=302)	**Std. Dev.**	0.058	0.527	0.034	0.447	7.324	0.051	0.235
1991	**Mean**	0.234	0.978	0.148	0.634	5.781	0.115	0.177
(n=313)	**Std. Dev.**	0.062	0.419	0.040	0.331	7.214	0.060	0.215
1992	**Mean**	0.224	0.903	0.143	0.589	6.422	0.135	0.166
(n=328)	**Std. Dev.**	0.077	0.483	0.054	0.376	8.470	0.073	0.630
1993	**Mean**	0.225	0.833	0.140	0.525	6.378	0.146	0.110
(n=348)	**Std. Dev.**	0.090	0.312	0.063	0.221	7.525	0.096	0.094
1994	**Mean**	0.214	0.836	0.136	0.542	6.015	0.132	0.133
(n=367)	**Std. Dev.**	0.083	0.306	0.061	0.241	7.324	0.081	0.137
1995	**Mean**	0.199	0.763	0.130	0.511	6.918	0.158	0.101
(n=373)	**Std. Dev.**	0.073	0.312	0.051	0.245	7.792	0.119	0.106
1996	**Mean**	0.192	0.724	0.127	0.493	7.362	0.168	0.090
(n=386)	**Std. Dev.**	0.067	0.316	0.043	0.249	8.487	0.101	0.109
1997	**Mean**	0.170	0.561	0.118	0.400	5.525	0.142	0.075
(n=388)	**Std. Dev.**	0.109	0.311	0.070	0.269	6.405	0.073	0.076
1998	**Mean**	0.151	0.566	0.103	0.386	3.636	0.097	0.115
(n=361)	**Std. Dev.**	0.048	0.268	0.032	0.185	2.535	0.045	0.133
ALL YEARS	**Mean**	0.210	0.818	0.137	0.545	5.990	0.134	0.133
(n=3760)	**Std. Dev.**	0.081	0.416	0.055	0.325	7.501	0.084	0.236

+ Thousands of shares
++ $ millions

Table 1 (contd)
Panel E: Quartile 4

YEAR		QSPR	RQSPR(%)	ESPR	RESPR(%)	DEPTH[+]	$_DEPTH[++]	COMP
1988	**Mean**	0.233	0.621	0.168	0.441	6.778	0.244	0.050
(n=298)	**Std. Dev.**	0.073	0.220	0.063	0.152	5.286	0.141	0.053
1989	**Mean**	0.219	0.512	0.148	0.345	8.053	0.319	0.030
(n=296)	**Std. Dev.**	0.085	0.172	0.064	0.119	6.626	0.195	0.026
1990	**Mean**	0.225	0.601	0.140	0.382	7.466	0.264	0.049
(n=302)	**Std. Dev.**	0.111	0.248	0.064	0.174	5.977	0.151	0.096
1991	**Mean**	0.230	0.549	0.145	0.352	7.336	0.274	0.043
(n=314)	**Std. Dev.**	0.128	0.210	0.073	0.140	6.713	0.177	0.082
1992	**Mean**	0.217	0.509	0.138	0.332	8.794	0.324	0.029
(n=327)	**Std. Dev.**	0.118	0.181	0.066	0.137	8.500	0.198	0.022
1993	**Mean**	0.208	0.497	0.128	0.316	9.603	0.358	0.025
(n=348)	**Std. Dev.**	0.101	0.202	0.059	0.163	9.220	0.227	0.022
1994	**Mean**	0.192	0.505	0.122	0.333	10.182	0.350	0.029
(n=367)	**Std. Dev.**	0.072	0.201	0.039	0.162	10.462	0.248	0.028
1995	**Mean**	0.178	0.453	0.119	0.311	11.501	0.420	0.021
(n=374)	**Std. Dev.**	0.042	0.170	0.018	0.138	11.003	0.286	0.020
1996	**Mean**	0.179	0.418	0.120	0.285	10.054	0.403	0.019
(n=386)	**Std. Dev.**	0.037	0.161	0.021	0.126	9.469	0.263	0.018
1997	**Mean**	0.153	0.327	0.107	0.232	7.655	0.333	0.017
(n=387)	**Std. Dev.**	0.042	0.117	0.028	0.090	6.300	0.191	0.015
1998	**Mean**	0.138	0.319	0.094	0.218	4.992	0.214	0.025
(n=361)	**Std. Dev.**	0.050	0.136	0.037	0.103	3.831	0.106	0.021
ALL YEARS	**Mean**	0.195	0.476	0.128	0.318	8.475	0.322	0.030
(n=3760)	**Std. Dev.**	0.088	0.207	0.054	0.150	8.180	0.217	0.045

[+] Thousands of shares
[++] $ millions

Table 2: Summary statistics for percentage daily changes in liquidity measures, 1988-1998

For each firm, percentage daily change in liquidity measures are averaged within each year. Panel A presents the firm-year averages and standard deviations for absolute percentage changes in liqudity measures. Summary statistics are also presented for firms sorted into quartiles, where the sorting is done each year based on the market capitalization at end of prior year. Panel B presents the time-series averages for cross-correlation in liquidity changes. For each firm and year, cross-correlation across liquidity measures are computed. These are then averaged across firm-years and the below tables present these averages. The prefix "D" denotes daily percentage change. QSPR: the quoted bid-ask spread,
RQSPR: the quoted bid-ask spread divided by the mid-point of the quote (in %), ESPR: the effective spread, i.e., the difference between the execution price and the mid-point of the prevailing bid-ask quote, RESPR: the effective spread divided by the mid-point of the prevailing bid-ask quote (in %), DEPTH: the average of the quoted bid and ask depths, $DEPTH: the average of the ask depth times ask price and bid depth times bid price, COMP = RQSPR/$DEPTH.

Panel A: Average for absolute percentage change in liquidity measures

YEAR		DQSPR	DRQSPR	DESPR	DRESPR	DDEP	D_$DEP	DCOMP
All firms	**Mean**	18.15	18.31	30.10	30.33	54.76	54.79	65.97
	Std. Dev.	6.65	6.63	128.87	131.68	18.08	18.05	22.49
Quartile 1	**Mean**	23.17	23.39	55.65	56.21	65.25	65.27	76.97
(small)	**Std. Dev.**	6.10	6.06	255.47	261.11	20.87	20.72	25.85
Quartile 2	**Mean**	20.64	20.78	30.04	30.18	60.86	60.90	74.63
	Std. Dev.	5.68	5.62	12.37	12.31	17.17	17.21	21.62
Quartile 3	**Mean**	16.77	16.89	21.29	21.40	52.54	52.57	63.93
	Std. Dev.	4.77	4.72	9.07	9.03	12.19	12.17	16.01
Quartile 4	**Mean**	12.11	12.24	13.59	13.72	40.58	40.60	48.57
(large)	**Std. Dev.**	3.84	3.80	5.99	5.95	8.82	8.81	11.44

Panel B: Cross-correlation of percentage change in liquidity measures

	DQSPR	DRQSPR	DESPR	DRESPR	DDEPTH	D$DEPTH	DCOMP
DQSPR	1.00	0.99	0.19	0.19	-0.20	-0.20	0.48
DRQSPR(%)	0.99	1.00	0.19	0.21	-0.20	-0.20	0.48
DESPR	0.19	0.19	1.00	0.99	-0.12	-0.12	0.16
DRESPR(%)	0.19	0.21	0.99	1.00	-0.11	-0.12	0.17
DDEPTH	-0.20	-0.20	-0.12	-0.11	1.00	1.00	-0.59
D$DEPTH	-0.20	-0.20	-0.12	-0.12	1.00	1.00	-0.59
DCOMP	0.48	0.48	0.16	0.17	-0.59	-0.59	1.00

Table 3: Average coefficients from time-series regression using daily data, 1988-1998.

For each firm and year, the following regression is estimated using daily data:

$$X_t = \alpha_1 + \alpha_2 DABSRET_t + \alpha_3 DABL5RET + \alpha_4 DABSMRET + \alpha_5 DABL5MRET_t + \alpha_6 MX_t + \alpha_7 MX_{t-1} + \alpha_8 MX_{t+1} + \sum_{j=1}^{5} \alpha_{9j} X_{t-j} + \varepsilon_{it}$$

where,

X_t = % Change in liquidity measure on day t (either % change in quoted spread or relative quoted spread or effective spread or relative effective spread or depth or dollar depth or volume or dollar volume or composite liquidity measure). "D" denotes daily percentage change. QSPR: the quoted bid-ask spread, RQSPR: the quoted bid-ask spread divided by the mid-point of the quote (in %), ESPR: the effective spread, i.e., the difference between the execution price and the mid-point of the prevailing bid-ask quote, RESPR: the effective spread divided by the mid-point of the prevailing bid-ask quote (in %), DEPTH: the average of the quoted bid and ask depths, $DEPTH: the average of the ask depth times ask price and bid depth times bid price, COMP = RQSPR/$DEPTH.

MX_t = % change in equally-weighted market-liquidity measure from day t-1 to day t
$DABSRET_t$ = Absolute return in day t – Absolute return in day t-1
$DABL5RET_t$ = ABL5RET(t) – ABL5RET(t-1)
ABL5RET(t) = Cumulative absolute return over days t-1 to t-5
$DABSMRET_t$ = Absolute equally-weighted market return in day t – Absolute market return in day t-1
$DABL5MRET_t$ = ABL5MRET(t) – ABL5MRET(t-1)
ABL5MRET(t) = Cumulative absolute market-return over days t-1 to t-5

Panel A of this table presents the cross-sectional averages and t-statistics for α_1 and the percentage of firms with positive coefficients. Panel B presents this information averaged across all years for firms sorted into size quartiles. These panels also present the cross-sectional average adjusted R-squares from the above regression. Panels C and D present the same information for α_3, Panels E and F for α_4 and Panels G and H for α_5.

Panel A: Average coefficient for DABSRET

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	ALL YEARS
DQSPR	**Mean coeff**	192.01	244.63	200.32	201.19	231.44	226.50	206.94	188.57	182.52	216.58	231.62	210.71
	t-statistic	(24.96)	(35.29)	(33.27)	(35.85)	(39.17)	(44.78)	(44.85)	(44.11)	(39.84)	(46.74)	(37.36)	(125.33)
	% coeff >0	90.4*	94.0*	94.4*	95.5*	95.9*	96.2*	96.3*	95.3*	95.6*	95.6*	96.9*	95.19*
DRQSPR	**Mean coeff.**	186.33	245.57	206.07	199.62	233.57	230.41	208.49	185.90	182.41	212.10	233.53	210.81
	t-statistic	(31.30)	(35.04)	(34.56)	(37.84)	(38.58)	(45.87)	(45.58)	(43.63)	(39.76)	(45.69)	(37.70)	(129.24)
	% coeff. >0	89.7*	93.5*	94.2*	94.5*	95.3*	96.7*	96.2*	94.7*	95.2*	94.9*	96.6*	94.77*
DESPR	**Mean coeff.**	430.60	334.09	215.78	243.82	263.01	200.03	194.32	179.10	205.75	238.62	270.75	248.38
	t-statistic	(29.34)	(18.41)	(13.58)	(20.63)	(19.51)	(21.18)	(19.04)	(19.13)	(16.35)	(25.36)	(30.48)	(67.09)
	% coeff. >0	91.3*	85.6*	78.0*	83.6*	81.3*	77.6*	75.1*	71.6*	76.6*	89.7*	97.7*	82.41*
DRESPR	**Mean coeff.**	426.04	324.75	221.56	244.63	264.31	202.18	192.99	174.90	197.95	242.56	277.38	247.81
	t-statistic	(28.06)	(14.89)	(14.72)	(19.44)	(20.30)	(20.98)	(19.74)	(18.95)	(18.15)	(21.18)	(32.61)	(65.09)
	% coeff. >0	91.0*	85.3*	79.9*	83.5*	80.8*	77.7*	75.4*	71.8*	75.2*	89.3*	97.0*	82.27*
DDEPTH	**Mean coeff.**	17.38	-88.27	-87.68	-66.92	-29.41	-28.53	2.37	20.62	46.25	66.53	62.70	-3.79
	t-statistic	(0.85)	(-3.78)	(-4.30)	(-3.53)	(-1.75)	(-1.81)	(0.14)	(1.14)	(2.71)	(4.23)	(3.93)	(-0.70)
	% coeff. >0	52.3	44.1*	42.1*	45.0*	50.2	48.5	49.0	50.6	50.3	54.3*	55.3*	49.45
D$_DEPTH	**Mean coeff.**	21.70	-67.97	-107.05	-63.39	-35.14	-32.46	3.76	22.52	45.28	64.48	65.86	-3.65
	t-statistic	(1.07)	(-2.83)	(-5.84)	(-3.31)	(-2.09)	(-2.04)	(0.21)	(1.19)	(2.53)	(3.94)	(3.75)	(-0.65)
	% coeff. >0	53.0*	45.4*	39.3*	46.0*	49.4	48.5	48.9	50.3	50.5	53.4*	54.8*	49.25
DCOMP	**Mean coeff.**	293.16	520.88	470.77	396.96	416.48	438.91	404.00	365.18	325.28	332.73	344.16	388.68
	t-statistic	(9.84)	(16.64)	(18.83)	(16.52)	(18.32)	(20.80)	(19.43)	(18.31)	(15.72)	(16.33)	(16.58)	(55.66)
	% coeff. >0	66.5*	75.9*	78.7*	74.8*	74.5*	77.2*	75.0*	71.8*	71.0*	70.5*	73.3*	73.48*

* Significant at the 5% level based on two-sided binomial test.

Panel B: Average coefficient for DABSRET across size quartiles

		Quartile 1 (small)	Quartile 2	Quartile 3	Quartile 4 (High)
DQSPR	**Mean coeff.**	157.72	242.32	238.75	203.75
	t-statistic	(43.44)	(61.21)	(78.80)	(82.01)
	% coeff. >0	89.4*	96.5*	97.3*	97.5*
DRQSPR	**Mean coeff.**	156.46	241.03	239.51	205.89
	t-statistic	(44.06)	(65.19)	(80.59)	(81.51)
	% coeff. >0	88.3*	96.2*	97.2*	97.4*
DESPR	**Mean coeff.**	262.44	326.42	243.94	162.45
	t-statistic	(24.10)	(44.05)	(43.87)	(43.01)
	% coeff. >0	77.9*	85.9*	85.4*	80.5*
DRESPR	**Mean coeff.**	254.29	326.64	244.84	167.02
	t-statistic	(22.35)	(43.37)	(43.94)	(43.76)
	% coeff. >0	77.6*	86.1*	85.1*	80.2*
DDEPTH	**Mean coeff.**	126.66	33.54	-59.05	-113.54
	t-statistic	(10.80)	(2.63)	(-5.80)	(-14.04)
	% coeff. >0	60.3*	52.1*	44.2*	41.4*
D$_DEPTH	**Mean coeff.**	136.95	35.06	-59.41	-124.23
	t-statistic	(11.33)	(2.74)	(-5.60)	(-15.33)
	% coeff. >0	61.2*	52.0*	43.7*	40.4*
DCOMP	**Mean coeff.**	219.98	393.94	500.17	438.10
	t-statistic	(14.00)	(25.57)	(38.27)	(40.55)
	% coeff. >0	63.0*	73.0*	79.7*	78.0*

Panel C: Average coefficient for DABL5RET

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	ALL YEARS
DQSPR	**Mean coeff.**	304.80	394.62	299.11	320.27	332.71	305.18	289.57	263.77	254.30	279.13	289.07	300.48
	t-statistic	(14.65)	(16.29)	(16.58)	(16.44)	(17.86)	(16.80)	(17.24)	(16.30)	(20.12)	(18.73)	(16.99)	(56.10)
	% coeff. >0	70.0*	74.4*	77.9*	76.4*	75.6*	76.9*	75.7*	75.3*	77.3*	74.6*	76.7*	75.6*
DRQSPR	**Mean coeff.**	238.06	315.61	298.98	254.82	292.31	293.20	261.00	205.52	207.93	223.35	271.38	258.02
	t-statistic	(10.93)	(12.78)	(16.50)	(14.31)	(15.36)	(16.44)	(15.68)	(12.64)	(14.26)	(14.83)	(15.54)	(47.57)
	% coeff. >0	64.1*	68.1*	75.5*	70.7*	71.9*	73.2*	71.6*	68.5*	68.8*	68.7*	74.8*	70.5*
DESPR	**Mean coeff.**	397.03	441.76	256.88	272.76	226.25	158.99	97.44	124.29	214.68	256.76	326.33	246.31
	t-statistic	(10.09)	(10.15)	(6.68)	(7.77)	(6.98)	(5.55)	(3.32)	(4.58)	(8.05)	(11.43)	(15.40)	(26.25)
	% coeff. >0	69.9*	68.5*	62.7*	65.4*	62.6*	57.8*	54.6*	56.0*	61.6*	70.9*	76.7*	64.1*
DRESPR	**Mean coeff.**	335.79	363.53	238.39	231.61	181.55	141.56	71.05	70.22	170.63	207.93	300.74	204.84
	t-statistic	(8.32)	(8.87)	(6.06)	(7.24)	(5.83)	(4.92)	(2.42)	(2.62)	(6.12)	(9.11)	(13.00)	(21.95)
	% coeff. >0	66.2*	64.6*	62.2*	61.3*	59.9*	57.1*	53.5*	52.2	56.6*	65.0*	74.3*	61.0*
DDEPTH	**Mean coeff.**	127.41	-122.45	-248.37	-87.46	10.02	-79.94	77.11	190.75	155.86	117.69	34.86	24.12
	t-statistic	(2.05)	(-1.74)	(-3.90)	(-1.43)	(0.18)	(-1.46)	(1.32)	(3.19)	(2.90)	(2.30)	(0.77)	(1.39)
	% coeff. >0	54.9*	49.8	46.9*	51.0	52.7	51.3	54.2*	54.8*	54.0*	56.3*	56.3*	53.1*
D$_DEPTH	**Mean coeff.**	227.73	-35.23	-260.85	-4.14	33.93	-77.42	106.57	260.89	221.60	155.06	64.04	70.55
	t-statistic	(3.58)	(-0.49)	(-4.18)	(-0.07)	(0.61)	(-1.40)	(1.82)	(4.38)	(4.09)	(3.03)	(1.43)	(4.04)
	% coeff. >0	56.6*	52.0	46.2*	53.9*	54.5*	52.3	54.9*	56.2*	55.4*	57.4*	56.3*	54.3*
DCOMP	**Mean coeff.**	21.12	326.59	439.25	184.65	82.07	170.03	79.24	-22.41	-69.11	-148.73	6.60	85.48
	t-statistic	(0.28)	(3.88)	(5.81)	(2.61)	(1.17)	(2.52)	(1.18)	(-0.33)	(-1.10)	(-2.46)	(0.12)	(4.13)
	% coeff. >0	47.5	54.5*	57.1*	53.0*	49.9	51.0	50.3	49.3	47.1*	46.1*	47.1*	50.1

* Significant at the 5% level based on two-sided binomial test.

Panel D: Average coefficient for DABL5RET across size quartiles

		Quartile 1 (small)	Quartile 2	Quartile 3	Quartile 4 (High)
DQSPR	**Mean coeff.**	220.76	291.40	331.16	357.13
	t-statistic	(17.36)	(23.84)	(35.02)	(46.71)
	% coeff. >0	68.5*	72.7*	76.9*	84.0*
DRQSPR	**Mean coeff.**	163.07	254.86	292.13	320.42
	t-statistic	(12.89)	(20.35)	(30.61)	(40.76)
	% coeff. >0	60.2*	68.7*	73.1*	79.9*
DESPR	**Mean coeff.**	213.73	231.68	257.65	281.15
	t-statistic	(8.69)	(10.48)	(16.73)	(29.01)
	% coeff. >0	58.6*	61.1*	65.7*	70.9*
DRESPR	**Mean coeff.**	143.38	204.76	218.01	251.71
	t-statistic	(5.95)	(9.24)	(14.07)	(25.83)
	% coeff. >0	53.9*	58.9*	62.8*	68.2*
DDEPTH	**Mean coeff.**	-0.29	-31.44	73.14	53.82
	t-statistic	(-0.01)	(-0.83)	(2.01)	(1.79)
	% coeff. >0	51.8*	51.7*	54.1*	54.7*
D$_DEPTH	**Mean coeff.**	87.19	1.58	121.60	71.04
	t-statistic	(2.50)	(0.04)	(3.30)	(2.39)
	% coeff. >0	53.9*	53.0*	55.1*	55.3*
DCOMP	**Mean coeff.**	183.36	128.84	8.96	23.00
	t-statistic	(4.56)	(2.84)	(0.21)	(0.63)
	% coeff. >0	53.3*	50.8	48.1*	48.1
		53.3*	50.8	48.1*	48.1*

Table 4: Summary statistics for determinants of the response of liquidity to absolute stock returns

This table presents the averages across firm-years of explanatory variables used to explain cross-sectional variation of response of liquidity to information. The variable definitions are as follows:

SIZE: market capitalization (in $billions) as of 31st December of each year
INSTPC: the percentage of the company held by institutions as of 31st December of each year
PRICE: the closing stock price level as of 31st December of each year
STDRET: the volatility (standard deviation) of daily returns estimated separately for each firm and each calendar-year.
AVETURN: the average daily stock turnover (trading volume/number of shares outstanding) estimated separately for each firm and each calendar-year.
STDTURN: the standard deviation of daily turnover estimated separately for each firm and each calendar-year.
NTRANS: average daily number of transactions, estimated separately for each firm and each calendar-year

		All firms	Quartile 1 (small)	Quartile 2	Quartile 3	Quartile 4 (large)
INSTPC	Mean	46.32	32.09	44.40	52.01	56.73
	Median	47.51	30.14	44.68	54.59	58.86
	Std. dev	22.25	19.13	21.88	21.99	17.47
SIZE	Mean	2.60	0.09	0.38	1.18	8.77
	Median	0.62	0.08	0.36	1.08	4.49
	Std. dev	7.59	0.07	0.16	0.49	13.37
PRICE	Mean	27.84	10.61	22.27	30.01	48.48
	Median	23.63	8.63	20.00	27.75	42.38
	Std. dev	23.89	8.03	12.85	14.71	32.85
STDRET	Mean	2.27	3.24	2.21	1.94	1.71
(*100)	Median	1.97	2.74	2.08	1.83	1.59
	Std. dev	1.36	2.07	0.91	0.76	0.59
AVETURN	Mean	3.05	2.77	3.20	3.26	2.98
(*1000)	Median	2.35	1.97	2.31	2.61	2.45
	Std. dev	3.02	3.68	3.24	2.78	2.15
STDTURN	Mean	3.76	4.38	4.55	3.65	2.47
(*1000)	Median	2.41	2.79	2.87	2.53	2.53
	Std. dev	5.60	7.37	6.68	4.00	2.80
NTRANS	Mean	112.32	19.29	41.05	87.51	299.48
	Median	46.26	12.58	27.57	62.47	176.72
	Std. dev	237.56	22.08	47.21	97.42	403.62

Table 5: Cross-sectional regression estimates for DABSRET
Average coefficients from cross-sectional regression and Fama-Macbeth t-statistics, where the dependent variable is the coefficient on DABSRET (change in absolute value of concurrent stock return) in the time-series regressions.
First, yearly time-series regressions are run for each stock to estimate the response of its liquidity to absolute returns (Table 3). Then, the coefficients from these regressions are regressed annually on the explanatory variables in Table 4. This table reports the Fama-Macbeth averages of the coefficients from these yearly cross-sectional regressions. T-statistics are in parentheses. The prefix "D" denotes daily perctentage change, RQSPR: the quoted bid-ask spread divided by the mid-point of the quote (in %), RESPR: the effective spread divided by the mid-point of the prevailing bid-ask quote (in %), COMP = RQSPR/$DEPTH.

	DRQSPR					DRESPR				
	All firms	Quartile 1 (small)	Quartile 2	Quartile 3	Quartile 4 (large)	All firms	Quartile 1 (small)	Quartile 2	Quartile 3	Quartile 4 (large)
INTERCEP	298.26	96.69	251.78	320.68	427.83	261.77	-156.06	163.48	25.86	189.48
	(16.89)	(3.27)	(4.76)	(9.24)	(7.28)	(5.69)	(-0.89)	(1.70)	(0.58)	(4.70)
SIZE	-19.51	2.61	-49.68	-43.30	-49.53	-84.92	-79.68	-144.16	-166.73	-74.27
	(-4.03)	(0.48)	(-2.51)	(-6.40)	(-7.13)	(-11.07)	(-3.23)	(-3.81)	(-10.23)	(-7.76)
INSTPC	0.00	-0.28	0.09	-0.45	-0.60	0.74	0.37	0.11	0.34	0.27
	(-0.03)	(-0.81)	(0.38)	(-3.75)	(-4.19)	(2.34)	(0.54)	(0.19)	(0.99)	(0.83)
PRICE	1.74	12.04	4.36	3.53	0.99	4.79	27.83	11.75	10.49	3.10
	(9.19)	(12.48)	(3.73)	(8.61)	(4.96)	(9.00)	(4.66)	(7.38)	(9.06)	(6.18)
STDRET*100	-54.42	-10.68	-56.15	-74.04	-83.41	-75.77	-17.04	-68.15	-9.96	-12.42
	(-15.24)	(-2.44)	(-5.61)	(-6.56)	(-4.14)	(-5.78)	(-0.88)	(-5.57)	(-0.92)	(-0.80)
AVETURN* 1000	-13.53	-12.15	-14.62	-7.95	-11.51	-23.82	-39.65	-33.35	-31.81	-12.38
	(-5.37)	(-4.49)	(-3.44)	(-3.25)	(-4.01)	(-6.67)	(-5.06)	(-5.20)	(-6.83)	(-2.80)
STDTURN*100	63.22	33.88	51.56	41.77	86.35	91.79	14.36	70.53	92.89	14.75
	(5.69)	(3.37)	(2.53)	(3.45)	(3.69)	(4.66)	(2.84)	(2.93)	(4.78)	(0.74)
Adj. R-sq. (%)*	17.83	24.31	20.44	24.83	21.66	11.65	13.68	19.47	25.69	23.74

Table 5 (contd)

	DCOMP				
	All firms	Quartile 1 (small)	Quartile 2	Quartile 3	Quartile 4 (large)
INTERCEP	681.33	167.46	686.32	1118.74	1397.20
	(21.17)	(1.93)	(4.18)	(6.91)	(6.50)
SIZE	3.11	39.71	64.21	5.75	-183.46
	(0.15)	(1.59)	(1.05)	(0.13)	(-8.24)
INSTPC	-0.13	0.54	0.35	-1.33	-2.14
	(-0.27)	(0.35)	(0.42)	(-1.95)	(-2.66)
PRICE	1.52	21.79	3.72	2.15	0.66
	(2.86)	(5.51)	(0.62)	(0.68)	(0.97)
STDRET*100	-110.20	-8.61	-96.50	-30.95	-30.28
	(-9.07)	(-0.55)	(-4.76)	(-6.27)	(-4.86)
AVETURN* 1000	-32.03	-19.85	-15.05	-22.70	-42.02
	(-3.70)	(-1.90)	(-1.15)	(-0.23)	(-4.07)
STDTURN*100	91.82	-21.54	-58.61	31.91	28.38
	(2.17)	(-0.38)	(-0.68)	(0.42)	(3.37)
Adj R-sq. (%)*	5.55	4.62	5.60	9.19	12.86

* Average adjusted r-square across years

TABLE 7: Estimates from panel regressions run across all years and all firms, 1988-1998

The following regression is estimated across all firms and all days in the sample (i.e, 1988-1998):

$$
\begin{aligned}
X_t = \alpha_0 &+ \alpha_1 DABSRET_t + a1\ DABSRET{*}SIZE + a2\ DABSRET{*}INSTPC + a3\ DABSRET{*}PRICE \\
&+ a4\ DABSRET{*}STDRET + a5\ DABSRET{*}AVETURN + a6\ DABSRET{*}STDTURN \\
&+ \alpha_2 DABL5RET_t + b1\ DABL5RET{*}SIZE + b2\ DABL5RET{*}INSTPC + b3\ DABL5RET{*}PRICE \\
&+ b4\ DABL5RET{*}STDRET + b5\ DABL5RET{*}AVETURN + b6\ DABL5RET{*}STDTURN \\
&+ \alpha_3 DABSMRET_t + \alpha_4 DABL5MRET_t + \alpha_5 MX_t + \alpha_6 MX_{t-1} + \alpha_7 MX_{t+1} \\
&+ \sum_{j=1}^{5} \alpha_{8j} X_{t-j} + \varepsilon_{it}
\end{aligned}
$$

where,

X_t = % change in liquidity measure from day t-1 to day t,"D" denotes daily percentage change, RQSPR: the quoted bid-ask spread divided by the mid-point of the quote (in %), RESPR: the effective spread divided by the mid-point of the prevailing bid-ask quote (in %), COMP = RQSPR/$DEPTH.

MX_t = % change in equally-weighted market-liquidity measure from day t-1 to day t

$DABSRET_t$ = Absolute return in day t – Absolute return in day t-1 (calculated from mid-points of closing bid-ask quotes)

SIZE = market-capitalization as of Dec 31st of previous year

INSTPC = percentage institutional holding as of Dec 31st of previous year

PRICE = stock price as of Dec 31st of previous year

STDRET = standard-deviation of returns measured during the previous calendar year

AVETURN = average turnover measured during the previous calendar year

STDTURN = standard-deviation of turnover measured during the previous calendar year

$DABL5RET_t$ = ABL5RET(t) – ABL5RET(t-1)

ABL5RET(t) = Cumulative absolute return over days t-1 to t-5 (calculated from mid-points of closing bid-ask quotes)

$DABSMRET_t$ = Absolute equally-weighted market return in day t – Absolute market return in day t-1

$DABL5MRET_t$ = ABL5MRET(t) – ABL5MRET(t-1)

ABL5MRET(t) = Cumulative absolute market-return over days t-1 to t-5

Table 7 (contd)

Dependent variable (X_t)	DRQSPR		DRESPR		DCOMP	
	Coeff.	t-statistic	Coeff.	t-statistic	Coeff.	t-statistic
Intercept	5.88	438.35	6.16	33.28	33.49	394.77
DABSRET$_t$	135.06	73.14	88.83	3.11	344.20	31.93
DABL5RET$_t$	205.43	23.98	719.82	5.47	415.34	8.31
DABSMRET	-0.42	-0.15	74.99	1.74	87.04	5.29
DABL5MRET	223.00	16.31	187.37	0.92	1120.95	14.27
DABSRET$_t$*SIZE	-1.56	-20.90	-2.34	-2.10	-4.91	-11.32
DABSRET$_t$*INSTPC	0.02	0.60	1.04	2.46	0.36	2.24
DABSRET$_t$*PRICE	1.09	30.27	2.26	4.17	0.90	4.28
DABSRET$_t$*STDRET*100	-10.63	-38.53	-15.68	-3.59	-31.75	-19.64
DABSRET$_t$*AVETURN*1000	-4.51	-17.60	-10.96	-2.85	-15.15	-10.15
DABSRET$_t$*STDTURN*100	22.19	16.14	61.10	2.97	54.48	6.80
DABL5RET$_t$*SIZE	1.88	5.10	5.09	0.92	5.30	2.46
DABL5RET$_t$*INSTPC	0.94	7.15	-1.01	-0.51	-1.41	-1.84
DABL5RET$_t$*PRICE	2.23	12.99	-5.92	-2.30	-6.18	-6.18
DABL5RET$_t$*STDRET*100	-20.55	-16.68	-221.68	-11.49	-30.38	-4.21
DABL5RET$_t$*AVETURN*1000	-51.51	-4.16	18.99	1.02	-12.36	-1.71
DABL5RET$_t$*STDTURN*100	27.84	4.25	24.49	0.25	45.23	1.19
Adj. R-sq. (%)	22.35		0.14		2.89	