SYSTEMATIC LIQUIDITY, CHARACTERISTIC LIQUIDITY AND ASSET PRICING

Duong Nguyen*
Tribhuvan N. Puri*

Address for correspondence:
Tribhuvan N. Puri, Professor of Finance
Chair, Department of Accounting and Finance
Charlton College of Business
University of Massachusetts Dartmouth
285 Old Westport Road
North Dartmouth, MA 02747
Voice: 508-999-8759
tpuri@umassd.edu

*University of Massachusetts, Dartmouth

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Abstract

This paper examines whether the traditional characteristic liquidity premium can be explained by market liquidity risk. We find that after adjusting for Pastor and Stambaugh market liquidity factor, the level of traditional liquidity remain priced. Also, consistent with previous studies on market liquidity and asset pricing, we do not find stock characteristics or Fama-French factors determine the impact of liquidity level on stock return. More interestingly, we document that the well-known size-return relationship might simply a proxy for the liquidity-return relationship. Our results are consistent in both time series and cross sectional frameworks as well as robust in both NYSE-AMEX and Nasdaq exchanges.

I. Introduction

Numerous studies, starting from Amihud and Mendelson (1986) have shown that liquidity is an important variable that affects the stock prices. Using various measures of liquidity, these studies generally support the liquidity premium theory, which provides a rationale for a trade off between return on assets and their liquidity. In general, higher rate of returns are associated with less liquid assets.. For example, using bid-ask spread as a measure of liquidity, Amihud and Mendelson (1986) show that the quoted bid-ask spread has a significant positive effect on stock returns. Similarly, Eleswarapu and Reinganum (1993) using the same quoted bid-ask spread as a proxy for liquidity find that the positive relation documented in Amihud and Mendelson is restricted only in January. Brennan and Subrahmanyam (1996) take an innovative approach by estimating the price impact of a trade based on Kyle's (1985) model and find that it is significantly positively related to average returns. Easley, Hvidkjaer, and O'Hara (2002) document a similar result using their measure of illiquidity called the probability of information trading, which reflects the adverse selection cost arising from information asymmetry among traders. Additional evidence on positive illiquidity-return relation is provided by Chalmers and Kadlec (1998) using the amortized bid-ask spread, by Datar, Naik, and Radcliff (1998) using share turnover, by Brennan, Chordia, and Subrahmanyam (1998) using dollar trading volume, and most recently by Hasbrouck (2003) using a liquidity proxy based on a newly created effective spread in the daily data.

While the above cited studies support the liquidity premium notion, it is important to note that in these papers, liquidity is considered as a stock characteristic rather than an aggregate risk factor of concern to investors. The recent discovery of commonality in liquidity by Chordia, Roll, and Subrahmanyam (2000), Hasbrouck and Seppi (2001), and Huberman and Halka (2001) has raised a new question about the role of liquidity in asset pricing. Their findings spurred further research that investigates whether market-wide liquidity is an important factor in explaining stock returns. A notable work by Pastor and Stambaugh (2003) develops a measure of aggregate liquidity, based on daily price reversal, and shows that stocks whose returns are more sensitive to market liquidity factor command higher required rate of return than stocks whose returns are less sensitive to market liquidity factor. Jacoby, Fowler, and Gottesman (2000) (JFG) develop a static one-period CAPM-based model to demonstrate that the true measure of systematic risk, when considering liquidity costs, is based on net (after bid-ask spread) returns. A dynamic version of the JFG liquidity-adjusted CAPM is presented by Acharya and Pedersen (2005) (assuming overlapping-generations), where the JFG liquidity-adjusted beta is decomposed into four components: the standard CAPM beta, and the three betas related to liquidity, one of which is the Pastor and Stambaugh (2003) liquidity beta and the other two are commonality in liquidity with market liquidity and liquidity sensitivity to market return. Using the liquidity measure of Amihud (2002), Acharya and Pedersen test the liquidity-adjusted CAPM and show that their model significantly improves the performance of a standard CAPM for most portfolios. Chan and Faff (2005) examine the role of liquidity in asset pricing for the Australian stock market and suggest augmenting the Fama-French (1993) three-factor model to a four-factor model by incorporating the liquidity as the forth factor.

The findings that have emerged from the recent literature on liquidity and asset pricing discussed above obviously lead to a pertinent question from an asset-pricing perspective. Does liquidity beta (*i.e.*, sensitivity of stock return to market liquidity) capture the effect of characteristic liquidity specific to individual stocks? Alternatively, if investors demand a risk premium for systematic liquidity, do they still demand another risk premium for the liquidity level *per se*? This question has not been answered conclusively in the literature thus far. Pastor and Stambaugh (2003) suggest that stocks with higher liquidity betas tend to have higher average return about 7.5 percent annual. However, they do not control for the level of illiquidity, which has been shown to command a significant premium in a number of studies (see the above citations). Acharya and Pedersen (2005) within the framework of the liquidity-adjusted CAPM, show that the expected return of a security is increasing in its expected illiquidity and its liquidity risk. They show that illiquid securities also have high liquidity risk. However, their evidence that the total effect of the liquidity risk matters over and above market risk and the level of liquidity . is rather weak. Acharya and Pedersen do not control for the effect of Fama-French factors and their analyses are limited to NYSE and AMEX stocks only.

Nguyen, Mishra, Prakash and Ghosh (2006) using turnover ratio as a measure of liquidity find that a liquidity premium exists in stock market even after adjusting for market factors, non-market factors as well as other stock characteristics. However, since their focus is whether the three-moment CAPM and the four-factor model which includes Fama-French and Pastor-Stambaugh factors can explain liquidity premium, it is not clear whether the market liquidity factor alone can explain the impact of liquidity level *per se.*

This paper builds on Nguyen et al. (2006). We examine whether the market liquidity factor alone can capture the liqudity level premium. We also examine whether their findings are robust to different measures of liquidity. This is important because as Brennan and Subrahmanyam (1996) suggest that one of the reasons for the mixed results on liquidity is that different proxies for liquidity are used in the asset pricing literature. .

There are various measures of liquidity have been used in the literature. However, they can be categorized into two basic types: trade-based measures such as volume, frequency of trading, dollar value of shares traded, turnover ratio, etc., and order-based measures such as quoted spread, effective spread, quoted depth, etc. Amihud and Mendelson (1986) use bid-ask spread as a measure of liquidity. Brennan and Subrahmanyam (1996) use fixed and variable components of trading cost as measures of liquidity. Their measures require intraday transaction data, which is available only for short period of time. Also, Peterson and Fialkowski (1994) suggest that spread is a poor proxy for liquidity and call for an alternative measure that may be a better proxy for liquidity of an asset.

As a compliment to Nguyen et al (2006) using turnover ratio as a measure for liquidity, we use dollar volume as a proxy for liquidity as in Brennan, Chordia, and Subrahmanyam (1998).[1] Dollar volume is related to how quickly a dealer expects to turn around her position and is related to liquidity in Stoll (1978). Brennan and Subrahmanyam (1995) find that trading volume is an important determinant of the measure of liquidity. Chordia et al. (2000) document a strong cross sectional relationship between dollar trading volume and various measures of bid-ask spread and market depth. Furthermore, it is possible to obtain these data over long periods of time, a requirement appropriate for empirical studies involving asset pricing models.

We investigate the issue using the stocks in NYSE-AMEX from 1963 to 2004 under both time series and cross sectional contexts and find similar results as documened in Nguyen et al (2006). In the time series context, we use both the Fama-French three factor model and the four-factor model that includes Fama-French and Pastor-Stambaugh market liquidity factors as models for risk adjustment. In both cases, we document a generally consistent decrease in the intercepts from low liquidity portfolios to high liquidity portfolios. The result is consistent with liquidity premium notion in Amihud and Mendelson (1986). The Gibbon-Ross-Shanken statistics

[1] We do not focus on whether turnover ratio is a better proxy for liquidity than dollar volume or vice versa since they are two popular proxies used in the literature. Our goal is to find out whether the results in Nguyen et al (2006) are robust to different measures of liquidity.

reject the null hypothesis that the time series intercepts are jointly equal to zero, suggesting that the three-factor and four-factor models do not account for liquidity level. This also implies that the market liquidity factor alone does not capture the impact of liquidity level either.

In the cross sectional test, we work with individual securities rather than portfolios. Using individual securities in asset pricing tests has several advantages as follows:

1. Guards against the data-snooping biases inherent in portfolio based asset pricing tests (Lo and MacKinlay (1990)).
2. This avoids the loss of information that results when stocks are sorted into groups (Litzenberger and Ramaswamy (1979)), and
3. This circumvents the problem raised by Berk (2000) that sorting data into portfolios introduces a bias in favor of rejecting the model considered.

We find that after controlling for Pastor and Stambaugh factor, liquidity level remains priced, suggesting the market liquidity factor does not capture the impact of liquidity level on expected return. We also focus on a controversy issue: what explain expected stock returns: risk factors or equity characteristics? Daniel and Titman (1997) question the risk-based Fama-French model, arguing that it is the stock characteristics, size and book to market, that explain stock return, not the factor loading on Fama-French factors. We find that the effect of characteristic liquidity is not influenced by Fama-French factors or stock characteristics. In fact, liquidity outweighs size in explaining average stock return, suggesting that size may be simply a proxy for liquidity.

Finally, we investigate whether differences in the measurement of trading volume on the NYSE-AMEX versus the Nasdaq exchange can affect our results. The volume figures in Nasdaq have different meaning than those in NYSE-AMEX because of the inclusion of inter-dealer trading on Nasdaq. We perform separate analyses for NYSE-AMEX and Nasdaq under both time series and cross sectional framework. The results are qualitatively similar for both exchanges.

Our paper proceeds as follows. Sectional II presents our methodology and empirical analysis. Section III concludes the paper.

II. Empirical Analysis

A. Time series testing

The purpose of time series testing is twofold. First, we control characteristic liquidity by sorting stocks into liquidity groups based on their dollar trading volume. We then perform time series regressions for these liquidity portfolios using both Fama-French model and a four factor model that includes Fama-French and Pastor-Stambaugh market liquidity factors. The time-series regression provides validity of the asset pricing model. Also, if the intercept of regression is significant, it indicates the presence of a premium associated with the characteristic liquidity. If market liquidity and Fama-French factors subsume the effect of characteristic liquidity, a systematic increase in the intercepts (or the liquidity premium on portfolios arranged in order of decreasing liquidity), will not be observed.. In addition, if the intercepts are jointly equal to zero after controlling for characteristic liquidity, then the asset pricing model as specified is able to explain stock returns after controlling for liquidity. The asset pricing model, therefore, captures the liquidity effect. On the contrary, if the time series intercepts are not jointly equal to zero, the model does not capture liquidity. To test whether the intercepts are jointly equal to zero, we use the test developed by Gibbon, Ross, and Shanken (1989).

Portfolio formation procedure

Using NYSE and AMEX stock data, we construct 25 portfolios based on size and dollar volume, book-to-market ratio and dollar volume, and dollar volume only. Specifically, at the end of each calendar year in the period 1963-2004, we rank all common stocks listed on the NYSE and AMEX by market capitalization and divide the sample into five portfolios of equal size. We employ annual dollar volume for each stock as a measure of characteristic liquidity. We define the annual dollar volume for each stock in the sample as the product of average monthly price and the trading volume during the year. Each size quintile comprises five groups of portfolios in increasing order of dollar volume or liquidity. Each of these five groups contain equal number of stocks,

Following the portfolio construction procedure, as described above, we sort portfolios based on book-to-market value and dollar volume. All common stocks in NYSE and AMEX from 1963 to 2004 are ranked by the book-to-market ratio in the beginning of period, and then divided into five portfolios of equal size. Within each book-to-market quintile, each stock is assigned to one of five portfolios of an equal number of securities based on annual dollar volume values.

Finally, all the NYSE and AMEX stocks are sorted into 25 portfolios based on their annual dollar volume alone, because the pre-sorting on both size and book-to-market ratio may obviously be interpreted as liquidity portfolios controlled by size and book-to-market value. Therefore, as a check for robustness, the analysis is further conducted with 25 portfolios sorted by dollar volume only.

Using the portfolios constructed above, we compute the equally-weighted-monthly returns for each of the 25 portfolios. The difference of the portfolio return and the 30-day Treasury bill yield gives the excess portfolio return. The portfolios are rebalanced every year from 1963 to 2004.

Gibbon, Ross, Shanken (1989) test (GRS)

We estimate the time-series regression of the excess returns on the 25 portfolios (sorted by size and dollar volume, by book-to-market ratio and dollar volume, and by dollar volume alone) on the four-factor model using ordinary least squares as follows:

$$r(i,t) = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + \psi_i LIQ_t + e_{it} \tag{1}$$

where $r(i,t)$ is the excess return on portfolio i in month t, ($R_{mt} - R_{ft}$), SMB_t, HML_t are the Fama and French (1993) three factors related to market premium, firm size, and the book-to-market ratio, and LIQ_t is the Pastor and Stambaugh (2003) liquidity factor in month t.

In order to make a comparative analysis with the four-factor model stated above, we also examine the bench-mark Fama-French 3-factor model alone can explain the liquidity premium. The time series regression model is as follows:

$$r(i,t) = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + e_{it} \tag{2}$$

where $r(i,t)$ is the excess return on portfolio i in month t and ($R_{mt} - R_{ft}$), SMB_t, and HML_t are the Fama and French (1993) three factors related to market premium, firm size, and the book-to-market ratio in month t. Our argument is that if neither the three-factor nor the four-factor model is capable of capturing liquidity level then the Pastor-Stambaugh market liquidity factor alone cannot capture characteristic liquidity either.

We test the null hypothesis that the characteristic liquidity, if proxied by the dollar volume, has no effect on expected stock returns and that the intercepts in these time series regressions are jointly equal to zero using the Gibbon, Ross, Shanken (1989) F-test. Briefly, the Gibbon, Ross, and Shanken test procedure can be summarized as follows:

Let N be the number of time series observations, L be number of portfolios, K be the number of regression parameters including the constant term, and X be the observation matrix. Then, the GRS test statistic is given by

$$\left(A'\Sigma^{-1}A\right)\frac{N-K-L+1}{L*(N-K)*\omega_{1,1}}$$

where A is the column vector of the regression parameters, Σ is the variance-covariance matrix of the residuals from the regression, and $\omega_{1,1}$ is the diagonal element of $\left(X'X\right)^{-1}$. Under the null hypothesis that the regression constants are zero, this statistic has an F-distribution with L and (N – K – L + 1) degrees of freedom.

The time series results are reported in Table 1, 2, and 3. We observe a consistent pattern in the intercepts as reported in Tables 1 and 2. The intercepts are generally decreasing from the lowest liquidity group (group 1) to the highest liquidity group (group 5).[2] These results imply that more liquid stocks demand higher expected return than less liquid stocks after controlling for risk using the Fama-French and Pastor-Stambaugh market liquidity factors. The evidence that the intercepts generally decrease from low liquidity to high liquidity portfolios within each size or book-to-market group also suggests that the size and book-to-market ratio do not relate to liquidity. In order to check the robustness of results,, we perform the same analysis for the 25 portfolios sorted by dollar volume only. The results are strikingly similar, as evident from Table 3.

[2] The results for the size group 5 (largest size group) and book-to-market group 1 (lowest book-to-market group) are less significant. The intercepts generally decrease from the low liquidity group to high liquidity group but not consistently. The difference in the intercepts between the highest liquidity and lowest liquidity groups in these two size and book-to-market groups are not negatively significant as in other cases. These evidences imply that liquidity may be less important for large or low book-to-market stocks than it is for smaller size or higher book-to-market stocks.

Our results also indicate that the systematic liquidity measure of Pastor and Stambaugh does not account for the characteristic liquidity level. If the liquidity beta subsumes the liquidity level *per se*, we should not observe systematic differences in the intercepts from the time series regressions for liquidity portfolios in both three-factor and four-factor models. However, the evidence in Tables 1, 2, and 3 generally shows a monotonic decrease in the intercepts from low liquidity to high liquidity portfolios. The differences in the intercepts between the highest liquidity and lowest liquidity group of portfolios are statistically significant and negative. The GRS statistics are also reported in Tables 1, 2, and 3. In all cases, the F-tests strongly reject the null hypothesis that intercepts are jointly equal to zero for both the four-factor and the Fama-French three-factor models at the 1 percent level. Overall, our results suggest that neither of the two models considered here capture the effect of liquidity preference *à la* Amihud and Mendelson (1986).

B. Cross-sectional tests

We use cross-sectional regressions to directly investigate the relationship between liquidity and stock returns after controlling for other variables. In particular, for each month *t* in the sample period, we perform cross-sectional regressions as follows:

Liquidity and stock characteristics

$$R_{it} = \gamma_{0t} + \gamma_{1t} Beta + \gamma_{2t} Size + \gamma_{3t} BM + \gamma_{4t} DV + \varepsilon_{it} \tag{3}$$

Liquidity and factor loadings

$$R_{it} = \gamma_{0t} + \gamma_{1t} F_{Rm-Rf} + \gamma_{2t} F_{SMB} + \gamma_{3t} F_{HML} + \gamma_{4t} F_{LIQ} + \gamma_{5t} DV + \varepsilon_{it} \tag{4}$$

where Beta, Size, BM, and DV are, respectively, the market beta, market value of equity, book-to-market ratio, and dollar volume value (as a proxy for the characteristic liquidity) of firm *i*. F_{Rm-Rf}, F_{SMB}, and F_{HML} are the factor loadings of firm *i* on the Fama-French common factors,

F_{LIQ} is the factor loading of firm *i* on the Pastor-Stambaugh market liquidity factor. The factor loadings for each month are estimated using return and factor observation from the previous 60 months. We require a stock to have a minimum of 24 monthly observations available for the estimation.

The coefficients from the cross-sectional regressions are averaged over time using the Litzenberger and Ramaswamy (1979) methodology. This methodology weights the coefficients by their precision when summing across the cross-sectional regressions and thus corrects for the inefficiency under time-varying volatility with the standard Fama-MacBeth (1973) procedure.[3]

Our dataset consists of all the NYSE and AMEX stocks from January 1963 to December 2004.[4] Monthly data on returns are collected from the Center for Research in Security Prices (CRSP) and the book values are extracted from the Compustat tapes.

We measure the dollar volume value of every stock in each month *t* as the natural logarithm of the average dollar volume of the previous three months, i.e., during months *t-3, t-2, t-1.* [5]

We construct the book-to-market variable (natural logarithm of book value to market value for individual firms) as suggested by Fama and French (1992). We define the log of firm size as the natural logarithm of total market capitalization of firm *i*, at the end of the prior month (month *t*-1). In our sample, the book-to-market variable has a minimum value of –7.81 and a maximum value of 4.40 with a mean of –0.31. The size variable ranges from 5.46 to 20.18 and has a mean of 12.37 (Table 4).

[3] See Litzenberger and Ramaswamy (1979) for more detail on the procedure.

[4] Our complete sample runs from 1963 to 2004. However, the estimation period runs from 1968 to 2004 since we lose the first five year of data when estimating the factor loadings.

[5] We also compute dollar volume on the basis of six month and twelve months of trading volume. The results are qualitatively similar.

We estimate betas for each security following Amihud and Mendelson (1986). In particular, at the end of each year, all the NYSE-AMEX stocks are sorted into 25 portfolios based on their pre-ranking betas using the past 5 year returns. Once the portfolios are formed, portfolio betas are computed using the five-year window. Portfolio betas are then assigned to each individual firm within the portfolios. By estimating betas at the portfolio level, we eliminate potential measurement errors that may occur if we estimate betas at the individual firm level.

Our results of cross sectional regressions are reported in Table 5 and 6. Table 5 presents correlations between the dollar volume and other stock characteristics. Panel A shows that size is negatively correlated with the book-to-market ratio with a factor of -0.35, while beta is positively correlated with the dollar volume with a factor of 0.04, respectively. We also observe that size has a very strong correlation with dollar volume (0.90). This might cause multicolinearity in the regression results. To remove the effect of multicolinearity, we orthogonalize size on dollar volume in the cross-sectional analysis. For each month, size is regressed on dollar volume cross-sectionally and the residuals from the regression are used as a measure for size in the analyses. The correlation between dollar volume and size residual now is 0.18 (see Panel B)

Table 6 summarizes the results of our cross-sectional regressions of stock returns on dollar volume after controlling for various stock characteristic variables, the Fama-French and Pastor-Stambaugh factor loadings. We find that the dollar volume variable is significantly negatively related to stock returns in all the models. Panel A reports the regression of stock return on the dollar volume and other characteristic variables. The evidence of a liquidity premium is documented here. Dollar volume is negatively correlated to stock returns (coefficient = -0.0034, t-stat = -15.34). We then estimate several multivariate regressions to examine whether the liquidity level is still priced after controlling for explanatory variables other than size. We find that the premium for liquidity still exists. For example, when controlling for book-to-market, the dollar volume coefficient is equal to -0.0021 (t-stat = -9.14). However, when controlling for size, the significance of dollar volume decreases as more variables are added. For example, the magnitude of t-stat of the dollar volume is equal to 4.72 when only size is included. It decreases to 3.63 when both size and book-to-market are included, and goes down to 0.28, which is insignificant, when size, beta, and book-to-market are all included. The reason for the decrease of significance level of the dollar volume, when size is included, may be due to a very strong correlation between size and dollar volume (0.90). To remove the multi-collinearity, we regress size on dollar volume cross sectionally. The residuals taken from these regressions are used to replace size in the testing models. The results presented in Table 6, Panel B confirms once again the presence of a liquidity premium. We find that the dollar volume is again negatively correlated to return, whether size alone or size along with other characteristic variables is included.

Another important observation from the results reported in Table 6 is that the effect of dollar volume dominates that of size in explaining cross-sectional stock return. Size becomes insignificant when only the dollar volume is included or when both dollar volume and book-to-market are included. Even when size is replaced by the size residual in the regression to remove the multicollinearity between size and dollar volume, the coefficients on size residual are still not significant when dollar volume alone or dollar volume and book-to-market are included. The implication is that size, the well-known determinant of stock return, may be just a proxy for liquidity. In other words, liquidity proxied by dollar trading volume has stronger effect on stock return than size does.

C. Nasdaq stocks

Our analysis up to this point has considered NYSE and AMEX stocks only. We separate Nasdaq stocks from NYSE-AMEX stocks since we are interested in finding out whether our results are driven by the design of the trading process. Nasdaq volume can be considered to be overstated relative to NYSE-AMEX volume due to the inclusion of inter-dealer trading on Nasdaq since trading on Nasdaq is done almost entirely through the market makers whereas on the NYSE-AMEX, most trading is done directly between buying and selling investors. We perform both time series and cross sectional regressions for Nasdaq stocks and report the results in Tables 7, 8, and 9. The results are very similar to those obtained for NYSE-AMEX stocks. In particular, in all 25 portfolios sorted by size and dollar volume, by book-to-market and dollar volume, and by dollar volume, the intercepts consistently decrease from the low liquidity to the high liquidity group with few exceptions in the cases of largest size and highest book-to-market groups. The GRS test statistics reject the null hypothesis that the 25 intercepts are jointly equal to zero for both the four-factor and three-factor models.

The cross sectional analyses reported in Table 9 also indicate that the dollar volume is negatively related to stock returns after controlling for stock characteristics, Fama-French and Pastor-Stambaugh factor loadings. The evidence that the dollar volume dominates size in explaining cross sectional stock return is valid in this case also. Therefore, our original results, obtained using NYSE and AMEX stocks are robust to differences in the measurement of trading volume on the NYSE-AMEX versus the Nasdaq exchange.

III. Conclusion

This paper primarily concerns with providing evidence on whether the market liquidity can explain the liquidity premium. Our analysis uses a four-factor asset pricing model that includes Fama-French and Pastor-Stambaugh market liquidity factors. In this model of risk adjustment, the liquidity factor controls for non-diversifiable liquidity risk. Our results support the Amihud and Mendelson (1986) argument that expected stock return is a positive function of illiquidity as a characteristic both in time series and cross sectional frameworks. In particular, time series tests based on the three-factor Fama-French model or the four-factor model that includes Fama-French and Pastor-Stambaugh market liquidity factors, demonstrate a consistently decreasing pattern in the intercepts from low liquidity portfolios to high liquidity portfolios suggesting a characteristic liquidity premium that can not be captured by the market-wide liquidity factor. Further, the Gibbon-Ross-Shanken statistics reject the null hypothesis that the time series intercepts are jointly equal to zero, suggesting that neither the three-factor nor the four-factor model is able to capture liquidity preference. This implies that the market liquidity factor does not account for the stock-specific liquidity level.

In the cross sectional tests, the two-step generalized least squares (GLS) framework of Litzenberger and Ramaswamy (1979), leads us to conclude that, after controlling for stock characteristics such as Fama-French and Pastor-Stambaugh factor loadings, the dollar volume is statistically significant and negatively correlated with stock returns. This result is also consistent with the liquidity premium notion in Amihud and Mendelson (1986) as documented in our time series tests Yet another important finding from the cross sectional test is that size becomes insignificant when dollar volume is included, or when both dollar volume and book-to-market are included. In order to remove the strong correlation between size and dollar volume in the regression, size is replaced by the size residual. We find that the coefficients on the size residual become insignificant when only dollar volume or dollar volume and book-to-market are included. The implication is that size, a well-known determinant of stock returns, may be just serving as a proxy for liquidity. This means that liquidity proxied by dollar trading volume is a better determinant of stock returns than size .

We also perform analysis for Nasdaq stocks to see whether the differences in volume measures arising from trading process on Nasdaq which substantially differs from that on NYSE and AMEX may have any impact on our results. Our findings confirm that the notion of characteristic liquidity preference as in Amihud and Mendelson still holds in both time series and cross sectional contexts.

Our findings strengthen the results of Nguyen et al (2006). Combined with their study, we show that liquidity level is an important variable in asset pricing and that the Pastor-Stambaugh market liquidity and Fama-French factors, and stock characteristics (size and book-to-market) do not capture the effect of liquidity level. The implication for investors is that they need to incorporate liquidity preference in their decision making regardless of the specifications of their asset pricing models used to adjust for risk. Alternatively, the search for a rational asset pricing model that can capture the impact of characteristic liquidity is still open.

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Table 1: Intercepts from time series regressions of the 25 portfolios sorted by size and dollar volume for the four-factor and three-factor models

This table reports the value of the intercepts obtained four-factor and three-factor models for 25 portfolios of NYSE-AMEX stocks sorted according to size and dollar volume. Dollar volume for each stock is defined as the average of number of shared trading multiplied by stock price during the year. Portfolios are formed yearly for the period 1963-2004. Within each calendar year, all stocks in the sample are allocated into five size portfolios based on their market equity ranking. Each size quintile is then subdivided into five liquidity portfolios using the dollar volume value. Panel A presents intercepts from the time series regression of four-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + \psi_i LIQ_t + e_{it}$ where $r(i,t)$ is the excess return on portfolio i in month t, and ($R_{mt} - R_{ft}$), SMB_t, HML_t, are Fama and French (1993) three factors related to market premium, firm size, and the book-to-market ratio in month t. LIQ_t is the Pastor and Stambaugh (2003) liquidity factor. Panel B presents intercepts from the time series regression of three-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + e_{it}$ .The last column represents the difference between liquidity group 5 and liquidity group1. The bottom of each panel presents the Gibbons, Ross, Shanken (1989) test of the hypothesis that the intercepts jointly equal zero for the four-factor model and three-factor model. Intercepts are reported in percentage terms (t-statistics are in parentheses).

Panel A: Four-factor model

	Liquidity group					
Size group	1	2	3	4	5	5 - 1
1	0.0107	0.0037	-0.0012	-0.0022	-0.0109	-0.0216
	(3.52)	(1.54)	(-0.59)	(-1.11)	(-4.00)	(-8.64)***
2	0.0027	0.0007	-0.0012	-0.0051	-0.0121	-0.0149
	(2.50)	(0.64)	(-1.02)	(-4.13)	(-6.48)	(-7.70)***
3	0.0019	-0.0001	-0.0012	-0.0041	-0.0082	-0.0101
	(2.25)	(-0.12)	(-1.19)	(-3.56)	(-5.59)	(-6.47)***
4	0.0015	-0.0002	-0.0003	-0.0015	-0.0049	-0.0065
	(1.87)	(-0.27)	(-0.31)	(-1.41)	(-3.52)	(-4.64)***
5	0.0000	0.0001	-0.0011	-0.0007	-0.0010	-0.0010
	(0.00)	(0.08)	(-1.39)	(-0.95)	(-1.30)	(0.38)

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 5.22***
(significant at 1 percent level)

Panel B: Three-factor model

	Liquidity group					
Size group	1	2	3	4	5	5 - 1
1	0.0112	0.0041	0.0008	-0.0009	-0.0074	-0.0186
	(4.24)	(1.98)	(0.46)	(-0.55)	(-3.10)	(-8.50)***
2	0.0016	0.0002	-0.0014	-0.0040	-0.0106	-0.0122
	(1.74)	(0.29)	(-1.38)	(-3.73)	(-6.56)	(-7.31)***
3	0.0015	-0.0004	-0.0013	-0.0039	-0.0080	-0.0095
	(2.06)	(-0.51)	(-1.40)	(-3.90)	(-6.29)	(-7.01)***
4	0.0010	-0.0003	-0.0005	-0.0019	-0.0048	-0.0058
	(1.32)	(-0.40)	(-0.63)	(-2.00)	(-3.97)	(-4.75)***
5	-0.0001	0.0000	-0.0009	-0.0007	-0.0012	-0.0011
	(-0.20)	(0.02)	(-1.32)	(-1.17)	(-1.84)	(-1.07)

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 5.17*
(significant at 1 percent level)

Table 2: Intercepts from time series regressions of the 25 portfolios sorted by book-to-market and dollar volume for the four-factor and three-factor models

This table reports the value of the intercepts obtained four-factor and three-factor models for 25 portfolios of NYSE-AMEX stocks sorted according to book-to-market and dollar volume. Dollar volume for each stock is defined as the average of number of shared trading multiplied by stock price during the year. Portfolios are formed yearly for the period 1963-2004. Within each calendar year, all stocks in the sample are allocated into five portfolios based on their book-to-market ratios ranking. Each book-to-market quintile is then subdivided into five liquidity portfolios using the dollar volume. Panel A presents intercepts from the time series regression of four-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + \psi_i LIQ_t + e_{it}$ where $r(i,t)$ is the excess return on portfolio i in month t, and ($R_{mt} - R_{ft}$), SMB_t , HML_t , are Fama and French (1993) three factors related to market premium, firm size, and the book-to-market ratio in month t. LIQ_t is the Pastor and Stambaugh (2003) liquidity factor. Panel B presents intercepts from the time series regression of three-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + e_{it}$ .The last column represents the difference between liquidity group 5 and liquidity group1. The bottom of each panel presents the Gibbons, Ross, Shanken (1989) test of the hypothesis that the intercepts jointly equal zero for the four-factor model and three-factor model. Intercepts are reported in percentage terms (t-statistics are in parentheses).

Panel A: Four-factor model

Book-to-market group	**Liquidity group**					
	1	2	3	4	5	5 - 1
1	-0.0005	-0.0031	-0.0030	-0.0010	0.0003	0.0008
	(-0.34)	(-2.43)	(-2.28)	(-0.87)	(0.31)	(0.47)
2	0.0031	-0.0027	-0.0023	-0.0018	-0.0008	-0.0039
	(2.23)	(-2.15)	(-1.94)	(-1.70)	(-0.73)	(-2.37)**
3	0.0028	-0.0001	-0.0029	-0.0018	-0.0024	-0.0053
	(2.08)	(-0.07)	(-2.73)	(-1.82)	(-2.38)	(-3.16)***
4	0.0035	0.0013	-0.0001	-1.1787	-0.0006	-0.0041
	(2.12)	(1.10)	(-0.13)	(-0.00)	(-0.54)	(-2.15)**
5	0.0098	0.0026	-0.0003	-0.0017	-0.0024	-0.0122
	(3.90)	(1.41)	(-0.23)	(-1.02)	(-1.76)	(-4.89)***

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 2.41***
(significant at 1% level)

Panel B: Three-factor model

Book-to-market group	**Liquidity group** 1	2	3	4	5	5 - 1
1	-0.0000	-0.0030	-0.0024	-0.0007	0.0001	0.0002
	(-0.05)	(-2.81)	(-2.07)	(-0.71)	(0.13)	(0.11)
2	0.0016	-0.0024	-0.0024	-0.0018	-0.0017	-0.0033
	(1.38)	(-2.21)	(-2.41)	(-1.95)	(-1.79)	(-2.34)**
3	0.0011	0.0001	-0.0024	-0.0010	-0.0025	-0.0036
	(0.98)	(0.17)	(-2.59)	(-1.14)	(-2.71)	(-2.45)**
4	0.0034	0.0013	-0.0002	-0.0006	-0.0005	-0.0039
	(2.39)	(1.28)	(-0.22)	(-0.62)	(-0.52)	(-2.38)**
5	0.0106	0.0033	-0.0002	-0.0007	-0.0003	-0.0109
	(4.88)	(2.12)	(-0.15)	(-0.48)	(-0.24)	(-5.02)***

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 2.33***
(significant at 1 percent level)

Table 3: Intercepts from time series regressions of the 25 portfolios sorted by dollar volume for the four-factor and the three-factor model.

This table reports the value of the intercepts obtained four-factor and three-factor models for 25 portfolios of NYSE-AMEX stocks sorted according to dollar volume. Dollar volume for each stock is defined as the average of number of shared trading multiplied by stock price during the year. Portfolios are formed yearly for the period 1963-2004. Within each calendar year, all stocks in the sample are allocated into 25 portfolios based on their average dollar volume during the previous year. Panel A presents intercepts from the time series regression of four-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + \psi_i LIQ_t + e_{it}$ where $r(i,t)$ is the excess return on portfolio i in month t, and $(R_{mt} - R_{ft}), SMB_t, HML_t$, are Fama and French (1993) three factors related to market premium, firm size, and the book-to-market ratio in month t. LIQ_t is the Pastor and Stambaugh (2003) liquidity factor. Panel B presents intercepts from the time series regression of three-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + e_{it}$. The bottom of each panel presents the Gibbons, Ross, Shanken (1989) test of the hypothesis that the intercepts jointly equal zero for the four-factor model and three-factor model. Intercepts are reported in percentage terms (t-statistics are in parentheses).

Dollar volume sorted group												
1	3	5	7	9	11	13	15	17	19	21	23	25
Panel A: Four-factor model												
0.0102	0.0009	-0.0002	-0.0002	-0.0031	-0.0025	-0.0033	-0.0038	-0.0039	-0.0035	-0.0021	-0.0021	-0.0017
(3.40)	(0.49)	(-0.16)	(-0.16)	(-2.85)	(-2.41)	(-3.10)	(-3.50)	(-3.81)	(-3.44)	(-2.22)	(-2.19)	(-2.04)
F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 2.40* (significant at 1 percent level)**												
Panel B: Three-factor model												
0.0108	0.0017	-0.0005	-0.0004	-0.0028	-0.0018	-0.0030	-0.0029	-0.0036	-0.0034	-0.0020	-0.0020	-0.0018
(4.13)	(1.08)	(-0.40)	(-0.40)	(-3.10)	(-2.03)	(-3.27)	(-3.22)	(-3.98)	(-3.81)	(-2.43)	(-2.40)	(-2.37)
F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 2.53* (significant at 1 percent level)**												

Table 4: Summary statistics

This table reports basic statistics on variables of concern for NYSE-AMEX stocks over the period 1963-2004. Book-to-market variable is the natural logarithm of the book to market ratio. Size is the natural logarithm of firm's total market capitalization in the prior month. Dollar volume is computed as the natural logarithm of average monthly trading volume multiply by price during the previous three months. Beta is computed as follows. First, at the end of each year, all stocks in NYSE-AMEX are sorted into 25 portfolios based on their pre-ranking betas using the past 5 year returns. Once the portfolios are formed, portfolios betas are computed using the five-year window. Portfolios betas are then assigned to each individual firm within the portfolios.

Variable	Mean	Standard Deviation	Minimum	25^{th} Percentile	50^{th} Percentile	75^{th} Percentile	Maximum
book-to-market	-0.3128	0.7988	-7.8186	-0.7720	-0.2571	0.2080	4.3981
dollar volume	10.8544	2.6374	2.0636	8.9478	10.7686	12.7192	20.0558
size	12.3659	2.1100	5.4595	10.7995	12.3380	13.8387	20.1804
beta	1.0744	0.3046	0.2488	0.8681	1.0890	1.2768	2.0196

Table 5: Simple correlations

This table reports time series averages of monthly cross-sectional correlation of variables in asset pricing tests for all NYSE-AMEX stocks over the period 1963-2004. Book-to-market variable is the natural logarithm of the book to market ratio. Size is the natural logarithm of firm's total market capitalization in the prior month. Dollar volume is computed as the natural logarithm of average monthly trading volume multiply by price during the previous three months. Beta is computed as follows. First, at the end of each year, all stocks in NYSE-AMEX are sorted into 25 portfolios based on their pre-ranking betas using the past 5 year returns. Once the portfolios are formed, portfolios betas are computed using the five-year window. Portfolios betas are then assigned to each individual firm within the portfolios. Size residual is the residual from the cross-sectional regression of size on dollar volume. Panel A provides the correlations between dollar volume and other stock characteristics. Panel B provides the correlations between size residual and other variables.

Panel A: Correlations among dollar volume and stock characteristics

	beta	book-to-market	size	dollar volume
beta	1.0000	-0.1172	-0.0981	0.0386
book-to-market	-0.1172	1.0000	-0.3501	-0.3638
size	-0.0981	-0.3501	1.0000	0.9001
dollar volume	0.0386	-0.3638	0.9001	1.0000

Panel B: Correlation between gamma residual and beta, book-to-market, and dollar volume

	beta	book-to-market	dollar volume
size residual	0.0386	-0.3639	0.1793

Table 6: Average slopes of monthly cross-sectional regression

This table reports average slopes of monthly cross-sectional regressions of returns on dollar volume using monthly individual security data of NYSE-AMEX stocks over the period 1963-2004 after controlling for stock characteristics as well as for market factors. In each month, a cross-sectional regression is estimated wherein the individual stock return is the dependent variable and the explanatory variable set comprises various combinations of the dollar volume with other variables corresponding to each asset pricing model. The book-to-market variable is the natural logarithm of book to market ratio. Size is the natural logarithm of firm's total market capitalization at the prior month. Dollar volume is computed as the natural logarithm of average monthly trading volume multiply by price during the previous three months. Beta is computed as follows. First, at the end of each year, all stocks in NYSE-AMEX are sorted into 25 portfolios based on their pre-ranking betas using the past 5 year returns. Once the portfolios are formed, portfolios betas are computed using the five-year window. Portfolios betas are then assigned to each individual firm within the portfolios. Size residual is the residual from the cross-sectional regression of size on dollar volume The GLS estimates of average slopes and associated t-statistics (in parentheses) are calculated using the Litzenberger and Ramaswamy (1979) procedure. Panel A presents the results for dollar volume and size, book-to-market, beta. Panel B presents the results for dollar volume, beta, book-to-market, and the size residual (calculated from cross-sectional regression). Panel C presents the results for dollar volume and factor loadings on three common factors of Fama-French (1993) and Pastor and Stambaugh (2003) market liquidity factor.

Panel A: dollar volume and characteristic variables: size, book-to-market ratio, beta

Constant	Dollar volume	Book-to-market	size	Beta
0.0201	-0.0034			
(20.34)	(-15.34)			
0.0151	-0.0021	0.0021		
(14.44)	(-9.14)	(10.26)		
0.0216	-0.0025		-0.0001	
(19.23)	(-4.72)		(-0.70)	
0.0260	-0.0034			-0.0055
(22.00)	(-15.58)			(-9.54)
0.0158	-0.0019	0.0021	0.0001	
(13.26)	(-3.63)	(9.97)	(0.42)	
0.0254	0.0001	0.0017	-0.0009	-0.0057
(16.83)	(0.28)	(8.37)	(-4.29)	(-9.09)

Panel B: dollar volume, size residual, and other characteristics

Constant	Dollar volume	Book-to-market	Size residual	Beta
0.0207	-0.0021	0.0017	-0.0009	-0.0057
(16.47)	(-8.71)	(8.39)	(-4.28)	(-9.07)
0.0191	-0.0032		-0.0001	
(19.38)	(-14.43)		(-0.72)	
0.0143	-0.0021	0.0021	0.0001	
(13.81)	(-8.87)	(9.97)	(0.41)	

Panel C: dollar volume and factor loadings on four factors

Constant	Dollar volume	SMB	HML	Rm-Rf	LIQ
0.0081	-0.0003	-0.0024	0.0020	-0.0032	-0.0004
(10.75)	(-4.97)	(-17.00)	(13.90)	(-13.96)	(-1.19)
0.0021	-0.0002		0.0014		0.0012
(3.39)	(-3.50)		(10.30)		(4.28)
-0.0016			0.0017		0.0014
(-11.76)			(11.96)		(4.74)
0.0004		-0.0011			0.0014
(2.92)		(-8.99)			(4.70)
0.0018				-0.0022	0.0008
(7.00)				(-10.01)	(2.47)
0.0088	-0.0004	-0.0020		-0.0022	0.0001
(11.86)	(-6.49)	(-14.54)		(-10.37)	(0.41)
0.0067	-0.0004	-0.0017			0.0011
(9.19)	(-7.42)	(-12.77)			(3.83)
0.0064	-0.0005	-0.0021	0.0016		
(8.64)	(-7.46)	(-15.63)	(11.84)		
0.0080	-0.0003	-0.0022	0.0020	-0.0030	
(10.80)	(-5.09)	(-16.15)	(13.95)	(-13.86)	

Table 7: Intercepts from time series regressions of the 25 portfolios sorted by size and dollar volume for Nasdaq stocks

This table reports the value of the intercepts obtained four-factor and three-factor models for 25 portfolios of Nasdaq stocks sorted according to size and dollar volume. Dollar volume for each stock is defined as the average of number of shared trading multiplied by stock price during the year. Portfolios are formed yearly for the period 1983-2004. Within each calendar year, all stocks in the sample are allocated into five size portfolios based on their market equity ranking. Each size quintile is then subdivided into five liquidity portfolios using the dollar volume value. Panel A presents intercepts from the time series regression of four-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + \psi_i LIQ_t + e_{it}$ where $r(i,t)$ is the excess return on portfolio i in month t, and ($R_{mt} - R_{ft}$), SMB_t, HML_t, are Fama and French (1993) three factors related to market premium, firm size, and the book-to-market ratio in month t. LIQ_t is the Pastor and Stambaugh (2003) liquidity factor. Panel B presents intercepts from the time series regression of three-factor model as in the following equation $r(i,t) = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \delta_i SMB_t + \gamma_i HML_t + e_{it}$ .The last column represents the difference between liquidity group 5 and liquidity group1. The bottom of each panel presents the Gibbons, Ross, Shanken (1989) test of the hypothesis that the intercepts jointly equal zero for the four-factor model and three-factor model. Intercepts are reported in percentage terms (t-statistics are in parentheses).

Panel A: Four-factor model

	Liquidity group					
Size group	1	2	3	4	5	5 - 1
1	0.0246	0.0186	0.0166	0.0099	0.0023	-0.0223
	(7.19)	(5.22)	(4.20)	(2.05)	(0.32)	(-3.87)***
2	0.0052	0.0022	0.0005	0.0000	-0.0118	-0.0170
	(2.98)	(1.08)	(0.22)	(0.00)	(-2.41)	(-3.73)***
3	0.0036	0.0006	-0.0008	-0.0053	-0.0131	-0.0167
	(2.33)	(0.37)	(-0.39)	(-2.05)	(-3.42)	(-4.24)***
4	0.0028	-0.0005	-0.0016	-0.0079	-0.0103	-0.0131
	(2.34)	(-0.47)	(-1.09)	(-3.81)	(-3.32)	(-3.99)***
5	0.0020	-0.0014	-0.0033	-0.0045	-0.0025	-0.0045
	(1.84)	(-1.22)	(-2.37)	(-2.41)	(-1.04)	(-1.70)*

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 9.40*
(significant at 1 percent level)

Panel B: Three-factor model

Size group	Liquidity group 1	2	3	4	5	5 - 1
1	0.0249	0.0192	0.0167	0.0104	0.0055	-0.0194
	(7.96)	(5.87)	(4.62)	(2.35)	(0.86)	(-3.66)***
2	0.0044	0.0024	0.0009	0.0006	-0.0095	-0.0139
	(2.74)	(1.26)	(0.40)	(0.20)	(-2.12)	(-3.32)***
3	0.0037	0.0006	0.0002	-0.0042	-0.0111	-0.0148
	(2.65)	(0.40)	(0.14)	(-1.76)	(-3.15)	(-4.09)***
4	0.0020	-0.0004	-0.0015	-0.0069	-0.0100	-0.0120
	(1.85)	(-0.39)	(-1.09)	(-3.63)	(-3.50)	(-3.98)***
5	0.0021	-0.0014	-0.0032	-0.0039	-0.0015	-0.0036
	(2.10)	(-1.33)	(-2.45)	(-2.28)	(-0.70)	(-1.49)

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 9.98***
(significant at 1 percent level)

Table 8: Intercepts from time series regressions of the 25 portfolios sorted by book-to-market and dollar volume for Nasdaq stocks

This table reports the value of the intercepts obtained four-factor and three-factor models for 25 portfolios of Nasdaq stocks sorted according to book-to-market and dollar volume. Dollar volume for each stock is defined as the average of number of shared trading multiplied by stock price during the year. Portfolios are formed yearly for the period 1983-2004. Within each calendar year, all stocks in the sample are allocated into five portfolios based on their book-to-market ratios ranking. Each book-to-market quintile is then subdivided into five liquidity portfolios using the dollar volume. Panel A presents intercepts from the time series regression of four-factor model as in the following equation $r(i,t)=\alpha_i+\beta_i(R_{mt}-R_{ft})+\delta_i SMB_t+\gamma_i HML_t+\psi_i LIQ_t+e_{it}$ where $r(i,t)$ is the excess return on portfolio i in month t, and ($R_{mt}-R_{ft}$), SMB_t, HML_t, are Fama and French (1993) three factors related to market premium, firm size, and the book-to-market ratio in month t. LIQ_t is the Pastor and Stambaugh (2003) liquidity factor. Panel B presents intercepts from the time series regression of three-factor model as in the following equation $r(i,t)=\alpha_i+\beta_i(R_{mt}-R_{ft})+\delta_i SMB_t+\gamma_i HML_t+e_{it}$ .The last column represents the difference between liquidity group 5 and liquidity group1. The bottom of each panel presents the Gibbons, Ross, Shanken (1989) test of the hypothesis that the intercepts jointly equal zero for the four-factor model and three-factor model. Intercepts are reported in percentage terms (t-statistics are in parentheses).

Panel A: Four-factor model

Book-to-market group	**Liquidity group**					
	1	2	3	4	5	5 - 1
1	0.0059	-0.0036	-0.0121	-0.0118	-0.0023	-0.0082
	(1.65)	(-1.11)	(-4.68)	(-5.11)	(-0.99)	(-2.01)**
2	0.0072	-0.0034	-0.0048	-0.0056	-0.0046	-0.0118
	(2.17)	(-1.32)	(-2.42)	(-2.89)	(-1.99)	(-3.10)**
3	0.0102	0.0037	-0.0009	-0.0020	-0.0046	-0.0148
	(3.69)	(1.53)	(-0.43)	(-1.01)	(-1.69)	(-4.15)***
4	0.0148	0.0074	0.0038	-0.0007	-0.0010	-0.0158
	(5.60)	(2.86)	(1.65)	(-0.30)	(-0.37)	(-4.42)**
5	0.0299	0.0184	0.0101	0.0120	0.0022	-0.0277
	(8.37)	(5.68)	(3.34)	(3.08)	(0.56)	(-6.34)***

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 7.17*
(significant at 1% level)

Panel B: Three-factor model

Book-to-market group	**Liquidity group**					
	1	2	3	4	5	5 - 1
1	0.0061	-0.0038	-0.0121	-0.0107	-0.0016	-0.0077
	(1.85)	(-1.26)	(-5.14)	(-5.01)	(-0.75)	(-2.05)**
2	0.0056	-0.0024	-0.0042	-0.0059	-0.0036	-0.0092
	(1.83)	(-1.02)	(-2.31)	(-3.33)	(-1.70)	(-2.61)**
3	0.0102	0.0032	0.0002	-0.0014	-0.0041	-0.0143
	(4.02)	(1.46)	(0.12)	(-0.75)	(-1.67)	(-4.39)***
4	0.0142	0.0078	0.0042	-0.0001	-0.0002	-0.0145
	(5.90)	(3.27)	(1.99)	(-0.05)	(-0.09)	(-4.42)***
5	0.0302	0.0186	0.0104	0.0126	0.0048	-0.0254
	(9.24)	(6.28)	(3.78)	(3.54)	(1.33)	(-6.34)***

F-value for Gibbons, Ross, Shanken, test that the intercepts jointly equal to zero is 8.57***
(significant at 1 percent level)

Table 9: Average slopes of monthly cross-sectional regression for Nasdaq stocks

This table reports average slopes of monthly cross-sectional regressions of returns on dollar volume using monthly individual security data of Nasdaq stocks over the period 1983-2004 after controlling for stock characteristics as well as for market factors. In each month, a cross-sectional regression is estimated wherein the individual stock return is the dependent variable and the explanatory variable set comprises various combinations of the dollar volume with other variables corresponding to each asset pricing model. The book-to-market variable is the natural logarithm of book to market ratio. Size is the natural logarithm of firm's total market capitalization at the prior month. Dollar volume is computed as the natural logarithm of average monthly trading volume multiply by price during the previous three months. Beta is computed as follows. First, at the end of each year, all stocks in Nasdaq are sorted into 25 portfolios based on their pre-ranking betas using the past 5 year returns. Once the portfolios are formed, portfolios betas are computed using the five-year window. Portfolios betas are then assigned to each individual firm within the portfolios. Size residual is the residual from the cross-sectional regression of size on dollar volume The GLS estimates of average slopes and associated t-statistics (in parentheses) are calculated using the Litzenberger and Ramaswamy (1979) procedure. Panel A presents the results for dollar volume and size, book-to-market, beta. Panel B presents the results for dollar volume, beta, book-to-market, and the size residual (calculated from cross-sectional regression). Panel C presents the results for dollar volume and factor loadings on three common factors of Fama-French (1993) and Pastor and Stambaugh (2003) market liquidity factor.

Panel A: dollar volume and characteristic variables: size, book-to-market ratio, beta

Constant	Dollar volume	Book-to-market	size	Beta
0.0322	-0.0070			
(17.61)	(-16.10)			
0.0289	-0.0057	0.0022		
(14.74)	(-11.39)	(4.40)		
0.0300	-0.0057		-0.0001	
(11.03)	(-6.37)		(-0.19)	
0.0354	-0.0049			-0.0133
(19.38)	(-15.95)			(-10.43)
0.0269	-0.0047	0.0021	-0.0001	
(9.55)	(-5.04)	(4.32)	(-0.10)	
0.0411	0.0005	0.0011	-0.0019	-0.0150
(13.72)	(0.52)	(2.33)	(-4.13)	(-16.54)

Panel B: dollar volume, size residual, and other characteristics

Constant	Dollar volume	Book-to-market	Size residual	Beta
0.0435	-0.0067	0.0014	-0.0017	-0.0126
(20.83)	(-13.83)	(2.91)	(-3.54)	(-12.49)
0.0410	-0.0092		-0.0001	
(21.54)	(-14.43)		(-0.23)	
0.0371	-0.0078	0.0023	-0.0001	
(18.27)	(-14.77)	(4.58)	(-0.10)	

Panel C: dollar volume and factor loadings on four factors

Constant	Dollar volume	SMB	HML	Rm-Rf	LIQ
0.0193	-0.0022	-0.0020	0.0026	-0.0012	-0.0019
(12.47)	*(-4.06)*	*(-8.75)*	*(12.13)*	*(-4.47)*	*(-5.91)*
0.0245	-0.0044		0.0017		-0.0015
(16.36)	*(-12.77)*		*(8.62)*		*(-3.37)*
0.0061			0.0022		-0.0013
(29.49)			(11.25)		(-2.86)
0.0086		-0.0018			-0.0015
(25.08)		(-8.21)			(-3.13)
0.0087				-0.0012	-0.0021
(22.94)				(-4.72)	(-4.37)
0.0264	-0.0042	-0.0015		-0.0002	-0.0016
(17.95)	*(-11.82)*	*(-6.78)*		*(-0.77)*	*(-3.51)*
0.0267	-0.0043	-0.0015			-0.0014
(18.28)	*(-12.71)*	*(-7.04)*			*(-3.13)*
0.0220	-0.0033	-0.0022	0.0021		
(14.52)	*(-9.35)*	*(-9.60)*	*(10.55)*		
0.0196	-0.0024	-0.0021	0.0026	-0.0011	
(12.66)	*(-6.22)*	*(-9.06)*	*(11.98)*	*(-4.22)*	