Risk of Liquidity Risk Premium

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Abstract

Most of the empirical and theoretical work on liquidity and asset pricing focuses on the determination and quantification of the liquidity risk premium. During the last decade however, the interest of many researchers has been attracted by the risk of the liquidity risk premium. A negative relationship has been addressed between risk of trading activity and asset prices which is attributed mostly on the clientele effect. Our paper underlines this finding and provides a comparative analysis of the volatility of liquidity risk through an asset pricing framework considering several dimensions of liquidity such as transaction cost, trading activity and price impact. Our empirical findings are consistent with the literature and additionally provide evidence of a heterogeneity that is apparent with respect to the liquidity component under examination (i.e. transaction cost, trading activity and price impact) as well as to the risk metric which is adopted.

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1. Introduction

Liquidity refers to a set of characteristics that jointly comprise a factor associated, but not limited, to the transaction cost, the trading activity and the price impact.

The transaction cost presumes that rational investors' preferences lie within liquid assets and thus their expectations about liquidity are priced through the demand and supply forces and consequently form the bid and ask quotes. Amihud and Mendelson (1986) used the bid-ask spread as a proxy of the transaction cost. However, the pricing mechanism is even more complicated due to the heterogeneity of the market participants' informational content. This informational asymmetry imposes a premium or a discount on securities' prices as a signal of good and bad news resulting from the excess demand (liquid) or supply (illiquid) of securities, respectively.

The trading activity which accounts for the number of trades and the volume of these trades is another important component of liquidity. According to Datar, Naik and Radcliff (1998) turnover ratio is defined as the ratio of the number of trades over the number of outstanding securities and is related to how quickly a dealer expects to turn around her position. Turnover ratio is thus, the reciprocal of average holding period in that less liquid assets are allocated to investors with longer investment horizons. Consequently, investors would require a compensation for securities with lower turnover ratio resulting in high expected returns. However, the empirical findings of the literature are conflict, since the negative relationship between expected returns and turnover ratio, due to higher holding periods, could turn to positive when the adverse information effect is accounted for, i.e. higher level of turnover ratio indicates the adverse information which results in higher spreads and higher illiquidity. The next trading activity liquidity measure is the Dollar trading volume which is defined as the product of the total number of shares traded by the average price per share. This is assumed to be one of the most important determinants of the transaction cost which is decomposed to the inventory cost, the order processing cost and the adverse selection cost. Accordingly, the inventory cost or holding cost of securities is a function of holding period which depends on trading volume allowing investors to reverse their position when dealing with heavily traded assets, resulting, thus, to a negative relationship between spread and dollar volume. In other words, dollar volume measures the speed of transaction to unwind the position and consequently, low dollar volume indicates illiquidity.

Another important component of liquidity is the price impact which represents the changes of securities' prices due to changes of the dollar volume. High trading for a specific share with low impact on its price implies that the security is a liquid one. The Amivest ratio (Amihud 2002) is a proxy for the price impact component of liquidity. This is defined as the ratio of absolute return over the dollar volume and expresses the average daily price change for $1 trading volume. Florakis, Gregoriou, and Kostakis (2011) proposed an alternative price impact metric controlling for the size bias which is apparent at the amivest ratio, by consideration of the ratio of the absolute return to the turnover ratio.

While most of the empirical work on liquidity refers to the liquidity risk premium in an asset pricing framework and to the market-wide risk factor of liquidity, recently the risk of the liquidity risk premium is on the spot light. The former refers to the positive relationship that is expected between asset returns and the illiquidity of asset returns, while the latter on the investigation of the impact of the volatility of liquidity measures on asset returns. Chordia, Subrahmanyam, Anshuman (2001) were the first who investigated the volatility of liquidity measures and found a negative impact on asset returns on a cross-sectional level.

This paper investigates the risk of liquidity risk on an asset pricing framework. While extant literature concentrates on the trading activity component of liquidity we conduct a comparative analysis considering several dimensions of liquidity such as transaction costs, trading activity and price impact. Specifically, we use six individual liquidity measures covering three dimensions of liquidity: S and RS (transaction cost), DVOL and TR (trading activity), , and D/DVOL and R/TR (price impact).

The rest of the paper is organized as follows; the second section provides a brief literature review, the third explains the dataset and the research methodology, the fourth presents the empirical findings and the last one concludes the paper.

2. Literature Review

Many researchers have focused on the systematic component of liquidity on an aggregated market level. Chordia, Roll and Subrahmanyam (2001), Hasbrouck and Seppi (2001), and Huberman and Halka (2001) find commonality of order flow and liquidity across assets. This empirical finding motivated Chordia, Subrahmanyam, Anshuman (2001) to investigate the second moment of market aggregated liquidity and its relationship with asset returns on a cross sectional level.

Specificallty, Chordia et.al (2001) was the first who introduced the investigation of the risk of liquidity risk and its explanatory power with respect to asset returns. They recruited liquidity measures relevant with trading activity (DVOL and TR) and found a solid negative cross-sectional relationship between risk of liquidity risk and asset returns on an asset pricing model framework. They define the risk of liquidity risk as the standard deviation of the 36 lagged monthly observations of DVOL and TR divided by the mean of the prior 36 monthly observations. An alternative risk approach is also examined where the authors estimate the conditional volatility of DVOL and TR using a GARCH (1,1) model as a robustness check.

Although a positive relationship is expected between the risk of the liquidity factor and the expected returns, the empirical findings suggest a negative one. They attribute this surprising relationship on the clientele hypothesis of Merton (1987) according to which securities that attract many investors would yield lower returns. Thus, variability of liquidity metrics could potentially proxy for the heterogeneity of the clientele holding the share and consequently, higher variability would imply a greater heterogeneity among the investors who hold the specific security, yielding lower returns.

In this direction, Pereira and Zhang (2010) investigated the negative impact of volatility of liquidity on asset returns. They adopted the price impact component of liquidity (R/DVOL) for a multiperiod investor who requires additional compensation for the adverse price impact of trading. Most importantly, they provided evidence that the puzzling negative effect is consistent with a risk-averter, fully rational and utility maximizing investor with a CRRA utility function.

In contrast Akbas, Armstrong and Petkova (2011) proposed the use of a risk measure of liquidity which is based on daily liquidity observations over a month and found that the idiosyncratic component of risk of liquidity is priced positively on an asset pricing framework.

3. Data and Research Methodology

For the purposes of our analysis we use data from CRSP and COMPUSTAT. Our sample consists of several time series of common securities listed in NYSE-AMEX. Specifically, our data comprise a set of time series on a daily basis such as closing prices, bid and ask prices, trading volume, number of shares outstanding and returns and additionally a set of time series of annual frequency such as book value, earning per share and dividend yield. The raw data from CRSP and COMPUSTAT are adjusted and expressed on a monthly basis covering the period from January 1962 to December 2011. However, the bid/ask prices are available only after 1991. The risk free rate is proxied by the one-month T-bill rate in the US market. We filter our final sample according to several characteristics in order to exclude:

- securities that are traded on Nasdaq;
- securities that are not available in either CRSP or COMPUSTAT tape;
- observations that correspond to the first and last trading month for each firm;
- stocks that have fewer than 2 years prices or fewer than 15 trading days in one month;
- stocks with extreme ask/bid prices (less than $5 or larger than $1000, or the closing bid prices are higher than ask prices);
- stocks with negative BM values and those which are in the financial services sector;
- stocks with extreme dollar market capitalization, B/M, DY, and EP (less than 0.5% or lager than 99.5% percentile).

The imposed filtration results on average to 2050 firms and it spans from 1000 to 3154 firms as shown in Figure 1 of the appendix. The descriptive statistics are presented in panel A of.

Please insert Figure 1 about here

Besides, we construct several liquidity metrics that account for the transaction cost, the trading activity and the price impact. Specifically, with respect to the transaction cost we construct the spread (S) and relative spread (RS), the dollar volume (DVOL) and turnover ratio (TR) for trading activity, and the return to dollar volume (R/DVOL) and return to turnover ratio (R/TR) for the price impact dimension as shown below:

DVOL: the sum of the daily dollar volume, over month m, is the monthly dollar volume for a stock.

$$DVOL_{i,m} = \sum_{t=1}^{n} DVOL_{i,t} \quad : (1)$$

S: the daily absolute spread is calculated as the difference between bid price and ask price. For a single stock, its monthly spread is calculated by averaging the daily spread over the month:

$$S_{i,m} = \frac{1}{n}\sum_{t=1}^{n}(ask_{i,t} - bid_{i.t}) \quad : (2)$$

RS: the daily relative spread is calculated as the daily spread over the price, where the monthly spread is calculated by averaging the daily spread over the month:

$$RS_{i,m} = \frac{1}{n}\sum_{t=1}^{n}\frac{ask_{i,t} - bid_{i.t}}{price_{i,t}} \quad : (3)$$

TR: The ratio at month m is calculated as: number of shares traded in month m/number of share outstanding:

$$TR_{i,m} = \frac{\sum_{t=1}^{n} trading\_volume_{i,t}}{share\_of\_outs\tan ding_{i,m}} \quad : (4)$$

R/DVOL: average the daily ratio of absolute return/dollar volume over month m:

$$R/DVOL_{i,m} = \frac{1}{n}\sum_{t=1}^{n}\left(\frac{\left|RET_{i,t}\right|}{DVOL_{i,t}}\right) \quad : (5)$$

R/TR: average the daily ratio of absolute return/turnover ratio over month m, where daily turnover ratio is obtained by daily trading volume/ share of outstanding:

$$R/TR_{i,m} = \frac{1}{n}\sum_{t=1}^{n}\left(\frac{\left|RET_{i,t}\right|}{TR_{i,t}}\right) \quad : (6)$$

where $TR_{i,t} = \dfrac{trading\_volume_{i,t}}{share\_of\_s\tan ding_{i,t}}$

With an exception to the spread and relative spread for which available data exist only after 1990, the rest of four liquidity measures are available in the whole time period, i.e. 1962-2011. The descriptives of the monthly liquidity measures, obtained by the time-series averages of the firm characteristics, are displayed in Panel A of Table 1.

Please insert Table 1 about here

The quantification of the risk of the liquidity measures is expressed through the standard deviation over the mean of the liquidity and is implemented through two approaches depending on the frequency of the data and the time period that they cover. The former is used by Akbas, Armstrong and Petkova (2011) and is based on daily observations of liquidity within each month, while the latter one was proposed by Chordia et.al (2001) using the 36 prior monthly liquidity values. The volatility of liquidity measures is expressed through the standard deviation over the expected mean of the liquidity:

$$vol_{i,t} = \frac{\sigma_{i,t}}{\mu_{i,t}} = \frac{\sqrt{\operatorname{var}(liq_{i,t})}}{\frac{1}{T}\sum_{t-T}^{t-1} liq_{i,t}} \qquad : (7)$$

where $\sigma_{i,t}$ is the standard deviation of the prior T liquidity observations of asset i, and μ_t is the mean of the prior liquidity observations of asset i. Consequently, the paper uses two volatility specifications as follows:

$$vol1_{i,t} = \frac{\theta_{i,t}}{\upsilon_{i,t}} = \frac{\sqrt{\operatorname{var}(liq_{i,\tau})}}{\frac{1}{T}\sum_{\tau=1}^{\tau=T} liq_{i,\tau}} \qquad : (8)$$

where $vol1_{i,t}$ denotes the realized volatility of liquidity in month t of asset i, which is calculated by the daily liquidity $liq_{i,\tau}$ from day 1 to day T which is number of trading days in month t of asset i, and $\theta_{i,t}$ is the standard deviation of daily liquidity levels of asset i in month t, and $\upsilon_{i,t}$ is the mean of the daily liquidity levels of asset i in month t:

$$vol2_{i,t} = \frac{\sigma_{i,t}}{\mu_{i,t}} = \frac{\sqrt{\operatorname{var}(liq_{i,t})}}{\frac{1}{36}\sum_{t-36}^{t-1} liq_{i,t}} \qquad : (9)$$

where $\sigma_{i,t}$ is the standard deviation of the prior 36 monthly liquidity levels of asset i, and μ_t is the mean of the prior month liquidity observations of asset i. It is expected that *vol1* would be larger and more volatile than *vol2*.

Chodia et.al. (2001) used the second volatility specification of liquidity *vol2* and investigated empirically its relationship with expected returns through a multifactor approach of a cross-sectional framework, concluding on a negative effect. Similarly, Pereira and Zhang (2010) found a negative relationship between the stocks excess return and second moment of liquidity level, even after controlling for other stock characteristics. Pereira and Zhang (2010) explain the negative relation as the less required compensation for investors who hold the asset with higher liquidity volatility, since they can take advantage of the liquidity state to adjust the trading strategy, in order to take the trading opportunity when the liquidity volatiles. In contrast, Akbas et.al. (2011) extracted the idiosyncratic component of risk of trading activity and through a cross-sectional analysis concluded in a positive association with expected returns.

In order to examine empirically the effect of risk of liquidity we adopt an asset pricing model according to the Fama-MacBeth approach, controlling for firm fundamentals. The APT equation is expressed as follows:

$$R_{i,m} - R_{f,m} = c_0 + \sum_{k=1}^{K} \beta_{i,k} f_{k,m} + \sum_{n=1}^{N} c_n Z_{n,i,m} + \varepsilon_{i,m} \qquad : (10)$$

where $R_{i,m}$ is monthly asset return, $R_{f,m}$ is risk free rate which is proxied by US one-month T-bill rate, $\sum_{k=1}^{K} \beta_{i,k} f_{k,m}$ indicates the sum of premium of risk characteristics as expressed by the Fama-French factors $f_{k,m}$ and the relevant factor loadings $\beta_{i,m}$, and $Z_{n,i,m}$ is the value of non-risk characteristic n of firm i in month m. The coefficients c_n would potential allow us to examine empirically the relation between asset returns, liquidity and volatility of liquidity as well vol1 and vol2. Hence, the statistic model might be written as:

$$R^{*}{}_{i,m} = c_0 + \sum_{n=1}^{N} c_n Z_{n,i,m} + \omega_{i,m} \qquad : (11)$$

where $R^{*}{}_{i,m}$ is risk-adjusted return, $R_{i,m} - R_{f,m} - \sum_{k=1}^{K} \beta_{i,k} f_{k,m}$, where $\beta_{i,k}$ are estimated using a 60 months rolling window. For the rolling estimations we require at least 24 in 60 monthly data for each stock to be available. The first rolling estimation starts from 30 monthly observations, and then extents to 31, 32..., until reaches 60.

For robustness check, we consider the dependent variables, asset return, with two specifications: excess return $R_{i,m} - R_{f,m}$ and risk-adjusted return $R^{*}{}_{i,m}$.

The non-risk characteristics $Z_{n,i,m}$ are liquidity levels, liquidity volatility and other firm fundamentals, such as firm size (CAP), Book-to-Market ratio (BM), Dividend Yield (DY), Earnings-Price ratio (EP), momentum cumulative returns (RET23, RET46, RET712), reciprocal monthly prices (1/P). The former characteristics (CAP and BM) are following Fama-French's (1993) pioneer work while the rest firm characteristics such as DY and EP are also used extensively in this literature. In spirit of Jegadeesh and Titman (1993), the asset return is highly related to the momentum effect, and the variables of cumulative past returns could proxy the effect to some extent. Besides, we are also mindful of Lee and Swaminathan's (1998) argument in that the turnover may not be an adequate liquidity measure due to its sensitivity with past performance. Thus, we employ the prior cumulative monthly return, RET23, RET46, RET712 in our cross-sectional regression test. Finally, Based on Miller and Scholes (1992) in that low priced assets are in financial distress, we recruit the reciprocal of share prices at the end of month.

We report the cross-sectional estimation of slopes of characteristics as the time-series mean $\bar{c}_{i,j}$, as well as the t-statistic of the estimation coefficients t_c in the cross-sectional regressions. We calculate the t-statistic by Fama-MecBeth (1973) approach:

$$\bar{c}_{i,j} = \frac{1}{M}\sum_{m=1}^{M}\hat{c}_{i,j,m} \qquad : (12)$$

$$se(c) = \sigma(c)/\sqrt{M} \qquad : (13)$$

$$t_c = \frac{\bar{c}}{se(c)} \qquad : (14)$$

where $\hat{c}_{i,j,m}$ is the estimated slopes of characteristic j of asset i in month m, $\sigma(c)$ is the sample standard deviation of the cross-section regressions estimates and M is the number of observations in time-series.

The mean of time-series slopes of non-risk characteristics is also reported indicating the significance and the sign of a potential relationship between expected returns and control variables. We employ the Fama-MacBeth approach to run cross-section regressions of individual stocks excess return in month m against its share characteristics including liquidity level in month (m-2). The lag of firm characteristics follows the extant literature (e.g. Brennan, Chordia, and Subrahmanyam (1998), Chordia, Subrahmanyam and Anshuman (2001), Pereira and Zhang (2010)) in order to avoid potential spurious relation between return and firm characteristics due to thin trading or extraordinary values of the bid-ask spread. Finally, all of the variables are taken in a logarithmic form in order to improve the efficiency of estimations.

4. Empirical Findings

Pane B of Table 1 presents several descriptive characteristics of the volatility of liquidity risk, through the three examined dimensions of liquidity. The first risk metric, vol1, is based on the daily liquidity on a current month, while the second one, vol2, on the 36 previous monthly observations of liquidity. Specifically, these descriptives represent the time-series averages of the cross-sectional mean, median and standard deviation.

From these descriptives it is apparent that liquidity metrics within a specific liquidity dimension (i.e. transaction cost, trading activity or price impact) share common characteristics reflected on similar mean/median or standard deviation. Consequently, these statistics provide evidence of a commonality within each component of liquidity risk, i.e. S with RS, DVOL with TR and r/DVOL with r/TR. This is apparent mostly in vol1 metric. The descriptives reflect the monthly time-series average of individual securities and thus provide insights about potential patterns or differences between the two measures. In this direction, we observe that volatility of liquidity risk as measured according to the first volatility metric (vol1) is greater magnitude than the second one, but of higher volatility as well. This finding is justified mostly due to the greater sensitive of the first metric with respect to the data time period span frequency.

The investigation of the pricing mechanism of volatility of liquidity risk which is the main focus of this paper is implemented on a comparative framework between volatility metrics and liquidity components as well. Table 2 presents the empirical findings of the Fama-MacBeth cross sectional regressions. Panel A corresponds to the first volatility metric while panel B to the second one. For each liquidity component (i.e. transaction cost, trading activity and price impact) we consider two liquidity measures and for each case we consider two alternative models with respect to the expression of the dependent variable. The returns on the left hand side are either the excess returns or the risk-adjusted returns providing thus two alternative estimations of the significance of the explanatory variables. In the risk risk-adjusted form we control for the liquidity level, additionally.

From Penal A of Table 2, the estimated slopes of vol1 are negative and significant in the case of spread (S) and relative spread (RS), irrelevant of the inclusion of the liquidity levels (S or RS). Regarding the other factors Moreover, regarding the other liquidity measures, the coefficients of vol1 are insignificant, though the coefficients of liquidity levels are consistently significant.

From Penal B of Table 2, the coefficients of vol2 of four liquidity measures on trading activity and price impact, i.e. Dollar Volume (DVOL), Turnover Ratio (TR), Return to Dollar Volume (R/DVOL) and Return to Turnover Ratio (R/TR), are negative and significant. However, volatility of S and RS is not priced on a cross-sectional level. In addition, the liquidity levels of trading activity and price impact are also significant. With the variable of liquidity level included, the results of vol2 do not change when the dependent variables are excess returns. Nevertheless, the effect of liquidity levels dominates the liquidity volatility vol2 when the dependent variables are risk-adjusted return.

Please Insert Table 2 about here

Overall our empirical findings provide strong evidence of a negative relationship between the volatility of liquidity and expected returns. Although this relationship seems to be irrelevant with respect to the consideration of several risk characteristics on firm fundamentals, its statistical and economic significance depend on the volatility metric under consideration. Specifically, while the transaction cost governs this relationship when dealing with vol1 (i.e. monthly volatility liquidity of daily liquidity levels), trading activity and price impact components of liquidity seem to have a strong presence on vol2 (i.e monthly volatility liquidity of 36 past monthly liquidity observations).

Our findings are fully consistent with that of extant literature and precisely, Chordia, Subrahmanyam, and Anshuman (2001) and Pereira and Zhang (2010) in that trading activity's volatility is negatively priced on asset pricing models. In addition we contribute on the extension of this literature by consideration of the Akba's et.al (2011) volatility liquidity metric and the consideration of a comparative analysis among different liquidity dimensions.

5. Conclusions

This paper investigates the volatility of liquidity risk and its impact on asset returns in a comparative framework both in terms of liquidity components and in terms of the adopted volatility metric.

Extant literature considers the trading activity component of liquidity and forms its volatility using the past 36 months of liquidity observations, addressing a negative relationship between volatility of liquidity and expected returns. Our approach uses additionally the transaction cost and the price impact components of liquidity and furthermore adopts in addition the daily liquidity observations to form the risk of liquidity risk.

The findings with respect to the trading activity and the 36 lagged observations risk of liquidity risk are consistent with those of extant literature. Moreover, when dealing with transaction cost and price impact components of liquidity under the 36 lagged observations' risk and the lagged corresponding month's daily observations the results turn to be ambiguous. Specifically, only the transaction cost component provides a solid negative effect between the lagged corresponding month's daily observations' risk and the expected returns, while only the trading activity and the price impact components provide such a relationship under the 36 months' volatility of liquidity risk.

The heterogeneity which is apparent on the investigation of the volatility of liquidity contributes on this literature which is limited on the trading activity component of liquidity only. Thus, investors are compensated for undertaking portfolios of higher risk of liquidity, differently, depending on the component of liquidity they refer to and on the past information that they use in order to form their estimations of the priced risk component.

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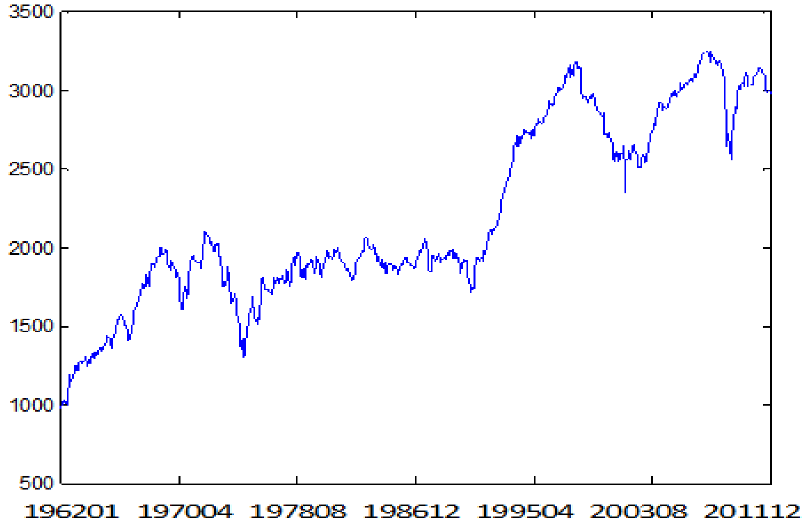
Appendix

Figures

Figure 1. The evolution of the examined securities



Tables

Table 1

Table 1 Descriptive Statistics of firm fundamentals, liquidity measures and volatility of liquidity

This table demonstrates the statistics of monthly variables, which are going to be used in the Fama-MacBech cross-sectional regressions. The mean, median, standard deviations are obtained by the time-series average of monthly cross-sectional mean, median, standard deviation. The listed variables are observed or calculated from a sample of average 2050 NYSE-AMEX firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The fundamental control variables and six liquidity measures variables are reported in Panel A. RET is the monthly return of assets. CAP is the market capitalizations of firms. PRICE denotes the closing prices at the end of month. B/M is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning price ratio. DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively. DVOL denotes sum of daily dollar trading volumes within month for each stock. S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread. Note that the data availability of S and RS is from January, 1991 to December, 2011. TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio. In Panel B, the results are two types of volatility of liquidity, where liquidity is measured by six different measures. Vol1 indicates liquidity variability in month t as the standard deviation of daily liquidity levels in month t divided by the mean of daily liquidity levels in month t, while Vol2 in month t is obtained by the standard deviation of prior 36 monthly liquidity levels divided by the mean of prior 36 monthly liquidity levels. For each asset, Vol1 and Vol2 are calculated every month, respectively.

Panel A

	Mean	*Median*	*Standard deviation*
CAP	1.4247	0.3331	3.5107
BM	0.7711	0.6039	0.7790
EPS	0.0801	0.0676	0.1470
DY	0.0344	0.0246	0.0494
RET23	0.0245	0.0181	0.1297
RET46	0.0365	0.0293	0.1555
RET712	0.0745	0.0639	0.2144
PRICE	27.05	21.50	23.45
DVOL	130.05	25.95	251.79
TR	68.23	45.62	99.61
S	0.2284	0.1978	0.1410
RS	0.0122	0.0101	0.0078
R/DVOL	0.2421	0.1126	0.3296
R/TR	0.0185	0.0136	0.0165

Panel B

		Mean	*Median*	*Standard deviation*
DVOL	Vol1	0.7932	0.6997	0.3943
TR	Vol1	0.7848	0.6976	0.3772
S	Vol1	0.4999	0.4543	0.2422
RS	Vol1	0.5046	0.4563	0.2467
R/DVOL	Vol1	1.0312	0.9657	0.3294
R/TR	Vol1	1.0262	0.9632	0.3216
DVOL	Vol2	0.6212	0.5550	0.3006
TR	Vol2	0.5485	0.4945	0.2519
S	Vol2	0.4155	0.3858	0.1766
RS	Vol2	0.4689	0.4412	0.1867
R/DVOL	Vol2	0.5904	0.5449	0.2256
R/TR	Vol2	0.4670	0.4425	0.1458

Table 2. Panel A. Cross Sectional analysis of asset returns on firm fundamentals and volatility of liquidity

Table 2 **Cross Sectional analysis of asset returns on firm fundamentals and volatility of liquidity**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return and Fama-French risk adjusted return. There are two sets of independent variables: one set is Vol1 (2), CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P and liquidity measures (DVOL, S, RS, RE, R/DVOL, R/TR respectively), where the liquidity variability Vol1 (Vol2) in month t as the standard deviation of daily liquidity levels in month t (prior 36 monthly liquidity levels) divided by the mean of daily liquidity levels in month t (prior 36 monthly liquidity levels), by equation (1) and (2); CAP is the market capitalizations of firms; BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month; EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month; DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month; Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively; 1/P denotes the reciprocal of closing prices at the end of month; liquidity measures (DVOL, S, RS, RE, R/DVOL, R/TR respectively): S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month; RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread; DVOL denotes sum of daily dollar trading volumes within month for each stock; TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month; R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio. Panel A reports the results related to Vol1, while Panel B is in terms of Vol2. Each one specific liquidity measure provides a group of results and the cross-sectional regressions generate monthly coefficients for each independent variable. The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed beneath the coefficients estimation. Note that, due to the data availability, the results from liquidity measures S and RS are using the data from January, 1992 to December, 2011; while other results are using data from January, 1962 to December, 2011. We use * to denote the significance of the coefficients at 5%.

	DVOL				S				RS				TR				RTODVOL				RTOTR			
Panel A	Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return	
vol1	0.000	0.000	0.000	0.000	-0.003 *	-0.003 *	-0.003 *	-0.004 *	-0.002 *	-0.002 *	-0.001 *	0.000 *	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
	0.592	*1.118*	*0.444*	*1.168*	*-8.384*	*-8.672*	*-2.118*	*-2.295*	*-4.686*	*-4.531*	*-2.641*	*-1.897*	*0.496*	*0.858*	*0.263*	*0.124*	*0.270*	*-0.269*	*0.749*	*-0.138*	*0.713*	*0.293*	*0.482*	*0.572*
cap	-0.001 *	0.000	0.000 *	0.001	-0.001 *	0.000	0.000 *	-0.001	-0.001 *	-0.001 *	0.000 *	-0.001 *	-0.001 *	-0.001 *	0.000 *	-0.001 *	-0.001 *	0.000	0.000 *	0.001	0.000 *	0.000 *	-0.001 *	0.000 *
	-1.792	*0.857*	*-1.831*	*0.466*	*-5.042*	*-1.025*	*-1.997*	*-1.317*	*-4.612*	*-3.126*	*-1.959*	*-2.198*	*-2.017*	*-2.422*	*-2.205*	*-2.811*	*-1.916*	*0.514*	*-2.044*	*0.350*	*-1.712*	*-1.705*	*-1.967*	*-1.921*
bm	0.001 *	0.001 *	0.006 *	0.008 *	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001 *	0.001 *	0.001 *	0.000	0.001 *	0.001 *	0.001 *	0.001 *	0.001 *	0.001 *	0.000 *	0.001 *
	3.004	*3.150*	*2.632*	*2.891*	*0.493*	*0.699*	*0.552*	*0.438*	*0.198*	*0.177*	*0.592*	*0.544*	*2.422*	*2.614*	*1.896*	*1.667*	*2.440*	*2.512*	*2.293*	*2.162*	*2.622*	*2.706*	*2.555*	*1.943*
eps	0.005	0.004	0.009 *	0.005	0.002 *	0.002 *	0.003 *	0.001 *	0.003 *	0.003 *	0.001 *	0.010 *	0.005 *	0.005 *	0.003 *	0.001	0.004	0.004	0.003	0.004	0.005	0.005	0.002 *	0.003
	1.397	*1.483*	*1.803*	*1.575*	*2.587*	*2.390*	*2.646*	*2.199*	*3.149*	*3.233*	*2.431*	*2.688*	*1.636*	*1.724*	*1.815*	*1.499*	*1.467*	*1.443*	*1.393*	*1.518*	*1.567*	*1.555*	*1.891*	*1.608*
dy	-0.020	-0.026 *	-0.041	-0.096 *	0.007	0.005	0.004 *	0.005	0.001	0.001	0.001	0.001	-0.018	-0.024 *	-0.003 *	-0.008 *	-0.018	-0.021 *	-0.095	-0.015	-0.020 *	-0.023 *	-0.004 *	-0.039 *
	-1.501	*-2.411*	*-1.311*	*-2.254*	*1.259*	*0.960*	*1.920*	*0.677*	*0.213*	*0.228*	*0.754*	*0.862*	*-1.451*	*-2.347*	*-1.975*	*-2.633*	*-1.506*	*-1.798*	*-1.467*	*-1.580*	*-1.650*	*-1.984*	*-1.976*	*-1.880*
ret23	0.005 *	0.006 *	0.010 *	0.005 *	0.001	0.002	0.000	0.010	0.001	0.001	0.000	0.001	0.004	0.005 *	0.002	0.005 *	0.005 *	0.005 *	0.005	0.008 *	0.005 *	0.006 *	0.003 *	0.002 *
	1.889	*2.446*	*1.931*	*2.177*	*0.350*	*0.419*	*0.746*	*0.591*	*0.189*	*0.220*	*0.918*	*0.289*	*1.456*	*1.888*	*1.552*	*1.948*	*1.636*	*1.830*	*1.237*	*1.943*	*1.780*	*2.053*	*1.829*	*2.711*
ret46	0.010 *	0.010 *	0.005 *	0.005 *	-0.001	-0.001	0.000	0.000	0.005 *	0.005 *	0.002 *	0.007 *	0.009 *	0.010 *	0.005 *	0.006 *	0.009 *	0.009 *	0.002 *	0.009 *	0.009 *	0.009 *	0.003 *	0.004 *
	4.360	*4.891*	*1.903*	*1.912*	*-0.264*	*-0.299*	*-0.776*	*-0.893*	*1.976*	*1.947*	*1.902*	*1.975*	*3.902*	*4.362*	*2.767*	*1.931*	*3.750*	*3.888*	*2.388*	*1.971*	*3.715*	*3.919*	*1.971*	*1.921*
ret712	0.007 *	0.007 *	0.006 *	0.005 *	-0.006 *	-0.006 *	-0.006 *	-0.006 *	-0.002	-0.002	-0.003	-0.003	0.006 *	0.006 *	0.001 *	0.003 *	0.006 *	0.006 *	0.003 *	0.006 *	0.006 *	0.006 *	0.008 *	0.005 *
	4.604	*5.019*	*2.384*	*5.497*	*-3.282*	*-3.333*	*-1.823*	*-2.523*	*-1.213*	*-1.216*	*-1.544*	*-1.578*	*3.719*	*4.103*	*2.296*	*2.069*	*3.522*	*3.658*	*1.889*	*1.889*	*3.653*	*3.792*	*1.921*	*2.041*
1/p	0.002 *	0.002 *	0.005 *	0.010 *	0.003 *	0.004 *	0.006 *	0.009 *	0.003 *	0.003 *	0.003 *	0.001 *	0.002 *	0.002 *	0.002 *	0.001 *	0.003 *	0.002 *	0.002 *	0.002 *	0.002 *	0.002 *	0.004 *	0.001 *
	3.585	*3.418*	*1.852*	*1.948*	*3.733*	*5.204*	*1.925*	*1.861*	*5.193*	*5.075*	*2.533*	*2.614*	*3.491*	*3.329*	*2.127*	*1.813*	*3.791*	*3.542*	*2.010*	*1.841*	*3.626*	*3.318*	*1.960*	*1.850*
measure		-0.001 *		-0.008 *		0.002 *		0.002 *		0.000		0.000		-0.001 *		0.000 *		0.001 *		0.000 *		0.001 *		0.001 *
		-2.366		*-1.824*		*3.570*		*1.941*		*0.659*		*0.142*		*-2.414*		*-1.956*		*2.433*		*2.902*		*2.497*		*2.150*

Table 2. Panel B. Cross Sectional analysis of asset returns on firm fundamentals and volatility of liquidity

Table 2 **Cross Sectional analysis of asset returns on firm fundamentals and volatility of liquidity**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return and Fama-French risk adjusted return. There are two sets of independent variables: one set is Vol1 (2), CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P and liquidity measures (DVOL, S, RS, RE, R/DVOL, R/TR respectively), where the liquidity variability Vol1 (Vol2) in month t as the standard deviation of daily liquidity levels in month t (prior 36 monthly liquidity levels) divided by the mean of daily liquidity levels in month t (prior 36 monthly liquidity levels), by equation (1) and (2); CAP is the market capitalizations of firms; BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month; EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month; DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month; Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively; 1/P denotes the reciprocal of closing prices at the end of month; liquidity measures (DVOL, S, RS, RE, R/DVOL, R/TR respectively): S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month; RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread; DVOL denotes sum of daily dollar trading volumes within month for each stock; TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month; R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio. Panel A reports the results related to Vol1, while Panel B is in terms of Vol2. Each one specific liquidity measure provides a group of results and the cross-sectional regressions generate monthly coefficients for each independent variable. The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed beneath the coefficients estimation. Note that, due to the data availability, the results from liquidity measures S and RS are using the data from January, 1992 to December, 2011; while other results are using data from January, 1962 to December, 2011. We use * to denote the significance of the coefficients at 5%.

Panel B	DVOL				S				RS			
	Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return	
vol2	-0.001 *	-0.001 *	0.000 *	-0.001	0.000	0.000	-0.001	0.000	0.000	0.001	0.000	0.000
	-1.777	-1.899	-1.856	-1.239	-0.543	-0.362	-0.391	-0.243	0.717	1.127	0.901	1.218
cap	-0.001 *	0.000	0.000 *	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001
	-2.992	-0.106	-2.531	-1.414	-0.826	-0.434	-0.355	-0.455	-1.180	-0.871	-1.196	-0.997
bm	0.001 *	0.001 *	0.001 *	0.001 *	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	1.661	1.843	1.852	1.759	0.277	0.341	0.514	0.521	0.416	0.396	0.844	0.495
eps	0.007 *	0.007 *	0.002 *	0.002 *	0.007 *	0.007 *	0.004 *	0.003 *	0.007 *	0.007 *	0.003 *	0.003 *
	2.326	2.434	2.300	2.148	4.700	4.536	1.832	2.252	4.855	4.802	2.715	1.826
dy	-0.019 *	-0.024 *	-0.022 *	-0.094 *	-0.002	-0.002	-0.001	-0.008	-0.001	-0.001	-0.001	-0.006
	-1.624	-2.413	-1.700	-2.604	-0.219	-0.278	-0.900	-0.873	-0.187	-0.196	-0.124	-0.211
ret23	0.003	0.004	0.003	0.003	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000
	1.116	1.465	1.159	1.388	0.208	0.120	0.978	0.170	0.274	0.152	0.168	0.739
ret46	0.009 *	0.009 *	0.006 *	0.005 *	0.008 *	0.008 *	0.002 *	0.006 *	0.008 *	0.008 *	0.005 *	0.009 *
	3.681	3.956	1.931	1.940	3.129	3.198	2.675	1.803	3.120	3.192	2.700	1.981
ret712	0.006 *	0.006 *	0.008 *	0.003 *	0.001	0.001	0.004	0.001	0.002	0.001	0.002	0.001
	3.926	4.089	2.618	2.406	0.694	0.730	0.960	0.598	0.858	0.791	0.797	0.956
1/p	0.003 *	0.002 *	0.008 *	0.007 *	0.004 *	0.005 *	0.009 *	0.006 *	0.004 *	0.004 *	0.010 *	0.004 *
	3.665	3.551	2.602	2.242	6.650	6.641	2.405	2.711	6.233	5.910	1.960	2.740
measure		-0.001 *	*	0.000 *		0.001		0.001		0.000		0.000
		-1.818		-1.957		1.251		1.410		0.680		0.514

Panel B	TR				RTODVOL				RTOTR			
	Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return		Excess Return		Risk-adjust Return	
vol2	-0.002 *	-0.002 *	-0.002 *	-0.001 *	-0.002 *	-0.001 *	0.000 *	0.000	-0.002 *	-0.001 *	-0.002 *	0.000
	-2.808	-2.806	-1.950	-1.839	-1.827	-1.916	-1.947	-0.845	-2.655	-1.911	-1.927	-1.067
cap	-0.001 *	-0.001 *	-0.001 *	-0.001 *	-0.001 *	-0.001 *	-0.001 *	-0.001 *	-0.001 *	-0.001 *	-0.001 *	0.000 *
	-3.280	-3.530	-2.338	-2.056	-2.716	-2.335	-2.056	-2.187	-3.126	-2.599	-1.910	-2.663
bm	0.001 *	0.001 *	0.000 *	0.000 *	0.001 *	0.001 *	0.000 *	0.000 *	0.001 *	0.001 *	0.000 *	0.000 *
	1.695	1.890	1.922	1.810	1.628	1.875	1.844	1.869	1.698	1.908	1.978	2.226
eps	0.007 *	0.007 *	0.003 *	0.002 *	0.008 *	0.009 *	0.004 *	0.009 *	0.008 *	0.009 *	0.004 *	0.005 *
	2.350	2.444	2.759	2.580	2.832	3.377	2.653	1.966	2.568	3.162	2.339	2.216
dy	-0.018	-0.023 *	-0.005	-0.018 *	-0.022 *	-0.031 *	-0.011 *	-0.008 *	-0.020 *	-0.030 *	-0.072 *	-0.026 *
	-1.526	-2.328	-1.588	-2.169	-2.005	-2.953	-2.244	-1.976	-1.704	-2.686	-1.841	-2.728
ret23	0.003	0.004	0.005	0.004	0.003	0.006 *	0.003	0.003 *	0.003	0.006 *	0.002	0.005 *
	1.081	1.426	1.118	1.323	1.133	2.390	1.140	1.979	1.089	2.369	1.682	2.525
ret46	0.009 *	0.009 *	0.005 *	0.004 *	0.009 *	0.010 *	0.001 *	0.008 *	0.009 *	0.010 *	0.008 *	0.011 *
	3.534	3.853	1.974	1.975	3.732	4.502	2.063	1.817	3.628	4.395	2.789	2.784
ret712	0.006 *	0.006 *	0.007 *	0.006 *	0.006 *	0.007 *	0.001 *	0.009 *	0.006 *	0.007 *	0.003 *	0.006 *
	3.779	4.046	2.433	2.445	4.028	4.221	2.070	2.044	3.793	4.000	1.876	2.605
1/p	0.003 *	0.002 *	0.003 *	0.009 *	0.002 *	0.002 *	0.003 *	0.002 *	0.003 *	0.002 *	0.002 *	0.002 *
	3.703	3.566	2.753	2.011	3.708	3.418	1.815	1.935	3.832	3.525	2.768	1.971
measure		-0.001 *		0.000 *		0.001 *		0.001 *		0.001 *		0.001 *
		-1.897		-1.784		1.782		2.113		2.024		2.729