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The Variation of Liquidity Risk Premium*

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ABSTRACT

New liquidity measure, based on trading volume induced by order flow as in Pastor and Stambaugh (2002) but estimated with turnover rather than with absolute level of dollar volume, is introduced and analyzed in this paper. Aggregate liquidity measures are found to well track the history of market liquidity problems. However, market price of liquidity risk, estimated as a coefficient of liquidity shock, does not show any systematic time-series behavior so we could not find the variables which have significant explanatory power for liquidity risk premium.

Keywords: Liquidity, Liquidity risk, Liquidity risk premium, Liquidity shock

INTRODUCTION

In this paper, we introduce a new liquidity measure and investigate the empirical features of this liquidity measure. In addition, we estimate the liquidity risk *premium* and analyze its time-series behavior using some ex-ante variables. Theoretically, our measure is based on Campbell, Grossman and Wang (1994, CGW thereafter) as is that of Pastor and Stambaugh's (2002), which is constructed as a measure induced by orderflow using absolute

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level of trading volume (ie, dollar volume of trade). Our new liquidity measure is based on *relative* trading volume rather than absolute trading volume. We construct our liquidity measure using each individual firm's turnover (relative trading volume). Our liquidity measure is found to track the history of market liquidity problems well and shows the different characteristics by market capitalization of firms, which is now well known: Firms with large market capitalization are more liquid than small firms.

In terms of asset pricing, great concern was shown if the given liquidity *risk* can explain the cross-sectional variation of stock returns (Amihud 1989, 2002; Pastor and Stambaugh 2002). But to our knowledge, no efforts were shown to explain the behavior of the liquidity risk *premium* in stock returns[1]. Though some papers report the estimated value of liquidity risk premium (Pastor and Stambaugh, 2002), they did not try to find out its time-varying behavior by using some pre-specified variables. In the conditional test of multifactor model, Ferson and Harvey (1991) shows some economic variables can track stock market risk premiums. In this paper, we will investigate the economic factors that explain the liquidity risk premium.

We found some evidence that the liquidity, obtained by our new measure, is cross-sectionally priced, but it depends on the different sample periods used in the analysis, thus not robust. We could not find economic variables that explain the behavior of liquidity risk premium.

LITERATURE REVIEW

Amihud and Mendelson (1989) relate the firm's liquidity problem to the availability of information and found evidence that the asset return increases with the illiquidity of the stock: the less the information about the firm is available, the more illiquid (higher bid-ask spread) the stock becomes, which makes investors require more compensation for bearing more of liquidity risk, which finally leads to higher asset return. In their subsequent study, Amihud and Mendelson (1991) extended the test assets to bonds and found yield to maturity of bonds is negatively related to liquidity, which

1) In a recent paper, Longstaff (2002) analyzed *bond* liquidity risk premium.

is measured by bid-ask spread of inter-dealer quotes. Recently, Amihud (2002) found positive cross-sectional relation between return and illiquidity, which is measured by the ratio of absolute value of return to dollar volume of trade. This ratio tries to capture the price concession by trading, thus works as an illiquidity measure in his study. By following standard Fama-MacBeth approach, this illiquidity measure was shown to be priced.

Longstaff (1995) analyzed bond liquidity premium, which is measured as the difference in yields between Treasury and non-Treasury government issued bonds, Refcorp. In a time-series regression to find significant variables for bond liquidity premium, he found that the changes in consumer confidence level, money market mutual fund, Treasury holding level of foreign investors and equity mutual funds have explanatory powers.

Chordia, Shivakumar and Subrahmanyam (2000) analyzed the cross-sectional heterogeneity in the time-series variation of liquidity, which is measured by two spread-based proxies: effective spread and quoted spread. They viewed this cross-sectional heterogeneity is from the information asymmetry and the risk of holding inventory. In a time-series, it was shown that the responsiveness of liquidity to absolute stock returns and volatility is higher for small firms though this result varies depending on the liquidity measures used. In a cross-sectional, they found return volatility, volume and firm size are strongly negatively related to the response of liquidity to stock-specific absolute return. Pastor and Stambaugh (2002) showed liquidity is a cross-sectionally priced factor using their orderflow-induced liquidity measure. By grouping stocks with pre-ranked liquidity betas or historically estimated liquidity beta in a regression with other common factors, they found significant difference in intercepts from various asset pricing models among each group.

LIQUIDITY MEASURE

Theoretical Background of Liquidity Measure

Motivation of our liquidity measure is largely from Pastor and Stambaugh (2002) whose theoretical background is based on CGW. CGW shows negative return accompanied by large trading volume is more likely to be reversed (negative serial correlation) in a later period. Key result of their study can be summarized into the following equation.

$$E[\tilde{Q}_{t+1}|Q_t, V_t] = (\phi_0 - \phi_1\tilde{V}_t)\tilde{Q}_t.$$

where *Qt* and *Vt* are excess return and trading volume at time *t*, respectively and $\varphi 1 > 0$. Though this return reversal is from the change of aggregate risk aversion of market participants, Pastor and Stambaugh (2002) successfully derived liquidity measure from the above equation. They used *dollar* amount of daily trading volume to derive the individual firm's liquidity measure.

While dollar volume denotes an absolute measure of trading volume, turnover can be interpreted as a relative measure of trading volume. The reason of using relative trading volume is as follows: First, original work of CGW used number of shares traded as a proxy for trading volume. Dollar volume, which is calculated from the multiplication of number of shares traded and the stock price, is affected by the absolute level of stock price. This tends to overvalue the trading volume of large cap stocks whose absolute level of stock price is higher than that of small caps. Second, absolute level of number of traded shares alone is not a good proxy either, especially when we are interested in volume effect on its liquidity problem. High liquidity is viewed as an ability of trading large amount of shares without affecting the stock price. But the number of traded shares itself does not give us the information of how *heavy* those tradings are. So, the trading volume should be viewed in terms of relative amount related to the total number of shares outstanding in the market. For example, let's consider stock A and B whose outstanding shares are one million and a hundred thousand, respectively. If 90,000 shares were traded in the market on a given day for each firm respectively, that amount of share trading is more likely to bring a liquidity problem to stock B. Thus, as a ratio of share trading volume and total outstanding shares, turnover may be a superior measure.

Data

Daily return, volume (number of shared traded) and number of shares outstanding of all individual common stocks (share code of 10 or 11) traded in NYSE or in AMEX (exchange code of 1 or 2) for period of Jul 1, 1962 to Dec 31, 2001 were collected from CRSP. CRSP daily value-weighted stock index for the same period is also collected from the same source. Common factors of SMB, HML and Market risk premiums (all monthly for the same period with the above) were collected from French's website. Our test assets are monthly value-weighted and equal-weighted stock returns of size-deciled portfolios downloaded from French's website.

Constructing Market-Wide Liquidity Measure

Based on Pastor and Stambaugh (2002), following regression is used to get our monthly *individual firm's* liquidity measure.

$$r_{i,d,t} - r_{m,d,t} = c_{i,t} + \xi_{i,t} r_{i,d,t} - \gamma_{i,t} sign(r_{i,d,t} - r_{m,d,t}) TOV_t + \varepsilon_{i,d,t} \quad (1)$$

Note that we use turnover (*T OVt*) instead of dollar volume as in Pastor and Stambaugh (2002). By using turnover, we are using relative volume measure rather than absolute volume. Range of absolute dollar volume varies much by company and depends on the absolute level of stock price. Especially when the liquidity is viewed as an ability of being traded without much price concession, turnover may give us a better measure of liquidity. Since the unit of the number of outstanding shares of each firm from CRSP is 1000, turnover is calculated as a dollar volume ($1 unit) divided by 1000 times of share outstanding. Also note that we inserted negative sign in front of *sign* in equation (1) to change illiquidity measure to liquidity measure.

Market-wide monthly liquidity measure is constructed as an equal-weighted average of monthly liquidity measures of each firm, $\hat{\gamma}_t = \frac{1}{N}\sum_{i=1}^{N}\hat{\gamma}_{i,t}$.

Property of Liquidity Measure

Descriptive statistics of our liquidity measure are summarized in table 1 and line-plotting is given in figure 1 to 12. Figure 1 is our aggregate market liquidity measure while figure 2-12 are from each size-deciled portfolio group. In table 1, we see significant autocorrelations in reported 5 lags for our total market liquidity measures and for liquidity measures obtained from size 2, 5, 6,

Table 1. Descriptive Statistics for Market Liquidity Measure

	total	size 1	size 2	size 3	size 4	size 5	size 6	size 7	size 8	size 9	size 10
Mean	-0.0023	-0.0016	-0.0025	-0.0018	-0.0016	-0.0016	-0.0019	-0.0051	-0.0026	-0.0019	-0.0023
Med	-0.0019	-0.0006	-0.0014	-0.0009	-0.0013	-0.0015	-0.0013	-0.0044	-0.0017	-0.0017	-0.0020
Max	0.0255	0.0635	0.0370	0.0336	0.2328	0.0468	0.0442	0.0521	0.0438	0.0590	0.0298
Min	-0.0759	-0.1196	-0.1084	-0.0699	-0.0862	-0.0498	-0.0608	-0.1497	-0.0879	-0.0515	-0.0600
Std	0.0079	0.0182	0.0141	0.0110	0.0158	0.0107	0.0097	0.0160	0.0111	0.0092	0.0069
AC (1)	0.0750	0.0240	0.0450	-0.0240	0.0280	0.0650	**0.1180**	0.0030	**0.1070**	**0.0920**	0.0440
AC (2)	**0.1310**	0.0020	**0.0930**	0.0550	0.0410	**0.1090**	**0.0770**	0.0410	**0.0680**	**0.0960**	0.0580
AC (3)	**0.0600**	0.0720	**0.0850**	**0.0990**	0.0140	**0.0680**	**0.0550**	-0.0860	**0.0400**	**0.1020**	0.0790
AC (4)	**0.0760**	-0.0490	**0.0450**	0.0460	0.0320	**0.0990**	**0.0590**	0.0160	**-0.0080**	**0.1230**	0.0660
AC (5)	**0.0980**	0.0230	**0.0860**	0.0430	0.0880	**0.1260**	**0.0490**	0.0500	**0.0820**	**0.1950**	**0.0880**

* Liquidity measure obtained by all common stocks in the data
** Liquidity measure obtained by stocks in the first size decile
*** First-order autocorrelation

Bold-faced numbers in AC rows denote significance at 10% from Q-statistics.

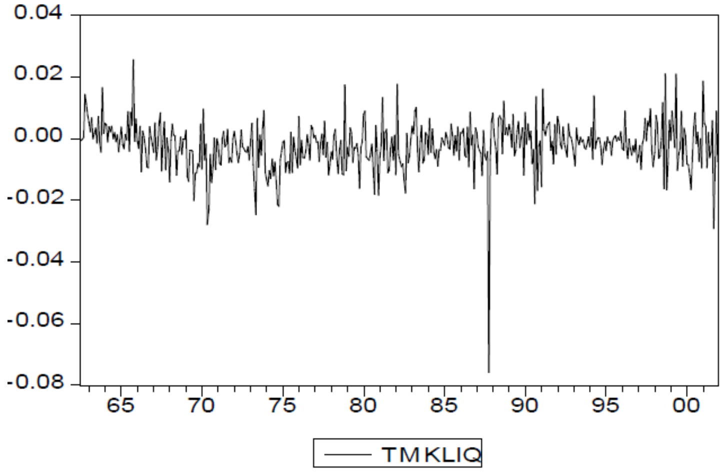

Figure 1. Total Market Liquidity Measure

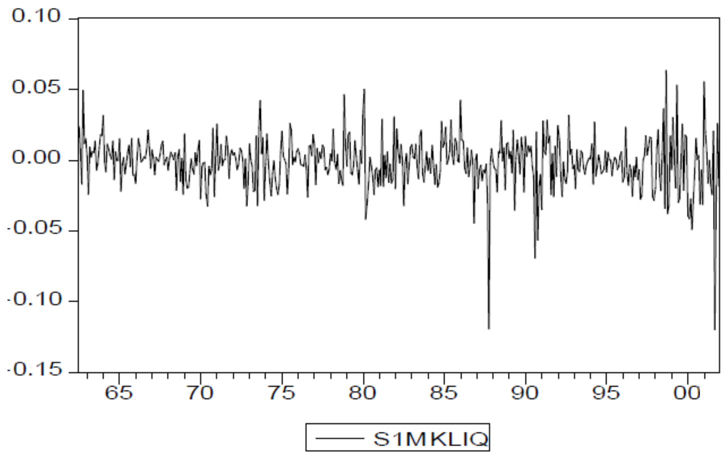

Figure 2. Total Market Liquidity Measure (Size Decile 1)

8 and 9 deciled portfolios. But for liquidity measures from other portfolios, we see only a few significant autocorrelation. Presence of autocorrelation for our total market liquidity measure requires time-series fitting to construct market liquidity *shock*. To do so, aggregate liquidity measure was fitted by ARMA(1,1), which gives us white noise residuals.[2)] Those residuals form our monthly liquidity shock,

2) When dollar volume is used instead of turnover in equation (1), re-scaling of the

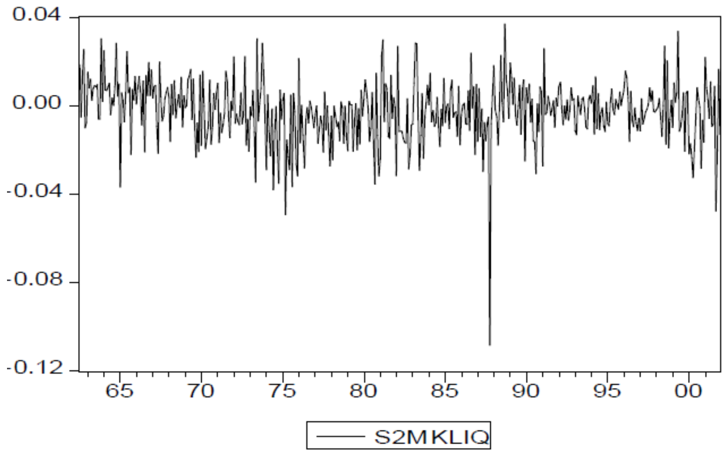

Figure 3. Total Market Liquidity Measure (Size Decile 2)

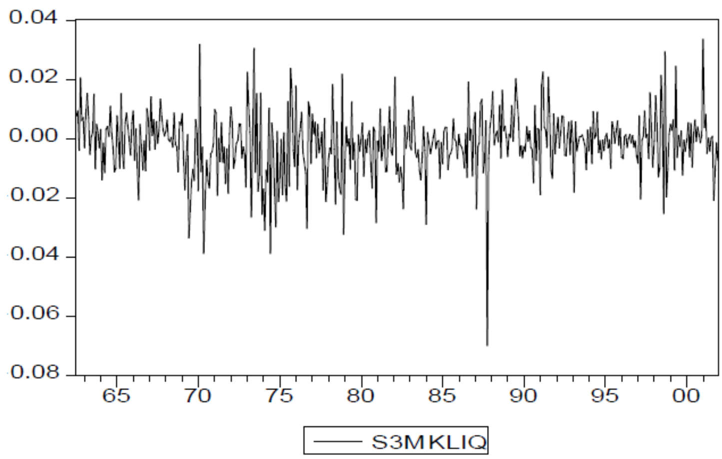

Figure 4. Total Market Liquidity Measure (Size Decile 3)

LIQt.

Figure 1-11 show the empirical features of liquidity measure.

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liquidity measure is necessary as in Pastor and Stambaugh (2002) since the trading dollar volume has increased for the past years (ie, it has clear increasing trend as a value of the currency, US dollar, changes). This is not the case for us since turnover, as a relative volume measure, does not related to the value of currency.

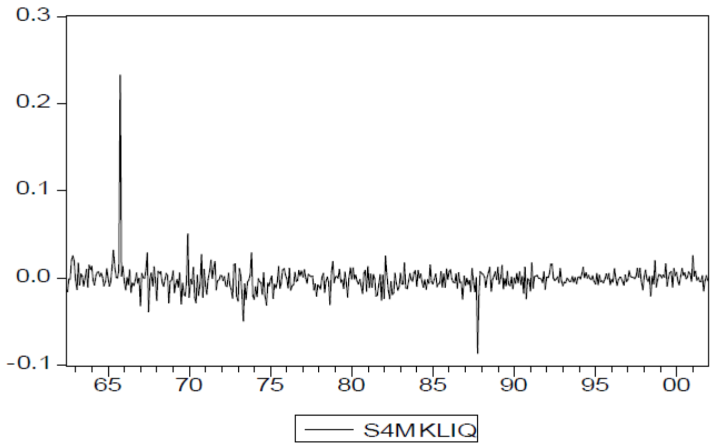

Figure 5. Total Market Liquidity Measure (Size Decile 4)

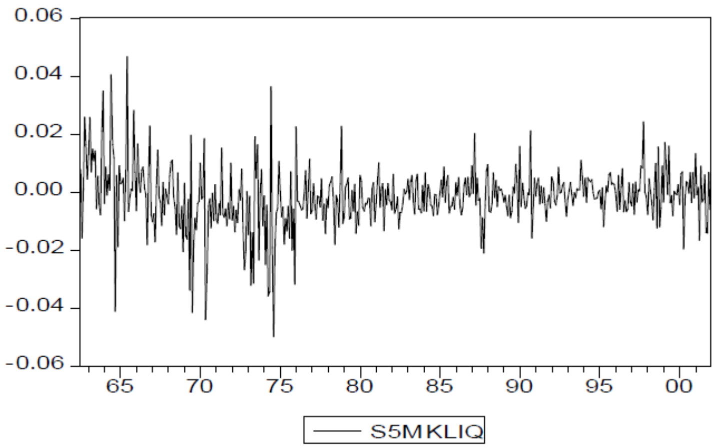

Figure 6. Total Market Liquidity Measure (Size Decile 5)

Figure 1 shows a very similar result with that of Pastor and Stambaugh (2002). It clearly shows the very highly illiquid event of October, 1987. It also captures Nov 1973 mideast oil embargo and LTCM, Russian default of 1998. We can also see this in figure 2-11. Liquidity measures from all size-deciled groups show similar results with our total market liquidity measure. It is easily noticed that as size decile increases, variation of liquidity increases: For size decile 1 (figure 2), liquidity varies from -12% to 6% while liquidity measure

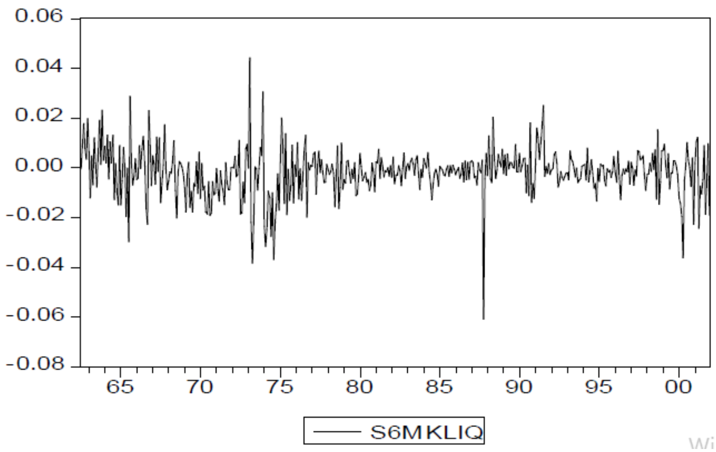

Figure 7. Total Market Liquidity Measure (Size Decile 6)

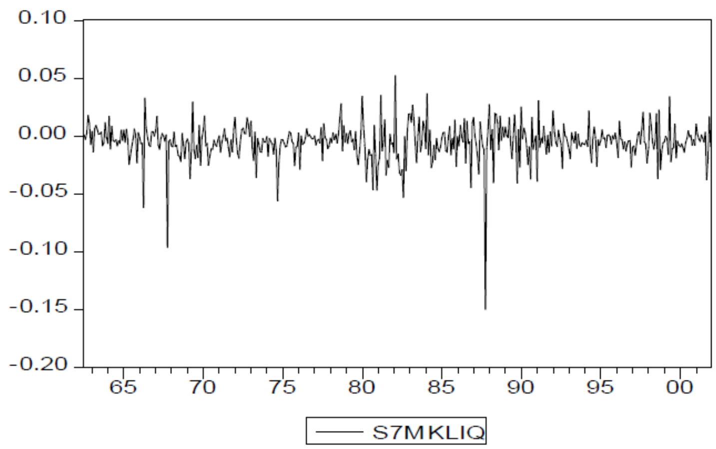

Figure 8. Total Market Liquidity Measure (Size Decile 7)

obtained from the largest size portfolio (figure 11) varies from -6% to 3%. By comparing the estimated liquidity for October 87 in figure 2 and 10, we see that small firms' liquidity level is less than -10% while that of large firms for the same period is around -5%. This implies that small firms would be affected more by liquidity risk than large firms would be.

In table 1, we see bigger range and standard deviation of liquidity for small stocks than for large firm stocks as is consistent with

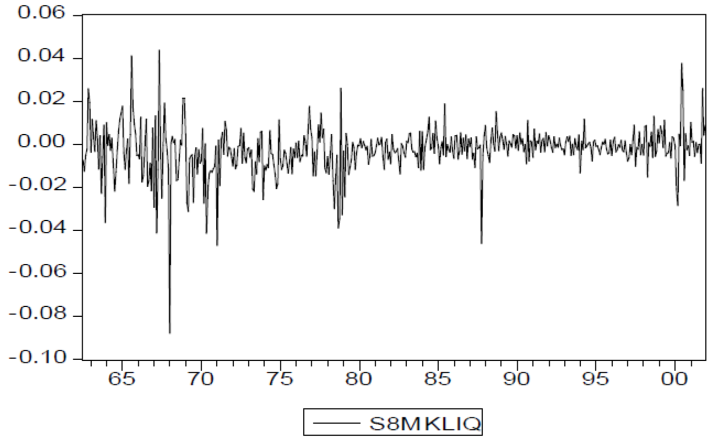

Figure 9. Total Market Liquidity Measure (Size Decile 8)

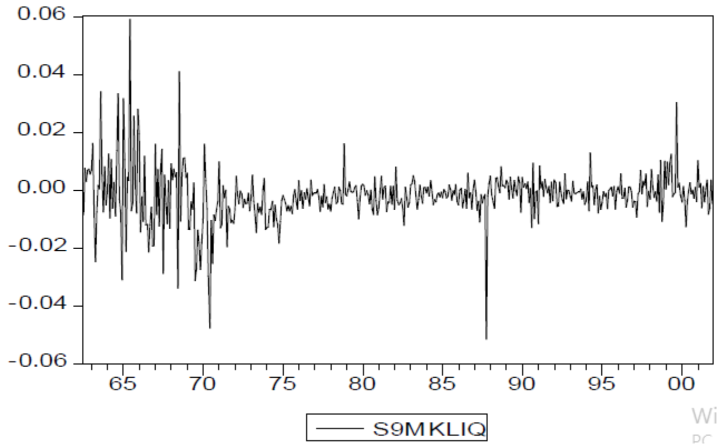

Figure 10. Total Market Liquidity Measure (Size Decile 9)

figure 2-11. Mean and medians are all negative. But we see that mean and median are not monotonic across the size-deciled portfolios. Both mean and median of liquidity of size 10 are smaller than those of size 1. This result is puzzling and seems like saying that large firms are less liquid than small firms. However, the result should be interpreted with care since, as implied by standard deviations and range, small firms' total liquidity measures are more likely to depend on few observations which act as outliers. Ie, though small firms are less liquid (thus, have small liquidity

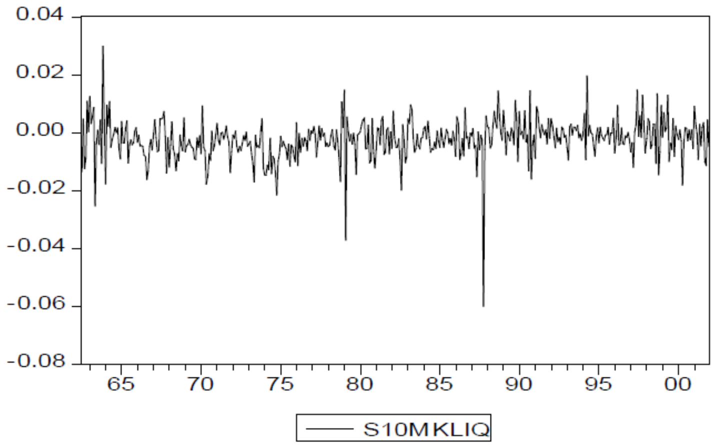

Figure 11. Total Market Liquidity Measure (Size Decile 10)

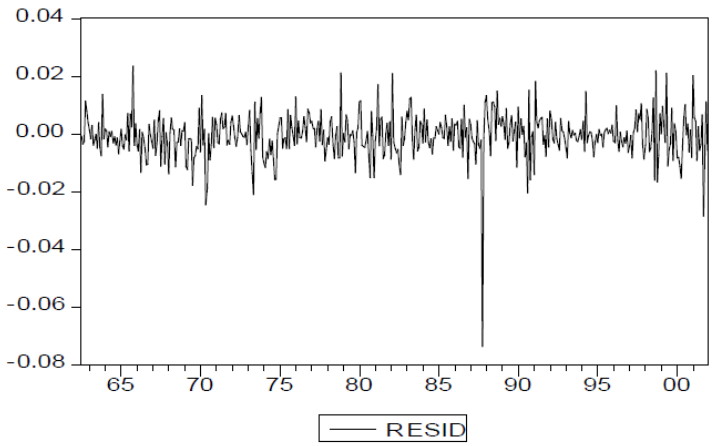

Figure 12. Total Market Liquidity Shocks (Residuals from ARMA(1,1))

measure), but larger fluctuation of liquidity level in small firm group may have contaminated the mean statistic.

IS LIQUIDITY CROSS-SECTIONALLY PRICED?

In this section, we investigate whether our liquidity measure is cross-sectionally priced. Equal-weighted and value-weighted returns from size-deciled portfolios obtained from French's website were used as test assets.[3)]

Methodology

Using the previous 60-months data (time $t-60$ to $t-1$), factor loadings for common factors of MKT, HML and SMB and the loading for liquidity (liquidity beta) were estimated in a time series regression of (2).

$$r_{i,t} - r_f = b_i^0 + b_i^M MKT_{t-1} + b_i^S SMB_{t-1} + b_i^H HML_{t-1} + b_i^L LIQ_{t-1} + u_{i,t} \quad (2)$$

where $i = 1, \cdots, 10$. Since our data begins in July, 1962, the first estimates are obtained from the data of July 1962 to June 1967. These estimated loadings are used as independent variables at time t (July, 1967) in a cross-sectional regression of excess portfolio returns on three common factors and liquidity shock in each group. This step is repeated by moving the window of previous 60-months every month. Thus, the estimated loadings are updated every month. Cross-section regression is in (3).

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3) Instead of using size as a criterion for grouping stocks, estimated liquidity beta from previous sixty months was also used for grouping stocks, though the result is not reported. While we don't need to form a portfolio group and generate the equally- or value-weighted portfolio returns in the above (since we are using French's *already-constructed* size portfolio returns), this second method should include the estimation and portfolio formation periods. The brief procedure is as follows: Every month, all individual stocks were grouped into 10 categories by estimated liquidity beta obtained from the time-series regression of excess return on factors as in (2) using previous 60 months data. If the number of observations in the previous 60 months is less than 24 (ie, less than 2 years of data in the window), those data were excluded from the window. The portfolio group, formed on July, 1967, is maintained for the next 12 months periods (ie, until June 1968). We calculated equally weighted portfolio returns for each group for the period of July 1967 - June 1968. Next, using the data of July 1963 to June 1968, we estimated liquidity beta of each company for July 1968. Again, after forming 10 portfolios by the size of estimated liquidity beta of July 1968, the equally weighted return of each portfolio was calculated for the one year period of July 1968 - June 1969. This procedure was repeated until we get the equally weighted portfolio return for the year 2001 (For the period from July 2001 to Dec 2001, estimated liquidity beta obtained by the data from the periods of July 1997 - June 2001 was used). Thus, we have 414 monthly time-series of equally weighted return for each 10 group of portfolios. Using these equally-weighted portfolio return, Fama-MacBeth (73) procedure was performed.

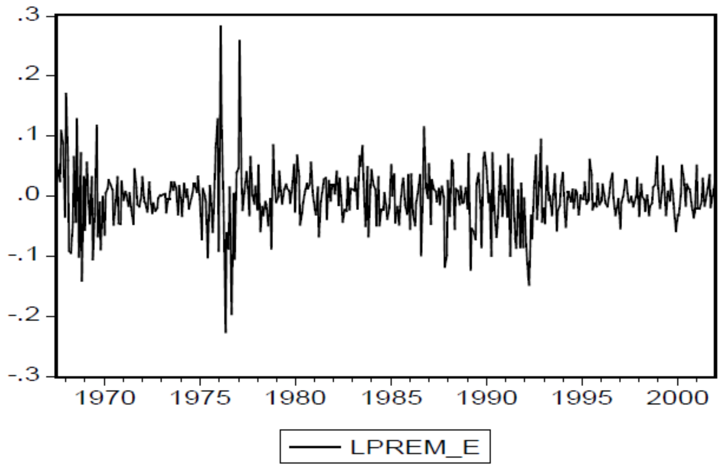

Figure 13. Estimated Liquidity Risk Premium (EWR, 7/1967 – 12/2001)

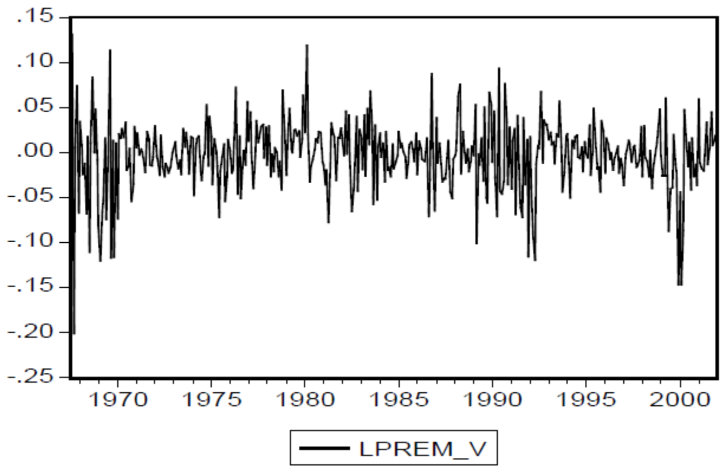

Figure 14. Estimated Liquidity Risk Premium (VWR, 7/1967 – 12/2001)

$$r_{i,t} - r_f = \lambda_{0,t} + \lambda_t^M \beta_{i,t}^M + \lambda_t^S \beta_{i,t}^S + \lambda_t^H \beta_{i,t}^H + \lambda_t^L \beta_{i,t}^L + e_{i,t} \quad (3)$$

Estimates for λ's are risk premiums of each factor.

Results

Figure 13 is the plotting of estimated liquidity risk premium from

Table 2. Estimated Risk Premiums (Equally-Weighted)

	N	Mean	Median	t-val	p-val
Panel A: 8/1967 - 12/2001					
MKT	414	-0.0231980	-0.0257530	-3.096830	**0.00105**
SMB	414	-0.0014052	-0.0026993	-0.741040	0.22955
HML	414	0.0048530	-0.0002508	1.099470	0.13610
LIQ	414	-0.0029321	-0.0016092	-1.206580	0.11414
Panel B: 8/1967 - 9/1987					
MKT	242	-0.0121670	-0.0203260	-1.709560	**0.04433**
SMB	242	-0.0005233	-0.0020755	-0.223000	0.41186
HML	242	0.0074785	0.0011867	1.299910	**0.09745**
LIQ	242	0.0001631	0.0008217	0.046755	0.48137
Panel C: 10/1987 - 12/2001					
MKT	172	-0.0387170	-0.0403530	-2.590700	**0.00521**
SMB	172	-0.0026461	-0.0033719	-0.838050	0.20160
HML	172	0.0011589	-0.0030855	0.168170	0.43332
LIQ	172	-0.0072870	-0.0056077	-2.302570	**0.01127**
Panel D: 10/1987 - 10/1997					
MKT	121	-0.0418530	-0.0547240	-2.260470	**0.01282**
SMB	121	-0.0032930	-0.0040117	-1.284190	0.10081
HML	121	-0.0073688	-0.0070872	-0.959450	0.16966
LIQ	121	-0.0102830	-0.0073532	-2.445430	**0.00798**
Panel E: 11/1997 - 12/2001					
MKT	51	-0.0312780	-0.0234790	-1.253620	0.10809
SMB	51	-0.0011113	-0.0022753	-0.126250	0.45003
HML	51	0.0213910	0.0145030	1.511630	**0.06866**
LIQ	51	-0.0001792	-0.0015131	-0.048951	0.48058

equal-weighted size portfolio returns as test assets for the period of 7/1967 - 12/2001. By comparing this with the result for value-weighted size portfolio return case (figure 14), it is easily found that equal-weighted case is more volatile than that of value-weighted. Especially, for the period 1975 - 1976 (oil shock), volatility of liquidity risk premium for equal-weighted returns is larger than that of value-weighted returns.

Table 2 and table 3 are the summary tables of the estimated liquidity risk premium for equal-weighted and value-weighted portfolio returns, respectively. As expected, liquidity risk premium is negative in most cases and significant results are all negative. This

Table 3. Estimated Risk Premiums (Value-Weighted)

	N	Mean	Median	t-val	p-val
Panel A: 8/1967 - 12/2001					
MKT	414	0.000180977	-0.005394497	0.349920	0.36329
SMB	414	0.000612324	-0.001903299	0.337100	0.36811
HML	414	0.000485774	-0.000276346	0.114370	0.45450
LIQ	414	-0.003896512	-0.001419755	-2.018490	**0.02210**
Panel B: 8/1967 - 9/1987					
MKT	242	-0.0009115	-0.0117550	-0.130910	0.44798
SMB	242	0.0021822	-0.0019149	0.951910	0.17105
HML	242	-0.0018443	-0.0018729	-0.331690	0.37021
LIQ	242	-0.0027996	-0.0002227	-1.102720	0.13563
Panel C: 10/1987 - 12/2001					
MKT	172	0.0123550	0.0069524	1.321480	**0.09447**
SMB	172	-0.0001506	-0.0014558	-0.059682	0.47626
HML	172	0.0061461	0.0061225	0.824370	0.20571
LIQ	172	0.0021663	0.0017933	0.766610	0.22243
Panel D: 10/1987 - 10/1997					
MKT	121	0.0087473	0.0029072	0.658780	0.25566
SMB	121	-0.0014468	-0.0009975	-0.585140	0.27979
HML	121	-0.0030502	-0.0006550	-0.550230	0.29161
LIQ	121	-0.0028545	-0.0001911	-0.835270	0.29161
Panel E: 11/1997 - 12/2001					
MKT	51	0.0016427	0.0065381	0.067179	0.47336
SMB	51	-0.0019518	-0.0047596	-0.240860	0.40536
HML	51	0.0199320	0.0016442	1.116310	0.13498
LIQ	51	-0.0115740	-0.0117510	-1.967430	**0.02753**

means that if there is a positive liquidity shock (ie, stock becomes more liquid), then the investors will require lower required rate of return. But the significance of liquidity risk premium is not robust by period or by test assets. In the whole sample period (panel A of each table), liquidity risk premium is highly significant for value-weighted return case (table 3) but it is insignificant in case of equal-weighted returns (table 2).

Panel E of each table show that liquidity risk premium is significant in value-weighted case while it is not in equal-weighted case. One possible reason of this is as follows. In the subperiod of 11/1997 - 12/2001, which panel E represents, we have big credit

Table 4. Regression of estimated liquidity risk premium obtained by value-weighted size portfolio returns

	CRSPV	DIVYLD	PREM	TERM	TBILL	CONSUM	FTQ	NBER	JAN
					Panel A				
coeff	0.00774	1.46618	-0.19443	-0.05952	-0.26755	0.07663		0.00447	0.00216
t-val	0.16	1.55	-0.93	-0.78	-0.28	0.27		0.79	0.30
					Panel B				
coeff		1.35415					-0.00708		
t-val		1.53					-1.44		
					Panel C				
coeff		1.34608				0.02916	-0.00705		
t-val		1.52				0.11	-1.43		
					Panel D				
coeff		1.36475	-0.10496			0.04893	-0.00697		
t-val		1.53	-0.58			0.18	-1.42		
					Panel E				
coeff		1.40684	-0.15227	-0.03541		0.04437	-0.00649		
t-val		1.57	-0.75	-0.5		0.16	-1.29		

Table 5. Regression of estimated liquidity risk premium obtained by equally-weighted size portfolio returns

	CRSPV	DIVYLD	PREM	TERM	TBILL	CONSUM	FTQ	NBER	JAN
					Panel A				
coeff	0.15964	1.58771	-0.06198	-0.25122	0.27295	-0.18727		0.00246	0.00336
t-val	2.23	1.1	-0.19	-2.17	0.19	-0.44		0.29	0.31
					Panel B				
coeff		1.39402					-0.01164		
t-val		1.03					-1.55		
					Panel C				
coeff		1.40873				-0.05285	-0.01169		
t-val		1.03				-0.13	-1.55		
					Panel D				
coeff		1.35125	0.25834			-0.09616	-0.01191		
t-val		0.99	0.92			-0.23	-1.58		
					Panel E				
coeff		1.49738	0.0959	-0.12124		-0.11195	-0.01026		
t-val		1.09	0.31	-1.13		-0.27	-1.33		

events such as LTCM and Enron. Since they are large firms, those events affected the market heavily, thus making investors concern more about the safety of their investment, which leads to moving their investment into relatively safer instruments such as Treasury (flight-to-quality). Through updating of their risk perception by these credit events (Dufresne, Goldstein and Helwege, 2002), investors move their investment from large and sound (at least 'perceived' as it is until that time) companies and this brings liquidity problems. When we use value-weighted return as our test assets, it is affected more by large firms' returns via higher weight given to them, which makes one possible explanations of the result of panel E in table 2 and 3.

Panel C and D show significant liquidity risk premiums. These are the periods that cover October 1987 stock market crash, Black Monday of 1997 and Asian financial crisis. The liquidity problem perceived by the investors became more important in this period relative to others and because these events do not separately affect large or small firms, equally-weighted return case shows significant liquidity risk premium in this period.

PREDICTABLE VARIATION IN MARKET PRICE OF LIQUIDITY RISK

In this section, we investigate the components that have explanatory power for the behavior of the market price of liquidity risk. Summary of the candidate variables are as follows:

- CRSP value-weighted index return is used as market portfolio return (CRSPV).
- Dividend yield (DIVYLD) is known to capture the variation in expected returns (Fama and French, 1988) and is popular instrument to be used as an ex-ante variable (Harvey, 1988; Ferson and Harvey, 1991). CRSP value-weighted dividend yield data was used for DIVYLD.
- Default premium (PREM) and term premium (TERM) are collected from Ibbotson Associate.
- Other important variable to be expected to capture some of the variation of liquidity risk premium is NBER business cycle index (NBER). The recession periods (from peak to trough) were

marked as one.

- January dummy (JAN) was also considered.
- One-month Treasury Bill rate (TBILL; from Ibbotson) is used as instruments.
- Consumption growth (CONSUM) is believed to be related to discount factor and was used as an instrument.

While three variables of DIVYLD, PREM and TERM are shown to be inversely related to business cycle (Fama and French, 1989), four flight-to-quality indicators are also considered as ex-ante variables though only one of them is reported in the table. Some explanations for these flight-to-quality indicators are given below.

Longstaff (2002) used percentage change in the amount of money market mutual funds as a variable to verify the flight-to-quality effect on bond yields. In this paper, we built a flight-to-quality *indicator* rather than using the change of institutional money market fund level itself. Level of institutional money market fund collected from FRB was detrended by ARMA(1,3) and its residuals were ranked into 10 groups by the size of them. The periods that have the residuals belonging to the largest residual group were marked as value of one in the indicator (and other periods have values of zero).

Other flight-to-quality indicators are from news search. Using Lexis-Nexis (for year of 1962-1989), Wall Street Journal ProQuest (1986 - 1998), Moody's bond survey (1962-1979) and Langston (1970-1979), the month that has at least one event of flight-to-quality was marked as one. *Reverse*-flight-to-quality (outflow of fund *from* Treasury after flight-to-quality occurred) was also checked from the news sources given above. If there are more than twice flight-to-quality events in a given month, then as long as there are smaller number of reverse-flight-to-quality events in that month, that month was marked as one.

With the estimated liquidity risk premium in hand, the following regression was run to investigate the variation of market price of liquidity risk:

$$\lambda_t^L = \delta_0 + \delta_1 Z_{t-1} + \nu_t^L \tag{4}$$

where Z_{t-1} includes the ex ante variables explained above. Table 4 and 5 are the summary of the result of regression (4) for value-weighted size portfolio returns as test assets (table 4) and equal-weighted size portfolio returns as test assets (table 5). Quite disappointingly, almost all ex-ante variables are insignificant except a few cases in table 5. Why?

FUTURE WORKS

Recall that we estimated liquidity risk premium on liquidity *shock* of LIQ while other premiums are estimated for the factor mimicking portfolios of MKT, SMB, and HML. Liquidity shock is a rare event, which is unsystematic itself. So, forming factor mimicking portfolio for LIQ and using it in the estimation of liquidity risk premium can be considered.[4)] Construction of factor mimicking portfolio for liquidity risk is as follows:

- By the size of monthly liquidity measure of individual stock built from the average of daily liquidity measure which is estimated by (1) within that month, sort the stock into 3 groups: high, medium and low liquidity.
- Generate equally weighed portfolio monthly return for three groups separately.
- LIQ, now as a factor mimicking portfolio return, is a monthly payoff from the long position of $1 on high liquidity portfolio and the short position of $1 on low liquidity portfolio.
- LIQ, constructed in the above way, will be used in all the analysis that we did in the previous sections.

If the liquidity risk premium which is estimated using the newly constructed LIQ contains systematic part, some of the ex-ante variables will have some explanatory powers for the behavior of liquidity risk premium. Then, as in Ferson and Harvey (1991), decomposition of predictable variation of liquidity risk premium or investigation of the sources of the predictable variation can be performed.

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