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STOCK LIQUIDITY PREMIUM ON THE TOKYO STOCK EXCHANGE

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Abstract:

The main purpose of this study is to examine whether the liquidity of firms listed on the Tokyo Stock Exchange is priced in Japanese stocks. We investigate the relationships between several types of illiquidity measures and realized stock returns by employing the portfolio formation method. We find that most of the illiquidity measures proposed in the previous literature are positively associated with stock returns. This study also examines the interrelationship among illiquidity measures, return momentum, and historical volatility. Different to the previous literature for Japanese stocks, this study finds that return spreads between illiquid and liquid portfolios are not always positive and statistically significant after controlling firms' book-to-market ratio. Thus, the liquidity premium overlaps the value premium and size premium in Japan. In addition, different types of illiquidity measures are quite differently related to momentum and volatility. Furthermore, these different associations with volatility and momentum can be explained to some extent by the book-to-market ratio.

Keywords: Illiquidity measure, Liquidity premium, Value effect, Market impact, Trading speed.

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INTRODUCTION

Nowadays, more and more researchers are emphasizing that liquidity plays an important role in the field of financial research. Many strands of literature have shown that liquidity not only has a statistically significant effect but also an economically significant effect on asset prices. These studies propose that investors require higher compensation for bearing more liquidity risk. For that reason, more illiquid stocks usually have higher expected returns (Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005; Korajczyk and Sadka, 2008). Therefore, analyzing liquidity risk is vital for fund managers to trade off risk and return, or to induce changes in investment opportunities in the market.

Liquidity is generally described as the ability of financial securities to trade within a certain period without affecting market price. However, liquidity itself is not observable and therefore, has to be estimated by different liquidity measures. Liu (2006) categorizes liquidity into four dimensions—trading quantity, trading cost, price impact, and trading speed—and points out that current liquidity measures mainly focus on a single dimension. For example, Amihud (2002) estimates liquidity from the perspective of asset returns and trading quantity. Liu (2006) emphasizes trading speed from the viewpoint of zero daily trading volume. Datar et al. (1998) use the turnover ratio as a proxy for liquidity. Pastor and Stambaugh (2003) regard price impact as sensitivity to innovations in aggregate liquidity. Lesmond et al. (1999) focus on the marginal trading cost by estimating the incidence of zero returns. Roll (1984) proposes an estimator of market spread based on the serial covariance of price changes. This study employs all aforementioned liquidity measures to cover all four liquidity dimensions summarized by Liu (2006), aiming to capture liquidity in the Japanese stock market comprehensively. This is the first novel feature of this study.

Although previous works of literature (e.g., Amihud, 2002; Pastor and Stambaugh, 2003; Liu, 2006) have proved the existence of the liquidity premium, few studies have estimated the impact of the estimation window of liquidity proxies, or the timing and frequency of rebalancing portfolios on the performance of liquidity portfolios. Ma et al. (2016) point out that there is little knowledge about how liquidity is priced in non-US markets, and thus, the investigation of funding liquidity in international markets is an important area for future study. Therefore, focusing on the Japanese stock market, this study discusses portfolio behavior among different liquidity portfolios constructed at different times, in different rebalance intervals, and by different liquidity proxies with different estimation periods. This is the second novelty of this study.

Considerable research has examined the relationships among liquidity, size, book-to-market ratio, volatility, and returns. For example, Kubota and Takehara (2010) find that size, book-to-market momentum, and liquidity are associated with long-run stock returns in the Japanese stock market. Chen et al. (2001) find a positive correlation between trading volume and the absolute value of the stock price change. Domowitz et al. (2001) show that increased volatility, acting through costs, reduces the expected return of a portfolio. Xu et al. (2006) prove that volatility and volume are persistent and highly correlated with past volatility and volume. Nevertheless, none of this research mentions the detailed relationships between these factors. Hence, this study analyzes the relationships among liquidity, size, and book-to-market ratio, as well as the interrelationship among liquidity, volatility, and momentum, aiming to provide an all-around analysis of liquidity to obtain a more conclusive result. This is the third novel aspect of this study.

The rest of the paper proceeds as follows. Section 2 introduces the research methodology and data. Section 3 explains the six liquidity measures used in the study and shows the preliminary analysis of the liquidity proxies and multiple quintile liquidity portfolios. In addition, this section examines the relationships among liquidity, size, and book-to-market ratio. Sections 4 and 5 explore portfolio behavior under different levels of construction timing and rebalancing frequency of the larger portfolio universe and by multiple liquidity proxies in different estimation windows. Section 6 investigates the interrelationship among liquidity, volatility, and momentum. Section 7 concludes.

RESEARCH METHODOLOGY AND DATA

Illiquidity measures

Numerous studies have shown that current prevalent liquidity measures mainly focus on different single aspects of liquidity and therefore, have their own limitations. This study applies six different liquidity measures to conduct the empirical analysis, in order to span almost all dimensions of liquidity. Specifically, these six liquidity measures are estimated from the perspectives of price impact, trading quantity, trading speed, and trading cost.

The first liquidity measure this study uses is proposed by Amihud (2002); it estimates the relationship between trading volume and return:

$$ILLIQ_{j,t} = \frac{1}{D_{j,t}} \sum_{d=1}^{D_{j,t}} \frac{|r_{j,d,t}|}{v_{j,d,t}} \qquad (1)$$

where $r_{j,d,t}$ is the return of stock *j* on day *d* in estimation period *t*, $v_{j,d,t}$ is the daily stock trading volume in dollars, and $D_{j,t}$ is the number of the trading days of stock *j* in the estimation period. This measure can capture the daily price response associated with 1 dollar of trading volume (Goyenko et al., 2009). In order to apply this measure, the stock must have a positive trading volume, because it is undefined if the denominator is zero.

However, if the trading costs of the security are higher than the expected trading benefits, people might prefer not to trade, and therefore, the trading volume for that security is zero. Thus, the absence of trade in a security reflects the degree of illiquidity; the more frequent the zero trading day is, the less liquid the security is. For such illiquid securities, Liu (2006) proposes a turnover-adjusted zero-return measure, namely,

$$LMx = \left[\begin{array}{l} \text{Number of zero} \\ \text{daily volumes in} + \dfrac{1/(x\text{-month turnover})}{\text{Deflator}} \\ \text{a prior } x\text{-months} \end{array} \right]$$

(2)

where *x* is the estimation period in the month, and the deflator is set up to ensure that the second term in the square brackets falls in the range of zero to one (not inclusive) for all sample stocks.

The third liquidity measure is the security's turnover, as suggested by Datar et al. (1998), and is the original inspiration of Liu's (2006) measure. The third illiquidity measure, $Turn_t$, is defined as follows:

$$Turn_t = -\frac{\#\text{shares traded in the prior } x\text{-months}}{\#\text{shares issued}} \quad (3)$$

Since a higher turnover rate means the stock is more liquid, this study computes the result of the turnover rate with minus 1 to ensure uniformity with the preceding liquidity measures.

Another liquidity measure used in this study is the regression slope γ, developed by Pastor and Stambaugh (2003); it is computed by running the following regression:

$$r^e_{j,d+1,t} = \theta_{j,t} + \varphi_{j,t} r_{j,d,t} + \gamma_{j,t}\mathrm{Sign}(r^e_{j,d,t}) \cdot v_{j,d,t} + \varepsilon_{j,d+1,t}, \quad (4)$$

where $r^e_{j,d,t}$ is the excess return of stock j above the market return on day $d+1$ in estimation period t; $r_{j,d,t}$ is the return of stock j on day d; $v_{j,d,t}$ is the trading volume in dollars on day d; and γ, which is expected to have a negative sign, is the coefficient on the signed trading volume and the liquidity proxy in this measure. Hence, this study multiplies -1 by γ in order to capture the implied price impact.

Lesmond et al. (1999) develop a limited dependent variable model to estimate the marginal costs of trades. Specifically, they define $\alpha_1 \le 0$ as the seller's transaction cost and $\alpha_2 \ge 0$ as the buyer's transaction cost. They consider the marginal cost of trade (MCT), $\alpha_1 - \alpha_2$, as a measure of illiquidity. α_1 and α_2 can be estimated by numerically maximizing a logarithm of the likelihood function.

The last liquidity measure is an estimator of the effective spread, which is proposed by Roll (1984). The intuition of Roll(1984) is that if the market is informationally efficient, the stock price should contain all current information, and there would be no serial dependence in successive price changes. When new information is released, market makers adjusts both bid and ask prices such that their average is the new equilibrium value. Therefore, the variance of observed price changes is likely to be dominated by new information, whereas the covariance between successive price changes cannot be owing to new information. Roll (1984) explains this unexplained serial covariance of price changes as an estimator of effective bid–ask spread. In detail, Roll's (1984) measure can be computed as follows:

$$RO_{j,t} = 2\sqrt{\left|Cov(\Delta P_t, \Delta P_{t-1})\right|}, \quad (5)$$

where P_t is the last observed transaction price on day t and Δ is the difference from the previous day.

Since all of the aforementioned liquidity measures do not state the optimal calculation period, this study applies both 1-year and 1-month data to compute those liquidity measures. Section 3 uses the 1-year moving estimation window to compute monthly liquidity proxies. To provide a robustness test, Section 4 re-computes the liquidity using past 1-month data and compares the results with Section 3.

Portfolio formation approach

This study first computes six liquidity proxies for all listed firms in Japan from 1978 to 2016, using a 1-year estimation window. Next, using firms listed on the Tokyo Stock Exchange (TSE) First Section as an example, this study constructs various portfolios at the end of June in each sample year and then buys and holds these portfolios for 1 year. Specifically, quintile portfolios are constructed based on multiple liquidity proxies and the performance of these portfolios is estimated. In addition, 25 book-to-market ratio and liquidity portfolios and 45 book-to-market ratio, size, and liquidity portfolios are built to investigate the relationships among liquidity premium, value effect, and size effect. To investigate the reliability of the results, this study further constructs liquidity portfolios at the end of each month and rebalances these portfolios every year and every month, separately. Then, this study expands the universe of sample firms beyond the TSE First Section and conducts similar research to that undertaken in the previous steps, so as to examine whether the results change according to different sample data. Finally, in the robustness test, the liquidity proxies are re-computed using past 1-month data and a similar analysis is performed. In summary, this study builds all possible 1,404 kinds of portfolios, to guarantee the reliability and dependability of the result. The entire scope of the research is depicted in Figure 1.

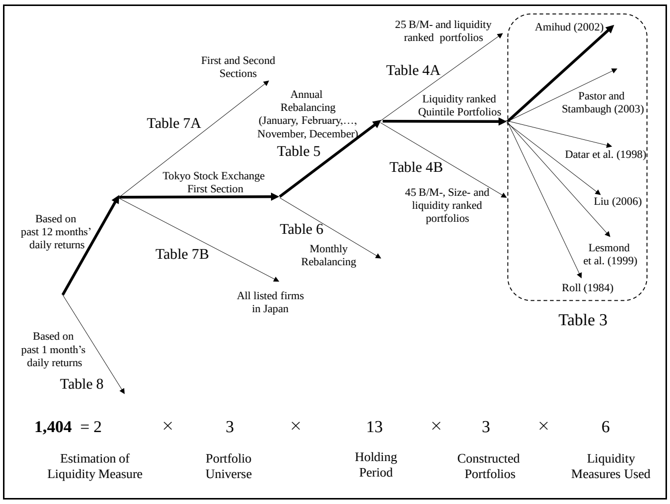

Figure 1. Scope of the research

Data and observation period

The data used in this study include daily returns, daily prices, daily trading volumes, number of shares outstanding, book-to-market ratio, and market capitalization of the stocks of all listed firms in Japan from January 1978 to December 2016. Exchange-traded funds and the Japan Real Estate Investment Trust are excluded from the sample. The primary data source is the NIKKEI NEEDS Database. For the illiquidity estimated by monthly data, the sample stocks are required to have at least 15 trading days in a month. For the illiquidity estimated by yearly data, the sample stocks are required to have at least 150 trading days in a year. After this screening process, there are 1505 sample stocks in 1980, and this number increases to 3129 stocks in 2016. The details of the numbers of sample firms are reported in Table 1.

Table 1. Number of sample firms at the end of June

Year	Tokyo Stock Exchange			Other Exchanges
	First Section	Second Section	Other Sections	
1980	926	439	0	263
1985	1024	400	0	296
1990	1153	434	0	594
1995	1219	449	0	972
2000	1131	383	0	816
2005	1550	432	34	1015
2010	1594	398	139	1090
2015	1795	486	107	779

The sample period of this study is from 1978 to 2016. The numbers shown in this table are the number of listed firms on the Tokyo Stock Exchange First and Second Sections, other sections (including Mothers Section), and the number of firms listed on other stock exchanges.

Multidimensional liquidity measures and stock returns

Variety of liquidity measures and stock returns

Table 2 reports the results of the Pearson moment correlations and Spearman rank correlations among multiple liquidity measures estimated by yearly data. It should be noted that this section includes only firms listed on the TSE First Section. The liquidity proxies are estimated at the end of June of each year from 1978 to 2016. Generally, the results of two correlation tests are very similar. The results show that ILLIQ, LMx, Turn, PS-γ, and MCT roughly have positive correlations with each other. The exceptions are negative Pearson correlations between PS-γ and ILLIQ, and between MCT and Turn. RO has a more complicated correlation pattern than the other proxies have. RO is positively correlated with ILLIQ, PS-γ, and MCT, but negatively correlated with LMx and Turn. The absolute value of the correlation results among the six liquidity proxies is between 0.001 and 0.833. In particular, LMx has the highest correlation magnitude, while PS-γ takes the lowest. Inspired by the findings of Korajczyk and Sadka (2008), this study simply infers that there are some commonalities among these liquidity measures.

Table 2. Correlations among multiple liquidity measures

	ILLIQ	LMx	Turn	PS-γ	MCT	RO
ILLIQ	1.000	0.628	0.549	0.033	0.599	0.183
LMx	0.317	1.000	0.833	0.019	0.411	-0.008
Turn	0.116	0.130	1.000	0.012	0.228	-0.078
PS-γ	-0.005	0.001	0.003	1.000	0.021	0.008
MCT	0.465	0.285	-0.040	0.007	1.000	0.325
RO	0.254	-0.048	-0.155	0.001	0.475	1.000

ILLIQ: Amihud's (2002) illiquidity measure, LMx: Liu's (2006) zero-trading volume day measure, Turn: Turnover rate, PS-γ: Pastor and Stambaugh's (2003) return reversal measure, MCT: Lesmond et al.'s (1999) marginal cost of trades, RO: Approximation of effective spread in Roll (1984). Numbers in the lower-left triangular matrix are Pearson moment correlations and those in upper-right triangular matrix are Spearman rank correlation. The sample period is from January 1978 to December 2016.

To evaluate the relationship between the liquidity proxies and stock returns, this study constructs quintile portfolios sorted by various liquidity measures. The firms are ranked in descending order and the portfolios are rebalanced at the end of June each year from 1978 to 2016. Table 3 reports the performance of the portfolios sorted by 1-year estimated liquidity measures.

Table 3. Returns from liquidity measure-ranked portfolios

	P1	P2	P3	P4	P5	Spr.	p-val.
ILLIQ	0.955	0.798	0.708	0.604	0.568	0.387	0.041
LMx	0.730	0.869	0.773	0.742	0.545	0.185	0.300
Turn	0.780	0.839	0.836	0.713	0.495	0.284	0.153
PS-γ	0.867	0.685	0.553	0.643	0.886	-0.019	0.712
MCT	0.808	0.766	0.786	0.662	0.628	0.180	0.322
RO	0.728	0.788	0.728	0.715	0.699	0.028	0.828

ILLIQ: Amihud's (2002) illiquidity measure, LMx: Liu's (2006) zero-trading volume day measure, Turn: Turnover rate, PS-γ: Pastor and Stambaugh's (2003) return reversal measure, MCT: Lesmond et al.'s (1998) marginal cost of trades, RO:

Approximation of effective spread in Roll (1984). At the end of June of years t=1978,…,2016, firms listed on the TSE First Section are ranked in descending order based on various illiquidity(liquidity) measures and liquidity-ranked quintile portfolios are constructed. Spr. denotes average monthly returns from zero-cost trading strategy (P1–P5) and p-val. denotes corresponding probability values in Welch's two-sample t-test

The results show that except PS-γ, the portfolios of illiquid stocks have higher monthly returns and the portfolios of liquid stocks have lower monthly returns. This study confirms the existence of a monotonic decreasing pattern in the quintile portfolios sorted by ILLIQ. The quintile portfolios sorted by LMx, Turn, MCT, and RO have an outlier return in the second illiquid portfolio, but a decreasing pattern is generally followed. However, for the portfolios sorted by PS-γ, the return shows a U-shaped pattern. Given the low correlations between PS-γ and other liquidity proxies, this result is not surprising.

The return spreads between the most illiquid portfolio and the most liquid portfolio under ILLIQ, LMx, Turn, MCT, and RO are all positive. Apart from that, the return spread under ILLIQ is significant at the 5% level, confirming the existence of the risk premium of liquidity. This result is in keeping with Pastor and Stambaugh (2003), Acharya and Pedersen (2005), and Korajczyk and Sadka (2008), that the investor requires more compensation when investing in more illiquid stocks.

Liquidity premium and value effect

This subsection constructs two kinds of portfolios to investigate the relationships among liquidity, book-to-market ratio, and size. Considering the monotonic decreasing pattern and significant return spread of ILLIQ-sorted portfolios in Subsection 3.1, this subsection focuses on the ILLIQ measure.

First, 25 annually rebalanced portfolios sorted by book-to-market ratio and ILLIQ are constructed. At the end of June of each year, firms listed on the TSE First Section are first ranked by their book-to-market ratio and BM-ranked quintile portfolios (BM portfolios, hereafter) are constructed. Each of BM portfolios is further divided into five groups based on the ILLIQ values. Panel A of Table 4 presents the results of the returns for each portfolio ranked in two steps. In the same BM portfolio group, the returns of liquidity portfolios still present a monotone decreasing tendency. In other words, the return spreads between the most illiquid portfolio (P1) and the most liquid portfolio (P5) are all positive, although none of them are statistically significant. In this study, the insignificance of the return spreads is interpreted as the value effect absorbing the liquidity premium. There is an overlapping between liquidity premium and value premium. Moreover, this study assumes that the liquidity premium cannot be totally captured by the value effect, considering the positive return spreads in all cases.

Table 4. Book-to-market, size, and liquidity premium

Panel A. 25 book-to-market- and ILLIQ-ranked portfolios

	P1	P2	P3	P4	P5	Spr.	p-val.
BM1	1.156	1.165	0.980	0.980	0.931	0.225	0.220
BM2	0.861	0.863	0.817	0.838	0.835	0.026	0.882
BM3	0.822	0.665	0.737	0.713	0.731	0.090	0.635
BM4	0.864	0.608	0.493	0.462	0.514	0.351	0.116
BM5	0.704	0.468	0.321	0.354	0.283	0.421	0.139

At the end of June of each year, firms listed on the TSE First Section are first ranked by their book-to-market ratio (BM) and BM-ranked quintile portfolios are constructed. Each BM quintile portfolio is further divided into five groups based on the ILLIQ values.

Panel B. 45 book-to-market-, size-, and ILLIQ-ranked portfolios

B/M	Size	P1	P2	P3	P4	P5	Spr.	p-val.
BM1	MV1	0.881	0.912	0.930	0.845	0.936	-0.055	0.788
	MV2	0.871	0.874	0.930	0.898	1.004	-0.133	0.554
	MV3	1.258	1.076	1.066	1.142	1.010	0.247	0.252
BM2	MV1	0.566	0.686	0.824	0.650	0.710	-0.144	0.432
	MV2	0.480	0.690	0.697	0.693	0.613	-0.134	0.465
	MV3	1.117	0.914	0.744	0.813	0.826	0.292	0.166
BM3	MV1	0.537	0.396	0.453	0.379	0.363	0.173	0.358
	MV2	0.420	0.439	0.327	0.349	0.288	0.131	0.483
	MV3	0.905	0.792	0.642	0.597	0.467	0.438	0.053

At the end of June of each year, firms listed on the TSE First Section are first divided into three BM groups. In the second step, each BM-ranked portfolio is further divided into three groups based on its market value of equity. Finally, each of these nine BM- and size-ranked portfolios is divided into five groups based on the ILLIQ values. As a result, 45=(3×3×5) portfolios are obtained.

For further analysis, 45 portfolios sorted by the book-to-market ratio, size, and ILLIQ are constructed. First, the sample stocks are divided into three BM portfolio groups. In the second step, each BM portfolio is further divided into three groups based on market value of equity. Finally, each of the nine BM- and size-ranked portfolios is divided into five groups based on the ILLIQ values. Panel B of Table 4 reports the results of the returns in these portfolios. When controlling the book-to-market ratio and size at the same time, the return spreads are positive in five of the nine portfolios. It is noteworthy that in BM3 (growth stock category), the return spreads are all positive. The spread is positive and significant at 10% level in BM3–MV3 portfolio (small and growth stocks). In other words, the liquidity premium exists among growth stocks. However, such a clear liquidity premium cannot be found in the value group or the neutral group. Considering the magnitude and significance of return spreads, this study finds that the liquidity premium is larger and more significant in small growth firms. Thus, this study further infers that the pricing effect of liquidity may overlap that of the book-to-market ratio and the size for some specific value and/or large cap groups. Again, considering the positive liquidity return spreads, this study concludes that there is still a liquidity risk premium in the Japanese stock market, after controlling the size effect and value effect.

Robustness checks

Timing and frequency of portfolio rebalancing

In the previous section, annually rebalanced portfolios are constructed at the end of June, since about 90% of Japanese firms' fiscal years end at the end of March and release reports promptly in May. However, this study also aims to confirm that the timing and frequency of portfolio rebalancing does not alter the results in the previous section. To demonstrate this further, portfolios with different rebalancing dates and holding periods are created.

First, based on six liquidity measures (ILLIQ, LMx, Turn, PS-γ, MCT, and RO), this study constructs quintile portfolios at the end of each month and buy and hold them for a year. Table 5 reports the details of the return spreads among these portfolios. Similar to the analysis presented in Section 3, the return spreads of portfolios constructed by PS-γ have two negative results while other positive spreads under PS-γ- sorted portfolios almost equal zero. Moreover, in the result in Table 5, only the portfolios formed by ILLIQ have a significant spread for all time. Although the return spreads under other liquidity proxies are also positive in most cases, those spreads are almost insignificant. This result is roughly the same as that in Subsection 3.1. Hence, the timing of the portfolio construction has little effect on the performance of liquidity pricing.

Table 5. Portfolio construction timing and liquidity premium

	ILLIQ		LMx		Turn	
	Spr.	*p*-val.	Spr.	*p*-val.	Spr.	*p*-val.
Jan	0.483	0.013	0.158	0.385	0.237	0.238
Feb	0.434	0.024	0.143	0.436	0.255	0.210
Mar	0.428	0.027	0.159	0.381	0.247	0.222
Apr	0.419	0.029	0.202	0.258	0.281	0.162
May	0.395	0.040	0.152	0.399	0.247	0.220
Jun	0.387	0.041	0.185	0.300	0.284	0.153
Jul	0.384	0.042	0.191	0.289	0.290	0.153
Aug	0.405	0.033	0.173	0.338	0.258	0.198
Sep	0.396	0.038	0.147	0.411	0.226	0.260
Oct	0.409	0.031	0.141	0.427	0.212	0.293
Nov	0.423	0.027	0.107	0.551	0.187	0.355
Dec	0.394	0.044	0.051	0.777	0.154	0.446

	PS-γ		MCT		RO	
	Spread	*p*-value	Spread	*p*-value	Spread	*p*-value
Jan	0.060	0.250	0.252	0.188	0.497	0.003
Feb	0.100	0.059	0.273	0.141	0.038	0.779
Mar	-0.021	0.666	0.263	0.152	0.051	0.701
Apr	0.030	0.577	0.213	0.248	0.057	0.670
May	0.025	0.626	0.223	0.229	0.032	0.805
Jun	-0.019	0.712	0.180	0.322	0.028	0.828
Jul	0.029	0.562	0.164	0.375	-0.014	0.913
Aug	0.005	0.914	0.222	0.237	0.084	0.529
Sep	0.033	0.514	0.260	0.173	0.044	0.747
Oct	0.003	0.957	0.224	0.243	0.074	0.587
Nov	0.041	0.405	0.237	0.219	0.075	0.587
Dec	0.084	0.117	0.230	0.254	0.204	0.068

Based on six liquidity measures (ILLIQ, LMx, Turn, PS-γ, MCT, and RO), quintile portfolios are constructed at the end of each month and bought and held for 1 year. Spread denotes an average monthly return spr. (P1–P5) and the *p*-val. denotes the corresponding probability value in Welch's two-sample *t*-test.

Furthermore, this study proves that the holding period has less impact on the behavior of liquidity portfolios. To verify this, the portfolios in each month are rebalanced, but are bought and held in the next month. The performances of those portfolios are presented in Table 6. Compared with the result in Table 5, the monotonic decreasing pattern of quintile portfolios is tenable only in ILLIQ, whereas the quintile portfolios constructed by other liquidity proxies show fluctuating patterns. However, similar to the result in Table 5, the return spreads between the most illiquid portfolios and the most liquid portfolios are positive in IILIQ, Turn, MCT, and RO. Moreover, the return spread is still significant for portfolios sorted by ILLIQ, at the 5% level.

Table 6. Monthly rebalancing case

	P1	P2	P3	P4	P5	Spr.	p-val.
ILLIQ	0.976	0.806	0.645	0.636	0.595	0.381	0.044
LMx	0.682	0.816	0.739	0.768	0.689	-0.007	0.967
Turn	0.708	0.809	0.716	0.774	0.689	0.018	0.920
PS-γ	0.834	0.675	0.630	0.657	0.871	-0.037	0.493
MCT	0.804	0.822	0.742	0.652	0.655	0.149	0.320
RO	0.740	0.793	0.715	0.734	0.698	0.042	0.750

The portfolios are rebalanced in each month and bought and held in the next month. The definition of the variables is the same as in Table 3.

Expansion of portfolio universe

The previous analysis uses only firms on the TSE First Section to conduct the empirical study. In order to investigate whether the results are stable for all listed firms in Japan, this subsection expands the universe of the sample data and examines the risk premium for the new liquidity portfolios that are formed using various sample universes. Table 7 reports the performance of portfolios constructed using the TSE First Section and Second Section firms, as well as portfolios constructed using all listed firms in Japan. The method to form the new liquidity portfolio is the same as that in Subsection 2.2.

Table 7. Expansion of universe and liquidity premium

Panel A. Portfolio universe is Tokyo Stock Exchange First and Second Section firms

	P1	P2	P3	P4	P5	Spr.	p-val.
ILLIQ	1.000	0.847	0.725	0.670	0.554	0.446	0.023
LMx	0.816	0.825	0.868	0.716	0.601	0.215	0.234
Turn	0.779	0.911	0.879	0.760	0.500	0.278	0.149
PS-γ	0.920	0.679	0.574	0.687	0.943	-0.023	0.614
MCT	0.845	0.857	0.769	0.711	0.637	0.208	0.243
RO	0.748	0.800	0.792	0.761	0.727	0.021	0.873

Panel B. Portfolio universe is all listed firms in Japan

	P1	P2	P3	P4	P5	Spr.	p-val.
ILLIQ	1.113	0.862	0.767	0.710	0.542	0.571	0.003
LMx	0.821	0.911	0.844	0.795	0.651	0.169	0.406
Turn	0.757	0.903	0.973	0.859	0.540	0.218	0.307
PS-γ	0.953	0.726	0.547	0.791	0.982	-0.029	0.528
MCT	0.892	0.892	0.828	0.757	0.634	0.258	0.144
RO	0.835	0.842	0.846	0.774	0.727	0.108	0.461

In summary, the result for the new quintile portfolios is similar to that in Subsections 3.1 and 4.1. The result verifies that only the quintile portfolios sorted by ILLIQ show a monotonic decreasing pattern in returns, and only the return spread among ILLIQ portfolios is significant. In addition, the return spread is negative among PS-γ portfolios, which is in keeping with the result in Table 3. Thus, this study concludes that using a different portfolio universe has little impact on the portfolio behavior. To simplify the calculation, it is reasonable to use only the firms on the TSE First Section to perform the research.

Annual estimation versus monthly estimation of illiquidity measures

In Sections 3 and 4, all the research is based on the liquidity measures that are calculated using the 1-year estimation window. In order to examine the reliability of the previous results concluded by the 1-year estimated liquidity, this subsection re-computes all six liquidity proxies based on the past 1-month data and conduct a similar analysis to that presented in Section 3. Table 8 reports the results of the portfolios constructed by 1-month estimated liquidity proxies.

Table 8. Liquidity measures estimated based on

past 1-month daily data

	P1	P2	P3	P4	P5	Spr.	p -val.
ILLIQ	0.976	0.806	0.645	0.636	0.595	0.381	0.044
LMx	0.682	0.816	0.739	0.768	0.689	-0.007	0.967
Turn	0.708	0.809	0.716	0.774	0.689	0.018	0.920
PS-γ	0.834	0.675	0.630	0.657	0.871	-0.037	0.493
MCT	0.804	0.822	0.742	0.652	0.655	0.149	0.320
RO	0.740	0.793	0.715	0.734	0.698	0.042	0.750

The definition of liquidity measures is the same as in Table 3. However, those in this table are estimated based on daily returns and trading volumes of firms listed on the TSE First Section in the month.

In Table 8, only the ILLIQ-sorted quintile portfolios show a monotonic decreasing pattern whereas all the other kinds of portfolios show fluctuating patterns. Moreover, all liquidity proxies except PS-γ and LMx have positive return spreads. The spread under ILLIQ is still significant at the 5% level.

A comparison of the results deduced from 1-year estimated liquidity with those in this section provides evidence that the conclusion related to ILLIQ is strongly justified, since all the previous robustness tests reveal a similar phenomenon, that is, the return spreads under ILLIQ portfolios are positive and significant. Therefore, this study affirms that the liquidity premium is statistically significant in the Japanese stock market. Considering the efficiency of computing liquidity proxies and the consistency of the conclusion, this study suggests using annual data to capture Japanese stock liquidity.

The interrelationship among liquidity, volatility, and momentum

Considerable research has examined the relationships between transaction cost, volatility, and realized returns. For example, Chen et al. (2001) find a positive correlation between trading volume and the absolute value of the stock price change. Domowitz et al. (2001) show that increased volatility, acting through costs, reduces the expected return of a portfolio. Xu et al. (2006) prove that volatility and volume are persistent and highly correlated with past volatility and volume. Analyzing these relationships is vital for fund managers to trade off risk and return, or to induce changes in investment opportunities in the market. However, few works have discussed the interrelationship among these three characteristics integrally. The primary goal in this section is to provide a comparative investigation of the performance of the historical volatility and cumulative returns of different liquidity portfolios.

At the end of June for each of the years 1978–2016, firms listed in TSE First Section are ranked in descending order based on an illiquidity measure and liquidity-ranked quintile portfolios are constructed. For those liquidity portfolios, this section estimates several related characteristics, including the average monthly return, the historical volatility, which is computed by using the daily return data of the past year (in %), and the cumulative return (MOM) in the previous 1-year period (in %). The results are presented in Panel A of Table 9.

In general, the patterns of volatility and momentum change according to the liquidity portfolios. Specifically, for ILLIQ portfolios, portfolio returns decrease with an ILLIQ decrease. Meanwhile, realized volatility shows a positive relationship with ILLIQ whereas the MOM shows a negative relationship with ILLIQ. ILLIQ is also positively associated with the book-to-market ratio.

For LMx portfolios, although the cumulative return approximates the same pattern as that for ILLIQ portfolios, the volatility is opposite to that of ILLIQ portfolios, which is negatively correlated with LMx. For Turn portfolios, again, both volatility and momentum are negatively associated with the turnover ratio, which is the same as in LMx portfolios. A possible explanation is that both LMx and Turn focus on trading speed and trading speed-related illiquidity measures may be negatively associated with historical volatility and past cumulative return. It is notable that for ILLIQ, LMx, and Turn, the portfolio return is negatively correlated with momentum. There are two reasons for this phenomenon. First, the momentum in Panel A of Table 9 is defined as the past 1-year cumulative return whereas the portfolio return is computed as the next 1-year average return. Second, as demonstrated by Chou et al. (2007), the contrarian trading strategy is profitable in Japan on all horizons, and thus, the past “winner” portfolios would be “loser” portfolios in the future. To conclude, it is possible that there is a negative correlation between portfolio returns and momentum in Japan.

By contrast, MCT and RO are positively associated with volatility and cumulative return. Higher MCT and RO indicate that the stock prices in the past 1-year are more stable and realized returns are lower. The interrelationship among illiquidity, volatility, and momentum is completely the opposite to that between LMx and Turn, although MCT and RO are positively correlated with stock returns in the next year.

Interestingly, RO and MCT are more weakly associated with the book-to-market ratio than LMx and Turn are. Book-to-market values across RO1 (High) and RO5 (Low) are almost constant. As for the MCT portfolio, the book-to market difference between MCT1 and MCT5 is 0.159 (=0.809-0.650) which is about half the differences in the LMx and Turn portfolios. Thus, this study assumes that the different magnitudes of value effect among MCT and RO quintile portfolios lead to different volatility and momentum patterns to those in the ILLIQ, LMx, and Turn portfolios. Furthermore, both illiquidity measures MCT and RO mainly focus on the market impact (or trading cost). It is possible that those market impact-related illiquidity measures are positively associated with historical volatility and past 1-year cumulative return. Meanwhile, trading speed-related illiquidity measures, LMx and Turn, are negatively associated with volatility and cumulative return.

In Panel A of Table 9, returns from long–short trading strategies based on illiquidity measures are no longer statistically significant after controlling the value effect. Thus, the opposite directions observed in Panel A of Table 4 can be explained by the effect of book-to-market on historical volatility and cumulative return, that is, by the overlapping between value effects and liquidity premium. To validate this prediction, this study constructs a quintile portfolio based on the book-to-market ratio of the firm and further investigates the relationship between the book-to-market ratio and illiquidity measures.

Table 9. Interrelationship among liquidity, volatility, and momentum

Panel A. Volatility and momentum of illiquidity-ranked quintile portfolios

ILLIQ	Return	HVOL	MOM	lnMV	BM
ILLIQ1	0.955	2.473	4.060	9.670	0.946
ILLIQ2	0.798	2.390	7.161	10.301	0.851
ILLIQ3	0.708	2.406	8.994	10.880	0.762
ILLIQ4	0.604	2.354	10.148	11.604	0.658
ILLIQ5	0.568	2.203	13.843	13.015	0.538
LMx	Return	HVOL	MOM	lnMV	BM
LMx1	0.730	2.050	3.736	10.248	0.921
LMx2	0.869	2.228	5.817	10.738	0.834
LMx3	0.773	2.312	7.568	11.378	0.724
LMx4	0.742	2.349	7.490	11.748	0.676
LMx5	0.545	2.886	19.587	11.359	0.601
Turn	Return	HVOL	MOM	lnMV	BM
Turn1	0.780	1.846	2.439	10.836	0.925
Turn2	0.839	2.149	2.695	10.868	0.852
Turn3	0.836	2.323	5.630	11.208	0.731
Turn4	0.713	2.492	9.763	11.396	0.661
Turn5	0.495	3.015	23.666	11.162	0.586
MCT	Return	HVOL	MOM	lnMV	BM
MCT1	0.808	2.955	11.057	10.050	0.809
MCT2	0.766	2.458	9.634	10.631	0.807
MCT3	0.786	2.269	8.723	11.051	0.759
MCT4	0.662	2.047	7.467	11.487	0.731
MCT5	0.628	2.095	7.314	12.251	0.650
RO	Return	HVOL	MOM	lnMV	BM
RO1	0.728	3.065	12.506	10.562	0.723
RO2	0.788	2.445	8.848	11.026	0.763
RO3	0.728	2.236	8.177	11.201	0.763
RO4	0.715	2.104	7.324	11.320	0.749
RO5	0.699	1.974	7.332	11.361	0.757

At the end of June of years 1978,…,2016, firms listed in the TSE First sections are ranked based on a liquidity measure and liquidity ranked quintile portfolios are constructed. Return: Average monthly return of quintile portfolios. HVOL: Historical volatility which is computed by using the daily returns of past one year (in %), MOM: Cumulative return in the previous on-year period (in %), lnMV: Logarithm of market value equity, B/M: Book-to-market ratio.

Panel B. Average liquidity of B/M ranked quintile portfolio

	BM1	BM2	BM3	BM4	BM5	Diff.	*p*-val.
BM	1.37	0.90	0.69	0.51	0.28	1.09	0.00
lnMV	10.46	10.89	11.18	11.45	11.48	-1.02	0.00
Return	1.04	0.84	0.73	0.59	0.42	0.62	0.00
ILLIQ	23.01	14.58	12.30	10.06	11.42	11.60	0.00
LMx	9.96	5.83	4.06	3.57	4.24	5.72	0.00
Turn	-18.07	-21.56	-26.57	-32.01	-43.32	25.24	0.00
MCT	240.62	219.34	208.42	202.18	232.10	8.53	0.19
RO	1.28	1.27	1.28	1.30	1.49	-0.21	0.00
HVOL	2.21	2.23	2.30	2.38	2.71	-0.50	0.00
MOM	-1.40	3.30	6.97	12.24	23.10	-24.50	0.00

At the end of June of years 1978,…,2016, firms listed on the TSE First Section are ranked based on their book-to-market ratios and a book-to-market-ranked quintile portfolio is constructed. BM1 is the highest BM portfolio (value stock) and BM5 is the lowest BM portfolio (growth stock). Diff. is the difference between BM1 and BM5 (BM1–BM5) and p-value is the probability value in the Student's t-test in which the null hypothesis is that the difference (Diff) is zero. The definition of the variables is the same as in Panel A of Table 3.

Panel B of Table 9 shows the characteristics of the quintile portfolios ranked by the book-to-market ratio. ILLIQ, LMx, and Turn are positively associated with the book-to-market ratio and the differences between BM1 and BM5 are significant at the 1% level. However, the difference of MCT between BM1 and BM5 is small and statistically insignificant (*p*-value=0.189). As for RO, the difference is negative as -0.213 and significant at the 1% level. This result confirms the previous conclusion—that ILLIQ, LMx, and Turn have higher overlap degrees with the book-to-market ratio than MCT and RO have.

As demonstrated by Chou et al. (2007), one of the biggest differences between the Japanese financial market and those of other developed countries is that the Japanese market is profitable with a contrarian strategy whereas other developed markets are profitable with a momentum strategy. Because the book-to-market ratio is positively correlated with realized returns, it is negatively correlated with the past 1-year cumulative return from the viewpoint of the contrarian strategy. Meanwhile, high realized returns are usually accompanied by high volatility, and thus, the book-to-market ratio is positively correlated with historical volatility. Since both historical volatility and past 1-year cumulative return are negatively associated with the book-to-market ratio, the different relationship between illiquidity measures and the book-to-market ratio is consistent with the inverse relationship observed in Panel A of Table 4.

CONCLUSION

This study shed lights on the interrelationship among liquidity premium, value premium, contrarian profit, and realized volatility. This study demonstrates the existence of liquidity premium even after controlling value and size effects, although the liquidity premium and value premium overlap considerably in Japan.

First, the return behavior in the quintile liquidity portfolios constructed at the end of June of each year from 1978 to 2016 is estimated. The result shows that except PS-γ, the portfolios of illiquid stocks have higher average monthly returns and the portfolios of liquid stocks have lower average monthly returns. In addition, the return spread under ILLIQ is significant at the 5% level, confirming the existence of liquidity risk premium in TSE firms. This result, that the investor requires more compensation when investing in more illiquid stocks, is supported by Pastor and Stambaugh (2003), Acharya and Pedersen (2005), and Korajczyk and Sadka (2008).

The relationships between liquidity, book-to-market ratio, and size are further investigated by using the liquidity measures estimated based on past 1-year data. When controlling the book-to-market ratio and size at the same time, the liquidity risk premium exists only in the growth firms. Thus, this study infers that the pricing effect of liquidity may overlap with that of the book-to-market ratio for some specific growth groups.

To explore whether the timing and frequency of portfolio rebalance impact the performance of liquidity portfolios, this study constructs liquidity portfolios formed at the end of each month and buy and hold them for 1 year and 1 month. The return pattern of these portfolios is generally similar to that of annually rebalanced portfolios constructed at the end of June. In other words, both the timing and rebalancing frequency have little effect on the behavior of liquidity portfolios. This study expands the portfolio universe to the whole of the Japanese stock market, and this result of liquidity portfolios remains almost consistent. In addition, all illiquidity measures are re-computed based on the past 1-month daily data and a similar analysis is conducted. Then, return spreads become much smaller and they are not always positive. Therefore, this study affirms that the estimation period of the liquidity measures has negligible influence on the performance of illiquidity-ranked portfolios and it is necessary to use larger sample data to estimate illiquidity measures.

Finally, this study analyzes the interrelationship among liquidity, volatility, and momentum. However, there are huge differences among the patterns of volatility and momentum in different liquidity portfolios. This result implies that all illiquidity measures used may place a different emphasis on information included in the past stock price and trading volume. Illiquidity measures that are related to trading speed, LMx, and Turn, are negatively associated with the historical volatility and past 1-year cumulative return. By contrast, illiquidity measures related to market impact, MCT, and RO, are positively associated with the volatility and cumulative return. By constructing book-to-market ranked quintile portfolios, this study confirms that difference in direction can be explained to some extent by the inverse relationship between the book-to-market ratio and illiquidity measures.

This study has a few important limitations. First, the influences of the change of the tick table, the bursting of the Japanese asset price bubble, and the launching of the arrowhead trading system are ignored. Moreover, this study does not consider the illiquidity measures computed using tick data, since tick data are not available for 1978. In addition, Acharya and Pedersen (2005) propose a liquidity-adjusted capital asset pricing model, which is closely related to liquidity asset pricing and thus, is worthy of further investigation. Therefore, analyzing the liquidity risks in different sample periods, for more illiquidity measures, and in more related asset pricing models are worthwhile directions for future studies.

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