Liquidity Risk and Asset Returns in Korea

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JEL classification: G12

Keywords: Asset pricing; Liquidity premium; Liquidity factor; Size effect; Value effect

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Abstract

We propose a simple way to capture the multidimensionality of liquidity. Our analysis indicates that existing liquidity measures have considerable asset specific components, which justifies our new approach. Constructing a two-factor model with the market and liquidity factor proposed in this paper, we find that our two-factor model well explains the cross-section of stock returns in Korea during 1987~2010, describing the liquidity premium, size and value effects that the CAPM and Fama-French three-factor model fail to explain. Our results also show that the role of liquidity risk on expected stock returns is especially pronounced during the post-Asian financial crisis period.

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1 Introduction

Understanding the cross-section of stock returns is one of the central research questions in financial economics. One possible way to describe the stock market behavior is to take a look at liquidity risk, since the cost of illiquidity should affect stock returns if investors require compensation for bearing liquidity risk. Based on this conjecture, researchers have investigated the role of liquidity risk in explaining the cross-section of equity returns over the last decade.

One big concern in examining the effect of liquidity risk on asset returns is the choice of liquidity measure, since liquidity is a complex concept that generally describes an asset's ability to be sold quickly without causing a significant price movement and transaction costs. Although a number of studies have proposed liquidity measures that may be able to capture parts of the liquidity concept, there is hardly a single measure that reflects all of its aspects. For example, the bid-ask spread measure in Amihud and Mendelson (1986) focuses on the trading cost, the turnover measure used by Datar et al. (1998) captures the trading quantity aspect, and the measures proposed by Amihud (2002) and Pastor and Stambaugh (2003) emphasize the concept of price impact to capture the price reaction to trading volume. In addition, Liu (2006) proposes a new liquidity measure to reflect the trading speed dimension of liquidity. It is likely that the existing measures have limited ability to describe the multidimensional aspects of liquidity fully.[1]

As one possible way to get around this problem, we propose a simple way to capture many aspects of liquidity as possible. While previous studies have considered only one specific dimension of liquidity in constructing the liquidity mimicking portfolio in the asset pricing tests, a distinctive feature of this study is a unique construction of the liquidity mimicking portfolio to incorporate the present liquidity measures together which helps to capture as many aspects of

[1] Amihud (2002) documents that a single measure cannot capture the liquidity. Pastor and Stambaugh (2003) state that any liquidity measure is somewhat arbitrary. Korajczyk and Sadka (2008) argue that each of liquidity measures may have systematic and asset-specific components.

liquidity as possible. This investigation is very important since given the multidimensional aspects of liquidity, it is premature to claim that liquidity risk is indeed an important determinant in equity returns because an explanatory power of each liquidity measure can be a result from a noisy estimate of a single fundamental risk. The measures we employ are the turnover measure proposed by Datar et al. (1998), the illiquidity measure introduced by Amihud (2002), and the number of zero trading days in Liu (2006). Specifically, we define a stock is illiquid (liquid) and include it into a low-liquidity (high-liquidity) portfolio if the stock is recognized as the least (most) liquid by all the three measures simultaneously, based on each of a 30% breakpoint. The return on the liquidity mimicking portfolio is then defined as the return difference between the two portfolios.

Constructing a two-factor asset pricing model with the market and liquidity factor proposed in this paper, we investigate the model's ability to explain the cross-section of stock returns in the Korean stock market. Specifically, we raise the following three questions. First, can the CAPM or Fama-French three-factor model explain the cross-section of stock returns in Korea? Second, does our two-factor model well explain cross-sectional patterns of stock returns including the liquidity premium if they are not explained by the CAPM and Fama-French three-factor model? Finally, does the explanatory power of our model substantially change after the Asian financial crisis of 1997-1998?

We are particularly interested in the effect of liquidity risk on stock returns in one emerging market, Korea, with the following reasons. First, as documented by Lo and MacKinlay (1990), an out-of-sample experiment can test whether findings in developed markets should be acknowledged as a worldwide phenomenon. Previous literature on liquidity is primary focused on the US market. While the US market is generally recognized as a developed market, investigating liquidity in an emerging market may provide different empirical results compared to the evidence on developed markets due to difference in the level of liquidity (Bekaert, Harvey, and Lundblad; 2007).

Second, the Korean stock market is currently one of the largest emerging markets which ranked thirteenth in terms of market capitalization as of December 31, 2010. Moreover, among emerging markets, the Korean market is experiencing explosive growth over the last decade. Worldbank estimates that market capitalization of listed companies in Korea increases from $172 billion in 2000 to $1089 billion in 2010. Therefore, the Korean market provides an ideal out-of-sample playground to investigate the effect of liquidity risk on stock returns.

The main findings of this paper are summarized as follows. First, our analysis indicates that existing liquidity measures have considerable asset specific components, which justifies our new approach of extracting the systematic component of liquidity risk from various liquidity measures.

Second, our two-factor model explains well the liquidity premium in the Korean stock market that cannot be accounted for by the CAPM and Fama-French three-factor model. The CAPM alphas display an increasing pattern from the most to the least liquid portfolios, and most of abnormal returns are positive and statistically significant. In the presence of the Fama-French factors, zero-cost portfolios buying the least and selling the most liquid portfolios create economically huge and statistically significant abnormal returns of 0.94% to 1.45% per month. On the other hand, after controlling for our two factors, the abnormal returns on the zero-cost portfolios are reduced by more than 65% compared to the CAPM or Fama-French model, and are not statistically significant. Also, the alphas no longer display monotonic patterns from the most to the least liquid portfolio. More importantly, the liquidity beta monotonically increases from the most to the least liquid portfolio, indicating low-liquidity stocks bear high liquidity risk supporting the risk-based explanation of the liquidity premium.

Third, our model explains better the CAPM-related anomalies such as the size and value premium than the CAPM or Fama-French three-factor model. While the CAPM and Fama-

French three-factor model cannot explain the return behavior of small firms, there is no small-firm effect in the presence of our two factors. Also, our specification shows better performance in explaining the value effect than the CAPM and Fama-French three-factor model. The improvement of our model in explaining these portfolios is quite striking, as test portfolios are not formed using the same characteristics as employed in constructing the factors.[2]

Finally, we document that liquidity premium is more strongly present during the post-crisis period. The mean return of the liquidity mimicking portfolio is 1.26% per month with *t*-value of 1.81 during the pre-crisis period, while it is 1.41% per month with *t*-value of 2.27 during the post-crisis period. One possible explanation is that investors' perception of liquidity risk is higher during the post-crisis period since investors learn from the crisis which occurred due to the illiquidity, as documented by Chang and Velasco (2001). In addition, compared to the CAPM and Fama-French model, the explanatory power of our two-factor model is especially highlighted during the post-crisis period. The CAPM and Fama-French three-factor model do a poor job in explaining time variation in returns of illiquid stocks during the post-crisis period. Our model, however, explains well the return behavior of illiquid stocks during the post-crisis period: abnormal returns on the two least liquid portfolios are reduced substantially compared to the CAPM and Fama-French model, and not statistically significant for any sorting variables.

A recent paper by Korajczyk and Sadka (2008) is based on the similar motivation to our work. To combine information from various liquidity measures, they employ the asymptotic principal component approach of Connor and Korajczyk (1986). However, one important disadvantage of principal component analysis is that researchers have difficulty identifying the economic intuition for the factors and determining how many components should be used to effectively

[2] For example, some argue that it is not surprising that the Fama-French three-factor model can explain the cross-section of the size and book-to-market sorted portfolios, because explanatory variables and test portfolios are formed using the same set of characteristics in the Fama-French three-factor model (Berk, 1995).

represent the original dataset. As a result, although it uses a huge dataset, there is a possibility that some critical information may be still missing, as documented by Brandt and Wang (2010).

The remainder of this paper is organized as follows. Section 2 introduces existing liquidity measures and a new approach used in this paper. Section 3 presents the data and empirical methodology. Section 4 reports the empirical results. Finally, Section 5 summarizes and presents our conclusions.

2 Existing liquidity measures and a new approach

2.1 Liquidity Measures

Liquidity is a complex concept that generally describes an asset's ability to be sold quickly without causing a significant price movement and transaction costs. According to this description, there are four dimensions to liquidity: trading quantity, trading speed, trading cost, and price impact.

To capture as many aspects of liquidity as possible, we use three different liquidity measures in this study, not depending on one specific measure.[3] The first liquidity measure is a turnover measure, proposed by Datar et al. (1998). The turnover rate of a stock is defined as the number of shares traded divided by the number of shares outstanding in that stock. Specifically, we define *TOx* as the average daily turnover rate over the prior *x* months, that is,

[3] In this paper, we do not include a liquidity measure that reflects trading cost dimension of liquidity with the following reasons. First, while liquidity proxies computed from high-frequency data are not adequate in this study since our sample covers 25 years approximately, most liquidity measures capturing trading cost dimension of liquidity are computed using high-frequency data. Second, we review some previously proposed trading cost proxies from low-frequency data, but we find that they are not appropriate for our purpose. For example, based on the serial covariance of the price changes, Roll (1984) develops an effective spread estimator. The measure yields poor empirical results when used to estimate individual stock spreads using daily data since for about half of sample securities, estimated serial covariances are positive (Harris, 1990). Hasbrouck (2009) proposes a Gibbs estimate of the effective cost based on daily closing prices, but he documents that the monthly Gibbs estimates for individual stocks would be highly biased due to small sample properties of Bayesian estimates.

$$TOx = \frac{1}{D_x} \sum_{d=1}^{D_x} \frac{\left(\text{Number of shares traded}\right)_d}{\left(\text{Number of shares outstanding}\right)_d}, \tag{1}$$

where D_x is the total number of trading days in the market over the prior x months. The high turnover rate means that the stock is actively traded, and this measure captures the trading quantity dimension of liquidity.

The second liquidity measure is the illiquidity measure of Amihud (2002), which is one of the most commonly used measures. The Amihud's measure is defined as the average ratio of the daily absolute return to the trading volume,

$$ILLIQx = \frac{1}{D_x} \sum_{d=1}^{D_x} \left| R_d \right| / VOL_d , \tag{2}$$

where R_d is the return on day d, VOL_d is the daily volume in dollars, and D_x is the number of days with nonzero trading volume over the prior x months. It can be interpreted as the daily price response associated with one unit of trading volume, reflecting the impact of order flow on price. Thus, this measure is chosen to capture the price impact dimension of liquidity.

The third one is the number of zero trading days proposed by Liu (2006). Specifically, Liu (2006) defines a liquidity measure, *LMx*, as the standardized turnover-adjusted number of zero daily trading volumes over the prior x months.

$$LMx = \left[\text{Number of zero daily volumes in prior } x \text{ months} + \frac{1/\left(x - \text{month turnover}\right)}{\text{Deflator}} \right] \times \frac{21x}{NoTD}, \tag{3}$$

where x-month turnover is computed as the sum of daily turnover over the prior x months, *NoTD* is the total number of trading days over the prior x months. For all stocks, Deflator should satisfy the following inequality,

$$0 < \frac{1/\left(x - \text{month turnover}\right)}{\text{Deflator}} < 1 .$$ [4]

The number of zero trading days captures the continuity of trading and the potential delay or difficulty in executing an order, which indicates the degree of illiquidity of each stock. Since the

[4] We use 120,000 as a deflator for constructing the *LM*6.

number of zero trading days can have only an integer value, to distinguish two stocks with the same number of zero trading days, the number is adjusted using the turnover measure as a tiebreaker, and the number is standardized to have 21 trading days in each month. The Liu's illiquidity measure reflects the trading speed dimension of liquidity.

It should be noted that all three measures can be constructed using daily stock market data. While commonly used liquidity measures such as bid-ask spreads, or signed order flows are constructed using high-frequency data, we do not use these data because high-frequency data are usually available only for much shorter time periods. Since our sample covers 25 years approximately, liquidity measures computed using high-frequency data are not adequate in this study. In contrast, the liquidity measures calculated from daily data are available for longer periods and readily used to study the time-series behavior of liquidity.

2.2 Characteristics of the existing liquidity measures

Panel A of Table 1 presents the means and medians of the firm characteristics for the sample stocks, and the three liquidity measures. The values of *TO*6, *ILLIQ*6, and *LM*6 are calculated for each stock at the beginning of each month. During our sample period, there are 3.97 zero trading volume days over the prior 6 months. Panel B shows the time-series means of the cross-sectional correlations between firm characteristics and the three liquidity measures. *TO*6 is negatively correlated with *ILLIQ*6 and *LM*6 at -0.47 and -0.75, respectively, and *ILLIQ*6 and *LM*6 are positively correlated at 0.69. These correlations imply that all three measures capture some common features of liquidity risk. However, they are not perfectly correlated – all their correlation coefficients are below 0.8 in absolute terms, which means that each of liquidity measures may have asset specific components as well.

Figure 1 displays the time-series of pairwise cross-correlations among the three liquidity measures, n*TO*6, *ILLIQ*6, and *LM*6, where n*TO*6 denotes the negative value of the *TO*6. Unlike the *ILLIQ*6, and *LM*6 measures, high *TO*6 value means that an asset is liquid, we use n*TO*6 values for computing the correlations. It appears that in any pair of the two liquidity measures, correlations vary substantially during our sample period. More importantly, at a given time, correlations computed from different pairs of liquidity measures are very different, which again confirms that each liquidity measure has significant asset specific component.

Table 2 presents the characteristics of equally-weighted decile portfolios classified by each of the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. At the beginning of each month, all stocks are ranked by each of liquidity measures. The characteristics of each portfolio are calculated as mean values at the time of portfolio formation, and the time-series averages of the portfolio characteristics are reported. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, or the lowest-*LM*6), and *B* represents the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, or the highest-*LM*6).

Consistent with Table 1, *TO*6 tends to decrease as *ILLIQ*6 and *LM*6 increase, which indicates that the systematic components of different liquidity measures are correlated. However, market values (*MV*) do not decrease from the most to the least liquid portfolio. While with the *ILLIQ*6 measure, *MV* decreases monotonically from the most to the least liquid portfolio, it is not the case with the *LM*6 measure. Furthermore, with the *TO*6-sorted portfolios, the most liquid portfolio has the lowest *MV*, and *MV* tends to increase from the highest-turnover to the lowest-turnover portfolio. Given the fact that firm size is an important determinant for the cross-section of stock returns in Korea (Yun et al., 2008), these patterns imply that the choice of a liquidity measure critically affects the explanatory power of the cross-section of stock returns. Given the inconsistency between the existing liquidity measures, one may want to extract the systematic component of liquidity risk and then employ this common component as an explanatory variable in the asset pricing tests, while acknowledging the association among the different liquidity measures.[5]

2.3 A New Approach

Over the last decade, researchers have used different liquidity measures and documented that each liquidity measure is a determinant of the cross-section of stock returns. In Figure 1 and Table 2, we provide the evidence that each liquidity measure has significant asset specific component. Therefore, the seemingly strong evidence that many suggested liquidity measures can describe the cross-section of stock returns has two possible interpretations. First, as previous studies have concluded, it indicates that liquidity risk is an important determinant in explaining the cross-section of stock returns. Second, the explanatory power is present because the noisy liquidity measures may serve as proxies for other priced risk, rather than the liquidity risk. To make this clear, one needs to combine information from different liquidity measures to construct the systematic components of liquidity risk, and investigate whether the systematic components are priced. Therefore, our study asks whether liquidity risk *does* play an important role in describing the cross-section of equity returns.

Our study has a similar motivation to the work of Korajczyk and Sadka (2008). Specifically, they employ the asymptotic principal components approach of Connor and Korajczyk (1986) to combine information from various liquidity measures. However, one important disadvantage of principal components analysis is that researchers have difficulty identifying the economic intuition for the factors and determining how many components should be used to effectively represent the original dataset. As a result, although it uses a huge dataset, there is a possibility

[5] Table 2 also indicates that liquidity risk may be served as a priced factor in explaining the cross-section of stock returns in Korea. Unlike the US evidence, firm size is still an important determinant for the cross-section of stock returns in Korea (Yun et al, 2008). Given that *MV* is a good proxy for the priced risk, illiquid stocks should have relatively low *MV*. It is because illiquid stocks have higher holding period returns than liquid stocks, which will be shown in Table 5. The patterns between firm size and liquidity measures, however, indicate that firm size is not a perfect proxy for liquidity and a liquidity premium may be robust in the presence of firm size.

that some critical information may be still missing, as documented by Brandt and Wang (2010).

As an alternative to Korajczyk and Sadka (2008), we propose a simple way to capture various aspects of liquidity risk. While previous studies have considered only one specific dimension of liquidity in constructing the liquidity mimicking portfolio, we incorporate numerous liquidity measures to capture as many aspects of liquidity as possible. Specifically, we define a stock is illiquid (liquid) and include it into a low-liquidity (high-liquidity) portfolio if the stock is recognized as the least (most) liquid by all three measures simultaneously, based on each of a 30% breakpoint. The return on the liquidity mimicking portfolio is then defined as the return difference between the two portfolios.

3 Data and empirical specification

We investigate the monthly returns of all Korea Stock Exchange ordinary common stocks over the period from January 1987 to July 2010. The average 655 stocks are included each month for this period. For each stock, daily stock price, trading volume, number of trading shares, number of shares outstanding, monthly market capitalization, and annual accounting data come from the FnGuide database. For each individual stock, monthly time-series of three liquidity measures are calculated. These liquidity measures are constructed based on the three different prior periods, 1, 6, and 12 months, respectively. We use mainly the prior 6-month-based measures and report the results using them, but the empirical results are not much different from the reported ones when we use the prior 1 or 12-month-based measures.

3.1 The explanatory returns

We perform time-series regressions to investigate whether the competing asset pricing models explain the cross-section of average stock returns. The models considered in this paper are the CAPM, Fama-French three-factor model, and a two-factor model with the market and liquidity factors.[6] Specifically, we run the following regression.

$$r_{it} - r_{ft} = \alpha_i + \beta_i' Factor_t + \varepsilon_{it} \tag{4}$$

r_{it} is the return on portfolio i at time t, r_{ft} is the risk-free rate at time t. $Factor_t$ represents explanatory variables in each model where $Factor_t$ = (MKT_t) in the CAPM, $Factor_t$ = (MKT_t, SMB_t, HML_t)´ in the Fama-French three-factor model, and $Factor_t$ = (MKT_t, LIQ_t)´ in a two-factor model with market and liquidity factors. LIQ_t represents the return on the liquidity mimicking portfolio.

The construction of the liquidity mimicking portfolio is as follows. We first rank stocks by each of the three liquidity measures at the beginning of each month. When sorting stocks, extremely high- and low-priced stocks are excluded by 5% trimming at each month, to eliminate the abnormal effect of extremely priced stocks. We form 30%, and 70% breakpoints for each liquidity measure, and construct 27 portfolios based on the three independent sorts. We then hold equally-weighted portfolios for 6-month overlapping periods. To calculate the multimonth holding period returns, we follow Liu and Strong (2008). The low-liquidity (*LL*) and high-liquidity (*HL*) portfolios are defined as follows. *LL(HL)* contains stocks which are recognized as the least (most) liquid by all three measures simultaneously, based on each of a 30% breakpoint. The liquidity mimicking portfolio, *LIQ*, is then defined as the return difference between the two portfolios.

Table 3 presents firm size, book-to-market ratio, and mean monthly returns of the 27 portfolios. For each liquidity measure, “1” represents the most liquid portfolio, and “3” means the least liquid portfolio. Consistent with intuition, stocks that have small market capitalizations, and high book-to-market ratios are recognized as less liquid in our approach. For example, the

[6] The validity of the Fama-French three-factor model in the Korean stock market has been proved in many papers. See, for example, Kim and Kim (2000), Yun et al. (2008).

market capitalizations of portfolios in group (1, 1, 1), (2, 2, 2), and (3, 3, 3) are observed as 382.31, 67.96, and 50.07 billion won, respectively. Also, stocks that the new approach identifies as less liquid tend to have higher average returns. The mean monthly return of 6-month holding period in group (3, 3, 3) is 1.81% per month, whereas it is only 0.54% per month in the most liquid group, (1, 1, 1).

Figure 2 shows the time-series of the liquidity factor over the sample period. Our liquidity factor identifies large declines in market liquidity, corresponding to major financial crises. During our sample period, the Korean stock market experienced the largest tightness in liquidity over the Asian financial crisis that began in November 1997. The liquidity factor shows much larger time variations during the period from November 1997 to March 2001 than other periods. This period also coincides with several other global events, including the Russian default in 1998 and the collapse of the US hedge fund, Long Term Capital Management. Our liquidity factor reaches its highest level of 29.51% in August 2000, and its second-highest level of 29.16% in November 1998. It seems that our measure reflects economic conditions in Korea and is able to capture market liquidity conditions.

To perform the asset-pricing tests, we construct the monthly returns of the Fama-French factors, *MKT*, *SMB*, and *HML*. *MKT* is defined as the difference between KSE value-weighted returns and risk-free rates, *SMB* is defined as the difference of the average returns of small and large stock groups, and *HML* is defined as the difference of the average returns of high and low book-to-market stock groups.[7] Following Kim and Shin (2005), a 364 day monetary stabilization bond issued by the Bank of Korea is used as a risk-free asset.[8]

Table 4 shows the time-series mean returns and correlation matrix of the liquidity mimicking

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[7] We refer the reader to section 2 of Fama and French (1993) for the construction of the Fama-French factors.

[8] We use *ex-post* holding period returns for stocks and a risk-free asset. Since monetary stabilization bond rates are *ex-ante* promised yield, we convert these rates to holding period returns for consistency. Specifically, at month *t*, we compute the monetary stabilization bond price with maturity 12 months, and at month *t*+1, we compute the bond price with maturity 11 months. With these two bond prices, we calculate the holding period returns over one month.

factor and the Fama-French three factors. *LIQ* has a high and significant mean return of 1.21% per month with its *t*-value of 2.49. The liquidity factor is negatively correlated with the market returns, and positively correlated with the *SMB*.

3.2 The returns to be explained

As test assets, we choose the liquidity, size, and book-to-market sorted portfolios, respectively. We study these portfolios with the following two reasons. First, the returns sorted on these characteristics have a large dispersion in average returns so that they represent one of the most interesting sets of portfolios in the asset pricing literature.[9] Especially, the existence of liquidity and size premium is well documented in the Korean stock market (Yun et al., 2008; Choe and Yang, 2009). Second, these portfolios have been a standard playground for evaluating asset pricing models so that we can compare our specification with the competing asset pricing models such as the CAPM and Fama-French three-factor model.

The construction of the liquidity sorted portfolios is as follows. At the beginning of each month, stocks are sorted into decile portfolios based on the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, for the sorted decile portfolios, we calculate monthly equally-weighted portfolio returns for 6-month overlapping holding periods.[10] We employ portfolios sorted by each liquidity measure as dependent variables to investigate whether the proposed model well captures the multidimensional aspects of liquidity.

Our construction of the size, and book-to-market sorted portfolios is as follows. For size

[9] We also examine the long-term contrarian strategy documented by DeBondt and Thaler (1985) and the short-term momentum strategy of Jegadeesh and Titman (1993) because they are challenging set of portfolios in the asset pricing literature. We observe only weak evidence of the long-term contrarian effect. The portfolio returns tend to increase from the long-term past winner to the long-term past loser, but their differences are not significant. Moreover, consistent with previous studies, we do not observe the momentum effect in the Korean stock market (Chui, Titman, and Wei, 2010). Therefore, we do not include them into our test assets.

[10] We report only equally-weighted portfolio returns, not value-weighted portfolio returns, because it is generally acknowledged that illiquid stocks tend to be small, so value-weighting tends to underestimate the liquidity premium.

sorted portfolios, at the end of June in year *t*, eligible stocks are sorted based on their market value of equity at the end of June in year *t*. For book-to-market sorted portfolios, at the end of June in year *t*, stocks are grouped based on the ratio of the book equity in the prior fiscal year to market equity at the end of December of the prior year. Based on each sort, stocks are grouped into 10 equally weighted portfolios and held for 12 months, from July of each year *t* to June of the next year *t*+1.[11]

Panel A of Table 5 presents the 6-month holding period returns of the equally-weighted decile portfolios classified by each of the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. *S* denotes the most liquid portfolio, and *B* is the least liquid portfolio. All three measures display a significant liquidity premium. In any case, the portfolio returns tend to increase from the most to the least liquid portfolio. In case of the *TO*6-sorted portfolios, the zero-investment portfolio (*B* - *S*) return shows highly significant premium of 1.29% per month with *t*-value of 2.37. The *ILLIQ*6-based zero-investment portfolio also displays huge premium of 1.42% per month whose *t*-value is more than two standard errors from zero.

Panel B of Table 5 shows the mean returns for the size-sorted decile portfolios. In this panel, *S* denotes a portfolio with the biggest stocks, and *B* represents a portfolio with the smallest stocks. The portfolio returns tend to increase from *S* to *B*, though the pattern is not monotonic. Especially, small stocks have statistically significant positive returns. For example, the highest mean monthly return of 2.42% per month with *t*-value of 2.80 is observed in the portfolio with the smallest stocks. Panel C of Table 5 displays mean returns for decile portfolios sorted by book-to-market ratios. *S* represents the lowest-*B/M* portfolio, and *B* is the highest-*B/M* portfolio. The portfolio returns increase almost monotonically from *S* to *B*, which indicates that value stocks earn more than growth stocks during our sample period.

[11] We also perform the asset-pricing tests with the value-weighted portfolios. Since the results are qualitatively similar, we do not report the results with the value-weighted portfolios for the sake of brevity.

4 Empirical results

4.1 Performance of portfolios sorted by liquidity measures

In this subsection, we investigate whether the competing asset pricing models explain the cross-section of liquidity sorted portfolios in the Korean stock market. First, we perform the time-series regressions of the CAPM and Fama-French three-factor model, and the estimated coefficients, their *t*-statistics, and adjusted R^2 are shown in Table 6.

Panel A presents the results for the *TO*6-sorted portfolios. The CAPM alphas display an increasing pattern from the most to the least liquid portfolio. Also, the zero-investment portfolio (B – S) return remains economically huge (1.34% per month) and statistically significant (*t*-value=2.70), after controlling for the market risk. It is noteworthy that the market betas are decreasing from S to B, and their patterns are almost monotonic. If the market beta captures the return behavior of the liquidity sorted portfolios, market betas should increase from the most to the least liquid portfolio. However, the opposite patterns are observed, which means that the market beta is not a determinant in explaining the liquidity premium. Panel B presents results for the *ILLIQ*6-sorted portfolios, and Panel C shows results for the *LM*6-sorted portfolios. The patterns of the CAPM alphas and the market betas are very similar to those of the *TO*6-sorted portfolios, indicating that the CAPM fails to explain the liquidity premium in the Korean stock market.

One may argue that employing firm size and book-to-market ratio as explanatory variables helps to account for the liquidity premium since it is well-known that liquidity is related to these characteristics. To test this conjecture, we perform the time-series regressions with the Fama-French three-factor model. Looking at the results of the Fama-French three-factor model, the liquidity premium is robust after controlling for the Fama-French factors. The zero-cost portfolios create higher abnormal returns for the *TO*6- and *LM*6-sorted portfolios than that of the

CAPM-adjusted case and statistically significant for all zero-cost portfolios. In sum, both the CAPM and Fama-French three-factor model cannot explain the liquidity premium in the Korean stock market.

We now examine the performance of our two-factor model in explaining the liquidity sorted portfolios. Table 7 presents the results for our two-factor specification. In Panel A, sample stocks are sorted by the *TO*6 measure, and a couple of features deserve highlighting. First, in a sharp contrast to the results of the CAPM and Fama-French model, any abnormal return in our two-factor model is not statistically different from zeros, except for portfolio "*D7*". Moreover, the abnormal return on the zero-investment portfolio (*B* - *S*) is reduced by 73% (75%) compared to the CAPM (Fama-French model), and is not statistically significant. Second, some desirable patterns are observed on the two-factor alphas and liquidity betas. The two-factor alphas no longer display monotonic patterns from the most to the least liquid decile portfolio. More importantly, the liquidity beta monotonically increases from *S* to *B*, indicating that low-liquidity stocks bear high liquidity risk, supporting the risk-based explanation of the liquidity premium. Panel B and C show estimates of the two-factor model on decile portfolios sorted by the *ILLIQ*6 and *LM*6, respectively. The results are very similar to those in Panel A. In sum, our two-factor model explains well the liquidity premium that cannot be explained by the CAPM and Fama-French three-factor model.[12]

For Asian markets, Lam and Tam (2011) document that liquidity is an important determinant for pricing returns in the Hong Kong stock market. However, since their liquidity factor is formed by one specific dimension of liquidity, the explanatory power can be a result from a noisy estimate of a single fundamental risk. Our study is different in that we combine

[12] In our two-factor model, however, there are some statistically significant alphas by individual *t*-tests. To test whether the two-factor alphas are jointly zeros, we perform the Gibbons, Ross, and Shanken (1989)'s *F*-test for the CAPM, Fama-French model, and our specification. For the CAPM, and the Fama-French model, the null hypothesis of zero alphas is rejected for any liquidity-sorted portfolios at the 5% significance level. For our specification, we cannot reject the null hypothesis of zero alphas at the 5% significance level for the *TO*6-sorted and the *ILLIQ*6-sorted portfolios. In case of the *LM*6-sorted portfolios, however, the null hypothesis is rejected at the 5% significance level.

information from various liquidity measures to construct the systematic components of liquidity risk, and examine whether the systematic components are priced. Therefore, the results in this subsection confirm that liquidity risk *does* play an important role in describing the cross-section of equity returns.

4.2 Performance of portfolios sorted by size and book-to-market ratios

We now examine the performance of our two-factor model on the CAPM-related anomalies, especially the size and value effect. We perform this additional experiment with the following reasons. First, since the explanatory variable and test assets are formed using the same set of characteristics, one may argue that it is not surprising that our model can explain the cross-section of the liquidity sorted portfolios. Second, one possible way to improve empirical tests is to expand the set of test portfolios, as suggested by Lewellen, Nagel, and Shanken (2010).

Panel A of Table 8 shows the results of the CAPM, Fama-French three-factor model, and our two-factor model for the size-sorted decile portfolios. *S* denotes a portfolio with the biggest stocks, and *B* represents a portfolio with the smallest stocks. The CAPM does not explain the return behavior of small firms: abnormal returns on the two smallest portfolios, “D9”, and “B” are more than 1% per month, and statistically significant. Moreover, even the Fama-French three-factor model cannot explain the size effect. After controlling for the three factors, small firms outperform large firms by 1.04% per month with *t*-value of 2.14.

In our two-factor specification, however, there is no small firm effect. All two-factor alphas are not significantly different from zeros in their individual *t*-tests, except for the portfolio with the biggest stocks. It should be noted that the market betas of the two-factor model are almost identical, but the liquidity beta is increasing from *S* to *B*. This indicates that small firms earn more than large firms, not due to higher market risk, but due to higher liquidity risk. This evidence supports that the two-factor model can explain the size effect much better than the

CAPM and Fama-French three-factor model.

Panel B of Table 8 shows performance of our two-factor model for decile portfolios sorted by book-to-market ratios. *S* denotes the lowest-*B/M* decile portfolio, and *B* refers to the highest-*B/M* decile portfolio. After controlling for the market beta, the value effect still remains: the CAPM alphas display an increasing pattern from the lowest-*B/M* decile portfolio to the highest-*B/M* decile portfolio, and some abnormal returns on stocks with relatively higher B/M ratios are statistically significant. The Fama-French three-factor model does a much worse job in explaining the cross-section of the portfolios sorted by *B/M* than the CAPM. After controlling for the Fama-French three factors, the zero-cost portfolio still creates significant return of 1.12% per month with *t*-value of 2.28.

The two-factor model shows better performance in explaining the value effect than two other models. The abnormal returns of stocks with relatively higher *B/M* ratio are reduced substantially, and not statistically significant. In a sharp contrast to the results of the size-sorted portfolios, the market beta is increasing almost monotonically from the lowest-*B/M* decile to the highest-*B/M* decile, and the liquidity beta seems to be U-shaped from *S* to *B*. Therefore, it seems that the market beta plays an important role in explaining the value effect in the Korean stock markets. Also, adding liquidity factor especially helps to explain the return behavior of the value stocks. In sum, the results in this subsection show that our two-factor model is able to capture the size and the value premium, which are not explained by the CAPM and Fama-French three-factor model.

4.3 Sub-sample period results

The Korean stock market underwent a structural break during our sample period. That is, Korea experienced the first financial crisis of the postwar period in 1997~1998. Figure 2 shows large fluctuations in liquidity risk during this period. If a structural break is present, investors may learn about underlying parameters that can have an important influence on the risk-return tradeoff (Hansen, 2007). Since it is well-known that financial crisis occurred due to the illiquidity, investors' perception of the liquidity risk is likely to be higher during the post-crisis period (Chang and Velasco, 2001). Thus, we conjecture that the liquidity premium is more strongly present during the post-crisis period than the pre-crisis period. Also, the role of liquidity risk on expected stock returns may be highlighted during the post-crisis period. In this subsection, we investigate whether this is indeed the case.

Following Baek, Kang, and Park (2004), we define the financial crisis period as between November 1997 and December 1998. Table 9 shows the sub-period returns of the decile portfolios sorted by the three liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Panel A reveals the results for the pre-crisis period (1987.1~1997.10), and Panel B displays the results for the post-crisis period (1999.1~2010.7). During the pre-crisis period, the least liquid portfolio has economically huge and statistically significant return for each of the three measures. In addition, strong liquidity premium of the *ILLIQ*6-sorted portfolio is observed during this period. Panel B indicates that liquidity premium is more strongly present during the post-crisis period. For the three measures, most returns from the sixth to the least liquid decile portfolios are positively significant. Moreover, for the *TO*6- and *LM*6-sorted portfolios, the zero-cost portfolios that buying the least and selling the most liquid portfolio create statistically positive returns. We also calculate the mean values of our liquidity factor, *LIQ*. The mean return of 1.26% per month with *t*-value of 1.81 is observed during the pre-crisis period, and it is 1.41% per month with *t*-value of 2.27 during the post-crisis period. These evidences indicate that liquidity premium is more strongly present during the post-crisis period.

We now investigate whether the explanatory power of the competing asset pricing models changes after the Asian financial crisis of 1997-1998. Table 10 reports the results during the pre-crisis period, and Table 11 shows the results during the post-crisis period.

Several features of the empirical findings are worth highlighting. First, the explanatory power of the CAPM and Fama-French three-factor model has weakened during the post-crisis period. While the poor performance of the models is observed among extremely illiquid stocks during the pre-crisis period, the CAPM and Fama-French model cannot explain the return behavior of most portfolios during the post-crisis period. Moreover, for any sorting variable, abnormal returns of the zero-cost portfolios from buying the least liquid and selling the most liquid stocks are positively significant in the Fama-French three-factor model during the post-crisis period.

Second, while the overall performance of our two-factor model is better than that of the CAPM and Fama-French model, the improvement is especially pronounced during the post-crisis period. During the pre-crisis period, (1) in contrast with the results of the CAPM and Fama-French model, abnormal returns of our model on the least liquid portfolios are not statistically significant for the *TO*6- and *LM*6-sorted portfolios, (2) when stocks are sorted by the *ILLIQ*6 measure, however, the abnormal return of the least liquid portfolio is 1.27% per month with *t*-value of 2.12, and (3) the abnormal return on the zero-cost portfolio is positively significant. However, our model well explains the return behavior of illiquid stocks during the post-crisis period: abnormal returns on the two least liquid portfolios, "D9", and "B" are reduced substantially compared to the CAPM and Fama-French model, and not statistically significant for any sorting variables. In addition, *t*-statistics for the zero-cost portfolios are less than two standard errors from zero for all panels. In sum, Table 11 shows that the role of liquidity risk on stock returns is highlighted during the post-crisis period. In the presence of our two factors, however, some statistically significant alphas are observed by individual *t*-tests. Therefore, it appears that our two-factor model could still be missing some important determinants of the cross-section of the stock returns in Korea.

5 Conclusion

Researchers have documented the role of liquidity risk in explaining the cross-section of stock returns over the last decade. We provide the evidence that each liquidity measure has significant asset specific component. Therefore, the seemingly strong evidence that many suggested liquidity measures can describe the cross-section of stock returns has two possible interpretations. First, as previous studies have concluded, it indicates that liquidity risk is an important determinant in explaining the cross-section of stock returns. Second, the explanatory power is present because the noisy liquidity measures may serve as proxies for other priced risk, rather than the liquidity risk. To make this clear, we propose a simple way to capture the various aspects of liquidity, and examine whether liquidity risk *does* play an important role in describing the cross-section of equity returns. Constructing a two-factor asset pricing model with the market and liquidity factor proposed in this paper, we investigate the model's ability to explain the cross-section of stock returns in the Korean stock market.

Our analysis indicates that the existing liquidity measures have considerable asset specific components, which justifies our new approach of extracting the systematic component of liquidity risk from various liquidity measures. Our two-factor specification explains well the liquidity premium in the Korean stock market that cannot be accounted for by the CAPM and Fama-French three-factor model. After controlling for our two factors, the abnormal returns on the zero-cost portfolios are reduced by more than 65% compared to the CAPM or Fama-French model, and are not statistically significant. Our model also explains the CAPM-related anomalies such as the size and value premium better than the CAPM or Fama-French three-factor model. While the CAPM and Fama-French three-factor model cannot explain the return behavior of small firms, there is no small-firm effect in the presence of our two factors. Finally, the role of liquidity risk on equity returns is especially pronounced during the post-crisis period.

Our empirical findings confirm the role of liquidity risk in describing the cross-section of stock returns. Given many anomalous return behaviors which the present asset pricing models cannot explain, our paper suggests that further investigation of liquidity risk can be one possible direction for future research. Although we attempt to capture multidimensional aspects of liquidity, various liquidity measures other than the three measures are needed to extend this line of research.

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Table 1. Summary statistics for three liquidity measures

Panel A of this table presents the mean and medians of the firm characteristics for the sample stocks, and the three liquidity measures. Panel B shows the time-series mean of the cross-sectional correlations between firm characteristics and the three liquidity measures. *MV* is market value measured in billions of KRW; *B/M* is the book-to-market ratio; *TO*6 is the average daily turnover over the prior 6 months; *ILLIQ*6 is the daily ratio of the absolute return to the trading volume averaged over the prior 6 months; *LM*6 is the standardized turnover-adjusted number of zero daily trading volumes over the prior 6 months. The results include all KSE ordinary common stocks over the period January 1987 to July 2010.

Panel A: Descriptive statistics					
	MV (bil. KRW)	*B/M*	*TO*6 (%)	*ILLIQ*6 (in 1/1000)	*LM*6
Mean	408.47	0.76	1.28	8.62	3.97
Median	52.86	0.42	0.70	0.53	0.45
Panel B: Correlation matrix					
	MV	*B/M*	*TO*6	*ILLIQ*6	*LM*6
MV	1.00				
B/M	-0.37	1.00			
*TO*6	-0.11	0.35	1.00		
*ILLIQ*6	-0.68	0.05	-0.47	1.00	
*LM*6	-0.22	-0.23	-0.75	0.69	1.00

Table 2. Characteristics of portfolios sorted by the three liquidity measures

The table reports the characteristics of equally-weighted decile portfolios classified by each of the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. At the beginning of each month, eligible stocks are sorted based on their three liquidity measures. The characteristics of each portfolio are calculated as mean characteristic values at the time of portfolio formation, and the time-series averages of the portfolio characteristics are reported. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, the lowest-*LM*6), *B* denotes the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, the highest-*LM*6). *MV* is market value measured in billions of KRW; *B/M* is the book-to-market ratio; *TO*6 is the average daily turnover over the prior 6 months; *ILLIQ*6 is the daily ratio of the absolute return to the trading volume averaged over the prior 6 months; *LM*6 is the standardized turnover-adjusted number of zero daily trading volumes over the prior 6 months. The sample period is from January 1987 to July 2010.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*
Panel A: Characteristics of the *TO*6-sorted portfolios										
MV (bil. KRW)	76.44	190.93	294.25	343.81	366.04	415.91	372.93	365.03	293.53	310.98
B/M	0.95	0.83	0.72	0.68	0.68	0.64	1.03	2.21	3.37	0.65
*TO*6	5.03	2.08	1.40	1.04	0.79	0.61	0.46	0.34	0.22	0.09
*ILLIQ*6	1.15	0.95	1.12	2.19	2.02	2.87	3.61	4.61	8.60	29.83
*LM*6	1.37	1.14	1.17	1.28	1.64	2.17	2.74	3.84	6.60	23.17
Panel B: Characteristics of the *ILLIQ*6-sorted portfolios										
MV (bil. KRW)	2,100.29	388.80	159.66	106.26	71.57	57.77	50.48	45.18	40.26	28.12
B/M	0.44	0.50	0.57	0.60	0.63	1.82	3.10	2.00	0.99	1.07
*TO*6	1.22	1.72	1.85	1.68	1.45	1.23	1.05	0.87	0.66	0.40
*ILLIQ*6	0.02	0.05	0.11	0.21	0.38	0.67	1.15	2.03	4.59	47.63
*LM*6	0.42	0.44	0.50	0.71	1.15	1.98	3.41	5.16	8.66	22.11
Panel C: Characteristics of the *LM*6-sorted portfolios										
MV (bil. KRW)	94.58	240.95	355.51	395.36	455.12	406.31	428.94	344.37	224.94	84.61
B/M	0.87	0.74	0.64	0.64	0.61	0.59	2.23	3.42	0.67	1.32
*TO*6	4.49	1.83	1.22	0.91	0.70	0.56	0.42	0.38	0.62	1.02
*ILLIQ*6	0.31	0.36	0.43	0.70	0.83	1.22	1.92	4.15	8.22	38.03
*LM*6	0.00	0.00	0.02	0.08	0.29	0.71	1.49	3.15	7.18	31.43

Table 3. Firm size, book-to-market raio, and mean monthly returns of the 27 portfolios

This table presents firm size, book-to-market ratio, and mean monthly returns of the 27 portfolios sorted by the three liquidity measures, turnover, illiquidity measure of Amihud (2002), and number of zero trading days proposed by Liu (2006). Specifically, we first rank stocks by each of the three liquidity measures at the beginning of each month. We form 30%, and 70% breakpoints for each liquidity measure based on the rankings, and construct 27 portfolios based on the three independent sorts. We then hold equally-weighted portfolios for 6-month periods. To calculate the multimonth holding period returns, we follow Liu and Strong (2008). For each liquidity measure, "1" represents the most liquid portfolio, and "3" means the least liquid portfolio. Firm size is measured in billion won. The sample period covers from January 1987 to July 2010.

TO6	ILLIQ6	Panel A: Size			Panel B: Book-to-Market			Panel C: Returns (%)		
		LM6			LM6			LM6		
		1	2	3	1	2	3	1	2	3
1	1	382.31	64.92	362.34	0.62	0.58	1.09	0.54	0.52	-2.60
1	2	31.29	18.97	35.23	0.81	0.53	1.20	1.34	1.54	-0.27
1	3	15.67	12.02	19.70	1.39	0.72	1.49	2.29	2.38	0.82
2	1	683.60	1,025.08	750.78	0.44	0.40	0.73	1.01	1.02	0.74
2	2	48.84	67.96	72.70	0.68	0.83	0.85	1.46	1.44	1.32
2	3	18.39	24.21	24.25	1.38	1.11	1.31	2.41	2.57	1.92
3	1	411.44	1,839.14	2,880.82	0.46	0.32	0.29	0.74	0.93	1.40
3	2	191.28	119.58	163.36	0.36	3.79	4.20	1.40	1.14	1.08
3	3	173.76	42.53	50.07	0.56	1.01	1.44	1.69	2.17	1.81

Table 4. Mean factor returns and correlations among factors

This table shows the time-series mean returns and correlation matrix of the liquidity factor (*LIQ*) and the Fama-French factors. The mimicking liquidity factor (*LIQ*) is constructed as follows. At the beginning of each month, all KSE ordinary common stocks are sorted by their three liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, two portfolios, low-liquidity (*LL*) and high-liquidity (*HL*), are formed. *LL* contains the least liquid stocks which are recognized by all three measures using 30% breakpoint. Similarly, *HL* contains the most liquid stocks. The two portfolios are held for six months and *LIQ* is constructed as the monthly return from buying one unit of equally weighted *LL* and selling one unit of equally weighted *HL*. *MKT*, *SMB*, *HML* are the Fama-French factors which are constructed by the same method used by Fama and French (1993). Numbers in parentheses are *t*-statistics. The sample period covers from January 1987 to July 2010.

	MKT	*SMB*	*HML*	*LIQ*
Mean (%)	0.30	0.38	-0.12	1.21
	(0.50)	(0.91)	(-0.26)	(2.49)
Correlation matrix				
MKT	1.00			
SMB	-0.24	1.00		
HML	0.33	0.15	1.00	
LIQ	-0.51	0.28	-0.14	1.00

Table 5. Returns on portfolios sorted by the three liquidity measures, *MV*, and *B*/*M*

Panel A of this table present the 6-month holding period returns of the equally-weighted decile portfolios classified by each of the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. At the beginning of each month, stocks are sorted into decile portfolios based on the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, for the sorted decile portfolios, the monthly equally-weighted portfolio returns for 6-month overlapping holding periods are calculated. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, or the lowest-*LM*6), and *B* represents the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, or the highest-*LM*6). *T*-values are in the parentheses. Panel B and C reveal returns sorted on the size and book-to-market ratio, respectively. For size sorted portfolios, at the end of June in year *t*, eligible stocks are sorted based on their market value of equity at the end of June in year *t*. For book-to-market sorted portfolios, at the end of June in year *t*, stocks are grouped based on the ratio of the book equity in the prior fiscal year to market equity at the end of December of the prior year. Based on each sort, stocks are grouped into 10 equally weighted portfolios and held for 12 months, from July of each year *t* to June of the next year *t*+1. In Panel B (C), *S* denotes a portfolio with the biggest stocks (lowest *B/M* ratio stocks), and *B* represents a portfolio with the smallest stocks (highest *B/M* ratio stocks). The *t*-values are in the parentheses. The sample period covers from January 1987 to July 2010.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel A : Liquidity sorted portfolios											
Ret (*TO*6)	0.22	1.13	1.36	1.44	1.51	1.43	1.63	1.62	1.58	1.50	1.29
t-value	(0.29)	(1.67)	(2.07)	(2.27)	(2.47)	(2.38)	(2.81)	(2.84)	(2.92)	(3.22)	(2.37)
Ret (*ILLIQ*6)	0.89	0.75	1.01	0.89	1.13	1.39	1.57	1.72	1.84	2.31	1.42
t-value	(1.48)	(1.21)	(1.64)	(1.44)	(1.82)	(2.25)	(2.58)	(2.75)	(2.88)	(3.30)	(2.14)
Ret (*LM*6)	0.54	1.28	1.31	1.55	1.35	1.48	1.53	1.53	1.46	1.44	0.90
t-value	(0.73)	(1.93)	(2.04)	(2.51)	(2.23)	(2.48)	(2.63)	(2.66)	(2.43)	(2.49)	(1.68)
Panel B : size-sorted portfolios											
Ret (*MV*)	1.04	0.92	0.84	0.91	0.97	1.25	1.33	1.45	1.73	2.42	1.38
t-value	(1.80)	(1.60)	(1.43)	(1.61)	(1.56)	(2.11)	(2.11)	(2.37)	(2.63)	(2.80)	(1.74)
Panel C : book-to-market-sorted portfolios											
Ret (*B*/*M*)	0.83	0.90	1.05	1.19	1.19	1.39	1.48	1.38	1.69	1.96	1.13
t-value	(1.69)	(1.78)	(1.97)	(2.11)	(2.07)	(2.29)	(2.37)	(2.11)	(2.30)	(2.11)	(1.39)

Table 6. Performance of the CAPM and Fama-French model on portfolios sorted by liquidity

This table reports abnormal returns estimated from the capital asset pricing model (CAPM)

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \varepsilon_{it} ,$$

and the Fama-French three-factor model

$$r_{it} - r_{ft} = a_i + b_i (r_{mt} - r_{ft}) + s_i SMB_t + h_i HML_t + \varepsilon_{it} ,$$

where r_{it} is the return of portfolio *i* in month *t*, r_{ft} is the 364-day monetary stabilization bond rate for month *t*. r_{mt}, SMB_t, and HML_t are Fama-French three factors. The construction of the liquidity sorted portfolios is as follows. At the beginning of each month, stocks are sorted into decile portfolios based on the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, for the sorted decile portfolios, the monthly equally-weighted portfolio returns for 6-month overlapping holding periods are calculated. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, the lowest-*LM*6), *B* denotes the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, the highest-*LM*6), and *B* - *S* denotes the difference between *B* and *S*. The *t*-statistics are shown in parentheses, and the adjusted R^2 values are provided in the final row. The sample period covers from January 1987 to July 2010.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B* - *S*
Panel A : *TO*6-sorted portfolios											
CAPM-adjusted performance											
$\hat{\alpha}$	-0.40	0.50	0.72	0.77	0.84	0.75	0.97	0.96	0.94	0.94	1.34
	(-0.75)	(1.14)	(1.82)	(2.14)	(2.50)	(2.43)	(3.06)	(2.86)	(2.90)	(2.74)	(2.70)
$\hat{\beta}$	0.87	0.86	0.87	0.86	0.83	0.84	0.79	0.75	0.71	0.51	-0.36
	(16.34)	(19.80)	(22.09)	(23.81)	(24.89)	(27.46)	(25.12)	(22.34)	(21.98)	(15.02)	(-7.30)
R^2	0.49	0.58	0.64	0.67	0.69	0.73	0.69	0.64	0.63	0.45	0.16
Fama-French three-factor-adjusted performance											
$\hat{a}$	-0.70	0.24	0.47	0.54	0.63	0.55	0.78	0.77	0.74	0.75	1.45
	(-1.96)	(0.86)	(2.00)	(2.65)	(3.24)	(2.87)	(3.70)	(3.22)	(3.01)	(2.71)	(3.20)
$\hat{b}$	0.97	0.95	0.96	0.93	0.90	0.92	0.87	0.82	0.80	0.60	-0.37
	(24.31)	(31.06)	(37.08)	(40.88)	(41.81)	(42.91)	(37.15)	(31.17)	(29.21)	(19.54)	(-7.35)
$\hat{s}$	0.91	0.78	0.75	0.68	0.63	0.57	0.56	0.57	0.53	0.51	-0.40
	(16.46)	(18.47)	(20.82)	(21.61)	(21.02)	(19.28)	(17.46)	(15.52)	(13.96)	(12.05)	(-5.70)
$\hat{h}$	0.21	0.16	0.13	0.15	0.14	0.09	0.08	0.08	-0.01	-0.01	-0.22
	(4.26)	(4.29)	(4.09)	(5.09)	(5.17)	(3.25)	(2.82)	(2.36)	(-0.37)	(-0.13)	(-3.45)
R^2	0.77	0.84	0.87	0.89	0.90	0.90	0.87	0.82	0.79	0.64	0.31

Table 6. Performance of the CAPM and Fama-French model on portfolios sorted by liquidity (*continued*)

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel B : *ILLIQ*6-sorted Portfolios											
CAPM-adjusted performance											
$\hat{\alpha}$	0.26	0.11	0.36	0.21	0.45	0.71	0.92	1.09	1.20	1.72	1.46
	(1.48)	(0.42)	(1.17)	(0.64)	(1.25)	(1.87)	(2.35)	(2.48)	(2.43)	(2.78)	(2.39)
$\hat{\beta}$	0.95	0.93	0.89	0.85	0.83	0.79	0.76	0.73	0.65	0.53	-0.42
	(53.60)	(37.01)	(28.78)	(26.00)	(23.04)	(20.79)	(19.45)	(16.72)	(13.27)	(8.66)	(-6.87)
R^2	0.91	0.83	0.75	0.71	0.65	0.61	0.57	0.50	0.39	0.21	0.14
Fama-French three-factor-adjusted performance											
$\hat{a}$	0.24	-0.01	0.18	-0.01	0.19	0.42	0.64	0.79	0.91	1.45	1.21
	(1.35)	(-0.02)	(0.82)	(-0.04)	(0.96)	(2.16)	(2.83)	(3.15)	(3.02)	(3.23)	(2.72)
$\hat{b}$	0.97	0.98	0.95	0.94	0.94	0.91	0.88	0.85	0.73	0.59	-0.38
	(49.18)	(41.34)	(38.56)	(42.41)	(43.19)	(42.22)	(34.98)	(30.31)	(21.83)	(11.75)	(-7.75)
$\hat{s}$	0.05	0.33	0.51	0.63	0.74	0.80	0.79	0.86	0.87	0.89	0.84
	(1.67)	(10.05)	(14.96)	(20.50)	(24.59)	(26.87)	(22.57)	(22.54)	(18.65)	(12.81)	(12.28)
$\hat{h}$	-0.04	0.05	0.06	0.08	0.05	0.04	0.04	0.11	0.24	0.36	0.40
	(-1.74)	(1.78)	(1.94)	(2.71)	(1.92)	(1.34)	(1.34)	(3.20)	(5.69)	(5.72)	(6.48)
R^2	0.91	0.88	0.87	0.89	0.90	0.90	0.86	0.84	0.77	0.59	0.55
Panel C : *LM*6-sorted Portfolios											
CAPM-adjusted performance											
$\hat{\alpha}$	-0.05	0.66	0.67	0.88	0.67	0.80	0.85	0.87	0.82	0.85	0.91
	(-0.11)	(1.66)	(1.91)	(2.86)	(2.31)	(2.61)	(2.65)	(2.39)	(1.84)	(1.80)	(1.86)
$\hat{\beta}$	0.88	0.87	0.89	0.88	0.87	0.83	0.78	0.72	0.65	0.53	-0.35
	(17.43)	(21.85)	(25.65)	(28.51)	(30.26)	(27.28)	(24.55)	(19.96)	(14.58)	(11.29)	(-7.17)
R^2	0.52	0.63	0.70	0.74	0.77	0.73	0.68	0.59	0.43	0.31	0.16
Fama-French three-factor-adjusted performance											
$\hat{a}$	-0.35	0.42	0.45	0.69	0.50	0.61	0.67	0.64	0.55	0.59	0.94
	(-1.00)	(1.64)	(1.94)	(3.48)	(2.83)	(3.07)	(2.96)	(2.51)	(1.83)	(1.63)	(1.94)
$\hat{b}$	0.98	0.95	0.98	0.95	0.93	0.90	0.84	0.81	0.75	0.64	-0.35
	(25.52)	(33.15)	(37.87)	(42.84)	(47.48)	(40.48)	(33.52)	(28.66)	(22.32)	(15.70)	(-6.45)
$\hat{s}$	0.86	0.71	0.62	0.56	0.52	0.54	0.53	0.63	0.78	0.74	-0.13
	(16.19)	(17.80)	(17.48)	(18.17)	(19.30)	(17.70)	(15.09)	(15.99)	(16.79)	(13.09)	(-1.73)
$\hat{h}$	0.16	0.14	0.08	0.09	0.13	0.09	0.10	0.05	0.11	0.08	-0.09
	(3.35)	(3.78)	(2.61)	(3.37)	(5.16)	(3.38)	(3.11)	(1.32)	(2.69)	(1.52)	(-1.26)
R^2	0.78	0.85	0.87	0.90	0.91	0.88	0.84	0.80	0.74	0.60	0.17

Table 7. Performance of our two factor model on portfolios sorted by liquidity

This table reports abnormal returns estimated from our two factor model

$$r_{it} - r_{ft} = \alpha_i + \beta_{m,i}(r_{mt} - r_{ft}) + \beta_{l,i} LIQ_t + \varepsilon_{it}$$

where r_{it} is the return of portfolio *i* in month *t*, r_{ft} is the 364-day monetary stabilization bond rate for month *t*, LIQ_t is the liquidity mimicking portfolio return in month *t*. The construction of the liquidity sorted portfolios is as follows. At the beginning of each month, stocks are sorted into decile portfolios based on the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, for the sorted decile portfolios, the monthly equally-weighted portfolio returns for 6-month overlapping holding periods are calculated. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, the lowest-*LM*6), *B* denotes the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, the highest-*LM*6), and *B* - *S* denotes the difference between *B* and *S*. The *t*-statistics are shown in parentheses, and the adjusted R^2 values are provided in the final row. The sample period is from January 1987 to July 2010.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel A : *TO*6-sorted Portfolios											
$\hat{\alpha}$	-0.05	0.65	0.73	0.67	0.63	0.48	0.60	0.51	0.39	0.31	0.36
	(-0.09)	(1.48)	(1.81)	(1.84)	(1.88)	(1.59)	(2.03)	(1.68)	(1.44)	(1.13)	(0.94)
$\hat{\beta}_m$	0.76	0.81	0.87	0.89	0.90	0.93	0.91	0.90	0.89	0.72	-0.04
	(12.44)	(16.09)	(18.87)	(21.29)	(23.63)	(27.27)	(26.91)	(25.62)	(28.65)	(22.80)	(-0.85)
$\hat{\beta}_l$	-0.29	-0.12	-0.01	0.08	0.17	0.22	0.29	0.36	0.44	0.50	0.79
	(-3.79)	(-1.98)	(-0.15)	(1.53)	(3.53)	(5.13)	(6.97)	(8.27)	(11.40)	(12.83)	(14.61)
R^2	0.51	0.59	0.64	0.67	0.70	0.75	0.74	0.71	0.75	0.65	0.52
Panel B : *ILLIQ*6-sorted Portfolios											
$\hat{\alpha}$	0.44	0.33	0.54	0.33	0.38	0.51	0.65	0.59	0.52	0.69	0.25
	(2.61)	(1.32)	(1.76)	(0.98)	(1.05)	(1.34)	(1.68)	(1.43)	(1.16)	(1.32)	(0.53)
$\hat{\beta}_m$	0.89	0.86	0.83	0.82	0.85	0.85	0.85	0.90	0.88	0.87	-0.02
	(45.81)	(30.59)	(23.49)	(21.46)	(20.36)	(19.61)	(19.16)	(18.99)	(17.19)	(14.64)	(-0.34)
$\hat{\beta}_l$	-0.15	-0.18	-0.14	-0.09	0.06	0.16	0.22	0.40	0.54	0.83	0.98
	(-6.02)	(-5.00)	(-3.29)	(-1.96)	(1.07)	(2.94)	(3.95)	(6.83)	(8.59)	(11.16)	(14.72)
R^2	0.92	0.84	0.76	0.71	0.66	0.62	0.60	0.57	0.51	0.45	0.52
Panel C : *LM*6-sorted Portfolios											
$\hat{\alpha}$	0.37	0.88	0.74	0.76	0.54	0.54	0.46	0.41	0.20	0.07	-0.30
	(0.75)	(2.18)	(2.08)	(2.44)	(1.86)	(1.81)	(1.55)	(1.21)	(0.50)	(0.18)	(-1.07)
$\hat{\beta}_m$	0.74	0.80	0.87	0.92	0.91	0.91	0.91	0.87	0.86	0.79	0.05
	(13.09)	(17.51)	(21.49)	(25.81)	(27.51)	(26.84)	(26.75)	(22.88)	(18.61)	(17.18)	(1.60)
$\hat{\beta}_l$	-0.34	-0.17	-0.06	0.10	0.10	0.21	0.31	0.37	0.50	0.63	0.97
	(-4.86)	(-3.00)	(-1.11)	(2.22)	(2.48)	(4.84)	(7.33)	(7.79)	(8.77)	(10.95)	(24.45)
R^2	0.56	0.64	0.70	0.75	0.77	0.75	0.73	0.66	0.55	0.52	0.73

Table 8. Performance of the asset-pricing models on portfolios sorted by *MV* and *B*/*M*

This table reports the abnormal returns of the asset-pricing models on portfolios sorted by size and book-to-market ratio, respectively. For size sorted portfolios, at the end of June in year *t*, eligible stocks are sorted based on their market value of equity at the end of June in year *t*. For book-to-market sorted portfolios, at the end of June in year *t*, stocks are grouped based on the ratio of the book equity in the prior fiscal year to market equity at the end of December of the prior year. Based on each sort, stocks are grouped into 10 equally weighted portfolios and held for 12 months, from July of each year *t* to June of the next year *t*+1. In Panel A (B), *S* denotes a portfolio with the biggest stocks (lowest *B/M* ratio stocks), and *B* represents a portfolio with the smallest stocks (highest *B/M* ratio stocks). $\hat{\alpha}_{CAPM}$ is the intercept estimate of the CAPM, and $\hat{\alpha}_{FF3F}$ is the intercept estimate of the Fama-French three-factor model. The two-factor model is

$$r_{it} - r_{ft} = \alpha_i + \beta_{m,i}(r_{mt} - r_{ft}) + \beta_{l,i} LIQ_t + \varepsilon_{it},$$

where r_{it} is the return of portfolio *i* in month *t*, r_{ft} is the 364-day monetary stabilization bond rate for month *t*, LIQ_t is the liquidity mimicking portfolio return in month *t*. Numbers in parentheses are *t*-statistics. The sample period covers from January 1987 to July 2010.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel A : *MV*-sorted Portfolios											
Raw, CAPM and Fama-French three-factor-adjusted performance											
Raw	1.04	0.92	0.84	0.91	0.97	1.25	1.33	1.45	1.73	2.42	1.38
	(1.80)	(1.60)	(1.43)	(1.61)	(1.56)	(2.11)	(2.11)	(2.37)	(2.63)	(2.80)	(1.74)
$\hat{\alpha}_{CAPM}$	0.39	0.25	0.17	0.29	0.32	0.62	0.72	0.83	1.06	1.75	1.36
	(2.34)	(1.18)	(0.61)	(0.97)	(0.88)	(1.75)	(1.66)	(1.89)	(2.11)	(2.30)	(1.75)
$\hat{\alpha}_{FF3F}$	0.40	0.15	0.01	0.09	0.07	0.35	0.40	0.51	0.72	1.44	1.04
	(2.49)	(0.78)	(0.03)	(0.43)	(0.28)	(1.77)	(1.88)	(2.28)	(2.66)	(2.81)	(2.14)
Two-factor adjusted performance											
$\hat{\alpha}$	0.42	0.26	0.15	0.19	0.22	0.54	0.48	0.62	0.67	0.90	0.48
	(2.44)	(1.19)	(0.52)	(0.62)	(0.59)	(1.49)	(1.12)	(1.39)	(1.35)	(1.25)	(0.66)
$\hat{\beta}_m$	0.91	0.87	0.86	0.82	0.86	0.81	0.84	0.77	0.80	0.93	0.03
	(46.47)	(34.84)	(26.98)	(23.47)	(20.36)	(19.76)	(16.91)	(15.16)	(14.25)	(11.37)	(0.32)
$\hat{\beta}_l$	-0.02	-0.01	0.02	0.08	0.08	0.07	0.19	0.18	0.32	0.68	0.70
	(-0.76)	(-0.22)	(0.43)	(1.90)	(1.55)	(1.30)	(3.06)	(2.78)	(4.52)	(6.70)	(6.74)
R^2	0.91	0.86	0.78	0.71	0.65	0.64	0.54	0.49	0.43	0.32	0.17

Table 8. Performance of the asset-pricing models on portfolios sorted by *MV* and *B/M* (*continued*)

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel B : *B/M*-sorted Portfolios											
Raw, CAPM and Fama-French three-factor-adjusted performance											
Raw	0.83	0.90	1.05	1.19	1.19	1.39	1.48	1.38	1.69	1.96	1.13
	(1.69)	(1.78)	(1.97)	(2.11)	(2.07)	(2.29)	(2.37)	(2.11)	(2.30)	(2.11)	(1.39)
$\hat{\alpha}_{CAPM}$	0.18	0.28	0.40	0.53	0.59	0.77	0.85	0.77	1.05	1.33	1.15
	(0.58)	(0.86)	(1.20)	(1.50)	(1.68)	(1.99)	(2.28)	(1.72)	(2.04)	(1.70)	(1.44)
$\hat{\alpha}_{FF3F}$	-0.03	0.02	0.12	0.24	0.31	0.50	0.61	0.50	0.82	1.09	1.12
	(-0.13)	(0.10)	(0.57)	(1.15)	(1.37)	(2.04)	(2.48)	(1.94)	(3.03)	(2.24)	(2.28)
Two-factor adjusted performance											
$\hat{\alpha}$	-0.03	0.09	0.26	0.36	0.51	0.61	0.82	0.70	0.76	0.70	0.73
	(-0.09)	(0.29)	(0.79)	(1.01)	(1.42)	(1.58)	(2.15)	(1.53)	(1.49)	(0.91)	(0.91)
$\hat{\beta}_m$	0.65	0.69	0.71	0.76	0.77	0.82	0.83	0.81	0.96	1.03	0.38
	(18.08)	(18.63)	(18.56)	(18.65)	(18.99)	(18.55)	(19.14)	(15.56)	(16.37)	(11.76)	(4.16)
$\hat{\beta}_l$	0.17	0.15	0.11	0.14	0.07	0.12	0.03	0.06	0.23	0.51	0.34
	(3.78)	(3.25)	(2.28)	(2.72)	(1.30)	(2.23)	(0.49)	(0.94)	(3.12)	(4.67)	(3.00)
R^2	0.57	0.59	0.60	0.60	0.62	0.60	0.63	0.53	0.52	0.34	0.06

Table 9. Sub-period returns on portfolios sorted by the three liquidity measures

This table shows the sub-period returns of the equally-weighted decile portfolios sorted by the three liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Panel A reveals the results for the pre-crisis period (1987.1~1997.10), and Panel B displays the results for the post-crisis period (1999.1~2010.7). Specifically, at the beginning of each month, stocks are sorted into decile portfolios based on the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, for the sorted decile portfolios, the monthly equally-weighted portfolio returns for 6-month overlapping holding periods are calculated. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, or the lowest-*LM*6), and *B* represents the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, or the highest-*LM*6). The *t*-values are in the parentheses.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel A : Pre-crisis period (1987.1~1997.10)											
Ret (*TO*6)	0.86	1.20	1.05	1.05	1.08	0.86	1.10	0.97	1.15	1.67	0.82
t-value	(0.85)	(1.35)	(1.27)	(1.34)	(1.45)	(1.20)	(1.57)	(1.44)	(1.73)	(2.62)	(0.99)
Ret (*ILLIQ*6)	0.12	0.28	0.77	0.79	1.02	1.26	1.35	1.47	1.75	2.07	1.95
t-value	(0.17)	(0.37)	(0.97)	(1.01)	(1.36)	(1.59)	(1.76)	(1.90)	(2.36)	(2.73)	(2.68)
Ret (*LM*6)	1.08	1.15	0.93	1.05	0.71	0.89	0.84	1.08	1.34	1.88	0.79
t-value	(1.05)	(1.33)	(1.16)	(1.38)	(0.95)	(1.23)	(1.17)	(1.48)	(1.85)	(2.69)	(0.94)
Panel B : Post-crisis period (1999.1~2010.7)											
Ret (*TO*6)	-0.39	0.98	1.55	1.72	1.78	1.84	1.93	2.09	1.85	1.53	1.92
t-value	(-0.40)	(1.12)	(1.81)	(2.13)	(2.30)	(2.38)	(2.69)	(2.87)	(2.75)	(2.67)	(2.68)
Ret (*ILLIQ*6)	1.44	1.08	1.17	0.79	0.99	1.36	1.74	1.88	1.88	2.62	1.18
t-value	(1.73)	(1.29)	(1.41)	(0.98)	(1.24)	(1.79)	(2.24)	(2.50)	(2.54)	(2.90)	(1.33)
Ret (*LM*6)	-0.04	1.35	1.55	1.88	1.76	1.85	2.04	1.90	1.40	1.24	1.28
t-value	(-0.05)	(1.56)	(1.86)	(2.36)	(2.27)	(2.53)	(2.80)	(2.79)	(2.19)	(1.59)	(2.09)

Table 10. Pre-crisis period performance of the asset-pricing models on liquidity portfolios

This table reports the pre-crisis period (from January 1987 to October 1997) performance of the asset-pricing models on portfolios sorted by the three liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Specifically, at the beginning of each month, stocks are sorted into decile portfolios based on the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, for the sorted decile portfolios, the monthly equally-weighted portfolio returns for 6-month overlapping holding periods are calculated. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, or the lowest-*LM*6), and *B* represents the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, or the highest-*LM*6). $\hat{\alpha}_{CAPM}$ is the intercept estimate of the CAPM, and $\hat{\alpha}_{FF3F}$ is the intercept estimate of the Fama-French three-factor model. The two-factor model is

$$r_{it} - r_{ft} = \alpha_i + \beta_{m,i}(r_{mt} - r_{ft}) + \beta_{l,i} LIQ_t + \varepsilon_{it},$$

where r_{it} is the return of portfolio *i* in month *t*, r_{ft} is the 364-day monetary stabilization bond rate for month *t*, LIQ_t is the liquidity mimicking portfolio return in month *t*. Numbers in parentheses are *t*-statistics.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel A : *TO*6-sorted portfolios											
CAPM and Fama-French three-factor-adjusted performance											
$\hat{\alpha}_{CAPM}$	0.73	1.02	0.84	0.76	0.77	0.50	0.76	0.59	0.75	1.31	0.58
	(1.00)	(1.75)	(1.60)	(1.60)	(1.77)	(1.27)	(1.90)	(1.45)	(1.68)	(2.51)	(0.79)
$\hat{\alpha}_{FF3F}$	-0.21	0.23	0.14	0.15	0.25	0.07	0.34	0.23	0.40	0.91	1.12
	(-0.52)	(0.82)	(0.54)	(0.61)	(1.02)	(0.28)	(1.40)	(0.82)	(1.26)	(2.24)	(1.87)
Two-factor adjusted performance											
$\hat{\alpha}$	1.23	1.29	0.99	0.83	0.74	0.40	0.55	0.28	0.32	0.80	-0.44
	(1.84)	(2.26)	(1.89)	(1.74)	(1.67)	(1.00)	(1.43)	(0.75)	(0.86)	(1.86)	(-1.05)
$\hat{\beta}_m$	0.75	0.83	0.84	0.83	0.86	0.87	0.91	0.90	0.88	0.78	0.03
	(7.27)	(9.42)	(10.48)	(11.36)	(12.68)	(14.37)	(15.38)	(15.76)	(15.56)	(11.87)	(0.48)
$\hat{\beta}_l$	-0.54	-0.29	-0.16	-0.08	0.04	0.11	0.22	0.33	0.46	0.54	1.08
	(-5.13)	(-3.22)	(-1.99)	(-1.09)	(0.54)	(1.84)	(3.70)	(5.77)	(8.01)	(8.11)	(16.57)
R^2	0.58	0.60	0.61	0.62	0.64	0.67	0.68	0.67	0.66	0.53	0.75
Panel B : *ILLIQ*6-sorted Portfolios											
Raw, CAPM and Fama-French three-factor-adjusted performance											
$\hat{\alpha}_{CAPM}$	0.00	0.13	0.56	0.48	0.67	0.89	1.03	1.15	1.34	1.67	1.67
	(0.02)	(0.36)	(1.26)	(1.08)	(1.41)	(1.73)	(1.92)	(2.00)	(2.42)	(2.62)	(2.61)
$\hat{\alpha}_{FF3F}$	-0.02	-0.21	0.03	-0.11	0.06	0.25	0.39	0.46	0.67	0.94	0.97
	(-0.09)	(-0.72)	(0.12)	(-0.45)	(0.26)	(1.10)	(1.56)	(1.66)	(2.51)	(2.30)	(2.26)
Two-factor adjusted performance											
$\hat{\alpha}$	0.17	0.35	0.75	0.61	0.68	0.79	0.84	0.86	0.99	1.27	1.11
	(0.75)	(1.01)	(1.76)	(1.36)	(1.41)	(1.53)	(1.59)	(1.55)	(1.90)	(2.12)	(2.01)
$\hat{\beta}_m$	0.91	0.87	0.84	0.81	0.79	0.87	0.86	0.89	0.85	0.77	-0.14
	(26.44)	(16.34)	(12.72)	(11.75)	(10.66)	(10.99)	(10.54)	(10.43)	(10.58)	(8.28)	(-1.67)
$\hat{\beta}_l$	-0.17	-0.23	-0.21	-0.14	-0.01	0.10	0.20	0.31	0.37	0.43	0.60
	(-4.97)	(-4.34)	(-3.14)	(-1.95)	(-0.13)	(1.29)	(2.34)	(3.53)	(4.58)	(4.53)	(6.95)
R^2	0.91	0.81	0.71	0.66	0.57	0.55	0.50	0.48	0.48	0.35	0.42

Table 10. Pre-crisis period performance of the asset-pricing models on liquidity portfolios (*continued*)

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel C : *LM*6-sorted Portfolios											
Raw, CAPM and Fama-French three-factor-adjusted performance											
$\hat{\alpha}_{CAPM}$	1.03	1.02	0.73	0.78	0.38	0.54	0.45	0.66	0.93	1.47	0.44
	(1.44)	(1.89)	(1.58)	(2.02)	(0.99)	(1.31)	(1.06)	(1.31)	(1.69)	(2.40)	(0.63)
$\hat{\alpha}_{FF3F}$	0.10	0.33	0.22	0.38	-0.08	0.09	0.06	0.14	0.33	0.92	0.82
	(0.27)	(1.08)	(0.68)	(1.45)	(-0.35)	(0.32)	(0.19)	(0.43)	(1.23)	(2.18)	(1.45)
Two-factor adjusted performance											
$\hat{\alpha}$	1.52	1.33	0.90	0.77	0.39	0.46	0.24	0.37	0.52	0.92	-0.60
	(2.29)	(2.61)	(1.97)	(1.96)	(0.99)	(1.11)	(0.57)	(0.77)	(1.05)	(1.76)	(-1.89)
$\hat{\beta}_m$	0.80	0.81	0.85	0.92	0.87	0.86	0.90	0.85	0.84	0.74	-0.06
	(7.86)	(10.30)	(12.12)	(15.38)	(14.30)	(13.49)	(14.17)	(11.57)	(10.95)	(9.23)	(-1.24)
$\hat{\beta}_l$	-0.52	-0.34	-0.18	0.01	-0.01	0.09	0.23	0.32	0.43	0.58	1.11
	(-5.01)	(-4.24)	(-2.57)	(0.22)	(-0.13)	(1.33)	(3.60)	(4.19)	(5.50)	(7.14)	(22.25)
R^2	0.60	0.66	0.68	0.73	0.70	0.65	0.64	0.53	0.49	0.42	0.86

Table 11. Post-crisis period performance of the asset-pricing models on liquidity portfolios

This table reports the post-crisis period (from January 1999 to July 2010) performance of the asset-pricing models on portfolios sorted by the three liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Specifically, at the beginning of each month, stocks are sorted into decile portfolios based on the liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, for the sorted decile portfolios, the monthly equally-weighted portfolio returns for 6-month overlapping holding periods are calculated. *S* denotes the most liquid decile portfolio (the highest-*TO*6, the lowest-*ILLIQ*6, or the lowest-*LM*6), and *B* represents the least liquid decile portfolio (the lowest-*TO*6, the highest-*ILLIQ*6, or the highest-*LM*6). $\hat{\alpha}_{CAPM}$ is the intercept estimate of the CAPM, and $\hat{\alpha}_{FF3F}$ is the intercept estimate of the Fama-French three-factor model. The two-factor model is

$$r_{it} - r_{ft} = \alpha_i + \beta_{m,i}(r_{mt} - r_{ft}) + \beta_{l,i} LIQ_t + \varepsilon_{it},$$

where r_{it} is the return of portfolio *i* in month *t*, r_{ft} is the 364-day monetary stabilization bond rate for month *t*, LIQ_t is the liquidity mimicking portfolio return in month *t*. Numbers in parentheses are *t*-statistics.

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel A : *TO*6-sorted portfolios											
CAPM and Fama-French three-factor-adjusted performance											
$\hat{\alpha}_{CAPM}$	-1.22	0.15	0.70	0.88	0.96	1.01	1.15	1.33	1.11	0.89	2.10
	(-1.69)	(0.26)	(1.41)	(2.02)	(2.35)	(2.67)	(2.98)	(2.98)	(2.79)	(2.27)	(3.10)
$\hat{\alpha}_{FF3F}$	-1.14	0.28	0.79	0.99	1.08	1.09	1.24	1.42	1.11	0.90	2.04
	(-2.15)	(0.71)	(2.32)	(3.34)	(4.06)	(4.00)	(4.36)	(4.44)	(3.54)	(2.68)	(3.29)
Two-factor adjusted performance											
$\hat{\alpha}$	-0.67	0.43	0.81	0.90	0.83	0.76	0.76	0.85	0.54	0.18	0.85
	(-0.92)	(0.75)	(1.57)	(1.98)	(1.98)	(1.98)	(2.00)	(1.93)	(1.45)	(0.55)	(1.47)
$\hat{\beta}_m$	0.64	0.72	0.79	0.79	0.80	0.85	0.80	0.79	0.77	0.66	0.02
	(7.71)	(10.98)	(13.31)	(15.24)	(16.56)	(19.27)	(18.44)	(15.81)	(18.29)	(17.23)	(0.31)
$\hat{\beta}_l$	-0.33	-0.17	-0.07	-0.01	0.07	0.15	0.23	0.29	0.35	0.42	0.75
	(-2.86)	(-1.86)	(-0.82)	(-0.14)	(1.09)	(2.41)	(3.83)	(4.21)	(5.86)	(7.88)	(8.19)
R^2	0.49	0.61	0.67	0.71	0.73	0.78	0.75	0.67	0.73	0.69	0.41
Panel B : *ILLIQ*6-sorted Portfolios											
Raw, CAPM and Fama-French three-factor-adjusted performance											
$\hat{\alpha}_{CAPM}$	0.52	0.18	0.31	-0.04	0.18	0.58	0.97	1.14	1.19	1.99	1.47
	(1.94)	(0.52)	(0.72)	(-0.10)	(0.38)	(1.23)	(1.93)	(2.23)	(2.10)	(2.44)	(1.82)
$\hat{\alpha}_{FF3F}$	0.44	0.19	0.34	0.03	0.25	0.67	1.09	1.26	1.34	2.19	1.75
	(1.68)	(0.63)	(1.03)	(0.11)	(0.84)	(2.38)	(3.44)	(3.85)	(3.45)	(3.16)	(2.57)
Two-factor adjusted performance											
$\hat{\alpha}$	0.83	0.57	0.63	0.17	0.25	0.46	0.79	0.74	0.58	0.49	-0.33
	(3.16)	(1.73)	(1.47)	(0.37)	(0.52)	(0.93)	(1.53)	(1.43)	(1.05)	(0.71)	(-0.55)
$\hat{\beta}_m$	0.85	0.80	0.75	0.74	0.74	0.72	0.74	0.75	0.71	0.83	-0.01
	(28.34)	(21.26)	(15.31)	(14.12)	(13.20)	(12.75)	(12.44)	(12.69)	(11.26)	(10.52)	(-0.18)
$\hat{\beta}_l$	-0.18	-0.24	-0.20	-0.13	-0.05	0.07	0.10	0.24	0.36	0.90	1.08
	(-4.42)	(-4.51)	(-2.87)	(-1.75)	(-0.59)	(0.94)	(1.25)	(2.94)	(4.14)	(8.15)	(11.25)
R^2	0.91	0.86	0.76	0.71	0.66	0.61	0.60	0.58	0.49	0.47	0.58

Table 11. Post-crisis period performance of the asset-pricing models on liquidity portfolios (*continued*)

	S	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*B*	*B - S*
Panel C : *LM*6-sorted Portfolios											
Raw, CAPM and Fama-French three-factor-adjusted performance											
$\hat{\alpha}_{CAPM}$	-0.88	0.51	0.70	1.04	0.92	1.05	1.26	1.15	0.70	0.52	1.40
	(-1.30)	(0.96)	(1.52)	(2.50)	(2.48)	(2.89)	(3.04)	(2.96)	(1.67)	(0.89)	(2.34)
$\hat{\alpha}_{FF3F}$	-0.80	0.63	0.77	1.16	1.03	1.10	1.37	1.17	0.78	0.59	1.40
	(-1.66)	(1.70)	(2.40)	(4.09)	(4.14)	(4.11)	(4.61)	(4.01)	(2.54)	(1.22)	(2.39)
Two-factor adjusted performance											
$\hat{\alpha}$	-0.30	0.81	0.85	0.99	0.74	0.75	0.81	0.76	0.29	-0.30	0.00
	(-0.45)	(1.47)	(1.78)	(2.29)	(1.94)	(2.06)	(2.00)	(1.98)	(0.70)	(-0.55)	(0.00)
$\hat{\beta}_m$	0.65	0.72	0.78	0.80	0.84	0.81	0.81	0.75	0.66	0.81	0.16
	(8.44)	(11.48)	(14.37)	(16.22)	(19.26)	(19.54)	(17.38)	(17.02)	(13.97)	(12.96)	(3.20)
$\hat{\beta}_l$	-0.35	-0.18	-0.09	0.03	0.11	0.18	0.27	0.23	0.25	0.49	0.84
	(-3.24)	(-2.04)	(-1.18)	(0.41)	(1.78)	(3.06)	(4.16)	(3.84)	(3.76)	(5.68)	(12.46)
R^2	0.54	0.63	0.71	0.73	0.78	0.78	0.72	0.71	0.62	0.56	0.56

Figure 1. Pairwise cross-correlation of three liquidity measures

This figure displays the time-series of the pairwise cross-correlations among the three liquidity measures, n*TO*6, *ILLIQ*6, and *LM*6, where n*TO*6 denotes the negative value of the *TO*6. The values of *TO*6, *ILLIQ*6, and *LM*6 are calculated for each stock at the beginning of each month. Then, the cross-sectional correlations between two liquidity measures are computed for each month. The sample period is from January 1987 to July 2010.

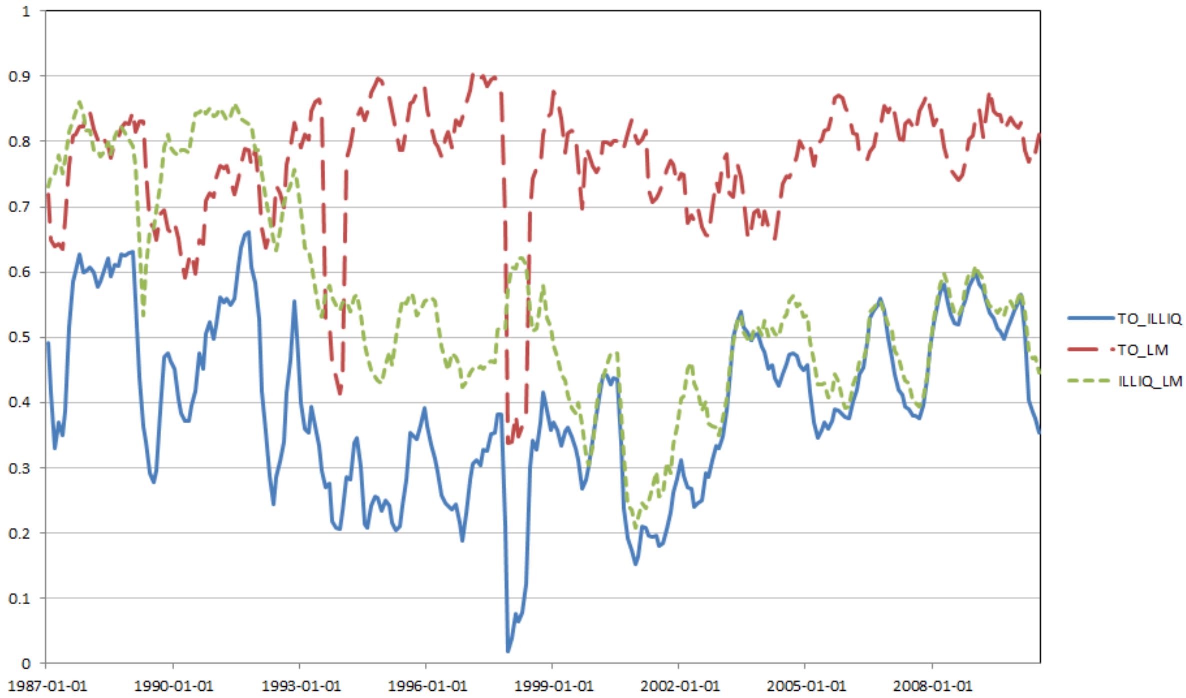

Figure 2. Time-series of liquidity factor

This figure shows the time-series of the liquidity factor over the period from January 1987 to July 2010. The liquidity factor (*LIQ*) is constructed as follows. At the beginning of each month, all KSE ordinary common stocks are sorted by their three liquidity measures, *TO*6, *ILLIQ*6, and *LM*6, respectively. Then, two portfolios, low-liquidity (*LL*) and high-liquidity (*HL*), are formed. *LL* contains the least liquid stocks which are recognized by all three measures using 30% breakpoint. Similarly, *HL* contains the most liquid stocks. The two portfolios are held for six months and *LIQ* is constructed as the monthly return from buying one unit of equally weighted *LL* and selling one unit of equally weighted *HL*.