The Pricing of Liquidity Risk around the World

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Abstract

This thesis examines the pricing of liquidity risk in stock returns around the world based on a sample of 23 developed countries, by testing the liquidity-adjusted CAPM (LCAPM, cf. Acharya and Pedersen, 2005) and a five-factor model which adds a liquidity factor to the widely used four-factor model. In the LCAPM, liquidity is priced around the world but different sources of liquidity matter to a different extend. Liquidity risk is priced if the separate liquidity risk effects: (i) commonality in liquidity, (ii) return sensitivity to market liquidity, and (iii) liquidity sensitivity to market return, have a separate risk premium. Conversely, under a combined risk premium for these separate liquidity risk effect, liquidity level is priced, while liquidity risk is not. In addition, a five-factor model which includes a liquidity factor (constructed in the spirit of the Fama and French (1993) factors, but based on liquidity) confirms that liquidity risk is priced around the world and improves the empirical fit of predicting stock returns. Finally, a separate liquidity factor for small and large stocks shows that liquidity risk is primarily important for small stocks.

Keywords: *Asset pricing; Liquidity risk; Liquidity level; Liquidity-adjusted CAPM; Five-factor model; Liquidity premium; Liquidity factor; Liquidity crises; Flight to liquidity*

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Table of Contents

1. Introduction

The work of Sharpe (1964), Lintner (1965) and Mossin (1966) marks the birth of asset pricing research by introducing the Capital Asset Pricing Model (CAPM), building on diversification and the Modern Portfolio Theory (MPT) of Markowitz (1952, 1959). Decades of asset pricing research have extended the CAPM to the widely used three- and four-factor models of Fama and French (1993) and Carhart (1997), which measure the performance of a portfolio of stocks based on a market-, size-, value- and momentum factor. More recent literature has pointed out that these models fail to account for another factor: liquidity (see Datar, Naik and Radcliffe, 1998; Pastor and Stambaugh, 2003; Korajczyk and Sadka, 2008).

Liquidity has become a common topic in the news as well as in academic literature over the past decades, as liquidity has a strong linkage to financial crises (see Diamond and Rajan, 2001; Cifuentes, Ferrucci and Shin, 2005; Brunnermeier and Pedersen, 2009; among others). The past decades have witnessed successive financial crises around the world: e.g. 1997-1998 Asian financial crisis, 1998 Long-Term Capital Management (LTCM) crisis, 2000-2001 Dot-com bubble burst, 2008 financial crisis, etc. One of the main lessons from these crises is that illiquidity can cause severe problems to financial markets: rapidly declining stock prices and a dry up of trading, causing turmoil and contagion across international financial markets (see Allen and Gale, 2000; Longstaff, 2010; Manconi, Massa and Yasuda, 2012; among others). So illiquidity is a source of risk, as it comes with the risk that an investor cannot trade a given security or asset quickly enough in the market to prevent a loss, generally called liquidity risk. Consequently, following the modern portfolio theory liquidity risk should be compensated, as investors are generally risk averse and trade off risk and expected return. That is why many investment funds consider liquidity in constructing their portfolios:

> *'Liquidity is a bad thing to be avoided rather than a good thing to be sought out, since it comes at the heavy price in the shape of lower returns'* (David Swensen, CIO, Yale Endowment Fund)[1]

[1] See http://seekingalpha.com/article/514771-3-high-growth-stocks-picked-by-a-pro-investor. Access: 7/17/13

While numerous studies have examined the pricing of liquidity risk in the U.S. (Amihud, 2002; Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005; among others), there is surprisingly limited evidence concerning liquidity risk and its pricing in other markets. A small number of studies has focused on specific countries outside the U.S. (Martinez, Nieto, Rubio and Tapia, 2005; Bekeart, Harvey and Lundblad, 2007; Lischewski and Voronkova, 2012; among others). Very little work exists, however, that attempts to look at liquidity risk on a broad cross-section of countries around the world (Lee, 2011; Liang and Wei, 2012). This is all the more surprising, particularly in light of the world-wide nature of recent liquidity shocks such as the financial crises mentioned above. The goal of my thesis is to fill this gap in the literature, providing evidence on the pricing of liquidity risk around the world.

I study the pricing of liquidity risk on a global level as well as on a regional level, based on the Fama and French (2012) regional subdivision: Asia-Pacific (ex. Japan), Europe, Japan and North America (including the U.S.). Overall my sample includes nearly 45,000 stocks, from 23 developed countries including the U.S., over the period January 1995 to December 2012.

The central research question of this thesis is *whether illiquid stocks earn a higher expected excess return than liquid stocks, i.e. whether a liquidity premium exists around the world*. In order to answer this question, I test for liquidity risk with a liquidity-adjusted CAPM developed by Acharya and Pedersen (2005) as well as with a five-factor model, which adds a liquidity factor to the widely used four-factor model of Carhart (1997). As liquidity itself is unobservable, the liquidity factor is constructed by ranking stocks based on their Amihud (2002) illiquidity ratio, i.e. the price impact of trade. In addition, I test for differences in the pricing of liquidity risk for small and large stocks by estimating a separate liquidity factor for small and large stocks, as in Fama and French (2012) for the value- and momentum factor. Finally, I analyze the liquidity premium over time, to check its relevance during recent financial crises.

The estimates of the LCAPM shows that liquidity risk is only priced if the separate liquidity risk effects: (i) commonality in liquidity, (ii) return sensitivity to market liquidity, and

(iii) liquidity sensitivity to market return, have their own risk premium. In other cases liquidity level is priced, with the exception of Japan were liquidity risk is always priced, while liquidity level is not. However, the pricing of liquidity is different for small and large stocks: the effects of liquidity, which are significant in equal-weighted portfolios, largely disappear in value-weighted portfolios.

Moreover, when I construct a liquidity factor for equal-weighted portfolios on a global level and for all regions, I find that liquidity risk is indeed priced around the world. Splitting this liquidity factor for small and large stocks shows that a liquidity factor on small stocks is much more relevant in predicting stock returns than it is for large stocks and that the difference is statistically different from zero. This is also reflected in the high positive correlation between the size- and the liquidity factor. Moreover, adding the liquidity factor to the four-factor model improves the empirical fit of predicting stock returns and decreases alphas.

The outline of this thesis is as follows. Section 2 reviews the literature and develops a theory to examine the relation of stock returns to liquidity. Section 3 explains the data collection and methodology. Section 4 presents and discusses the results. Section 5 concludes and briefly discusses upon liquidity. The appendices explain the specifics of data collection and screening.

2. Theory Development

Measurement of liquidity and liquidity level. There is no doubt that liquidity is an important concept to investors. More than half a century ago Tobin (1958) already described a liquidity preference of investors as a behavior towards risk. The concept of liquidity is widely addressed by academic literature, in a large survey Amihud, Mendelson and Pedersen (2005) summarize the costs of illiquidity in four categories. First, exogenous transaction costs such as brokerage fees. Second, demand pressure on inventory risk, i.e. quickly trading might be prevented in the absence of buyers, exposing a market maker to price changes while it holds the stock. Third, private information on fundamentals or order flows as informed investors will pay less, but uninformed investors too much (see also Brennan and Subrahmanyam, 1996 and O'Hara, 2003).

Fourth, and last, search friction as it might be difficult to find a counterparty that is willing to buy, which brings opportunity and financing costs. Illiquidity costs can thus help to explain why hard-to-trade securities, such as small illiquid stocks, are relatively cheap and why it is important for investment strategies (Amihud, Mendelson and Pedersen, 2005).

Liquidity itself is unobservable but there are a number of proxies available. As an asset-characteristic, liquidity is often measured by the bid-ask spread of a stock, a method that was integrated by Amihud and Mendelson (1986) and primarily used in the field of market microstructure (see Kyle, 1985; Admati and Pfleiderer, 1988; Grossman and Miller, 1988; among others). These models found stock-specific liquidity to be priced, by relating illiquidity costs to a stock's individual liquidity, generally called liquidity level as liquidity is persistent to a large extent. However, more recent literature focuses on liquidity risk as liquidity varies over time. These models measure liquidity risk as a risk factor to assess market-wide liquidity, see Pastor and Stambaugh (2003) and Acharya and Pedersen (2005), among others. Even though both studies find evidence for a liquidity premium in the U.S., their methods are different.[2] Pastor and Stambaugh (2003) measure market-wide liquidity based on order flows, relying on the principle that order flows induce greater return reversal when liquidity is lower. In contrast, Acharya and Pedersen (2005) measure market-wide illiquidity based on the price impact of trade (as proposed by Amihud, 2002), i.e. the absolute price change over (U.S. dollar) volume traded.[3] These methods are considered to be the main measures of market-wide liquidity (Sadka, 2006). Hasbrouck (2002) assesses multiple measures of liquidity and concludes that Amihud (2002) appears to be the best proxy.[4]

Liquidity risk. Market-wide liquidity risk is decomposed in three different effects. First of all, systematic shocks in liquidity reveal a commonality component (Chordia, Roll and Subrahmanyam, 2000; Huberman and Halka, 2001; Eckbo and Norli, 2002; Sadka, 2006; among

[2] Illiquidity and liquidity premium are used interchangeably in the literature, but it refers to the same concept that illiquid stocks are expected to earn a higher excess return than liquid stocks. For consistency with *liquidity risk* I prefer to refer to *liquidity premium* and *liquidity factor* throughout this thesis.
[3] Note the difference here between liquidity and illiquidity in the two methods.
[4] Hasbrouck (2002) also assessed the working paper version of Pastor and Stambaugh (2003), from 2001.

others). Commonality is described as the co-movement between a stock's individual illiquidity and market illiquidity.[5] The intuitive reason is as follows: when a stock's illiquidity positively co-moves with market illiquidity the stock is illiquid when the market is illiquid and liquid when the market is liquid (i.e. systematic risk). On the other hand, when a stock's illiquidity co-moves less with market illiquidity, stocks are easier to sell when the market is illiquid (i.e. sell at lower costs) which makes these stocks more favorable as investors' need to sell is higher in illiquid markets (Diamond and Rajan, 2001). As a consequence, investors will demand a liquidity premium for holding stocks with a positive co-movement between a stock's illiquidity and market illiquidity, i.e. a positive relation. Thereby, theory predicts stocks which are more sensitive to fluctuations in systematic liquidity to have higher expected returns than stocks that are less sensitive, i.e. the same interpretation as the classical market beta of CAPM. This allows me to lay out the following hypothesis:

H1: *The beta of a stock's commonality in illiquidity is positively related to the expected excess return of a stock.*

Recent stock market crashes as the LTCM, dot-com bubble and the latest financial crisis were accompanied by a high degree of commonality in liquidity shocks. Moreover, Sadka (2006) evidences that systematic liquidity shocks are persistent. Furthermore, Korajczyk and Sadka (2008) specifically evidence that commonality explains most of the variation in the liquidity of individual stocks, robust to size, value and momentum.

Second, there is the sensitivity of a stock's return to the market illiquidity (see for example Pastor and Stambaugh, 2003). The intuitive reason is as follows: when a stock's return co-moves positively with market illiquidity, it has a high return when market illiquidity is high. On the other hand, a stock's return that co-moves negatively with market illiquidity has a low return when market illiquidity is high. This makes stocks which return co-moves positively with market illiquidity relatively more attractive, as the cost of selling is high when the returns are

[5] As the applied method of Amihud (2002) measures the illiquidity ratio, I prefer to use the terms *market illiquidity* and *stock's illiquidity* hereafter in defining the three liquidity risk effect. Using *illiquidity* instead of *liquidity* is essential here to keep consistency between theory, hypotheses and results.

also high and the other way around. As a consequence investors will demand a liquidity premium for holding stocks which return co-moves negatively with market illiquidity, i.e. a negative relation. This allows me to formulate the following hypothesis:

H2: *The beta of a stock's return sensitivity to market illiquidity is negatively related to the expected excess return of a stock.*

Third, and last, there is the sensitivity of a stock's illiquidity to the market return, examined by Acharya and Pedersen (2005). The intuitive reason is as follows: when a stock's illiquidity co-moves positively with the market return it is illiquid in a booming market and liquid in a down market. On the other hand, a stock's illiquidity that co-moves negatively with the market return is liquid in a booming market and illiquid in a down market. Intuitively, the first is more favorable as the ability to sell easily in down markets is more valuable than in booming markets (investors' need to sell is higher in down markets, see Diamond and Rajan (2001)). As a consequence investors will demand a liquidity premium for holding stocks which illiquidity co-moves negatively with the market return, i.e. a negative relation. Even though the effect is tested far less than the other two effects, Acharya and Pedersen (2005) found that this is the most important source of liquidity risk. This allows me to lay out the following hypothesis:

H3: *The beta of a stock's illiquidity sensitivity to the market return is negatively related to the expected excess return of a stock.*

Liquidity-adjusted CAPM. An unconditional model that uses the three effects of liquidity risk described above, the liquidity level as well as the regular CAPM beta to explain expected excess returns is the liquidity-adjusted CAPM (LCAPM) of Acharya and Pedersen (2005):

$$E\left(r_t^i - r_t^f\right) = E\left(c_t^i\right) + \lambda\beta^{1i} + \lambda\beta^{2i} + \lambda\beta^{3i} + \lambda\beta^{4i} \tag{1}$$

where $E\left(r_t^i - r_t^f\right)$ is the expected excess return on stock *i* at time *t*, $E\left(c_t^i\right)$ the expected liquidity level of stock *i* at time *t* and also known as the liquidity level, and where

$$\beta^{1i} = \frac{cov(r_t^i, r_t^M - E_{t-1}(r_t^M)}{var(r_t^M - E_{t-1}(r_t^M), [c_t^M - E_{t-1}(c_t^M)])} \tag{2}$$

is the classical CAPM beta to measure commonality in returns,[6]

$$\beta^{2i} = \frac{cov(c_t^i - E_{t-1}(c_t^i), c_t^M - E_{t-1}(c_t^M))}{var(r_t^M - E_{t-1}(r_t^M), [c_t^M - E_{t-1}(c_t^M)])} \quad (3)$$

is the first liquidity beta to measure commonality in illiquidity,

$$\beta^{3i} = \frac{cov(r_t^i, c_t^M - E_{t-1}(c_t^M)}{var(r_t^M - E_{t-1}(r_t^M), [c_t^M - E_{t-1}(c_t^M)])} \quad (4)$$

is the second liquidity beta to measure a stock's return sensitivity to market illiquidity,

$$\beta^{4i} = \frac{cov(c_t^i - E_{t-1}(c_t^i), r_t^M - E_{t-1}(r_t^M))}{var(r_t^M - E_{t-1}(r_t^M), [c_t^M - E_{t-1}(c_t^M)])} \quad (5)$$

is the third liquidity beta to measure a stock's illiquidity sensitivity to the market return, and last, $\lambda = E(\lambda_t) = E(r_t^M - c_t^M - r_t^f)$ the risk premium which is constrained to be the same for all betas in this specification.

The results of studies that examine liquidity level and liquidity risk suggest that both are priced in the U.S. (see Lou and Sadka, 2011; among others). However, differences in the relative economic effects of the three separate effects of liquidity risk are however difficult to find, as a decrease in systematic liquidity has a large negative effect on illiquid stocks (Amihud, 2002) which is called a "flight-to-liquidity", implying collinearity in the separate effects. However, by combining the three effects Acharya and Pedersen (2005) find empirical evidence for the total and relative economic effect of the separate liquidity risk sources. Moreover, Lou and Sadka (2011) found that liquidity risk better explains expected excess return than liquidity level during liquidity crises but that both concepts remain an important source of asset pricing.

Five-factor model. Besides the fact that most recent literature on asset pricing focuses on adjusting or augmenting the classical CAPM, there is a large literature on asset pricing focusing on the explanation of size, value and momentum in stock returns (see Fama and French (2012); among others). These studies use factor models as the three-factor model of Fama and French (1993) and the four-factor model of Carhart (1997) which omit the pricing of liquidity in factor models (see Fama and French, 2012). To examine whether a liquidity factor adds value to these

[6] The terms $E_{t-1}(r_t^M)$ and $E_{t-1}(c_t^M)$ in the beta equations refer to predicted return and predicted illiquidity based on information up to t-1 and are explained in the methodology section.

models, I assess an unconditional five-factor model which adds a liquidity factor to the current four-factor model:

$$E\left(r_t^i - r_t^f\right) = \alpha_i + b_i\left[r_t^M - r_t^f\right] + s_i SMB_t + h_i HML_t + w_i WML_t + i_i IML_t \qquad (6)$$

where $E\left(r_t^i - r_t^f\right)$ is again the expected excess return on stock i at time t, α_i is the alpha (intercept) although the model implies this to be zero, b_i, s_i, h_i, w_i and i_i are the respective betas of the stocks on the factors, $\left[r_t^M - r_t^f\right]$ the classical market risk premium (MRP), SMB_t is the Small-Minus-Big factor at time t which buys small stocks and sells large stocks as stocks with lower market capitalization are found to have a higher expected excess return than stocks with a high market capitalization (see Banz, 1981), generally called the size-effect, HML_t is the High-Minus-Low factor at time t which buys value stocks and sells growth stocks as high book-to-market stocks (value stocks) are found to have a higher expected return than low book-to-market stocks (growth stocks), also referred as the value-effect (see Fama and French, 1992), WML_t is the Winner-Minus-Loser which buys last year's winners and sells past year's losers as stocks that performed well over the past tend to perform well over the next year (see Jegadeesh and Titman, 1993), also called momentum, and last, IML_t is the Illiquid-Minus-Liquid factor at time t which buys illiquid stocks and sells liquid stocks as illiquid stocks are found to have a higher expected return than liquid stocks (see Pastor and Stambaugh, 2003), called the liquidity factor throughout this thesis.

So far, I only considered unconditional models, however, these have an important limitation: pricing errors through time (Hansen and Richard, 1987). Unconditional models use time-invariant betas to predict stock returns, but betas most likely change over time due to the dynamic pattern of stock returns (Hansen and Richard, 1987). In contrast, conditional models use time-varying betas to predict stock returns which make them better to capture the dynamic pattern of stock returns (see Bollerslev, Engle and Wooldridge, 1988; among others). In a large study Avramov and Chordia (2006) review on multiple models as the CAPM and the three-factor model, unconditional and conditional, to test their explanatory power of anomalies such as size, value and momentum. They conclude that unconditional asset pricing leaves all anomalies unexplained, while conditional asset pricing with time-varying betas is able to explain most of them. Therefore I also test the conditional variant of equation (6):

$$E\left(r_t^i - r_t^f\right) = a_t^i + b_t^i\left[r_t^M - r_t^f\right] + s_t^i SMB_t + h_t^i HML_t + w_t^i WML_t + i_t^i IML_t \qquad (7)$$

where the only difference from equation (6) is conditionality of the betas and the alpha, i.e. time-varying betas and alpha. By constructing a liquidity factor (in the spirit of Fama and French (1993), but based on liquidity), that buys illiquid stocks and sells liquid stocks, theory predicts a positive liquidity premium (Pastor and Stambaugh, 2003). Therefore, in the unconditional and conditional five-factor model I test the following hypothesis:

> ***H4:*** *The coefficient on the liquidity factor is positively related to the expected excess return of a stock*

3. Data and Methodology

Data collection. I obtain daily data on total return index (RI), volume traded (VO), adjusted price (P) and market value (MV) in U.S. dollars of almost 45,000 common stocks in 23 developed countries including the U.S. over a period of 18 years, January 1995 to December 2012, from Thomson Reuters Datastream (TDS) and for the U.S. from the Center for Research in Security Prices (CRSP).). Throughout the analysis, I use U.S. dollars returns and market values rather than their local currency values. This ensures comparability to previous studies (cf. e.g. Fama and French, 2012), as well as across different countries within the sample. I group the 23 developed countries in a "global" sample as well as in four regions: Asia-Pacific (ex. Japan), Europe, Japan and North America (c.f. Fama and French, 2012). A list of countries in these four regions and the corresponding number of stocks per country as well as some other characteristics are presented in table I. Unlike Lee (2011), I include all common stocks listed on a particular stock exchange of the respective country instead of only using the major stock exchange(s). The reason for this is a potential bias in the major stock exchanges that might include especially liquid stocks and thereby exclude (small) illiquid stocks. A detailed download procedure to retrieve reliable (and complete) data from TDS is presented in Appendix A.

Besides using a proper download procedure, data from TDS need to be handled with care, as emphasized by Ince and Porter (2006). The proposed screening of Ince and Porter (2006) is closely followed and covers issues as coding errors and stocks that cease trading but have constant values for RI, P and MV equal to the value of the last trading day, such observations are set to missing.[7,8] A reasonable exception to this procedure are penny stocks, these are not excluded to prevent a biased sample. Additionally, as in Ince and Porter (2006) and Lee (2011) only common stock is used, thereby excluding stocks with special features such as exchange-traded funds (ETF), depositary receipts, closed-end funds (CEF), investment trust and preferred shares. Moreover, additional filters are used to screen for non-common stock, a detailed procedure for those filters is presented in Appendix B. Besides that, some filters are used to screen for errors in Volume (VO) and Market Value (MV) data.[9] Finally, dead and suspended stocks are included to prevent survivorship bias.

Illiquidity. Liquidity itself is unobservable, but several kinds of proxies exist as explained in the literature review. The Amihud (2002) illiquidity ratio is generally regarded as the best proxy for liquidity, and is widely used in other empirical research (Hasbrouck, 2002). Based on the returns calculated via the total return index, the volume traded and the adjusted price I construct the Amihud (2002) illiquidity ratio:[10]

$$ILLIQ_t^i = \frac{1}{D_t^i} \sum_{t=1}^{D_t^i} \frac{|R_{td}^i|}{V_{td}^i} \quad (8)$$

where $|R_{td}^i|$ is the absolute return of stock *i* in month *t* on day *d*, V_{td}^i is the U.S. dollar trading volume of stock *i* in month *t* on day *d* and D_t^i is the number of days for which data is available for

[7] Ince and Porter (2006) screen for coding errors, by setting any return above 300% that is reversed within one day to missing.

[8] For stocks that are not quoted in U.S. dollars the values of RI, P and MV still change after a stocks ceases trading due to changes in the exchange rate. Such stocks are cleaned based on the static variable *DateTime* in TDS and the last observation for VO.

[9] Tests on raw data show that for some stocks the daily turnover is unrealistic high, i.e. above 1000%. These errors are caused by discrepancies in the data of TDS by reporting either in normal, thousand or million units. Moreover, some discrepancies were due to flaws in MV data such as a large unexplainable difference between two days, if such discrepancies led to unrealistic turnovers MV data is corrected to the most recent MV data.

[10] The adjusted price is used to calculate the (U.S. dollar) trading volume of a stock, VO*P, as the turnover by value (VA) has missing data for most of the stocks. Moreover, as volumes are adjusted in TR Datastream the adjusted price is used, instead of the unadjusted alternative.

stock i in month t. *ILLIQ* can be interpreted as the average daily relation between a unit of trading volume and its respective price change. Thereby, the higher the *ILLIQ* the more illiquid a stock is as a small change in trading volume causes a relatively large change in price, i.e. the intuitive the reason why illiquid stocks are more risky.[11]

However, *ILLIQ* cannot be directly used to construct the liquidity betas. First of all, the terms in the nominator and denominator of *ILLIQ* are not consistent, i.e. 'percent per U.S. dollar' implying that *ILLIQ* is non-stationary (Acharya and Pedersen, 2005). Second, *ILLIQ* is an instrument for the cost of selling but it does not directly measure the cost of a trade (Acharya and Pedersen, 2005). To solve these issues a normalized measure of illiquidity, c_t^i, is used, defined by Acharya and Pedersen (2005):

$$c_t^i = \min(0.25 + 0.30 ILLIQ_t^i P_{t-1}^M, 30.00) \quad (9)$$

where the coefficients 0.25, 0.30 and 30.00 follow from Acharya and Pedersen (2005) which are based on Chalmers and Kadlec (1998), P_{t-1}^M is the ratio of the capitalizations of the market portfolio at the end of month *t-1* and the initial market portfolio at the end of January 1995, and last, c_t^i is capped at a maximum of 30% to ensure that results are not driven by extreme observations. Moreover, a cost of trade larger than 30% seems unintuitive and is probably an effect of low volume days.

Portfolios. Besides the earlier mentioned issues, regressing individual stock returns to predict expected returns is a noisy test as the required betas are unobserved and need to be estimated, causing an 'error-in-variables' problem (Fama and MacBeth, 1973). To alleviate this, I use portfolios of stocks instead of individual stocks as errors will be zero on average. The market portfolio is formed for each month t on stocks that have at least 15 days of return and volume

[11] Harris and Raviv (1993) suggest an alternative interpretation: *ILLIQ* can also be related to a possible disagreement between investors about new information that enters the market. In the case of disagreement trading volume will increase besides the price change, while in the case of consensus the price will change as a consequence of the new available information but without an increase in trading volume.

data in that particular month.[12] Moreover, 25 illiquidity portfolios are constructed for each year *y* by sorting stocks on their average daily illiquidity in year *y-1*, with the requirement that a stock has at least 100 days of return and volume data in year *y-1*. Likewise, 25 size portfolios are constructed by sorting stocks on their market capitalization at the beginning of the year. Consequently, the return and illiquidity are computed for each portfolio based on equal-weights as well as value-weights. For the market portfolio an equal approach is used, to compensate for the absence of other illiquid assets such as private equity, real estate and consumer durables (Heaton and Lucas, 1996).[13]

Innovations in illiquidity and returns. Last issue before deriving liquidity is the fact that liquidity is persistent as it has a large autocorrelation on past returns, which violates the ordinary least squares (OLS) assumption of independent error terms (Acharya and Pedersen, 2005). Focus is therefore on innovations in illiquidity, i.e. $c_t^M - E_{t-1}(c_t^M)$. To compute these, the un-normalized illiquidity truncated for outliers is defined as:

$$\overline{ILLIQ}_t^M = \sum_{i\ in\ M} w_t^{iM} \min(ILLIQ_t^i, \frac{0.3-0.0025}{0.3\ P_{t-1}^M}) \quad (10)$$

where w_t^{ip} is the market portfolio weight of stock *i* in month *t*.

Consequently, the *ILLIQ* is normalized to make it stationary and employs the following regression to predict market illiquidity:

$$\begin{aligned} 0.25 + 0.30\,\overline{ILLIQ}_t^M\,P_{t-1}^M = \; & a_0 + a_1\,(0.25 + 0.30\,\overline{ILLIQ}_{t-1}^M P_{t-1}^M) \\ & + a_2(0.25 + 0.30\,\overline{ILLIQ}_{t-2}^M P_{t-1}^M) \\ & + u_t \end{aligned} \quad (11)$$

Note that this equation uses P_{t-1}^M in all terms as the only interest is the measurement of innovations in liquidity, not changes in P^M. The above regression has a R^2 of 79.6% for an equal-weighted market portfolio on a global level, which is comparable to Acharya and Pedersen

[12] Acharya and Pedersen (2005) and Lee (2011) employ similar requirements for portfolio formation. Although these studies also employ a price restriction to reduce the measurement error further, it is unclear what price restrictions would be suitable on a global level as all prices are in U.S. dollars but are much smaller compared to the U.S. Therefore, as to prevent a biased sample no price restriction is used at all.

[13] For robustness, a value-weighted market portfolio is also constructed and tested (unreported), but the results appear similar to an equal-weighted market portfolio.

(2005). The residual of equation (11), u_t, is interpreted as the market illiquidity innovation in month t. Mathematically, this can be written as:

$$c_t^M - E_{t-1}(c_t^M) = u_t \tag{12}$$

The market illiquidity innovations on a global level for an equal-weighted market portfolio have a low autocorrelation (0.01), a standard deviation of 0.38% and appear stationary in all regions (see figure I). Moreover, figure I shows that market illiquidity innovations are relatively high during crises, i.e. the 1997-1998 Asian Crisis in Asia-Pacific (ex. Japan) and Japan, the September 11, 2001 attacks in North America and for all regions and global the 2008 financial crisis.

The innovations in portfolio illiquidity are computed similarly to the above market illiquidity innovations. The innovations in market returns are computed using an AR(2) that also employs market characteristics available at the beginning of the month: average return, volatility, average illiquidity, log of average dollar volume traded, log of average monthly turnover, all measured over the prior six months as well as the log of the one-month lagged market capitalization. Based on these three forms of innovations the betas in the equations (2), (3), (4) and (5) are computed and consequently the LCAPM is tested based on the Fama and MacBeth (1973) two-pass regression method.

Five-factor model. The liquidity factor, IML, is constructed based on the 25 illiquidity portfolios, by subtracting the average return on the 12 most liquid portfolios from the average return on the 12 most illiquid portfolios in each month t. Moreover, to check for differences in the pricing of small and large stocks, 25 size/illiquidity portfolios are constructed by first sorting into 5 size portfolios and second in 5 illiquidity portfolios. Consequently, a liquidity factor IML_s is constructed based on the 2 small size portfolios by subtracting the average return on the 4 most liquid portfolios from the average return on the 4 most illiquid portfolios in each month t, likewise IML_b is constructed on the 2 large size portfolios. The factors MRP, SMB, HML, WML as well as the risk-free rate are obtained from Kenneth French's website for all regions and global, to test a five-factor model. In addition to the portfolios constructed in the LCAPM I use the 25 size/BTM and 25 size/MOM portfolios from Kenneth French's website as a robustness check.

The five-factor model is tested conditionally and unconditionally in the classical way of Fama and MacBeth (1973), the two-pass regression test. The conditional five-factor model uses the previous 60 months to estimate the time-varying betas. Finally, the GRS test of Gibbons, Ross and Shanken (1989) will test the significance of the alphas from the first-pass regression, as the model implies them to be zero.

4. Results

Summary statistics and portfolio characteristics. Based on the innovations from the previous section the regular CAPM beta, β^{1p}, and the three liquidity betas, β^{2p}, β^{3p} *and* β^{4p} are computed based on the equations (2), (3), (4) and (5). Table II summarizes these betas and other characteristics of the equal-weighted illiquidity portfolios for all regions separately as well as global. A similar pattern is found in all panels: sorting on prior year's average illiquidity results in portfolios which average illiquidity, $E(c^p)$, increases from portfolio 1 (liquid) to portfolio 25 (illiquid). Moreover, table II shows that the standard deviation of a portfolio's illiquidity innovations, $\sigma(\Delta c^p)$, the average excess return, $E(r^{e,p})$, and the average standard deviation on daily returns, $\sigma(r^p)$ also increase from liquid to illiquid portfolios.[14] This suggests that illiquid stocks earn higher excess returns due to higher risks, i.e. volatility in illiquidity, $\sigma(\Delta c^p)$, and return volatility, $\sigma(r^p)$. Additionally, the average monthly turnover, *Trn*, and the average market capitalization, *Size*, decrease from liquid to illiquid. Which is reasonable for both as the turnover itself could be a proxy for liquidity and size is related to the dollar volume traded, the denominator in the Amihud (2002) illiquidity ratio.

Moreover, in absolute terms table II shows that the average illiquidity has relatively high values in the most illiquid portfolios compared to the capped maximum of 30%, for all panels with an exception for Japan. This is most likely due to the inclusion of tiny stocks, such as microcap stocks which have a relatively low dollar volume traded compared to larger stocks,

[14] Note that these standard deviations can be perceived as risks, but not idiosyncratic risk as the large number of stocks in the sample provides reasonable portfolio diversification. One limitation might be home bias when I test the separate regions (see Coval and Moskowitz, 1999).

thereby have a higher *ILLIQ*. Noteworthy, is that these very illiquid portfolios also have large monthly returns up to 5% in North America. Also, compared to Acharya and Pedersen (2005), the summarized characteristics are especially higher in the most illiquid portfolios. Even though Acharya and Pedersen (2005) report value-weighted portfolios (here unreported for the sake of brevity), the differences might be due to a different time period, but more reasonable is the fact that this study includes all common stocks listed in a country and includes no price restriction which makes it more likely that very small stocks are included as well.

Furthermore, considering absolute values for the liquidity betas (β^{2p}, β^{3p} and β^{4p}) in table II they all increase with illiquidity, except for some very illiquid portfolios. This implies that: (i) the illiquidity level of illiquid stocks co-moves (positively) stronger with market illiquidity, i.e. higher commonality in illiquidity, (ii) the return of illiquid stocks co-moves (negatively) stronger with market illiquidity, i.e. higher return sensitivity to market illiquidity, and (iii) the illiquidity level of illiquid stocks co-moves (negatively) stronger with the market return, i.e. higher illiquidity sensitivity to the market return. These findings are consistent with the notion of a flight to liquidity as found by Amihud (2002): i.e. illiquid stocks also have high liquidity risk. Besides that, the sign of the liquidity betas are consistent with the theory explained in section 2. Moreover, there is no clear pattern in the market beta, β^{1p}, which makes sense as the regular CAPM does not to explain liquidity risk as found in previous studies (Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005). However, it must be noted that in general the most illiquid portfolio has the highest market beta.

Also, we can decompose the numerator of the beta equations (2), (3), (4) and (5), the covariance terms, as the product of the correlation of the two components and their respective standard deviation:

$$\beta = Corr(x, y) \times SD(x) \times SD(y) \tag{13}$$

The standard deviations in equation (13) are as $\sigma(\Delta c^p)$ and $\sigma(r^p)$, which are found to increase in illiquid portfolios. But the correlation is another important driver of the beta and is found in the last columns of table II. The correlations show that: (i) β^{2p} is primarily driven by an increasing correlation, (ii) while β^{3p} deals with a quite stable negative correlation which makes the correlation less important, and (iii) β^{4p} deals with a negative correlation that decreases to more neutral portfolios (i.e. the portfolios 12-14) but increases thereafter. To summarize: altogether the portfolio characteristics suggests that illiquid stocks earn a higher excess return because they are riskier, which applies to all regions and global.

The portfolio characteristics of size portfolios are not reported for the sake of brevity, but show similar patterns as in illiquidity portfolios. Noteworthy is the relationship between size and illiquidity: figure II shows that as size increases the illiquidity decreases, i.e. small stocks are more illiquid than large stocks.

Correlations between the betas. Table III reports the correlations between the betas for all regions as well as global for equal-weighted portfolios. In general, correlations between the betas are relatively high in absolute values, which potentially cause collinearity in the regressions of the LCAPM. Furthermore, note that the correlations of Global, Asia-Pacific (ex. Japan) and North America are quite comparable and their signs are consistent to what theory predicts. However, the correlation between β^{3p} and β^{4p} is much lower in Europe and Japan as well as for β^{2p} and β^{3p}. The later one is even positive, while theory predict negative, but this is most likely due to the fact that the pattern in β^{3p} is a bit unclear for these regions. Finally, the correlation between β^{1p} and β^{2p} is negative in Europe, opposed to positive in other regions, which is due to the more or less decreasing pattern in β^{1p} of Europe.

LCAPM. To examine the relation between the aforementioned betas and the expected excess return I run the second-pass (cross-sectional) regressions of the Fama and MacBeth (1973) method. To overcome heteroskedasticity and autocorrelation in the error terms, I use Newey and West (1987) standard errors with two lags. To show the empirical fit of the LCAPM, the R^2 and adjusted R^2 are calculated in a single cross-sectional regression which uses the average excess return of a portfolio as dependent variable. Moreover, I test special cases of the LCAPM based on the following regression equation:

$$E\left(r_t^p - r_f^t\right) = \alpha + kE(c_t^p) + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p} + \lambda\beta^{net,p} \qquad (14)$$

where α is the intercept although the model implies none and $\beta^{net,p} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$, called net beta, by approach it combines the first three hypothesis in a single one:

***H5:** The net beta in LCAPM is positively related to the expected excess return of a stock.*

According to the model k must be the average monthly turnover, to tests its validity some specification will employ k as a free parameter.[15] To run regressions with a fixed k, the dependent variable is set to $(r_t^p - r_f^t) - kE(c_t^p)$. However, all R^2 and adjusted R^2 are based on the same dependent variable, $E(r_t^p - r_f^t)$, to keep a solid comparison across the different regressions. To do so, the explained variation in $E(r_t^p - r_f^t)$ of $kE(c_t^p)$ is taken into account when k is set to the average monthly turnover.[16]

Table IV and V present the results of the LCAPM regressions for respectively equal-weighted illiquidity- and size portfolios. Let us go through the lines step by step. Line (1) runs the following regression:

$$E(r_t^p - r_f^t) = \alpha + kE(c_t^p) + \lambda\beta^{net,p} \quad (15)$$

where k is set to the average monthly turnover. In these regressions all betas are constrained to have the same risk premium, to test whether the LCAPM has a better empirical fit than the regular CAPM under the same amount of free parameters. The regular CAPM is tested in line (3):

$$E(r_t^p - r_f^t) = \alpha + \lambda^1\beta^{1p} \quad (16)$$

By comparing these two lines I find that the LCAPM has a higher R^2 and adjusted R^2, thereby a better empirical fit than the regular CAPM in all regions as well as global. The CAPM beta is positively significant in all regions and global for either portfolio, except for Japan's illiquidity portfolios.[17] Moreover, in line (1) the net beta is positively significant in Asia-Pacific (ex. Japan) and Europe for either portfolio, while in Japan only for size portfolios.

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[15] Acharya and Pedersen (2005) explain $E(c_t^p)$ to be scaled by k to adjust for the difference between estimation- and holding periods, k corresponds to a holding period of $\frac{1}{k}$ months.

[16] This is calculated as the difference in the models' total variation of using a model with $E(r_t^p - r_f^t)$ as dependent variable and a model which uses $E(r_t^p - r_f^t) - kE(c_t^p)$ as dependent variable.

[17] By significant I mean conventional levels as either 1% or 5%.

Line (2) runs the same regressions as in equation (15), but k is set to be a free parameter here. Except for North America's illiquidity portfolios, the adjusted R^2 increases compared to line (1). However, the net beta becomes insignificant in all regions as well as global for either portfolio, except for Europe. On the other hand, the $E(c_t^p)$, i.e. the liquidity level, becomes positively significant in all regions and global for either portfolio, except for Europe's size portfolios. Altogether, this suggests that under a constrained risk premium for all betas liquidity level is priced around the world as k fares much better as a free parameter, except for Europe where liquidity level seems less important as the net beta, i.e. market- and liquidity risk are jointly priced.

While the LCAPM with a single risk premium fares much better than the regular CAPM, nothing can be stated about liquidity risk as market- and liquidity risk are combined in the net beta. To test these risks separately I allow for two risk premiums: one on β^{1p}, the market risk, and one on $\beta^{net,p}$, which still includes the four betas. This means that the total market risk premium is the sum of the coefficients on β^{1p} and $\beta^{net,p}$. Thereby, I run the following regression in line (4), (5) and (6):

$$E\left(r_t^p - r_f^t\right) = \alpha + kE(c_t^p) + \lambda^1\beta^{1p} + \lambda\beta^{net,p} \tag{17}$$

where k is set to the average monthly turnover in line (4), as a free parameter in line (5), and to zero in line (6) as k turns out to be negative in some cases of line (5) which violates the assumptions of the model. In line (4) the net beta is only positively significant in Japan for either portfolio and in Asia-Pacific (ex. Japan) only for illiquidity portfolios. These results are not very promising for the pricing of liquidity risk, especially if we consider line (5) where the net beta is only positively significant for Japan's illiquidity portfolios and most often negatively significant in other regions for either portfolio. Even though this might suggest a negative liquidity premium for all liquidity betas, results might be affected by the constrained risk premium and the inclusion of β^{1p} in the net beta. In contrast, liquidity level looks more promising as it is positively significant in all regions for either portfolio, with an exception for Japan which makes sense if we consider the results of liquidity risk. Line (6) is relevant for Japan as it has a negative coefficient on liquidity level in line (5), the results show that the adjusted R^2 obviously decreases but the results are not very different from line (4), liquidity risk remains positively priced in Japan. Moreover, it can be concluded that separating market- and liquidity risk by a different risk premium improves the empirical fit of the model as the adjusted R^2 increases. Altogether this suggests more or less the same as in line (1) and (2) that under a constrained risk premium for liquidity betas: liquidity level is priced around the world as k fares much better as a free parameter. However, in Japan liquidity risk is priced instead of liquidity level.

To test the three liquidity risk effects separately, I remove the net beta and add all betas as a separate independent variable, i.e. I allow all betas to have their own risk premium. I therefore run the following regression equation for line (7) and (8) to test for unconstrained risk premiums:

$$E\left(r_t^p - r_f^t\right) = \alpha + kE(c_t^p) + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p} \qquad (18)$$

where k is set to the average monthly turnover in line (7) and as a free parameter in line (8). Under these conditions the results seem to be much more intriguing for liquidity risk and less for liquidity level. In general the same conclusion can be derived from line (7) and (8). For illiquidity portfolios I find: in Asia-Pacific (ex. Japan) and global β^{2p} and β^{4p} to be positively significant, in North America β^{4p} to be positively significant and β^{3p} to be negatively significant, in Europe β^{3p} to be positively significant, and last in Japan β^{4p} to be negatively significant but only in line (7). For size portfolios I find similar results: in North America and global β^{2p} and β^{4p} are positively significant, in Europe and Asia-Pacific (ex. Japan) β^{2p}, β^{3p} and β^{4p} are positively significant, and last in Japan no liquidity betas are significant. The large coefficients and low t-stats in Japan suggest a collinearity problem, when checking correlation of β^{2p}, β^{4p} and $E(c_t^p)$ (unreported) this indeed seems to be the case: all correlations are higher than |0.90| for either portfolio. Even though the results for other regions and global appear more promising than Japan, some are surprising as theory predicts a negative coefficient for β^{3p} and β^{4p}. In general β^{4p} is most often positively significant, which implies a negative liquidity premium on a stock's illiquidity sensitivity to the market return. Moreover, β^{3p} is different across the regions as it is positively and negatively significant in some cases, but it is most often insignificant. Fortunately, β^{2p} is positive and most often significant as it should be according to the theory.

In contrast to the lines with a constrained risk premium, under an unconstrained risk premium liquidity level is never positively significant. Only for Japan's illiquidity portfolios the liquidity level is negatively significant which violates the model, testing without liquidity level (unreported) shows similar results to line (7). Furthermore, comparing line (4) with line (7) and line (5) with line (8) I find that the LCAPM which employs separate risk premiums for all betas has a higher adjusted R^2 than a LCAPM which employs only two risk premiums: one for market- and one for liquidity risk. Moreover, k still fares much better as a free parameter than by setting it to the average monthly turnover. Altogether the results on an unconstrained risk premium for all betas suggest that liquidity risk is priced in all regions and global, where β^{2p} (β^{4p}) has a positive (negative) risk premium, the relevance of liquidity level appears moderate, and Japan suffers from a collinearity problem.

Robustness LCAPM to value-weighted portfolios. Table VI reports the results of testing the second-pass regressions of Fama and MacBeth (1973) for the 25 global value-weighted illiquidity portfolios. The results are not very promising: I find liquidity risk not to be priced and the liquidity level is only positively significant under a constrained risk premium. The results for the regions are very similar to global, with the exception that even the liquidity level is not significant under a constrained risk premium. Moreover, the relation between the average excess returns and average illiquidity for the 25 value-weighted illiquidity portfolios (unreported) appears not to be so straightforward as for equal-weighted portfolios. Altogether this suggests that liquidity is in particular relevant for small/tiny stocks and less for large stocks. To study this more carefully I construct a separate liquidity factor for small and large stocks further on in this thesis.

Economic effect: the liquidity premium. Having examined the relevance of liquidity level and liquidity risk it is interesting to consider their economic effect. As line (8) is found to have significant results, although some are contradicting the theory, it is most interesting to examine the separate effects of liquidity risk from this line. The economic effect for illiquidity portfolios is calculated as the difference between the 12 most illiquid portfolios and the 12 most liquid portfolios multiplied by the coefficient in line (8) in the LCAPM for all regions and global, with an exception for Japan for which line (7) is used due to a negative coefficient on liquidity level in line (8).[18] Table VII reports the economic effects for the equal-weighted illiquidity portfolios. Most striking is the fact that the effect of β^{4p}, sensitivity of the portfolio's illiquidity to the market return is negative. This implies that liquid stocks earn a liquidity premium over illiquid stocks, which is contradictory to the theory. The effect of β^{3p}, return sensitivity to market illiquidity, seems to be rather small compared to the other effects, with an exception for North America where it seems rather important. Moreover, the effect of β^{2p}, commonality in illiquidity, seems to have the largest effect (consistent with Korajczyk and Sadka, 2008), with an exception for Japan. Finally, the effect of total liquidity risk is larger than for liquidity level with an exception for global.

Five-factor model. Besides the LCAPM it is interesting to examine liquidity risk in factor pricing to see whether it is still priced when other factors such as size, value and momentum are also used. To do so, I construct the liquidity factor, IML, based on the 25 equal- and value-weighted illiquidity portfolios, by subtracting the average return on the 12 most liquid portfolios from the average return on the 12 most illiquid portfolios in each month t. Moreover, as value-weighted portfolios seem less important than equal-weighted portfolios when we consider liquidity, it is interesting to test for differences in liquidity pricing between small and large stocks. To do so, I construct 25 size/illiquidity equal-weighted portfolios by first sorting into 5 size portfolios and second into 5 illiquidity portfolios. Consequently, I construct a liquidity factor IML_S based on the 2 small size portfolios by subtracting the average return on the 4 most liquid portfolios from the average return on the 4 most illiquid portfolios in each month t, likewise I

[18] Note that in contrast to Acharya and Pedersen (2005) and Lee (2011), the economic effect is not calculated as the difference between only the most illiquid portfolio and the most liquid portfolio, but by using all portfolios except the neutral portfolio 13. The reason for this is that it seems unlikely to employ a sizeable investment strategy that only buys the most illiquid and liquid portfolio due to the small size of the most illiquid portfolio.

construct IML_b on the 2 large size portfolios. The results are presented in table VIII. The *IML* is positively significant in all regions as well as global for equal-weighted portfolios, which suggests that liquidity is indeed priced around the world. However, for value-weighted portfolios *IML* is only positively significant for global, which suggests the same as in the LCAPM: liquidity is more important for small stocks. Considering, the separate liquidity factors I find that for global and for all regions, with an exception for Japan, the IML_s and the IML_{s-b} to be positively significant, while IML_b is insignificant. This suggests that there is a significant difference in the pricing of liquidity for small and large stocks and that pricing of liquidity appears to be only relevant for small stocks. In addition, considering the correlations between the factors *MRP, SMB, HML, WML* and *IML*, table IX shows that the correlation between *SMB* and *IML* is relatively large compared to the other correlations for global as well as in all regions, with an exception for North America. Also note that the *MRP* correlates high (negatively) with *IML* in Europe.

Let us use the *IML* in a five-factor model and see whether the model improves in terms of adjusted R^2 and alpha (using Gibbons, Ross and Shanken, 1989) by analyzing the first-pass (time series) regressions of Fama and MacBeth (1973). Table X reports the results for illiquidity- and size portfolios. Even though the alpha is still significantly different from zero in equal-weighted portfolios, with an exception for Japan's illiquidity portfolios, adding the liquidity factor to the four-factor model improves the adjusted R^2 and decreases the GRS statistic. As a consequence the liquidity factor helps to explain the expected excess return of a portfolio over time. These results are robust to the 25 size/BTM equal-weighted portfolios and the 25 size/MOM equal-weighted portfolios available at Kenneth French's website (see table X). Using a value-weighted *IML* for value-weighted illiquidity portfolios does improve the adjusted R^2 but the GRS statistic remains more or less the same, with an exception for global. However, what seems interesting here is that value-weighted illiquidity portfolios in all regions and for global have an alpha that is not statistically different from zero. This suggests that illiquidity portfolios are better in explaining alpha than the size/BTM and size/MOM portfolios in Fama and French (2012).

Consequently, the five-factor model is tested conditionally and unconditionally for the second-pass (cross sectional) regressions of Fama and MacBeth (1973), where the conditional model estimates betas based on the previous 60 months. Table XII and XIII report the results for respectively illiquidity- and size portfolios. In either portfolio for global as well as for all regions, with an exception for Europe's size portfolios and Japan's unconditional size portfolios, the liquidity factor is positively significant in unconditional testing as well as conditional testing. Moreover, in general I find the significance and relevance of the SMB factor to be reduced when the liquidity factor is added to the four-factor model. Furthermore, the adjusted R^2 is higher in most regions and global than for the regular four-factor model which suggests a better empirical fit. Differences between conditional and unconditional testing seem to be small for *IML*, although sometimes large for other factors. Potential limitation to the above results might be that the factors *MRP, SMB, HML* and *WML* are obtained from a different sample and therefore might be less significant and relevant. I therefore use the earlier mentioned size/BTM and size/MOM portfolios as a robustness check (tables are available upon request). The results of size/MOM are very similar to the size portfolios, with an exception that *IML* is not significant in the conditional model of Europe and North America. For size/BTM portfolios the results suggest that liquidity is not as robust to BTM as it is to momentum, since the *IML* is insignificant for global and in the regions Europe and North America. However, the *IML* is positively significant in Asia-Pacific (ex. Japan) and Japan. Checking value-weighted illiquidity portfolios (see global in table XIV) I find more or less the same results as in the LCAPM: for global liquidity is priced, but not for the regions in which liquidity seems less important. Once again, this suggests that the pricing of liquidity is primarily important for small stocks.

Finally, I plot the coefficients on the *IML* factor of the cross-sectional regressions for illiquidity portfolios in figure III to study the relevance of the liquidity premium over time. In particular I find: in Asia-Pacific (ex. Japan), shocks in the liquidity premium during the 1997-1998 Asian-crisis and the 2000-2001 Dot-com bubble burst, in North America and for global shocks due to the 2000-2001 Dot-com bubble burst, 2001 September attacks and the 2008 financial crisis, and last in Europe shocks related to the 1998 LTCM crisis and the 2000-2001 Dot-com bubble burst.

5. Conclusion

This thesis examines the pricing of liquidity risk with a liquidity-adjusted CAPM (LCAPM, cf. Acharya and Pedersen, 2005) and a five-factor model, tested on a global level as well as in four regions: Asia-Pacific (ex. Japan), Europe, Japan and North America (including the U.S.). The LCAPM shows that liquidity risk is only priced if the separate effects: (i) commonality in illiquidity, (ii) return sensitivity to market illiquidity, and (iii) illiquidity sensitivity to market return, have their own risk premium. Conversely, under a combined risk premium for these separate liquidity risk effect, liquidity level is priced, while liquidity risk is not. One exception is Japan, where liquidity risk is always priced and liquidity level not. More specifically, around the world I find: (i) commonality in illiquidity to have a positive liquidity premium and to be the largest liquidity risk effect, (ii) return sensitivity to market illiquidity primarily not to be priced, with the exception of North America where it has a substantial positive liquidity premium, and (iii) illiquidity sensitivity to market return to have a negative liquidity premium. However, the pricing of liquidity risk is different for small and large stocks: the effects of liquidity risk, which are significant in equal-weighted portfolios, largely disappear in value-weighted portfolios.

When I construct a liquidity factor (constructed in the spirit of the Fama and French (1993) factors, but based on liquidity) for equal-weighted portfolios on a global level and for all regions, I find that liquidity risk is indeed priced around the world. In addition, when I split this liquidity factor for small and large stocks, I find that a liquidity factor on small stocks is priced while a liquidity factor on large stocks appears not and their difference to be different from zero. This is also reflected in the high positive correlation between the size- and liquidity factor. Moreover, adding the liquidity factor to the four-factor model improves the empirical fit and decreases alphas, but the alphas are still different from zero with an exception for Japan. This liquidity factor is also priced in the five-factor model and reduces the relevance and significance of the size factor. Finally, by plotting the liquidity premium over time I find peaks in the Asian-crisis, LTCM crisis, dot-com bubble burst, September 11 attacks and the latest financial crisis.

Altogether, I find liquidity to be an important concept for investors as it is a priced risk factor around the world. Alternatively, it might be that liquidity is (also) priced due to investor irrationality and behavioral biases. A growing literature has pointed out limitations in the Efficient Market Hypothesis (EMH) as investors frequently make suboptimal investment decisions (see for example: Shefrin and Statman, 1985; Odean, 1999; DellaVigna and Pollet, 2009). As a consequence, liquidity might play a role here as under- and overreaction has a linkage with liquidity, e.g. Friday effect, excessive trading. Also, investors have a tendency to buy stocks that performed well over the past, but these buys underperform their sells (Odean, 1999). Liquidity can explain this result as increased demand for winners increases liquidity, thereby causes a price increase which decreases expected returns. Conversely, decreased demand for losers decreases liquidity, thereby causes a price decrease which increases expected returns. Therefore, it might be doubtful whether liquidity pricing is only related to a risk factor.

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Appendix A: Download procedure to retrieve reliable (and complete) data from Thomson Reuters Datastream

The download procedure below presents some important decisions/issues you should be familiar with in order to download reliable (and all) data from Thomson Reuters Datastream (TDS) for a particular country. Datastream static variables are printed bold and italic when introduced.

1) Make sure to select **all** stock Exchanges in a particular country with ***Exchange***, e.g. Netherlands, not only *Euronext Amsterdam* but also *Amsterdam Unlisted*.[19, 20] This might seem obvious, but small stock exchanges are easily forgotten, e.g. Japan: *Fukuoka*.
2) Consequently, make sure to incorporate foreign stocks listed on the stock exchange in the country of interest (e.g. Japan: *Medicinova*). Moreover, do **not** incorporate domestic firms listed on a foreign exchange (i.e. Japan: Kawasaki Steel listed on *Non-NASDAQ OTC*).
3) Make sure to select *equity* as the only ***InstrumentType***. In order to get common stock we don't need other data types such as *investment trusts* and *exchange-traded funds* (ETFs).
4) Do **not** select a type of ***Currency*** upfront, some foreign (or even domestic) stocks might me traded in a different currency than the currency in the country of interest (i.e. Hong Kong: *Hong Kong dollars*, but stock is traded in *U.S. dollars*).
5) Make sure to select only ***PrimaryQuote*** and thereby exclude secondary listings, as these stocks are not needed for the sample.
6) Make sure to use the ***DPL#*** *function* when downloading the data, as it can be used to indicate the number of decimals. This is an important step to get reliable data as TR Datastream will not give all the decimals it has if nothing is indicated, this is especially important when converting the data to another currency (i.e. all to *U.S. dollars* here). To give an example, Japan: **DPL#(141083(VO.SO)~U$,6)** is used for *Tohohira Steel.* Where, *141083* is the ***DSCode*** for the respective stock (in a function this should be denoted as *X*), ***VO*** is the variable (Volume), *SO* is the code for the respective stock exchange[21], *6* indicates the requested decimals, and last *~U$* stands for the conversion of the data to a particular currency (i.e. *U.S. dollars* in this case). Stocks listed in a foreign currency need to be converted to one specific currency to get reliable data and to make comparison possible across stocks.
7) Make sure to use ***DSCode*** when downloading the data for all stocks and **not** ***DSMnemonic*** as some stocks have no *DSMnemonic.*

Note: be aware that using the ***BaseDate*** of a stock can cause differences regarding the amount of stocks incorporated in the dataset. The amount of stocks in the dataset can differ as new stocks become listed over time, however, some stocks do not have a *BaseDate* while they have data in the period of interest. As a consequence, indicating a *BaseDate* will exclude these stocks and make the dataset less reliable due to missing data. This emphasizes the general point of this appendix: be careful with making assumptions when downloading the data from TDS.

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[19] *Note:* do **not** use ***Market*** to assign stocks to a country but use the stock exchanges. *Market* indicates the country of origin of the stocks but not necessarily where the stock is traded, e.g. Japan: *Medicinova (DSCode: 30088H)*, which is originally based in the United States but traded on *Japan OTC*.

[20] Practically all exchanges can simply be assigned to a specific country, however trading platforms such as *EASDAQ* and *XETRA* might be less obvious. *EASDAQ* was based in Belgium and *XETRA* is based in Germany.

[21] This is only required for stocks in Japan and Germany, because of secondary listings in the same country.

Appendix B: Screening procedure for common stocks

In order to filter out non-common stocks I use multiple screening steps , which are briefly explained in this appendix. Generally speaking a conservative approach is used in the screening procedure, which means that if in doubt the stock is kept in the sample. Datastream static variables are printed bold and italic when introduced.

1) As already explained stated in Appendix A, a first screen is the usage of the ***PrimaryQuote*** and ***InstrumentType***. Only primary stocks which are *equity* are kept in the sample.
2) The static variable ***TRCSDescription*** is used to filter out stocks such as *Investment Trust* which were not filtered out by the *InstrumentType* variable. This implies that only *'Ordinary Shares', 'Fully Paid Ordinary Shares', 'UNKNOWN'* and *blank cells* are kept in the sample.
3) Stocks that have a *'C'* in ***CoverageFlag*** are dropped as it means that the stock is a company account in Datastream, which implies that the data is not provided by Datastream but by the company. To enhance reliability and accuracy of the data these stocks are left out of the sample.
4) Following Ince and Porter (2006), ***Name*** and ***ExpandedName*** are screened for terms that indicate that a stock is not common stock. Such terms are found by manually checking the *Name* and *ExpandedName*. To mention a view examples: *REIT, PREF, ADR, Restricted* and *Deferred.* Note that all terms are handled with care, i.e. no stock is just simply dropped because they include the respective term but they are manually checked. To give an example: using *REIT* in Japan would drop 'YOKAHAMA REITO' while the stock has nothing to do with Real Estate Investment Trusts, in such cases the stock is kept in the sample.
5) Stocks that contain either *´Certificate´ or* a *'stock exchange'* (e.g. Frankfurt, XETRA, AMS) in their *ExpandedName* are dropped if the ***ADRParentCode*** is unequal to the ***DSCode***. Such terms are generally used for secondary listings which are left out.[22] The second requirement is used for conservativeness, as *ADRParentCode* is only equal to *DSCode* if the stock is considered to be a parent listing, which is clearly not the case for such secondary listings.
6) Stocks with the same *ADRParentCode* (i.e. duplicates) are manually checked to be sure that only the 'real' common stock of a company is included in the sample. *ADRParentCode* is the same for stocks which belong to the same company. Note that the manual screen in very conservative and uses the following criteria: (i) if stocks have not traded simultaneously traded both are kept, (ii) stocks with complete different names which are not due to a name change are kept both, [23] (iii) stocks with a different ***SICCode*** are kept both, as the stocks clearly operate in a different industry, (iv) stocks with the same name for which either one has only limited data, the one with the limited amount of data is dropped, (v) in case there are two stocks for which one contains '*A*' (referring to Class A) and one contains *'B'* the later one is dropped, following Durnev, Morck and Young (2004). They argue that type '*B*' shares are often referring to preferred shares. If there are still duplicates after considering all these

[22] Secondary listings are left out not only to prevent that a company is included multiple times in the sample, but primarily because the market value (MV) for these stocks is often inconsistent as it often just states the MV of the primary listings which would clearly overweight a company in the portfolios.
[23] The internet is primarily used to verify this.

criteria the data will 'speak' to assign the primary stock. Letting the data speak, means that the stock which has the highest average dollar volume traded and taking into account the number of trading days is kept in the sample and the other(s) are dropped. This criterion is based on the assumption that in general a company's primary stock would be traded the most. The trading days are considered as well as it could be that one stock is only traded for a couple of days but is traded a lot, clearly this would not be a company's primary stock,

Table I
Characteristics of stocks in the sample

The sample consists of 44,996 stocks in total, obtained from 23 countries in the period 1995 to 2012 and subdivided into four regions: Asia-Pacific (ex. Japan), Europe, Japan and North America. All primary listed common stocks in a particular country are included, i.e. exchange-traded funds (ETF), depositary, closed-end funds (CEF), investment trust and preferred shares are excluded as well as secondary listings. Note: several filters are used to drop non-common stock and secondary listings. The table presents the number of total, active, dead, suspended, foreign, MSCI and non-MSCI stocks for all countries separately, in subtotal per region and in total globally. The amount of MSCI stocks in US is unknown as US data is downloaded from CRSP and not from TR Datastream. Stocks with full missing data in the period 1995-2012 are excluded, missing in sense that for at least one of the required variables a particular stock has full missing data in the entire time period. Foreign stocks are listed in the specified country but have another country of origin, e.g. Japan: Medicinova *(DSCode: 30088H)* which country of origin is U.S. Dead stocks are included to prevent survivorship bias.

Country	*N*	*Active*	*Dead*	*Suspended*	*Foreign*	*MSCI*	*No MSCI*
Asia-Pacific (ex. Japan)							
Australia	2,758	1,707	939	112	15	947	1,811
Hong Kong	1,655	1,455	141	59	191	1,153	502
New Zealand	257	120	135	2	2	75	182
Singapore	931	693	224	14	12	474	457
Subtotal	***5,601***	***3,975***	***1,439***	***187***	***220***	***2,649***	***2,952***
Europe							
Austria	206	89	117	-	4	77	129
Belgium	317	141	174	2	19	101	216
Denmark	350	164	186	-	1	118	232
Finland	198	120	78	-	2	104	94
France	2,120	858	1,227	35	55	506	1,614
Germany	2,251	1,032	1,219	-	479	113	2,138
Greece	417	243	163	11	1	152	265
Ireland	77	34	43	-	2	44	33
Italy	528	266	259	3	3	331	197
Netherlands	296	98	198	-	20	127	169
Norway	518	214	304	-	18	201	317
Portugal	200	55	144	1	1	76	124
Spain	314	167	146	1	-	165	149
Sweden	930	450	480	-	22	286	644
Switzerland	384	228	156	-	3	215	169
United Kingdom	4,345	1,554	2,753	38	247	1,223	3,122
Subtotal	***13,451***	***5,713***	***7,647***	***91***	***877***	***3,839***	***9,612***
Japan							
Japan	4,969	3,550	1,419	-	2	3,049	1,920
Subtotal	***4,969***	***3,550***	***1,419***	***-***	***2***	***3,049***	***1,920***
North America							
Canada	6,678	3,179	3,290	209	82	957	5,721
United States	14,297	4,092	10,203	2	1,113	UNK	UNK
Subtotal	***20,975***	***7,271***	***13,493***	***211***	***1,195***	***957***	***5,721***
Total	**44,996**	**20,509**	**23,998**	**489**	**2,294**	**10,494**	**20,205**
Percentage		*45.6%*	*53.3%*	*1.1%*	*7.5%*	*34.2%*	*65.8%*

Table II
Characteristics of illiquidity portfolios

This table reports the properties of the 25 equal-weighted portfolios formed each year during 1995-2012. The market beta (β^{1p}) and the liquidity betas (β^{2p}, β^{3p} and β^{4p}) are computed using all monthly return and illiquidity observations for each portfolio and for an equal-weighted market portfolio, based on equations (2), (3), (4) and (5). The betas are multiplied by 100 for the sake of interpretation. The average illiquidity, $E(c^p)$, the average excess return, $E(r^{e,p})$, the turnover (Trn) and the market capitalization (Size) are computed for each portfolio as time-series averages of the respective monthly characteristics. The standard deviation of a portfolio's illiquidity innovations is reported under the column of $\sigma(\Delta c^p)$. The average of the standard deviation of daily returns, $\sigma(r^p)$, for the portfolio's constituent stocks is computed each month. Finally, $\rho(c^p, c^M)$, $\rho(c^p, r^M)$ and $\rho(r^p, c^M)$ present the correlations of respectively: the portfolio's illiquidity with the market illiquidity, the portfolio's illiquidity with the return on the market and the return of a portfolio with the market illiquidity. The panels A, B, C, D and E present these properties for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	β^{1p} (*100)	β^{2p} (*100)	β^{3p} (*100)	β^{4p} (*100)	$E(c^p)$ (%)	$\sigma(\Delta c^p)$ (%)	$E(r^{e,p})$ (%)	$\sigma(r^p)$ (%)	Trn (%)	Size (bn US$)	$\rho(C^p, C^M)$	$\rho(C^p, R^M)$	$\rho(R^p, C^M)$
Panel A: Global													
1	77.21	0.00	-1.79	0.00	0.27	0.04	0.55	2.23	18.21	24.71	-0.24	-0.22	-0.01
3	86.32	0.00	-2.03	0.01	0.29	0.05	0.54	2.57	16.42	2.64	-0.22	-0.16	-0.10
5	91.98	0.01	-2.34	-0.10	0.32	0.06	0.39	2.77	12.22	1.26	0.12	-0.15	-0.11
7	95.83	0.02	-2.57	-0.31	0.39	0.07	0.19	2.98	9.88	0.62	0.27	-0.16	-0.27
9	95.52	0.05	-2.87	-0.62	0.50	0.12	0.37	3.04	8.11	0.40	0.36	-0.15	-0.29
11	91.42	0.14	-2.98	-1.23	0.81	0.24	0.45	3.09	6.97	0.29	0.65	-0.18	-0.28
13	86.04	0.24	-3.00	-2.51	1.30	0.42	0.52	3.11	5.67	0.19	0.75	-0.19	-0.30
15	79.81	0.40	-3.07	-3.63	1.96	0.53	0.55	3.21	4.81	0.14	0.88	-0.21	-0.27
17	80.62	0.59	-3.04	-6.14	3.11	0.77	0.70	3.34	4.32	0.11	0.92	-0.22	-0.27
19	82.00	0.82	-3.51	-7.75	4.91	1.01	0.88	3.81	4.29	0.08	0.94	-0.23	-0.24
21	90.08	1.13	-3.86	-11.04	8.09	1.37	0.98	4.63	4.31	0.05	0.95	-0.25	-0.20
23	101.44	1.52	-4.43	-9.61	14.01	1.75	1.56	6.14	4.35	0.03	0.90	-0.23	-0.16
25	114.37	1.47	-4.90	-1.91	23.49	1.76	4.40	9.68	3.81	0.01	0.79	-0.15	-0.07
Panel B: Asia-Pacific (ex. Japan)													
1	72.50	0.00	-1.97	0.00	0.26	0.05	0.76	2.15	8.22	12.87	0.16	-0.22	0.06
3	92.89	0.01	-2.35	-0.19	0.38	0.14	0.56	2.77	8.71	1.12	0.06	-0.20	0.07
5	93.20	0.03	-2.71	-0.39	0.63	0.27	0.51	2.87	7.17	0.47	0.23	-0.23	-0.10
7	96.21	0.12	-2.92	-1.24	0.97	0.59	0.41	3.10	6.58	0.25	0.68	-0.26	-0.19
9	88.38	0.17	-2.73	-2.03	1.38	0.68	0.59	3.14	6.03	0.17	0.70	-0.28	-0.26
11	84.76	0.22	-2.65	-3.09	2.06	0.79	0.63	3.33	5.26	0.14	0.77	-0.26	-0.25
13	84.09	0.37	-2.72	-5.50	2.99	1.11	0.93	3.51	4.70	0.10	0.83	-0.27	-0.24
15	80.57	0.48	-2.82	-5.99	4.20	1.31	0.86	3.86	4.44	0.08	0.84	-0.30	-0.24
17	82.08	0.54	-2.95	-6.32	5.37	1.35	1.21	4.23	4.34	0.05	0.88	-0.30	-0.20
19	86.40	0.74	-3.34	-7.39	7.29	1.56	1.57	4.64	4.23	0.04	0.91	-0.31	-0.21
21	90.25	0.83	-3.36	-10.39	9.52	1.91	1.91	5.30	4.43	0.02	0.89	-0.27	-0.19
23	87.62	1.03	-3.62	-8.82	12.38	2.14	2.57	5.83	4.64	0.02	0.86	-0.30	-0.18
25	97.90	1.10	-3.92	-7.26	17.60	2.44	4.01	7.38	5.21	0.01	0.74	-0.29	-0.17

	β^{1p} (*100)	β^{2p} (*100)	β^{3p} (*100)	β^{4p} (*100)	$E(c^p)$ (%)	$\sigma(\Delta c^p)$ (%)	$E(r^{e,p})$ (%)	$\sigma(r^p)$ (%)	Trn (%)	Size (bn US$)	$\rho(C^p,C^M)$	$\rho(C^p,R^M)$	$\rho(R^p,C^M)$
Panel C: Europe													
1	63.06	0.00	-3.11	0.08	0.26	0.05	0.64	2.04	11.08	26.61	-0.11	-0.22	-0.01
3	72.32	0.00	-3.87	0.14	0.33	0.14	0.66	2.26	8.42	3.74	-0.28	-0.18	0.04
5	76.53	0.01	-4.16	-0.11	0.35	0.11	0.45	2.37	6.18	1.53	0.04	-0.20	-0.09
7	77.83	0.04	-4.11	-0.23	0.53	0.17	0.27	2.53	5.42	0.73	0.11	-0.20	-0.19
9	68.62	0.15	-4.16	-0.91	0.89	0.30	0.34	2.59	4.79	0.50	0.65	-0.23	-0.10
11	70.04	0.33	-3.98	-1.97	1.46	0.57	0.37	2.62	4.23	0.34	0.77	-0.21	-0.15
13	65.28	0.46	-3.91	-3.36	2.15	0.74	0.50	2.57	3.73	0.28	0.80	-0.26	-0.17
15	61.12	0.72	-3.94	-4.28	3.10	0.92	0.40	2.69	3.59	0.20	0.90	-0.23	-0.16
17	57.93	0.94	-3.99	-6.45	4.25	1.20	0.40	2.78	2.91	0.15	0.91	-0.27	-0.18
19	56.50	1.23	-3.99	-7.78	5.96	1.43	0.50	3.00	2.83	0.11	0.94	-0.27	-0.10
21	56.75	1.64	-4.00	-9.23	8.86	1.82	0.49	3.39	2.74	0.09	0.97	-0.24	-0.12
23	57.82	1.95	-3.73	-7.81	13.53	2.19	0.94	4.34	2.60	0.06	0.97	-0.24	-0.08
25	90.78	1.90	-3.57	-0.15	23.70	2.37	2.99	7.02	2.56	0.02	0.86	-0.03	-0.06
Panel D: Japan													
1	70.53	0.00	-0.35	0.00	0.25	0.00	-0.07	2.25	8.93	15.39	0.19	-0.19	-0.22
3	87.19	0.00	-0.39	-0.06	0.25	0.03	-0.10	2.42	8.75	1.83	-0.04	-0.15	-0.09
5	95.82	0.00	-0.39	-0.07	0.26	0.02	-0.15	2.51	7.22	0.87	0.17	-0.12	-0.18
7	102.86	0.00	-0.40	-0.06	0.27	0.04	-0.03	2.58	6.66	0.49	0.09	-0.11	-0.12
9	103.51	0.00	-0.45	-0.14	0.30	0.05	-0.01	2.61	6.75	0.34	0.39	-0.13	-0.24
11	104.67	0.00	-0.44	-0.15	0.33	0.05	0.09	2.66	6.05	0.23	0.42	-0.12	-0.19
13	100.86	0.00	-0.42	-0.36	0.39	0.08	0.18	2.69	5.49	0.18	0.54	-0.14	-0.20
15	98.24	0.01	-0.42	-0.37	0.45	0.07	0.36	2.69	5.04	0.13	0.71	-0.13	-0.22
17	91.01	0.01	-0.42	-0.68	0.57	0.11	0.40	2.66	3.83	0.12	0.83	-0.15	-0.26
19	91.34	0.02	-0.43	-1.03	0.72	0.16	0.41	2.70	3.20	0.08	0.89	-0.17	-0.22
21	94.04	0.02	-0.43	-1.45	0.94	0.21	0.64	2.80	2.71	0.06	0.90	-0.14	-0.25
23	94.24	0.04	-0.42	-1.78	1.43	0.32	0.63	3.09	2.80	0.04	0.90	-0.14	-0.20
25	105.60	0.10	-0.40	-5.11	3.74	0.88	1.08	4.06	3.00	0.03	0.91	-0.10	-0.16
Panel E: North America													
1	66.09	-0.01	-0.62	-0.11	0.27	0.05	0.50	2.27	21.42	31.46	-0.16	-0.15	-0.13
3	77.12	0.00	-0.90	-0.06	0.29	0.06	0.70	2.57	23.56	3.37	-0.03	-0.09	-0.04
5	87.94	0.01	-0.73	-0.15	0.30	0.07	0.79	2.85	20.94	1.53	0.08	-0.06	-0.15
7	91.64	0.02	-1.18	-0.19	0.35	0.09	0.73	3.12	16.89	0.80	0.06	-0.07	-0.15
9	96.59	0.03	-1.47	-0.26	0.42	0.11	0.51	3.43	14.06	0.45	0.11	-0.08	-0.16
11	101.12	0.06	-1.81	-0.99	0.58	0.19	0.74	3.68	11.57	0.27	0.21	-0.07	-0.24
13	92.88	0.19	-2.56	-1.75	1.04	0.38	0.79	3.72	9.17	0.18	0.40	-0.12	-0.23
15	88.11	0.39	-2.89	-3.78	1.87	0.64	0.79	3.91	7.65	0.11	0.69	-0.14	-0.23
17	83.43	0.82	-2.94	-6.72	3.95	1.14	0.61	4.19	6.48	0.07	0.85	-0.14	-0.25
19	90.02	1.26	-3.45	-8.34	7.71	1.77	0.75	5.10	5.56	0.05	0.90	-0.15	-0.17
21	102.21	1.44	-4.02	-9.27	13.14	2.04	1.14	6.46	5.65	0.03	0.91	-0.17	-0.15
23	106.33	1.47	-4.03	-7.11	20.05	2.11	1.83	8.26	4.61	0.01	0.82	-0.14	-0.11
25	110.45	1.30	-5.29	-1.56	26.02	1.69	5.47	11.24	3.69	0.01	0.71	-0.06	-0.08

Table III
Beta correlations for illiquidity portfolios

This table reports the correlations of the market beta (β^{1p}) and the liquidity betas (β^{2p}, β^{3p} and β^{4p}) for the 25 equal-weighted illiquidity portfolios formed for each year during 1995-2012. The panels A, B, C, D and E present these correlations for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	β^{1p}	β^{2p}	β^{3p}	β^{4p}
Panel A: Global				
β^{1p}	1.000	0.473	-0.589	-0.071
β^{2p}		1.000	-0.940	-0.849
β^{3p}			1.000	0.736
β^{4p}				1.000
Panel B: Asia-Pacific (ex. Japan)				
β^{1p}	1.000	0.204	-0.483	-0.022
β^{2p}		1.000	-0.918	-0.920
β^{3p}			1.000	0.809
β^{4p}				1.000
Panel C: Europe				
β^{1p}	1.000	-0.467	-0.153	0.822
β^{2p}		1.000	0.312	-0.734
β^{3p}			1.000	0.016
β^{4p}				1.000
Panel D: Japan				
β^{1p}	1.000	0.202	-0.664	-0.198
β^{2p}		1.000	0.038	-0.996
β^{3p}			1.000	-0.015
β^{4p}				1.000
Panel E: North America				
β^{1p}	1.000	0.498	-0.666	-0.218
β^{2p}		1.000	-0.914	-0.860
β^{3p}			1.000	0.727
β^{4p}				1.000

Table IV
LCAPM for equal-weighted illiquidity portfolios

This table reports the results from cross-sectional regressions of the liquidity-adjusted CAPM data, the second pass of Fama-Macbeth (1973), for the 25 equal-weighted portfolios sorted on prior year's average illiquidity with an equal-weighted market portfolio using monthly data from 1995-2012. Special cases of equation (13) are considered, where $\beta^{net,p} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$and in line (1), (4) and (7) k is set to be the average monthly turnover of all portfolios. The t-statistics are reported in parentheses and calculated with Newey-West (1987) standard errors. The R^2 is obtained via a single cross-sectional regression that employs the average return of the portfolios as dependent variable, the adjusted R^2 is reported in parentheses. The panels A, B, C, D and E present these results for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	Constant	$E(c^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	$\beta^{net,p}$	R^2
Panel A: Global								
(1)	-1.269	0.078					1.817	0.795
	(-1.16)	*(---)*					*(1.40)*	*(0.786)*
(2)	1.350	0.166					-1.101	0.897
	(2.49)	*(5.64)*					*(-1.48)*	*(0.888)*
(3)	-4.685		6.123					0.444
	(-4.44)		*(4.55)*					*(0.420)*
(4)	-1.712	0.078	2.379				0.071	0.808
	(-1.67)	*(---)*	*(1.51)*				*(0.03)*	*(0.791)*
(5)	2.231	0.200	4.437				-6.316	0.962
	(4.30)	*(6.71)*	*(2.42)*				*(-3.07)*	*(0.957)*
(6)	-4.542		0.073				5.449	0.542
	(-4.45)		*0.05*				*(2.76)*	*(0.501)*
(7)	2.199	0.078	-2.163	175.571	-6.679	22.088		0.961
	(4.10)	*(---)*	*(-2.96)*	*(3.55)*	*(-0.28)*	*(4.70)*		*(0.953)*
(8)	1.928	0.087	-1.745	203.301	-1.959	21.322		0.966
	(3.37)	*(1.81)*	*(-2.44)*	*(2.37)*	*(-0.08)*	*(3.08)*		*(0.957)*
Panel B: Asia-Pacific (ex. Japan)								
(1)	-4.549	0.056					5.732	0.699
	(-2.78)	*(---)*					*(2.96)*	*(0.686)*
(2)	-0.018	0.238					0.470	0.954
	(-0.03)	*(4.11)*					*(0.47)*	*(0.950)*
(3)	-3.296		5.119					0.106
	(-3.87)		*(4.13)*					*(0.068)*
(4)	-2.533	0.056	-8.387				11.337	0.782
	(-2.76)	*(---)*	*(-1.97)*				*(2.48)*	*(0.762)*
(5)	0.258	0.241	2.554				-2.327	0.981
	(0.35)	*(5.39)*	*(0.61)*				*(-0.54)*	*(0.978)*
(6)	-3.676		-13.000				17.056	0.651
	(-4.06)		*(-3.09)*				*(3.78)*	*(0.619)*
(7)	0.386	0.056	1.474	344.468	52.093	15.864		0.928
	(0.56)	*(---)*	*(1.15)*	*(4.87)*	*(1.30)*	*(2.94)*		*(0.914)*
(8)	0.496	0.078	1.382	335.422	53.345	14.132		0.990
	(0.74)	*(1.83)*	*(1.07)*	*(3.93)*	*(1.37)*	*(2.67)*		*(0.987)*

	Constant	$E(c^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	$\beta^{net,p}$	R^2
Panel C: Europe								
(1)	-1.931	0.046					3.130	0.742
	(-2.36)	*(---)*					*(2.80)*	*(0.731)*
(2)	-1.615	0.070					2.583	0.827
	(-1.79)	*(3.50)*					*(2.18)*	*(0.812)*
(3)	-0.602		1.839					0.089
	(-1.02)		*(2.37)*					*(0.049)*
(4)	-1.814	0.046	0.393				2.622	0.742
	(-1.61)	*(---)*	*(0.16)*				*(0.75)*	*(0.719)*
(5)	-0.017	0.091	5.615				-4.735	0.903
	(-0.02)	*(5.25)*	*(2.65)*				*(-1.91)*	*(0.890)*
(6)	-3.689		-4.999				10.237	0.284
	(-3.24)		*(-2.01)*				*(2.92)*	*(0.219)*
(7)	0.832	0.046	3.068	22.653	66.708	0.700		0.923
	(1.09)	*(---)*	*(2.52)*	*(1.27)*	*(3.00)*	*(0.26)*		*(0.908)*
(8)	0.911	0.008	3.125	74.687	69.986	3.370		0.963
	(1.23)	*(0.20)*	*(2.53)*	*(1.55)*	*(3.11)*	*(0.75)*		*(0.953)*
Panel D: Japan								
(1)	-0.624	0.054					0.860	0.259
	(-0.92)	*(---)*					*(0.99)*	*(0.226)*
(2)	-0.107	0.749					0.021	0.739
	(-0.17)	*(3.11)*					*(0.03)*	*(0.716)*
(3)	-0.335		0.607					0.024
	(-0.52)		*(0.71)*					*(-0.018)*
(4)	0.094	0.054	-21.616				21.470	0.809
	(0.16)	*(---)*	*(-3.90)*				*(3.71)*	*(0.792)*
(5)	0.269	-2.211	-86.503				86.374	0.907
	(0.43)	*(-2.37)*	*(-3.56)*				*(3.31)*	*(0.893)*
(6)	0.089		-25.135				24.989	0.819
	(0.15)		*(-4.56)*				*(4.34)*	*(0.802)*
(7)	-0.645	0.054	-0.741	-2479.084	-333.253	-72.306		0.888
	(-0.77)	*(---)*	*(-1.11)*	*(-1.97)*	*(-1.95)*	*(-2.57)*		*(0.866)*
(8)	0.037	-2.439	-0.381	*2789.220*	-222.479	-41.050		0.923
	(0.05)	*(-2.82)*	*(-0.55)*	*(1.89)*	*(-1.34)*	*(-1.40)*		*(0.903)*
Panel E: North America								
(1)	1.162	0.117					-0.719	0.684
	(0.90)	*(---)*					*(-0.47)*	*(0.670)*
(2)	0.577	0.121					0.009	0.685
	(0.85)	*(3.97)*					*(0.01)*	*(0.657)*
(3)	-4.054		5.592					0.356
	(-3.12)		*(3.36)*					*(0.328)*
(4)	-0.543	0.117	9.487				-7.874	0.801
	(-0.49)	*(---)*	*(3.72)*				*(-2.58)*	*(0.782)*
(5)	0.345	0.152	8.842				-8.266	0.828
	(0.54)	*(4.95)*	*(3.53)*				*(-3.08)*	*(0.803)*
(6)	-3.914		3.939				1.407	0.360
	(-3.55)		*(1.66)*				*(0.48)*	*(0.301)*
(7)	1.791	0.117	-2.214	-60.149	-67.333	20.435		0.936
	(2.79)	*(---)*	*(-2.26)*	*(-1.17)*	*(-2.91)*	*(2.57)*		*(0.923)*
(8)	1.415	0.032	-1.682	*131.192*	-64.745	33.999		0.937
	(2.26)	*(0.73)*	*(-1.76)*	*(1.70)*	*(-2.78)*	*(3.38)*		*(0.920)*

Table V

LCAPM for size portfolios

This table reports the results from cross-sectional regressions of the liquidity-adjusted CAPM data, the second pass of Fama-Macbeth (1973), for the 25 equal-weighted portfolios sorted on the market capitalization at the beginning of the year with an equal-weighted market portfolio using monthly data from 1995-2012. Special cases of equation (13) are considered, where the $\beta^{net,p} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$ and in line (1), (4) and (7) k is set to be the average monthly turnover of all portfolios. The t-statistics are reported in parentheses and calculated with Newey-West (1987) standard errors. The R^2 is obtained via a single cross-sectional regression that employs the average return of the portfolios as dependent variable, the adjusted R^2 is reported in parentheses. The panels A, B, C, D and E present these results for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	Constant	$E(c^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	$\beta^{net,p}$	R^2
Panel A: Global								
(1)	-1.625	0.078					2.172	0.820
	(-1.71)	*(---)*					*(1.87)*	*(0.812)*
(2)	1.777	0.209					-1.799	0.940
	(2.05)	*(5.48)*					*(-1.61)*	*(0.935)*
(3)	-5.591		7.149					0.804
	(-4.57)		*(4.55)*					*(0.795)*
(4)	-3.534	0.078	9.783				-4.887	0.909
	(-2.84)	*(---)*	*(3.97)*				*(-2.86)*	*(0.901)*
(5)	1.244	0.232	6.661				-7.527	0.980
	(1.85)	*(6.21)*	*(2.79)*				*(-3.21)*	*(0.977)*
(6)	-6.211		11.261				-3.154	0.820
	(-5.01)		*(4.64)*				*(-1.91)*	*(0.804)*
(7)	1.213	0.078	-1.254	283.537	-9.071	36.508		0.983
	(2.12)	*(---)*	*(-1.08)*	*(3.96)*	*(-0.30)*	*(4.30)*		*(0.980)*
(8)	0.920	0.120	-0.590	262.227	3.279	31.536		0.984
	(1.36)	*(1.90)*	*(-0.62)*	*(2.17)*	*(0.13)*	*(2.55)*		*(0.980)*
Panel B: Asia-Pacific (ex. Japan)								
(1)	-3.473	0.056					4.612	0.658
	(-2.37)	*(---)*					*(2.59)*	*(0.643)*
(2)	0.154	0.214					0.189	0.808
	(0.13)	*(3.87)*					*(0.12)*	*(0.791)*
(3)	-6.856		9.178					0.483
	(-3.86)		*(3.93)*					*(0.460)*
(4)	-3.542	0.056	0.287				4.421	0.658
	(-3.50)	*(---)*	*(0.07)*				*(1.11)*	*(0.627)*
(5)	-1.299	0.287	16.905				-14.277	0.903
	(-1.27)	*(5.01)*	*(4.01)*				*(-3.42)*	*(0.889)*
(6)	-4.201		-4.081				9.414	0.545
	(-4.17)		*(-1.07)*				*(2.41)*	*(0.504)*
(7)	-0.838	0.056	4.496	536.587	92.936	38.838		0.879
	(-0.85)	*(---)*	*(2.39)*	*(4.71)*	*(2.51)*	*(4.60)*		*(0.855)*
(8)	-0.458	0.012	3.592	526.279	77.029	34.121		0.927
	(-0.47)	*(0.19)*	*(1.98)*	*(3.82)*	*(2.09)*	*(4.19)*		*(0.908)*

	Constant	$E(c^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	$\beta^{net,p}$	R^2
Panel C: Europe								
(1)	-2.874	0.046					4.370	0.753
	(-2.49)	*(---)*					*(2.72)*	*(0.742)*
(2)	-4.812	-0.003					7.379	0.840
	(-4.39)	*(-0.10)*					*(4.85)*	*(0.826)*
(3)	-4.238		7.282					0.878
	(-4.25)		*(4.80)*					*(0.873)*
(4)	-3.194	0.046	8.213				-2.519	0.944
	(-2.81)	*(---)*	*(3.66)*				*(-0.89)*	*(0.938)*
(5)	-1.538	0.123	13.261				-9.685	0.980
	(-1.69)	*(4.69)*	*(5.06)*				*(-3.42)*	*(0.977)*
(6)	-4.457		4.856				2.452	0.898
	(-3.91)		*(2.22)*				*(0.88)*	*(0.889)*
(7)	-1.245	0.046	4.703	57.471	37.365	12.630		0.973
	(-1.35)	*(---)*	*(3.51)*	*(2.52)*	*(2.01)*	*(4.06)*		*(0.968)*
(8)	-1.027	0.055	4.391	61.170	37.785	11.543		0.988
	(-1.06)	*(1.63)*	*(2.89)*	*(2.89)*	*(2.04)*	*(3.40)*		*(0.985)*
Panel D: Japan								
(1)	-1.991	0.055					2.272	0.753
	(-3.25)	*(---)*					*(2.66)*	*(0.742)*
(2)	-0.858	0.896					0.676	0.970
	(-1.29)	*(2.53)*					*(0.72)*	*(0.967)*
(3)	-2.219		2.581					0.662
	(-3.39)		*(2.81)*					*(0.648)*
(4)	-0.421	0.055	-26.692				26.985	0.939
	(-0.61)	*(---)*	*(-3.96)*				*(4.21)*	*(0.933)*
(5)	-0.465	0.269	-5.779				6.158	0.971
	(-0.66)	*(0.61)*	*(-0.48)*				*(0.51)*	*(0.966)*
(6)	-0.406		-29.547				29.824	0.933
	(-0.59)		*(-4.41)*				*(4.69)*	*(0.927)*
(7)	-0.277	0.055	0.840	1921.940	136.841	8.573		0.963
	(-0.40)	*(---)*	*(0.83)*	*(1.29)*	*(0.81)*	*(0.29)*		*(0.955)*
(8)	-0.318	0.227	0.595	1068.232	81.345	-10.585		0.972
	(-0.45)	*(0.46)*	*(0.59)*	*(0.59)*	*(0.49)*	*(-0.32)*		*(0.965)*
Panel E: North America								
(1)	1.159	0.116					-0.739	0.748
	(1.21)	*(---)*					*(-0.60)*	*(0.737)*
(2)	2.034	0.167					-1.800	0.808
	(3.15)	*(4.69)*					*(-1.92)*	*(0.791)*
(3)	-3.070		4.547					0.380
	(-2.64)		*(2.93)*					*(0.353)*
(4)	-0.780	0.116	10.506				-8.553	0.847
	(-0.75)	*(---)*	*(4.27)*				*(-3.80)*	*(0.833)*
(5)	0.912	0.188	10.246				-10.379	0.919
	(1.79)	*(4.85)*	*(3.14)*				*(-3.08)*	*(0.908)*
(6)	-3.778		9.353				-3.757	0.401
	(-3.61)		*(4.00)*				*(-1.78)*	*(0.347)*
(7)	1.252	0.116	-1.053	96.978	-22.604	27.352		0.954
	(2.45)	*(---)*	*(-1.19)*	*(1.13)*	*(-0.92)*	*(2.47)*		*(0.945)*
(8)	0.913	0.064	-0.437	274.427	-10.177	44.271		0.957
	(1.83)	*(1.29)*	*(-0.49)*	*(2.17)*	*(-0.42)*	*(2.91)*		*(0.946)*

Table VI
L-CAPM for value-weighted illiquidity portfolios

This table reports the results from cross-sectional regressions of the liquidity-adjusted CAPM data, the second pass of Fama-Macbeth (1973), for the 25 value-weighted illiquidity portfolios sorted on prior year's average illiquidity with an equal-weighted market portfolio using monthly data from 1995-2012 for global. Special cases of equation (13) are considered, where $\beta^{net,p} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$ and in line (1), (4) and (7) k is set to be the average monthly turnover of all portfolios. The t-statistics are reported in parentheses and calculated with Newey-West (1987) standard errors. The R^2 is obtained via a single cross-sectional regression that employs the average return of the portfolios as dependent variable, the adjusted R^2 is reported in parentheses. The panels A, B, C, D and E present these results for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	Constant	$E(c^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	$\beta^{net,p}$	R^2
(1)	1.204	0.048					-0.884	0.574
	(1.21)	*(---)*					*(-0.67)*	*(0.555)*
(2)	0.176	0.042					0.447	0.653
	(0.23)	*(2.18)*					*(0.42)*	*(0.622)*
(3)	-0.258		1.175					0.127
	(-0.31)		*(0.96)*					*(0.089)*
(4)	1.281	0.048	-0.317				-0.685	0.578
	(1.27)	*(---)*	*(-0.29)*				*(-0.46)*	*(0.540)*
(5)	0.549	0.046	-1.122				1.021	0.665
	(0.75)	*(2.26)*	*(-0.95)*				*(0.71)*	*(0.617)*
(6)	-0.683		-0.836				2.332	0.447
	(-0.68)		*(-0.78)*				*(1.60)*	*(0.397)*
(7)	0.668	0.048	-1.221	-65.550	-34.138	-2.366		0.859
	(1.30)	*(---)*	*(-1.44)*	*(-2.46)*	*(-1.61)*	*(-1.04)*		*(0.831)*
(8)	0.712	0.011	-1.634	-1.177	-47.914	1.994		0.860
	(1.36)	*(0.33)*	*(-1.95)*	*(-0.03)*	*(-1.98)*	*(0.66)*		*(0.823)*

Table VII
Economic effect of illiquidity portfolios

This table reports the economic effects for equal-weighted illiquidity portfolios, which is calculated as the difference between the 12 most illiquid portfolios and the 12 most liquid portfolios multiplied by the coefficient in line (8) in the LCAPM for all regions and globally, except for Japan for which line (7) is used. *LR* reports the total effect of liquidity risk, *LL* the total effect of liquidity level and *Total* is the sum of LR and LL.

	Monthly						Yearly	
	β^{2p} (%)	β^{3p} (%)	β^{4p} (%)	LR (%)	LL (%)	Total (%)	LR (%)	Total (%)
Global	1.85	0.03	-1.39	0.49	0.68	1.16	5.82	13.93
Asia-Pacific (ex. Japan	2.13	-0.37	-0.88	0.88	0.60	1.48	10.59	17.79
Europe	0.92	0.08	-0.18	0.82	0.07	0.88	9.80	10.59
Japan	-0.66	0.03	1.02	0.39	0.04	0.43	4.63	5.17
North America	1.38	1.56	-1.97	0.97	0.34	1.31	11.66	15.74

Table VIII
The liquidity factor

This table reports the results from constructing a liquidity factor based equal- and value-weighted illiquidity portfolios. For the normal liquidity factor, IML, portfolios are firstly sorted into 25 portfolios based on previous year's average illiquidity and then IML is calculated by subtracting the average return on the 12 most liquid portfolios from the average return on the 12 most illiquid portfolios on a monthly base in the period 1995-2012, i.e. 204 months as the first year is lost by sorting on illiquidity. For the difference between small and large stocks, 25 equal-weighted size/illiquidity portfolios are constructed by first sorting into 5 size portfolios and secondly in 5 illiquidity portfolios. Consequently the liquidity factor IML_s is constructed based on the 2 small sized portfolios by subtracting the average return on the 4 most liquid portfolios from the average return on the 4 most illiquid portfolios in each month t, likewise IML_b is constructed on large stocks. IML_c is the difference between IML_s and IML_b. The *Mean* and the *Std. Dev.* are the mean and standard deviation of the liquidity factor, the *t-Mean* is the ratio of the Mean to its standard error.

	Value	Equal			
	IML	IML	IML_s	IML_b	IML_{s-b}
Global					
Mean	0.32	0.90	1.27	-0.09	1.36
Std. Dev.	2.14	2.88	3.61	2.47	3.42
t-Mean	2.14	4.46	5.03	-0.53	5.70
Asia-Pacific (ex. Japan)					
Mean	0.23	1.33	1.62	0.06	1.56
Std. Dev.	3.95	4.47	3.81	2.78	3.69
t-Mean	0.82	4.25	6.08	0.32	6.04
Europe					
Mean	0.02	0.41	1.01	0.12	0.88
Std. Dev.	2.02	2.43	3.18	2.00	2.64
t-Mean	0.16	2.38	4.53	0.88	4.77
Japan					
Mean	0.23	0.55	0.17	-0.07	0.24
Std. Dev.	2.28	2.24	2.93	2.31	2.53
t-Mean	1.42	3.49	0.82	-0.41	1.33
North America					
Mean	0.23	0.93	1.55	0.03	1.52
Std. Dev.	3.99	4.99	5.45	2.41	4.74
t-Mean	0.84	2.67	4.06	0.18	4.57

Table IX
Correlations between factors

This table reports the correlations between the factors used in the five-factor model. *IML* is the liquidity factor based on equal-weighted portfolios. The panels A, B, C, D and E present these correlations for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	MRP	*SMB*	*HML*	*WML*	*IML*
Panel A: Global					
MRP	1.000	0.198	-0.157	-0.245	-0.191
SMB		1.000	-0.214	0.195	0.372
HML			1.000	-0.264	-0.053
WML				1.000	0.266
IML					1.000
Panel B: Asia-Pacific (ex. Japan)					
MRP	1.000	0.135	0.097	-0.281	-0.112
SMB		1.000	-0.019	0.060	0.388
HML			1.000	-0.383	-0.227
WML				1.000	0.287
IML					1.000
Panel C: Europe					
MRP	1.000	-0.157	0.167	-0.349	-0.559
SMB		1.000	-0.123	0.111	0.403
HML			1.000	-0.279	-0.189
WML				1.000	0.409
IML					1.000
Panel D: Japan					
MRP	1.000	0.074	-0.216	-0.148	-0.190
SMB		1.000	0.060	-0.150	0.410
HML			1.000	-0.287	0.032
WML				1.000	0.114
IML					1.000
Panel E: North America					
MRP	1.000	0.251	-0.238	-0.173	-0.185
SMB		1.000	-0.383	0.230	0.131
HML			1.000	-0.231	-0.057
WML				1.000	0.280
IML					1.000

Table X
Time series regressions on illiquidity and size portfolios

This table reports some results from the first-pass regressions, time series regressions, in the Fama-Macbeth (1973) method for the CAPM, the Three-Factor, the Four-Factor and the Five-Factor model, in which the liquidity factor is added to the Four-Factor model to construct a Five-Factor Model. The models use monthly data from the period 1995-2012 and are calculated for 25 equal- and value-weighted illiquidity portfolios as well as 25 equal-weighted size portfolios, which are sorted on respectively the previous year's illiquidity and the beginning of the year market capitalization. *GRS* states the GRS statistic to test whether all intercepts are different from zero, *p-value* reports the respective p-value of the GRS, α is the average intercept of the 25 time series regressions, and finally, $R^{adj,2}$ is the average adjusted R^2.

	Illiquidity								Size			
	Value				Equal				Equal			
	GRS	p-value	α	$R^{adj,2}$	GRS	p-value	α	$R^{adj,2}$	GRS	p-value	α	$R^{adj,2}$
Global												
CAPM	1.04	0.42	0.28	0.723	3.71	0.00	0.44	0.687	2.62	0.00	0.44	0.707
Three-Factor	1.04	0.42	0.18	0.839	3.52	0.00	0.34	0.837	2.79	0.00	0.34	0.857
Four-Factor	0.89	0.62	0.12	0.842	3.55	0.00	0.50	0.853	2.64	0.00	0.50	0.871
Five-Factor	0.71	0.84	-0.02	0.890	2.62	0.00	0.09	0.930	1.80	0.02	0.09	0.935
Asia-Pacific (ex. Japan)												
CAPM	1.07	0.38	0.19	0.668	2.55	0.00	0.44	0.711	2.87	0.00	0.43	0.715
Three-Factor	1.38	0.12	0.26	0.793	2.74	0.00	0.56	0.846	3.44	0.00	0.56	0.854
Four-Factor	1.14	0.30	0.14	0.798	2.83	0.00	0.72	0.851	3.12	0.00	0.71	0.859
Five-Factor	1.13	0.31	0.12	0.831	1.65	0.03	0.42	0.906	2.05	0.00	0.41	0.905
Europe												
CAPM	1.18	0.26	0.25	0.713	3.00	0.00	0.13	0.722	2.25	0.00	0.13	0.739
Three-Factor	1.33	0.15	0.19	0.799	2.92	0.00	0.07	0.861	2.66	0.00	0.07	0.874
Four-Factor	0.93	0.56	0.09	0.805	2.75	0.00	0.26	0.873	2.42	0.00	0.26	0.886
Five-Factor	0.93	0.57	0.08	0.829	2.31	0.00	0.12	0.910	2.13	0.00	0.12	0.914
Japan												
CAPM	1.15	0.29	0.24	0.682	1.14	0.30	0.38	0.663	1.76	0.02	0.38	0.675
Three-Factor	1.47	0.08	0.16	0.862	1.15	0.29	0.24	0.909	1.80	0.02	0.24	0.917
Four-Factor	1.36	0.13	0.13	0.865	1.22	0.23	0.29	0.915	2.02	0.00	0.29	0.922
Five-Factor	1.30	0.17	0.08	0.892	0.69	0.86	0.13	0.946	1.49	0.07	0.13	0.946
North America												
CAPM	1.37	0.12	0.31	0.615	3.61	0.00	0.57	0.583	2.46	0.00	0.57	0.605
Three-Factor	1.24	0.21	0.17	0.769	3.47	0.00	0.44	0.715	2.45	0.00	0.44	0.743
Four-Factor	1.39	0.12	0.09	0.778	3.34	0.00	0.55	0.736	2.30	0.00	0.55	0.757
Five-Factor	1.37	0.12	0.01	0.892	2.98	0.00	0.05	0.901	2.21	0.00	0.05	0.908

Table XI
Time series regressions on size/BTM and size/MOM portfolios

This table reports some results from the first-pass regressions, time series regressions, in the Fama-Macbeth (1973) method for the CAPM, the Three-Factor, the Four-Factor and the Five-Factor model, in which the liquidity factor is added to the Four-Factor model to construct a Five-Factor Model. The models use monthly data from the period 1995-2012 and are calculated for the 25 size/BTM and 25 size/MOM portfolios available at Kenneth French's website. *GRS* states the GRS statistic to test whether all intercepts are different from zero, *p-value* reports the respective p-value of the GRS, α is the average intercept of the 25 time series regressions, and finally, $R^{adj,2}$ is the average adjusted R^2.

	Size/BTM				Size/MOM			
	GRS	p-value	α	$R^{adj,2}$	GRS	p-value	α	$R^{adj,2}$
Global								
CAPM	6.32	0.00	0.14	0.815	3.61	0.00	0.26	0.772
Three-Factor	5.95	0.00	0.04	0.923	5.38	0.00	0.14	0.875
Four-Factor	7.25	0.00	0.22	0.943	4.88	0.00	0.19	0.941
Five-Factor	6.04	0.00	0.14	0.956	3.87	0.00	0.13	0.954
Asia-Pacific (ex. Japan)								
CAPM	6.29	0.00	0.00	0.800	5.34	0.00	0.19	0.774
Three-Factor	5.95	0.00	0.09	0.888	5.98	0.00	0.25	0.856
Four-Factor	6.12	0.00	0.27	0.896	5.17	0.00	0.29	0.895
Five-Factor	4.74	0.00	0.27	0.913	3.72	0.00	0.28	0.908
Europe								
CAPM	3.84	0.00	0.14	0.807	4.68	0.00	0.26	0.782
Three-Factor	3.62	0.00	0.07	0.918	5.79	0.00	0.17	0.869
Four-Factor	4.50	0.00	0.24	0.928	4.77	0.00	0.21	0.924
Five-Factor	4.00	0.00	0.23	0.933	4.31	0.00	0.20	0.930
Japan								
CAPM	1.47	0.08	0.19	0.723	0.99	0.48	0.19	0.707
Three-Factor	1.56	0.05	0.06	0.909	1.20	0.24	0.05	0.848
Four-Factor	2.00	0.01	0.13	0.918	1.10	0.35	0.07	0.908
Five-Factor	1.71	0.02	0.15	0.924	0.96	0.53	0.08	0.915
North America								
CAPM	2.34	0.00	0.12	0.743	2.45	0.00	0.25	0.707
Three-Factor	2.28	0.00	0.04	0.885	2.44	0.00	0.12	0.831
Four-Factor	2.62	0.00	0.19	0.911	2.31	0.00	0.15	0.915
Five-Factor	2.32	0.00	0.10	0.925	1.99	0.01	0.09	0.930

Table XII

Cross-sectional regressions on illiquidity portfolios

This table reports the results from the second-pass regressions, cross-sectional regressions, in the Fama-Macbeth (1976) method for the CAPM, the Three-Factor, the Four-Factor and the Five-Factor model, in which the liquidity factor is added to the Four-Factor model to construct a Five-Factor Model. The models use monthly data from the period 1995-2012 and are calculated for 25 equal-weighted portfolios which are sorted on the previous year's illiquidity. The even lines test the above models in an unconditional state and the odd lines tests the respective model in a conditional state, i.e. time-varying betas based on the previous 60 months. The t-statistics are reported in parentheses and calculated with Newey-West (1987) standard errors. The R^2 is obtained via a single cross-sectional regression in which all portfolios are averaged, the adjusted R^2 is reported in parentheses. The panels A, B, C, D and E present these results for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	Constant	*MRP*	*SMB*	*HML*	*WML*	*IML*	R^2
Panel A: Global							
(1)	1.638	-0.731					0.005
	(1.81)	*(-1.06)*					*(-0.039)*
(2)	-0.030	0.571					0.002
	(-0.02)	*(0.49)*					*(-0.042)*
(3)	0.627	-0.307	1.078	-4.125			0.559
	(1.10)	*(-0.53)*	*(3.57)*	*(-5.25)*			*(0.496)*
(4)	-1.318	1.618	0.527	-0.392			0.428
	(-1.43)	*(1.91)*	*(1.95)*	*(-0.66)*			*(0.346)*
(5)	-1.909	4.402	0.257	-0.141	11.832		0.894
	(-2.79)	*(4.84)*	*(1.11)*	*(-0.36)*	*(6.24)*		*(0.873)*
(6)	-1.640	2.524	0.579	0.017	3.866		0.841
	(-1.86)	*(2.78)*	*(2.12)*	*(0.04)*	*(2.71)*		*(0.809)*
(7)	-2.154	4.024	-0.078	-0.162	7.631	1.018	0.900
	(-3.04)	*(4.69)*	*(-0.35)*	*(-0.41)*	*(4.49)*	*(4.48)*	*(0.874)*
(8)	-1.553	1.405	0.022	1.222	-2.176	0.937	0.933
	(-1.85)	*(1.91)*	*(0.10)*	*(2.50)*	*(-1.34)*	*(3.97)*	*(0.915)*
Panel B: Asia-Pacific (ex. Japan)							
(1)	4.569	-2.838					0.048
	(2.59)	*(-2.06)*					*(0.007)*
(2)	-1.352	2.144					0.114
	(-0.96)	*(1.98)*					*(0.075)*
(3)	-3.068	4.143	0.774	-4.992			0.846
	(-3.75)	*(4.66)*	*(2.41)*	*(-6.36)*			*(0.824)*
(4)	-0.036	0.741	0.514	0.372			0.634
	(-0.04)	*(1.15)*	*(1.68)*	*(0.61)*			*(0.582)*
(5)	-3.848	4.983	0.753	-4.526	3.133		0.852
	(-4.35)	*(5.10)*	*(2.37)*	*(-6.05)*	*(2.94)*		*(0.822)*
(6)	-0.046	0.982	0.410	0.034	0.444		0.656
	(-0.04)	*(1.45)*	*(1.34)*	*(0.06)*	*(0.61)*		*(0.587)*
(7)	-2.565	3.204	-0.312	0.057	-2.257	1.383	0.922
	(-3.20)	*(3.56)*	*(-1.09)*	*(0.06)*	*(-1.84)*	*(4.14)*	*(0.901)*
(8)	1.682	-0.250	-0.333	0.273	-0.974	1.257	0.944
	(2.05)	*(-0.43)*	*(-1.36)*	*(0.53)*	*(-1.72)*	*(4.48)*	*(0.929)*

	Constant	*MRP*	*SMB*	*HML*	*WML*	*IML*	R^2
Panel C: Europe							
(1)	2.292	-1.714					0.186
	(3.08)	*(-2.61)*					*(0.150)*
(2)	1.685	-1.253					0.199
	(2.35)	*(-1.95)*					*(0.164)*
(3)	2.645	-1.565	-0.359	-2.349			0.250
	(5.05)	*(-2.64)*	*(-1.65)*	*(-3.91)*			*(0.143)*
(4)	1.177	-0.823	0.228	0.006			0.211
	(1.74)	*(-1.27)*	*(0.88)*	*(0.02*			*(0.098)*
(5)	-0.467	2.364	-0.000	0.438	7.931		0.699
	(-0.73)	*(2.85)*	*(-0.00)*	*(0.85)*	*(5.76)*		*(0.639)*
(6)	0.551	0.104	0.309	0.024	1.874		0.570
	(0.86)	*(0.15)*	*(1.20)*	*(0.06)*	*(2.24)*		*(0.484)*
(7)	-2.228	3.273	-0.702	-0.498	0.943	0.456	0.914
	(-2.58)	*(3.48)*	*(-3.25)*	*(-0.99)*	*(1.27)*	*(2.75)*	*(0.891)*
(8)	-2.063	2.514	-0.249	0.182	-0.757	0.493	0.898
	(-2.49)	*(2.98)*	*(-1.00)*	*(0.48)*	*(-1.39)*	*(2.75)*	*(0.781)*
Panel D: Japan							
(1)	4.360	-4.081					0.417
	(3.76)	*(-3.98)*					*(0.392)*
(2)	4.047	-3.555					0.705
	(3.47)	*(-3.46)*					*(0.693)*
(3)	3.866	-4.214	0.223	1.331			0.668
	(4.22)	*(-4.23)*	*(0.82)*	*(2.24)*			*(0.620)*
(4)	4.158	-4.092	0.312	1.510			0.848
	(4.74)	*(-4.37)*	*(1.07)*	*(3.96)*			*(0.826)*
(5)	4.853	-5.390	0.367	0.692	-1.714		0.707
	(4.47)	*(-4.39)*	*(1.32)*	*(1.36)*	*(-1.92)*		*(0.649)*
(6)	4.206	-4.245	0.375	1.239	-0.609		0.934
	(4.63)	*(-4.46)*	*(1.28)*	*(3.62)*	*(-1.23)*		*(0.921)*
(7)	-0.365	0.199	-0.025	0.560	-0.915	0.539	0.966
	(-0.43)	*(0.19)*	*(-0.10)*	*(1.10)*	*(-1.07)*	*(3.56)*	*(0.957)*
(8)	2.388	-2.325	0.164	1.191	-0.557	0.671	0.967
	(3.26)	*(-3.26)*	*(0.58)*	*(3.66)*	*(-1.09)*	*(4.11)*	*(0.959)*
Panel E: North America							
(1)	6.836	-4.953					0.238
	(3.01)	*(-2.86)*					*(0.205)*
(2)	2.766	-1.814					0.267
	(1.90)	*(-1.54)*					*(0.235)*
(3)	4.137	-4.097	1.280	0.497			0.528
	(2.66)	*(-2.81)*	*(3.30)*	*(0.56)*			*(0.460)*
(4)	0.803	-1.027	1.396	1.680			0.433
	(0.59)	*(-0.96)*	*(2.18)*	*(2.23)*			*(0.352)*
(5)	-1.344	2.769	0.844	0.899	7.273		0.835
	(-1.00)	*(2.31)*	*(2.42)*	*(0.98)*	*(4.60)*		*(0.802)*
(6)	1.395	-0.770	1.174	0.558	3.065		0.754
	(1.48)	*(-1.13)*	*(2.06)*	*(1.08)*	*(2.10)*		*(0.705)*
(7)	-8.942	8.648	-0.355	1.926	-1.059	1.051	0.886
	(-5.30)	*(5.75)*	*(-0.97)*	*(2.07)*	*(-0.65)*	*(2.63)*	*(0.856)*
(8)	1.159	-0.985	0.977	1.114	0.897	1.108	0.938
	(1.26)	*(-1.39)*	*(1.60)*	*(2.45)*	*(0.59)*	*(2.48)*	*(0.922)*

Table XIII
Cross-sectional regressions on size portfolios

This table reports the results from the second-pass regressions, cross-sectional regressions, in the Fama-Macbeth (1976) method for the CAPM, the Three-Factor, the Four-Factor and the Five-Factor model, in which the liquidity factor is added to the Four-Factor model to construct a Five-Factor Model. The models use monthly data from the period 1995-2012 and are calculated for 25 equal-weighted portfolios which are sorted on the market capitalization at the beginning of the year. The even lines test the above models in an unconditional state and the odd lines tests the respective model in a conditional state, i.e. time-varying betas based on the previous 60 months. The t-statistics are reported in parentheses and calculated with Newey-West (1987) standard errors. The R^2 is obtained via a single cross-sectional regression in which all portfolios are averaged, the adjusted R^2 is reported in parentheses. The panels A, B, C, D and E present these results for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

	Constant	*MRP*	*SMB*	*HML*	*WML*	*IML*	R^2
Panel A: Global							
(1)	-8.073	8.421					0.207
	(-5.27)	*(5.28)*					*(0.173)*
(2)	-0.548	0.723					0.258
	(-0.29)	*(0.39)*					*(0.226)*
(3)	-3.588	3.789	0.870	-3.609			0.764
	(-3.79)	*(4.20)*	*(3.34)*	*(-4.69)*			*(0.730)*
(4)	-3.510	3.565	0.730	-0.946			0.592
	(-2.47)	*(2.88)*	*(2.56)*	*(-1.42)*			*(0.534)*
(5)	-3.577	5.093	1.383	-3.460	12.26		0.926
	(-3.78)	*(4.87)*	*(4.24)*	*(-4.56)*	*(5.41)*		*(0.911)*
(6)	-3.172	3.490	0.712	-1.078	1.517		0.902
	(-2.77)	*(3.21)*	*(1.99)*	*(-1.48)*	*(0.89)*		*(0.883)*
(7)	-4.159	4.486	-0.182	1.983	1.959	1.618	0.976
	(-4.24)	*(4.49)*	*(-0.92)*	*(3.12)*	*(1.63)*	*(4.60)*	*(0.970)*
(8)	-2.676	2.756	-0.005	0.547	-2.035	0.752	0.986
	(-2.74)	*(3.00)*	*(-0.02)*	*(1.19)*	*(-2.20)*	*(2.37)*	*(0.982)*
Panel B: Asia-Pacific (ex. Japan)							
(1)	-11.402	10.876					0.360
	(-5.07)	*(4.99)*					*(0.332)*
(2)	-2.668	3.171					0.619
	(-1.43)	*(1.87)*					*(0.602)*
(3)	-2.271	2.684	0.882	-2.422			0.823
	(-2.50)	*(2.96)*	*(2.51)*	*(-4.16)*			*(0.798)*
(4)	-4.631	5.347	0.511	-1.35			0.823
	(-3.21)	*(4.02)*	*(1.50)*	*(-2.88)*			*(0.797)*
(5)	-2.323	2.923	0.882	-2.404	0.931		0.823
	(-2.65)	*(3.17)*	*(2.52)*	*(-4.13)*	*(0.98)*		*(0.788)*
(6)	-4.387	5.178	0.530	-1.289	0.429		0.867
	(-3.02)	*(3.90)*	*(1.60)*	*(-2.80)*	*(0.79)*		*(0.841)*
(7)	-2.204	2.876	-0.139	0.139	-1.541	1.091	0.883
	(-2.52)	*(3.12)*	*(-0.50)*	*(0.23)*	*(-1.67)*	*(2.84)*	*(0.852)*
(8)	-0.247	1.627	-0.149	-0.217	-0.265	1.014	0.919
	(-0.30)	*(1.98)*	*(-0.61)*	*(-0.62)*	*(-0.49)*	*(3.25)*	*(0.898)*

	Constant	*MRP*	*SMB*	*HML*	*WML*	*IML*	R^2
Panel C: Europe							
(1)	2.094	-1.512					0.033
	(1.38)	(-1.11)					*(-0.009)*
(2)	1.574	-1.104					0.041
	(0.94)	*(-0.78)*					*(-0.001)*
(3)	-3.693	4.358	-0.017	-3.775			0.808
	(-3.13)	*(3.69)*	*(-0.08)*	*(-4.60)*			*(0.781)*
(4)	-2.392	2.448	0.389	-1.782			0.607
	(-1.67)	*(1.97)*	*(1.50)*	*(-3.42)*			*(0.551)*
(5)	-2.658	3.529	0.148	-3.471	2.697		0.819
	(-2.45)	*(3.18)*	*(0.72)*	*(-4.41)*	*(2.99)*		*(0.782)*
(6)	-2.485	2.689	0.372	-1.729	0.194		0.724
	(-1.84)	*(2.30)*	*(1.39)*	*(-3.37)*	*(0.22)*		*(0.669)*
(7)	-4.32	4.481	-0.323	1.209	-0.609	0.102	0.936
	(-3.58)	*(4.00)*	*(-1.63)*	*(2.39)*	*(-0.76)*	*(0.37)*	*(0.920)*
(8)	-3.926	4.426	-0.173	-0.432	-0.259	-0.015	0.877
	(-3.10)	*(3.90)*	*(-0.86)*	*(-1.10)*	*(-0.34)*	*(-0.06)*	*(0.845)*
Panel D: Japan							
(1)	-6.382	6.556					0.765
	(-3.88)	(3.41)					*(0.755)*
(2)	-1.985	2.831					0.547
	(-1.90)	*(2.59)*					*(0.527)*
(3)	-6.214	6.247	0.291	-0.329			0.770
	(-5.46)	*(4.83)*	*(0.98)*	*(-0.63)*			*(0.737)*
(4)	-2.57	2.492	0.993	-0.656			0.647
	(-3.49)	*(3.47)*	*(3.20)*	*(-1.42)*			*(0.596)*
(5)	-2.602	2.235	0.238	-0.554	-5.16		0.901
	(-3.34)	*(2.33)*	*(0.81)*	*(-1.03)*	*(-4.68)*		*(0.881)*
(6)	-1.576	1.425	0.701	-0.282	-2.561		0.841
	(-2.58)	*(2.43)*	*(2.48)*	*(-0.69)*	*(-3.66)*		*(0.809)*
(7)	-1.788	1.442	0.02	0.176	-4.357	-0.169	0.912
	(-2.76)	*(1.87)*	*(0.08)*	*(0.39)*	*(-3.59)*	*(-0.73)*	*(0.888)*
(8)	-0.765	0.828	0.153	0.725	-1.191	0.48	0.847
	(-1.39)	*(1.61)*	*(0.64)*	*(2.00)*	*(-1.81)*	*(2.63)*	*(0.806)*
Panel E: North America							
(1)	10.412	-8.118					0.316
	(3.89)	*(-3.77)*					*(0.286)*
(2)	5.582	-4.701					0.320
	(2.64)	*(-2.30)*					*(0.291)*
(3)	11.88	-11.817	0.607	4.757			0.743
	(4.33)	*(-4.19)*	*(1.67)*	*(2.88)*			*(0.706)*
(4)	6.156	-6.511	0.429	5.010			0.506
	(2.07)	*(-1.88)*	*(1.50)*	*(1.65)*			*(0.436)*
(5)	4.768	-3.566	1.12	1.009	9.035		0.947
	(2.36)	*(-1.77)*	*(2.81)*	*(0.66)*	*(5.11)*		*(0.936)*
(6)	5.562	-5.169	0.710	2.253	3.554		0.930
	(2.19)	*(-1.69)*	*(2.53)*	*(0.79)*	*(3.05)*		*(0.917)*
(7)	0.868	-0.262	0.378	2.525	5.112	2.285	0.969
	(0.58)	*(-0.16)*	*(1.15)*	*(1.59)*	*(3.53)*	*(4.13)*	*(0.960)*
(8)	1.976	-1.900	0.45	1.498	0.792	1.629	0.968
	(1.62)	*(-1.17)*	*(1.46)*	*(0.64)*	*(0.53)*	*(2.40)*	*(0.959)*

Table XIV
Cross-sectional regressions on value-weighted illiquidity portfolios

This table reports the results from the second-pass regressions, cross-sectional regressions, in the Fama-Macbeth (1976) method for the CAPM, the Three-Factor, the Four-Factor and the Five-Factor model, in which the liquidity factor is added to the Four-Factor model to construct a Five-Factor Model. The models use monthly data from the period 1995-2012 and are calculated for the 25 global value-weighted portfolios which are sorted on the previous year's illiquidity. The even lines test the above models in an unconditional state and the odd lines tests the respective model in a conditional state, i.e. time-varying betas based on the previous 60 months. The t-statistics are reported in parentheses and calculated with Newey-West (1987) standard errors. The R^2 is obtained via a single cross-sectional regression in which all portfolios are averaged, the adjusted R^2 is reported in parentheses.

	Constant	MRP	SMB	HML	WML	IML	R^2
(1)	2.036	-1.413					0.202
	(-2.66)	*(-2.18)*					*(0.167)*
(2)	1.341	-0.735					0.078
	(2.03)	*(-1.73)*					*(0.038)*
(3)	1.205	-0.855	0.419	-0.235			0.620
	(2.17)	*(-1.49)*	*(1.49)*	*(-0.47)*			*(0.565)*
(4)	1.051	-0.624	0.162	0.404			0.698
	(2.05)	*(-1.60)*	*(0.82)*	*(1.56)*			*(0.654)*
(5)	1.070	-0.740	0.254	0.135	1.756		0.671
	(1.85)	*(-1.25)*	*(0.85)*	*(0.23)*	*(2.01)*		*(0.605)*
(6)	1.005	-0.611	0.189	0.499	0.557		0.827
	(1.94)	*(-1.52)*	*(1.01)*	*(1.81)*	*(1.08)*		*(0.793)*
(7)	0.372	0.050	-0.141	0.662	1.375	0.345	0.858
	(0.50)	*(0.06)*	*(-0.62)*	*(1.21)*	*(1.58)*	*(2.16)*	*(0.821)*
(8)	1.137	-0.752	0.398	0.265	0.340	0.257	0.875
	(2.24)	*(-1.87)*	*(2.38)*	*(1.22)*	*(0.75)*	*(1.80)*	*(0.842)*

Figure I
Standardized market illiquidity innovations

The panels A, B, C, D and E below plot the standardized market illiquidity innovations from 1995-2012 for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America. The market illiquidity innovations in these panels are scaled to have unit standard deviation to ease interpretation and comparison.

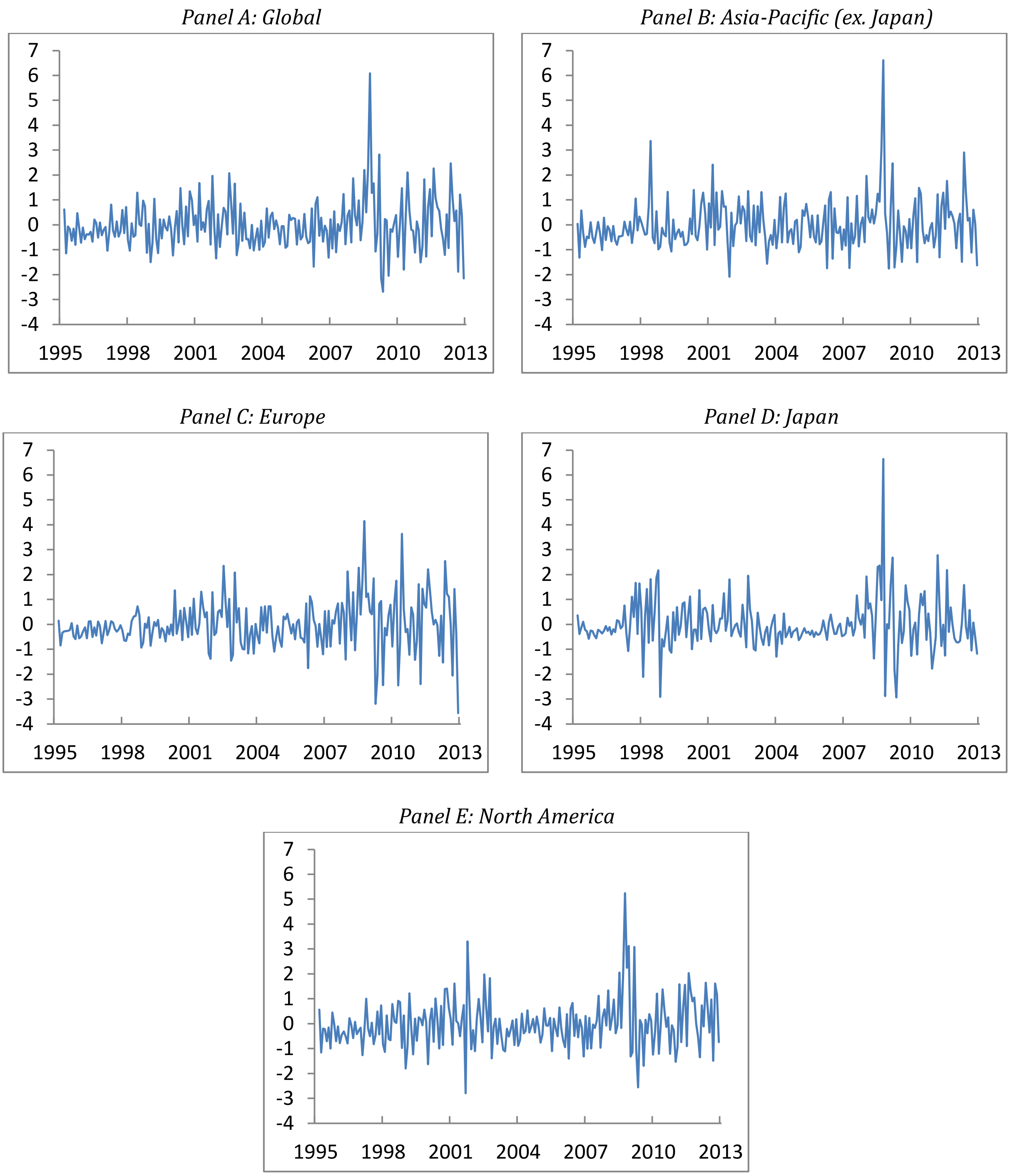
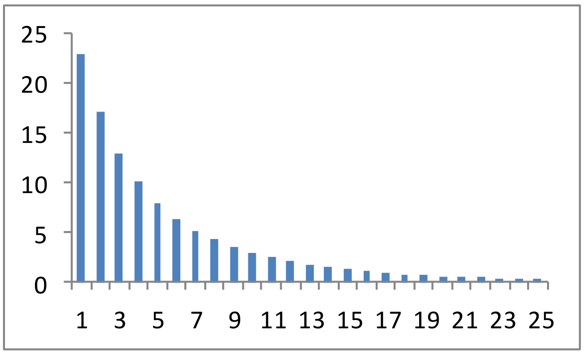


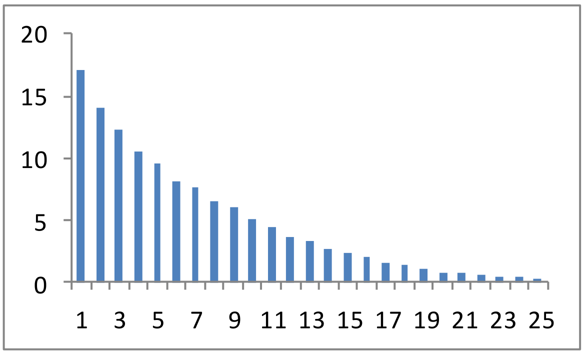
Figure II
Illiquidity of size portfolios

The panels below plot the average normalized illiquidity, $E(c^p)$, for the 25 equal-weighted size portfolios computed for each portfolio as time-series averages of the respective monthly characteristics. The size portfolios are sorted from small to large stocks. The panels A, B, C, D and E present this for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

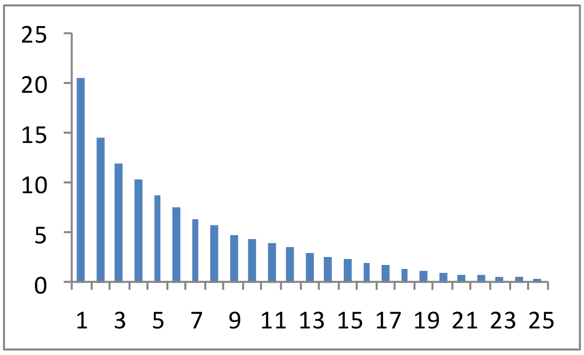
Panel A: Global



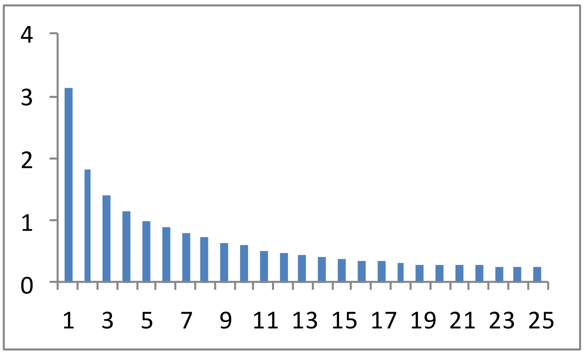
Panel B: Asia-Pacific (ex. Japan)



Panel C: Europe



Panel D: Japan



Panel E: North America

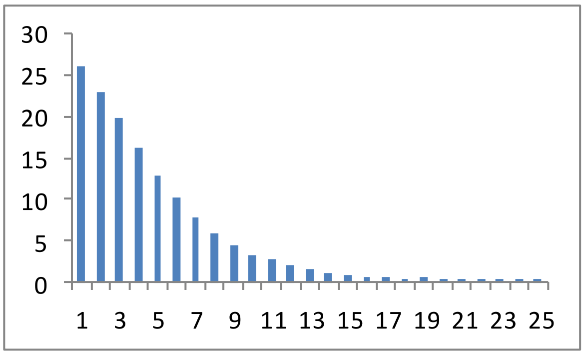
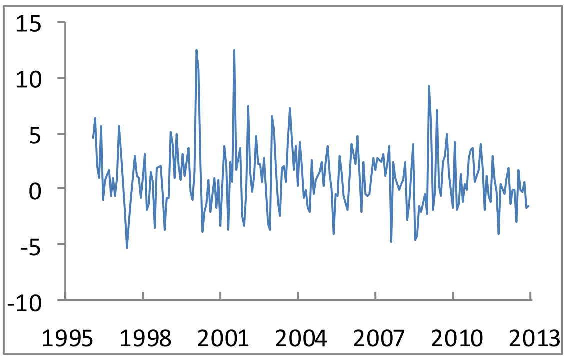


Figure III

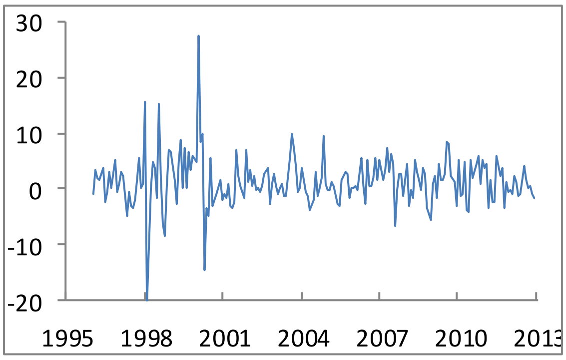
Liquidity premium over 1995-2012

The panels below plot the liquidity premium obtained as the coefficient on the liquidity factor of the unconditional second-pass regressions of Fama-MacBeth (1973), the cross-sectional regressions, based on 25 equal-weighted portfolios sorted on illiquidity in the period 1995-2012. The panels A, B, C, D and E present this for respectively: Global, Asia-Pacific (ex. Japan), Europe, Japan and North America.

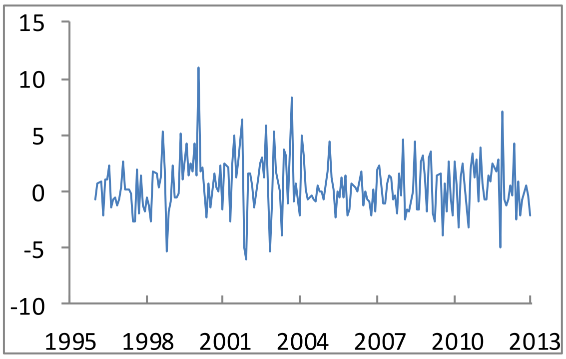
Panel A: Global



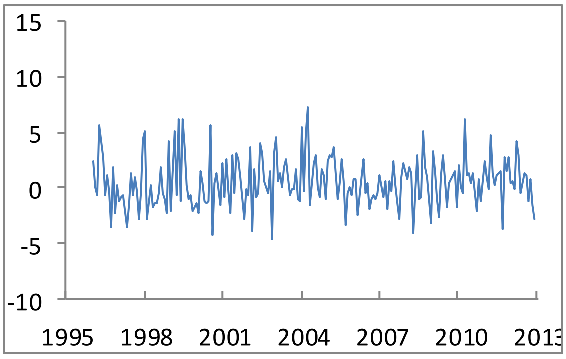
Panel B: Asia-Pacific (ex. Japan)



Panel C: Europe



Panel D: Japan



Panel E: North America