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The world price of liquidity risk

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ABSTRACT

This paper empirically tests the liquidity-adjusted capital asset pricing model of Acharya and Pedersen (2005) on a global level. Consistent with the model, I find evidence that liquidity risks are priced independently of market risk in international financial markets. That is, a security's required rate of return depends on the covariance of its own liquidity with aggregate local market liquidity, as well as the covariance of its own liquidity with local and global market returns. I also show that the US market is an important driving force of global liquidity risk. Furthermore, I find that the pricing of liquidity risk varies across countries according to geographic, economic, and political environments. The findings show that the systematic dimension of liquidity provides implications for international portfolio diversification.

1. Introduction

Liquidity has been shown to affect the cross-sectional differences of asset returns in the US market through two different channels, that is, as either a characteristic (Amihud and Mendelson, 1986; Brennan and Subrahmanyam, 1996; Amihud, 2002) or a risk factor (Pástor and Stambaugh, 2003; Acharya and Pedersen, 2005; Liu, 2006; Sadka, 2006; Watanabe and Watanabe, 2008). Encompassing multiple channels through which liquidity affects

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asset prices, Acharya and Pedersen (2005) propose the liquidity-adjusted capital asset pricing model (LCAPM), which incorporates three different types of liquidity risk that are independent of traditional market risk: the covariance of liquidity with market liquidity (commonality in liquidity), the covariance of liquidity with market return, and the covariance of return with market liquidity. In their paper, Acharya and Pedersen (2005) also show empirical evidence supporting the LCAPM in the US market.

However, to date, the potential importance of liquidity has not been explored as extensively in international financial markets as it has in the US market. In the study of world market liquidity, earlier research has primarily focused on liquidity level (Rouwenhorst, 1999; Brockman and Chung, 2003; Chiyachantana, Jain, Jiang, and Wood, 2004; Lesmond, 2005; Eleswarapu and Venkataraman, 2006), while researchers have recently paid more attention to the systematic aspects of liquidity (Liang and Wei, 2006; Bekaert, Harvey, and Lundblad, 2007; Brockman, Chung, and Pérignon, 2009; Karolyi, Lee, and van Dijk, 2009). Brockman, Chung, and Pérignon (2009) and Karolyi, Lee, and van Dijk (2009) investigate the commonality in liquidity in global financial markets. Liang and Wei (2006) examine the pricing of liquidity risk that arises from the sensitivity of stock returns to market-wide liquidity in 23 developed-market countries. However, the pricing of multiple liquidity risks in a unified framework such as the LCAPM has not been fully investigated for international financial markets. Recently, Bekaert, Harvey, and Lundblad (2007) investigate various forms of liquidity risk, but at the level of country portfolios, not individual stocks. Moreover, they restrict the sample to 19 emerging-market countries, leaving the importance of liquidity in asset pricing in developed markets for future research.

I contribute to the literature by empirically investigating an equilibrium asset pricing relation with liquidity both as a characteristic and as a risk factor in international financial markets by using 30 thousand stocks from 50 countries from January 1988 to December 2007. To my knowledge, this is the first paper that assesses multiple forms of liquidity risk as well as market risk, as specified in the LCAPM, in global financial markets. I evaluate the unconditional version of the LCAPM on a global level under different assumptions on the degree of world financial market integration. I specifically investigate the following research questions in this paper. First, I examine whether supporting evidence of the LCAPM in the US is also prevalent in global financial markets. In particular, I investigate whether liquidity risks are priced independently of market risk and examine which type of liquidity risk is most significant in pricing. I employ a cross-sectional regression framework and factor model regressions to investigate this issue. Second, I examine whether the US market plays an important role in the pricing of global liquidity risk. To achieve this goal, I compare the pricing of liquidity risk with respect to US factors with the pricing of liquidity risk with respect to global aggregates that are independent of both local and US factors. Third, I investigate the differences in the relative importance of local and global liquidity risk in asset pricing and further examine the sources of such differences according to geographic, economic, and political environments across countries.

An extension to global markets of the investigation of the pricing of liquidity risks is important for at least the following three reasons. First, the importance of liquidity could be more pronounced in markets other than the US, where liquidity is allegedly high. Hence, extending the study of liquidity to world markets could provide a good opportunity to evaluate the role of liquidity as an additional source of systematic risk. Second, liquidity could be a global phenomenon as can be seen from episodes such as the Asian financial crisis, the meltdown of Long-Term Capital Management, and the ongoing subprime mortgage crisis. As shown by these incidents, liquidity-related events are not restricted to either developed-market or emerging-market countries, but they are pervasive worldwide, making it necessary to investigate both developed and emerging markets together when studying liquidity in global markets. Third, the geographic, economic, and political environment could affect the importance of liquidity risk differently across countries. Extending the scope to global markets provides a unique opportunity to investigate such cross-country or cross-regional variations in the pricing of liquidity risk.

I find that market liquidity is persistent in most of the sample countries, consistent with US results in the literature (Pástor and Stambaugh, 2003; Acharya and Pedersen, 2005; Korajczyk and Sadka, 2008). In addition to this confirmatory evidence, I find some new and interesting results. First, consistent with the LCAPM, I find supporting evidence that liquidity risks are priced factors, independent of market risk, in international financial markets. Specifically, cross-sectional regressions show that, after controlling for market risk, liquidity level, size, and book-to-market, a security's required rate of return depends on the following two covariances: the covariance of its own liquidity with the liquidity aggregated at the local market, and the covariance of its own liquidity with local and global market returns. Factor model regressions show that trading based on local liquidity risk produces 7.6% annual excess returns (trading alpha) in the overall world market and 13.6% in emerging markets. The corresponding figure is 1.8% in the overall world market when trading is based on global liquidity risk. Second, I provide evidence that the global liquidity risk arising from the covariance of individual stock liquidity with US market return is priced. This highlights the key role of the US in global financial markets, contrasting sharply with the finding that the global liquidity risk formed by excluding the US is not priced or is priced with the wrong sign. Third, the pattern of the pricing of liquidity risk varies across geographic, political, and economic environments. On the one hand, global liquidity risk is shown to be more important than local liquidity risk in countries that are more open, that is, in developed countries as well as in countries with high transparency, low political risk, and large cross-border portfolio holdings. On the other hand, in countries with the contrary properties, i.e., where global investors are rare, I find that local liquidity risk is more important than global liquidity risk.

The findings of this paper have important implications for international investment and portfolio diversification. In the traditional capital asset pricing model, any systematic fluctuation of asset prices is captured solely by market risk. Therefore, the covariance of stock returns with (global) market returns is the key to the success of (international) portfolio diversification. However, the findings in this paper show that the commonality in liquidity and the covariance of liquidity with market returns are channels, independent of market risk, through which liquidity systematically affects asset prices. Hence, the findings provide an additional layer to consider when investors seek to diversify away risks in global financial markets. In this regard, theoretical models of the liquidity constraints of financial intermediaries shed some light on the importance of the findings in this paper in that they share the common feature of the increasing importance of liquidity as arbitrageurs are forced to liquidate their positions in the face of large market declines (Kyle and Xiong, 2001; Morris and Shin, 2004; Brunnermeier and Pedersen, 2009). This implies that liquidity risk is a relevant factor in asset pricing because arbitrageurs could demand compensation for bearing liquidity risk. The importance of liquidity risk is cited not only in the academic literature but also in the financial press:

> "Whenever the market turns against you, you take the biggest losses in illiquid securities," says Richard Bookstaber, former head of risk management at Salomon Bros. "Because there are so few buyers, you're forced to sell at a discount that is both huge and highly unpredictable" (p. 49, *Fortune*, November 26, 2007).

The significant pricing of global liquidity risk in developed counties and in countries with low information asymmetry, low political risk, and large cross-border holdings implies the importance of global investors and the relatively high degree of financial market integration in such countries. Supporting this view, Chan, Covrig, and Ng (2005) show that countries with these properties attract more global investors. The finding reveals that stocks whose liquidity improves in market downturns are valued by global investors because liquidity is an important concern, especially when investors rebalance their portfolios globally in the face of down markets.

One challenge in a study of liquidity at the global level is finding a suitable proxy for liquidity. In international financial markets, intra-day data are seldom available and trading volume data, upon which other popular proxies such as that of Amihud (2002) and turnovers are based, are also rare with the quality not being guaranteed. In addition, these data do not cover a sufficiently long period for many countries. Hence, it might be most appropriate to use a liquidity proxy that is based solely on returns. I employ the zero-return proportion measure, suggested by Lesmond, Ogden, and Trzcinka (1999), which is the ratio of the number of zero-return days to the total number of trading days in a given month. The economic intuition behind this measure is that informed traders will not trade on a given day, thus leading to a zero-return day, when the trading cost is high enough to offset the gains from informed trading. The zero-return proportion measure has been widely employed in the literature. It is used to evaluate the impact of trading costs in a momentum strategy (Lesmond, Schill, and Zhou, 2004), to examine the relation between market liquidity and political risks in emerging markets (Lesmond, 2005), and to investigate the implications of liquidity for asset pricing in emerging markets (Bekaert, Harvey, and Lundblad, 2007). The validity of this measure has been established both in the US market (Lesmond, Ogden, and Trzcinka, 1999; Goyenko, Holden, and Trzcinka, 2009) and in world financial markets (Lesmond, 2005; Bekaert, Harvey, and Lundblad, 2007).

The rest of the paper is organized as follows. In the next section, I briefly introduce the LCAPM of Acharya and Pedersen (2005). Section 3 describes the data and the sample construction procedure. Section 4 explains the methodology. Empirical evidence on the pricing of local and global liquidity risk as well as robustness tests are presented in Section 5. Section 6 demonstrates how the pricing of liquidity risk varies across countries with different geographic, economic, and political environments. Section 7 presents empirical results based on factor model regressions. I conclude in Section 8.

2. The liquidity-adjusted capital asset pricing model

The liquidity-adjusted capital asset pricing model of Acharya and Pedersen (2005) is derived in a framework similar to the traditional CAPM in that risk-averse investors maximize their expected utility under a given wealth constraint in an overlapping-generation economy. However, in the LCAPM, the trading cost-free stock price, $P_{i,t}$, is replaced with the price that is adjusted by the stochastic trading cost, $P_{i,t}-\Psi_{i,t}$, where $\Psi_{i,t}$ is the trading cost as an absolute amount. As a result, the LCAPM shown in Eq. (1) has three covariance terms that are related to stochastic trading costs in addition to the traditional market risk component

$$E_t(R_{i,t+1}-C_{i,t+1}) = R_f + \lambda_t \frac{Cov_t(R_{i,t+1}-C_{i,t+1}, R^D_{t+1}-C^D_{t+1})}{Var_t(R^D_{t+1}-C^D_{t+1})}. \tag{1}$$

$R_{i,t}$ is the gross return of stock i, $R_{f,t}$ is the gross risk-free rate, $\lambda_t$is the risk premium, and $C_{i,t}$ is the trading cost per price ($C_{i,t} \equiv \Psi_{i,t}/P_{i,t-1}$), all at time t. The subscript t for expectation, covariance, and variance denotes that these operators are conditional on the information set available up to time t. The superscript D denotes that the variable is defined in terms of the local market portfolio (D stands for the domestic market). It is clear that without the trading cost terms C^D and C_i, the LCAPM in Eq. (1) is equivalent to the traditional CAPM.

By assuming constant conditional variances or a constant premium, the unconditional version of the model is derived as

$$E(R_{i,t}-R_{f,t}) = E(C_{i,t}) + \lambda^D \beta_i^{1,D} + \lambda^D \beta_i^{2,D} - \lambda^D \beta_i^{3,D} - \lambda^D \beta_i^{4,D}, \tag{2}$$

where

$$\beta_i^{1,D} \equiv \frac{Cov(R_{i,t}, R_t^D)}{Var(R_t^D - C_t^D)}, \quad \beta_i^{2,D} \equiv \frac{Cov(C_{i,t}, C_t^D)}{Var(R_t^D - C_t^D)},$$
$$\beta_i^{3,D} \equiv \frac{Cov(R_{i,t}, C_t^D)}{Var(R_t^D - C_t^D)}, \quad \beta_i^{4,D} \equiv \frac{Cov(C_{i,t}, R_t^D)}{Var(R_t^D - C_t^D)}. \tag{3}$$

The risk premium is defined as $\lambda^D \equiv E(\lambda_t^D) = E(R_t^D - C_t^D - R_{f,t})$. In addition, following Acharya and Pedersen (2005), I define the liquidity net beta as a linear combination of the three liquidity betas, excluding the market beta:

$$\beta_i^{5,D} \equiv \beta_i^{2,D} - \beta_i^{3,D} - \beta_i^{4,D}. \tag{4}$$

The liquidity net beta helps to distinguish the pricing effect of liquidity risks from that of market risk.

Each beta in Eq. (3) has an economic interpretation. $\beta_i^{1,D}$ is similar to the market beta of CAPM except for the additional term that is related to the trading cost in the denominator. $\beta_i^{2,D}$ is a liquidity risk that arises from the comovement of individual stock liquidity with market liquidity (Chordia, Roll, and Subrahmanyam, 2000; Hasbrouck and Seppi, 2001; Huberman and Halka, 2001; Coughenour and Saad, 2004; Kamara, Lou, and Sadka, 2008; Karolyi, Lee, and van Dijk, 2009).[2] $\beta_i^{2,D}$ is positively related to the expected returns in the LCAPM, implying that stocks whose liquidity negatively comoves with market liquidity are traded at a premium because such stocks are easier to sell when the market is highly illiquid. An unexpected decrease in market liquidity causes a potential wealth reduction for investors who need to immediately liquidate stocks that are highly sensitive to market liquidity. This is because the liquidation of such stocks would be costlier under low market liquidity (Pástor and Stambaugh, 2003; Sadka, 2006). $\beta_i^{3,D}$ captures this liquidity risk and is negatively related to the expected returns in the LCAPM because investors are willing to accept low returns on stocks for which the expected return is high when the market is illiquid. The fourth beta, $\beta_i^{4,D}$, is negatively related to expected returns because stocks that become more liquid in a down market are preferred by investors and, thus, are traded at a premium.

I investigate the LCAPM under three different assumptions on the degree of world financial market integration. If world financial markets are fully segmented, the local market version of the LCAPM in Eqs. (2) and (3) should be able to explain the cross-sectional differences of expected returns. However, in fully integrated world financial markets, countries are irrelevant and, hence, individual stocks should comove with global factors instead of with local factors. Thus, the superscripts D of Eqs. (2) and (3) are replaced with W (for world) to signify that each beta is computed with respect to global factors instead of local factors under fully integrated financial markets.

It could be reasonable to assume that the degree of integration of world financial markets lies somewhere between full segmentation and perfect integration (Errunza and Losq, 1985; Bekaert and Harvey, 1995). When local and global liquidity risks are jointly tested under this assumption of mildly segmented world financial markets, the relative importance of local and global risks is affected by the degree of integration. To obtain an econometric model, I decompose the global factors into local factors and nonlocal global components:

$$R_t^W = \omega R_t^D + (1-\omega) R_t^{W-D},$$
$$C_t^W = \omega C_t^D + (1-\omega) C_t^{W-D}. \tag{5}$$

The weight ω is the ratio of the market values of local and world markets. R_t^{W-D} and C_t^{W-D} denote nonlocal global market returns and illiquidity, respectively, and are obtained by orthogonalizing the global factors to the local factors of a given country of interest (Jorion and Schwartz, 1986). By inserting Eq. (5) into the global version of Eqs. (2) and (3), I obtain the LCAPM under the assumption of mildly segmented global financial markets:

$$E(R_{i,t} - R_{f,t}) = E(C_{i,t}) + \lambda^{*D}(\beta_i^{*1,D} + \beta_i^{*2,D} - \beta_i^{*3,D} - \beta_i^{*4,D})$$
$$+ \lambda^{*W-D}(\beta_i^{*1,W-D} + \beta_i^{*2,W-D} - \beta_i^{*3,W-D} - \beta_i^{*4,W-D}). \tag{6}$$

The covariance terms with the superscript D ($W-D$) in the numerator of the betas are defined with respect to local (nonlocal global) factors, and the weight ω is forced to be included in the estimated premiums of λ^{*D} and λ^{*W-D} in the empirical tests. All of the betas in Eq. (6) have a common denominator of a variance that is related to global market returns and illiquidity, viz., $Var\left({R_t}^W - {C_t}^W\right)$.[3] The liquidity net beta is defined in a manner similar to Eq. (4). In empirical tests of the LCAPM, I posit the null hypotheses of zero intercept and zero premiums for illiquidity, market risk, and liquidity risks. The alternative hypotheses are nonzero intercepts and nonzero premiums for market risk and liquidity risks. Because the frequency of data matters in testing $E(C_{i,t})$, the null hypothesis of a zero premium for illiquidity is tested against a positive premium for the illiquidity term.[4]

3. Data

Daily returns are calculated using a daily total return index, which is adjusted for stock splits and dividend payments, from Datastream for all available stocks from 50 countries for the period of January 1988 to December 2007. According to the International Financial Corporation (IFC) of the World Bank Group, there are 22 developed-market countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, the UK, and the US) and 28 emerging-market countries (Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Israel, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Portugal,

[2] Throughout this paper, β_i^2 is sometimes referred to as a commonality beta or commonality risk.

[3] In empirical tests in this paper, I use global factors only for the period that overlaps with local factors. For example, if the data in a given country start from 1993 (e.g., Luxembourg), the variance of global factors in the denominator of the betas is calculated over the period commencing from 1993.

[4] I thank the referee for pointing this out.

Russia, South Africa, South Korea, Sri Lanka, Taiwan, Thailand, Turkey, and Venezuela) in the sample. The initial sample covers more than 58,300 stocks from around the world.

To build a reliable sample, I use the following screening procedure. For a stock to be included in the sample, it should have market capitalization data (in US dollars) at the end of each year. I select only stocks from major exchanges, which are defined as those in which the majority of stocks for a given country are traded. Most countries in the sample have a single major exchange except for China (Shenzen and Shanghai stock exchanges), Germany (Frankfurt stock exchange and Xetra), Japan (Osaka and Tokyo stock exchanges), and the US (Amex, NYSE, and Nasdaq). In addition, I use only common stocks by excluding stocks with special features.[5] Hence, Depository Receipts (DRs), Real Estate Investment Trusts (REITs), and preferred stocks are excluded.[6] To avoid survivorship bias, I retain all data for dead stocks in the sample.

In empirical tests in this paper, I use the zero-return proportion proposed by Lesmond, Ogden, and Trzcinka (1999) as a measure of illiquidity. Thus, it is important to exclude nontrading days from the sample because Datastream fills a nontrading day with the return index of the prior trading day, a process that inflates zero-return proportions. Similar to Lesmond (2005), I drop any day from the sample as a nontrading day if more than 90% of stocks in a given exchange have zero returns on that day.[7]

Ince and Porter (2006) emphasize the need for caution in handling data from Datastream. Similar to their suggestion of screening, I set the daily return to be missing if any daily return above 100% (inclusive) is reversed the following day. Specifically, the daily returns for both days t and $t-1$ are set to missing if $R_{i,t}R_{i,t-1}-1 \leq 0.5$, where $R_{i,t}$is the gross return for day t, and at least one of the two returns is 200% or greater. Daily returns that are calculated from a very small total return index could exaggerate the proportion of zero-return days because the return index is reported to the nearest tenth. Thus, the daily return is set to missing if either the total return index for the previous day or that of the current day is less than 0.01. Similar to Chordia, Roll, and Subrahmanyam (2000), Amihud (2002), and Pástor and Stambaugh (2003), I require sample stocks to have prices within a specific range. If the price at the end of the previous year is in the extreme 2.5% (inclusive) at the top or bottom of the cross section for each country, the corresponding stock is dropped from the sample for that year.

The monthly sample is constructed based on the daily file obtained through the procedure described above. The proxy for illiquidity, the zero-return proportion, is calculated as the ratio of the number of zero-return days to the number of non-missing trading days in a given month. To improve the precision of the illiquidity measure, I drop a stock-month observation from the sample if the total number of non-missing return days within a given month is less than ten or the zero-return proportion in that month is more than 80%, similar to Amihud (2002), Pástor and Stambaugh (2003), and Lesmond (2005).[8] The month-end total return index together with the month-end exchange rate is used to calculate the monthly US dollar-return. I obtain foreign exchange rate data from WM/Reuters through Datastream. By choosing US dollar-denominated returns, the returns across countries are comparable and the effect of different inflation rates across countries is reflected through purchasing power parity (Harvey, 1991, 1995; Rouwenhorst, 1999). However, as a robustness check, I also report empirical results that are based on local currency in Section 5.5. I use the 30-day US Treasury bill as a risk-free asset. The Treasury bill rates from Ibbotson Associates are obtained through K. French's data library.[9]

As with the screening of daily returns, any monthly returns (either in US dollars or in local currency) calculated from the total return index of less than 0.01, as well as those that exceed 300% and are reversed within a month, are set to missing. To handle splits, mergers, and potential data errors, monthly returns of the extreme 0.1% (inclusive) at the top or bottom of the cross section of each country are set

[5] Because Datastream/Worldscope do not provide any code for discerning noncommon shares from common shares, the exclusion of stocks with special features is performed manually by examining the names of the securities. Examples of such name filters are as follows. I extracted stocks with names including "REIT," "REAL EST," "GDR," "PF," "PREF," or "PRF" because these terms could represent real estate investment trusts, global depository receipts, or preferred stocks. By examining the names of these extracted stocks more carefully, I dropped stocks for which these terms represent such special features. In Belgium, AFV and VVPR shares are dropped because they have preferential dividend or tax incentives. In Canada, income trusts are excluded by removing stocks with names including "INC.FD." In Mexico, shares of the types ACP and BCP are removed because they have the special feature of being convertible into series A and B shares, respectively, after one year. In France, shares of the types ADP and CIP are dropped because they carry no voting rights but carry preferential dividend rights. In Germany, type-GSH shares are excluded because they offer fixed dividends and carry no voting rights. In Italy, RSP shares are dropped due to their nonvoting provisions. For US stocks, I deleted American depository receipts (ADRs) by examining the names of stocks. I also used the Committee on Uniform Security Identification Procedures (CUSIP) for US stocks to exclude noncommon shares because the seventh and eighth digits of the CUSIP are 1 and 0, respectively, for common shares.

[6] Worldscope usually tracks one share for each firm and it is mostly the PN share in Brazil. Though PN shares are preferred stocks, they are not excluded because they account for the majority of stocks in Brazil.

[7] Lesmond (2005) uses a similar criterion but with a cutoff of 100% instead of 90%. I use a 90% cutoff for the following reason. If only one stock, for example, has a nonzero return on an actual nontrading day, then that actual nontrading day is not captured by this 100% rule. In this case, because all other stocks have zero returns on that day, the zero-return proportion for the corresponding month is inflated. I indeed find days in the sample when only a handful of stocks have nonzero returns while all others have zero returns.

[8] By applying both these rules, 11.63% of stock-month observations are deleted from the sample (452,094 stock-months out of total 3,885,814 stock-month observations). To check whether these criteria are crucial to the results in this paper, I perform the empirical tests using a sample that is constructed without applying these screening rules. I find that the results are very similar. The results are available upon request.

[9] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. I thank K. French for making the data publicly available.

to missing for that month (Amihud, 2002; Hou, Karolyi, and Kho, 2006). After implementation of all these screens, a stock should have at least 12 months of data for the period 1988–2007 to be included in the sample.

The number of stocks in the sample and the descriptive statistics of returns and zero-return proportions are reported in Table 1. The total number of stocks in the sample is 30,069 and varies across countries and years. The country with the largest number of stocks in the sample is the US (5,754 stocks), and Venezuela, the country with the smallest coverage, has only 21 stocks. There are more than 9,000 stocks for all but one year in the 1990s and more than 18,000 stocks for all sample years in the 2000s. The year with the largest number of stocks in the sample is 2006 (20,958 stocks). The starting year of sample coverage also varies across countries. Hungary, which has the shortest sample period, has data beginning with 2000, while the starting year is 1988 for most countries in developed markets.

The last four columns of Table 1 show averages of the cross-sectional averages of monthly returns and zero-return proportions as well as cross-sectional averages of the standard deviations of the same variables. The figures are all expressed as percentages and are computed on the basis of local currency returns. Zero-return days are frequent in emerging markets and in developed markets. To check whether stocks are less liquid in countries with low gross domestic product (GDP) per capita, I collect data on GDP (in US dollars) and the total population, both as of 2003, from the World Development Indicator. Consistent with my conjecture, the correlation between the average zero-return proportions and GDP per capita is negative, viz., -0.07. Average zero-return proportions and the ranks of countries by average zero-return proportions are similar to those in Lesmond (2005) and Bekaert, Harvey, and Lundblad (2007) for emerging markets in spite of differences in sample periods and data frequencies. For example, Table 1 shows that Malaysia, Philippines, Poland, Taiwan, and Venezuela have average zero-return proportions of 23.9%, 42.4%, 18.7%, 10.3%, and 31.0%, respectively. In Lesmond (2005), the corresponding figures are 25.1%, 44.1%, 19.4%, 11.6%, and 30.0% for these countries. The (rank) correlation between the zero-return proportions in Table 1 and those in Lesmond is 0.85 (0.82). For emerging market countries, average zero-return proportions are consistent with Bekaert, Harvey, and Lundblad (2007), who show that India, Korea, and Taiwan are the most liquid markets, while Chile, Colombia, and Indonesia are the least liquid. The average zero-return proportions are 16.9%, 11.7%, and 10.3%, respectively, for India, Korea, and Taiwan and 31.6%, 38.1%, and 39.6%, respectively, for Chile, Colombia, and Indonesia. The correlation between the zero-return proportions in Table 1 and those in Bekaert, Harvey, and Lundblad (2007) for countries that are included in both studies is 0.74, and the rank correlation is 0.69.

It is striking that the average zero-return proportion for the UK is 37.8%, which is larger than that of most other countries in the sample. In unreported analyses, I investigate the UK data further and find that this high average zero-return proportion is widespread among UK stocks and does not stem from outliers. I form size-quintile portfolios for UK stocks and find that the zero-return proportions are high in all size-groups except for the largest-stock portfolio. In light of concern that potential problems in the UK data might have on inferences, I perform the cross-sectional regressions without the UK stocks. I find that the main results of the paper remain unaffected.

Turning to returns, the averages and standard deviations are generally greater in emerging-market countries than in developed-market countries. The average of the returns shown in the table is 2.53% for emerging markets and 1.19% for developed markets. The correlation between the average (standard deviation) and GDP per capita is -0.41 (-0.30). The standard deviations of returns exceed 15% for ten emerging-market countries, whereas only four developed-market countries exhibit such large standard deviations. The average of the standard deviations in emerging markets is 14.14%, and it is 11.91% for developed markets (not reported).

4. Methodology

In this section, I describe methodology. Specifically, I present evidence of persistence of market illiquidity and show how I construct innovations in illiquidity in Section 4.1. In Section 4.2, I demonstrate the details on the cross-sectional regression tests.

4.1. Innovations of illiquidity

I form local (world) market return and illiquidity by calculating equally weighted averages of individual stocks' returns and zero-return proportions in a given country (across countries). Consistent with US results (Pástor and Stambaugh, 2003; Acharya and Pedersen, 2005; Sadka, 2006; and Korajczyk and Sadka, 2008), market illiquidity is highly persistent in most sample countries. Specifically, first-order serial correlations of local market illiquidity range from 0.48 (Luxembourg) to 0.99 (US), with 45 sample countries showing serial correlations of greater than 0.60. The countries aside from the US with the highest first-order serial correlations are Canada (0.97), India (0.96), Japan (0.93), Greece (0.92), Sweden (0.92), Switzerland (0.91), Israel (0.91), and South Africa (0.91). On the contrary, Thailand (0.48), Philippines (0.51), Hungary (0.52), and Sri Lanka (0.53) have relatively low first-order serial correlations. The serial correlation of world market illiquidity is 0.97.

Given the persistence of market illiquidity, I obtain the innovations through AR(1) filtering of the first-differences of illiquidity, as shown in Eq. (7). This method of constructing innovations of illiquidity is also adopted by Liu (2006) and is similar in spirit to Pástor and Stambaugh (2003) and Acharya and Pedersen (2005)

$$\Delta C_{i,t}^{S} = \rho_i \Delta C_{i,t-1}^{S} + u_{i,t}^{S}, \tag{7}$$

where Δ is a first-difference operator and the superscript S denotes whether the market illiquidity, C_i, is the local aggregate (S=D) or the global aggregate (S=W; the subscript for country i vanishes in this case). I compute

Table 1
The number of stocks and the summary statistics of returns and zero-return proportions by country and year.

The table shows the number of stocks in the sample by country and year, the averages of the cross-sectional averages of monthly returns and zero-return proportions (ZR) and the cross-sectional averages of the standard deviation of returns and zero-return proportions (all in percentage) that are based on local currency. *N* denotes the total number of stocks across all sample periods in a given country.

	Number of stocks in the sample																					Average (percentage)		Standard deviation (percentage)	
Country	*N*	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Return	ZR	Return	ZR
Developed markets																									
Australia	1,856	146	249	309	322	353	420	465	535	565	790	813	857	946	1,033	1,033	1,058	1,131	1,242	1,343	1,276	1.39	27.19	16.80	14.63
Austria	121	29	33	37	46	50	61	65	71	74	76	78	73	76	74	72	61	66	63	69	66	1.07	24.72	8.53	15.06
Belgium	164	63	67	69	69	68	68	69	72	77	84	99	106	124	122	120	112	116	111	114	107	1.09	26.38	8.06	13.33
Canada	1,690	392	511	540	603	638	680	771	812	836	891	956	983	1,016	999	1,023	1,040	1,028	1,039	1,047	953	1.55	25.23	16.58	13.91
Denmark	250	38	105	120	117	132	141	160	154	155	176	159	167	169	151	126	145	147	143	147	142	1.33	34.66	9.01	16.87
Finland	161	4	21	31	32	36	39	43	62	69	85	93	104	118	125	124	124	116	118	117	116	1.19	26.71	10.76	15.05
France	1,084	102	139	319	370	379	391	405	439	474	534	604	672	715	773	760	710	692	677	682	637	1.23	19.98	13.03	13.03
Germany	1,597	159	293	308	319	334	315	339	330	361	416	457	583	855	1,143	1,172	1,144	1,175	1,214	1,293	1,239	0.62	21.82	15.15	14.25
Hong Kong	1,006	102	225	236	248	296	346	401	428	455	490	525	548	590	631	677	743	761	779	818	840	1.89	28.53	21.30	16.91
Ireland	71	32	38	41	37	40	40	42	43	42	46	47	48	52	53	50	46	45	43	41	39	1.37	12.45	10.03	10.59
Italy	344	113	123	128	138	141	143	145	144	157	174	188	202	218	250	254	238	234	231	235	228	0.84	11.21	9.93	9.09
Japan	3,106	997	1,501	1,724	1,831	1,889	1,949	1,997	2,075	2,172	2,225	2,262	2,303	2,318	2,400	2,407	2,429	2,462	2,525	2,561	2,496	0.45	18.62	11.89	12.77
Luxembourg	24						15	16	15	17	17	16	15	15	16	16	16	14	13	13	13	1.36	27.37	6.32	12.32
Netherlands	229	120	124	130	131	133	139	140	148	151	159	170	173	181	169	157	143	141	134	127	119	1.18	19.89	10.08	12.96
New Zealand	161	16	43	41	44	48	61	75	76	76	88	91	91	94	99	105	101	101	99	98	90	1.09	36.66	9.35	14.12
Norway	278	51	56	58	59	58	73	83	91	106	123	141	147	131	126	126	125	132	138	145	141	1.51	28.62	12.17	14.62
Singapore	504	106	109	114	125	135	149	166	186	201	211	227	234	253	289	293	313	338	378	401	395	1.31	28.16	13.88	15.23
Spain	188	52	58	94	101	104	107	112	117	117	123	137	128	135	133	132	124	118	119	116	111	1.10	16.89	9.49	13.05
Sweden	473	45	75	92	98	106	139	151	172	180	192	245	262	284	301	300	297	288	282	279	271	1.22	25.44	14.12	14.01
Switzerland	299	113	123	131	133	132	147	147	139	146	166	172	185	198	201	206	196	197	190	193	188	0.96	29.22	8.70	14.92
UK	2,417	394	419	432	389	387	388	419	409	472	491	500	463	1,385	1,492	1,467	1,446	1,450	1,498	1,518	1,401	1.03	37.76	13.40	15.34
US	5,754	1,609	1,658	1,664	1,708	1,856	2,039	2,293	2,477	2,647	2,857	2,914	2,842	3,518	3,529	3,509	3,459	3,365	3,391	3,354	3,096	1.45	16.40	13.54	10.13
Emerging markets																									
Argentina	74		9	9	10	12	22	49	46	54	58	53	46	48	37	50	57	57	54	54	56	7.67	24.08	16.73	15.69
Brazil	257				4	9		4	65	75	90	87	114	167	152	142	159	153	160	170	181	5.17	28.97	15.42	15.16
Chile	166			72	90	96	100	113	119	119	119	108	107	102	96	88	88	94	96	93	88	2.32	31.59	11.02	16.10
China	1,245					8	27	119	202	221	395	582	678	766	894	960	1,024	1,073	1,157	1,144	1,102	2.61	4.96	14.12	8.43
Colombia	30						18	19	17	15	17	16	17	13	14	18	18	21	21	20	18	2.49	38.08	10.78	18.29
Czech Repulic	77							27	42	71	73	71	58	44	36	9	9	10	11	7	6	0.90	24.71	13.03	19.52
Egypt	45										23	24	26	32	33	35	36	37	38	39	38	1.43	9.86	11.48	10.56
Greece	359		46	51	77	89	105	113	155	174	191	198	220	252	290	295	295	286	267	256	249	2.15	17.26	16.82	12.54
Hungary	40													34	32	32	31	30	28	27	25	1.04	20.86	9.28	12.90
India	937				374	411	442	500	571	636	645	652	678	680	717	741	747	775	789	804	790	3.38	16.94	19.30	14.37
Indonesia	243				80	85	99	99	117	159	170	56	112	108	68	78	87	107	110	101	116	2.12	39.55	14.81	16.25
Israel	119	19	20	22	16	17	31	57	58	59	62	63	85	87	85	90	92	92	93	95	92	1.85	19.10	10.97	10.81
Malaysia	722	196	205	217	250	278	317	345	377	414	466	501	505	512	521	532	551	586	601	610	569	1.58	23.89	14.94	15.33
Mexico	142		16	20	25	38	52	70	73	74	88	83	86	83	77	77	77	85	81	87	81	2.38	15.58	11.39	14.16
Morocco	23							4	8	10	15	19	20	20	21	21	21	19	21	21	20	1.58	36.78	6.84	15.59
Pakistan	112					6	52	57	58	62	57	65	70	77	77	80	90	88	91	93	92	2.25	23.48	14.28	16.04
Peru	50					7	20	27	38	42	42	14	12	12	10	12	14	13	16	15	13	2.28	18.64	13.47	14.09
Philippines	190	7	7	31	45	47	60	81	113	135	156	150	156	146	122	117	106	117	132	138	147	1.72	42.40	20.28	17.58
Poland	224						6	9	18	27	38	64	103	118	128	147	150	152	170	188	182	2.97	18.74	14.81	12.77
Portugal	106		43	52	58	60	63	64	66	71	75	82	76	65	57	55	50	51	50	50	45	0.73	28.36	9.29	16.07

Russia	76									18	25	35	25	31	37	51	49	58	64	63	57	4.75	20.22	15.66	16.34
South Africa	616	61	60	64	184	166	189	230	227	339	388	396	425	392	343	293	260	252	247	257	241	1.97	35.64	16.13	16.32
South Korea	822	325	402	486	514	531	535	545	574	600	651	645	637	622	594	583	576	554	569	585	576	1.69	11.65	17.52	9.59
Sri Lanka	34	9	10	12	13	15	18	22	25	23	25	26	26	27	27	28	28	30	32	33	33	1.86	38.58	11.44	17.40
Taiwan	748	26	46	139	156	179	208	231	259	289	351	389	444	505	558	583	636	658	653	653	640	1.22	10.32	14.12	8.91
Thailand	568	84	115	147	178	226	260	296	330	351	354	330	313	294	286	293	331	342	374	422	416	1.73	26.72	16.55	14.62
Turkey	246		42	52	77	93	105	118	136	151	169	188	193	190	212	210	207	207	210	208	204	6.26	18.95	21.32	11.09
Venezuela	21				7	7	4	7	10	13	14	10	9	11	13	8	11	14	11	14	16	2.78	31.01	14.22	17.05
Total	30,069	5,410	6,991	7,992	9,078	9,695	10,583	11,710	12,699	13,752	15,171	15,801	16,427	18,829	19,646	19,757	19,870	20,078	20,573	20,958	20,057				

the innovations of illiquidity for individual stocks in a similar way. For 47 sample countries, the first-differences of local market illiquidity have serial correlation that is significant at the 1% level. The serial correlation is significant at the 5% level for two other countries, leaving China as the only country in the sample that has insignificant correlation. The average t-statistic of the estimates of ρ_i in Eq. (7) across countries is -5.33. However, no countries have serial correlation that is significant at the 1% level for the residuals from AR(1) fitting, $u_{i,t}^D$. This validates the use of $u_{i,t}^D$ as the innovation in aggregate local market illiquidity. In the case of world market illiquidity, the first-differences have the coefficient ρ of -0.31 in Eq. (7) with a t-value of -5.10. However, the residuals from the AR(1) regressions, which are used as innovations in world market illiquidity, are again not significantly serially correlated.

4.2. Estimation of betas

I employ individual stocks as test assets because an analysis at the level of individual stocks provides the following benefits.[10] First, the use of individual stocks as test assets helps to avoid potentially spurious results that could arise when characteristic-based portfolios are used as test assets (Brennan, Chordia, and Subrahmanyam, 1998; Berk, 2000). Second, potential loss of information contained in each stock can be minimized by performing empirical tests at the level of individual stock. Third, a stock-level analysis could increase the power of the test by providing ample observations for empirical tests. It is also suitable for controlling for individual stock characteristics, such as market capitalization and book-to-market ratio. On the cost side, the loadings estimated at the level of individual stock generally have a higher level of noise than those estimated at the portfolio level. Therefore, considering these benefits and costs, I estimate market risk and liquidity risks at the portfolio level and subsequently assign these estimated loadings to individual stocks to perform cross-sectional regressions at the individual stock level.

This methodology is similar to that of Fama and French (1992). However, while Fama and French form portfolios on the basis of size and pre-ranking beta, I form portfolios on the basis of one-dimensional sorting determined solely on pre-ranking beta. This one-dimensional sorting could help to exclude potential bias that could arise from the use of characteristic-based sorting. The formation of portfolios based on pre-ranking beta has been widely used in the literature on empirical asset pricing, because the estimation of post-ranking beta for portfolios sorted on pre-ranking beta provide a wide dispersion of estimates across portfolios, while minimizing loss of information that might be caused by portfolio formation (Fama and MacBeth, 1973). A detailed description of the cross-sectional regression procedure follows.

[10] In Section 5.5, however, I also show empirical results when portfolios on size, book-to-market, and illiquidity are used as test assets.

For each stock i, I estimate beta k (k=1,…,4) of year t (pre-ranking beta) by Eq. (3) using the monthly returns and innovations of illiquidity over the years $t-5$ to $t-1$ with respect to local or global factors. The innovations in market illiquidity are obtained over the same 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. The window rolls forward at annual intervals. To have pre-ranking beta k of year t, stocks should have at least 36 monthly returns and innovations in illiquidity within the given 5-year window. Then, at the beginning of year t, stocks are sorted into ten equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Because sufficient numbers of stocks are needed to form 10 portfolios for each country, 12 countries for which the total number of stocks shown in Table 1 is less than one hundred are dropped.[11] Subsequently, I estimate beta k of portfolio p (post-ranking beta) for all ten portfolios (p=1,…,10) by Eq. (3) over the sample period and assign it to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure for all k, I compute the liquidity net beta by Eq. (4). Finally, I perform cross-sectional regressions for each month using individual stock returns and post-ranking betas. I then report the averages of the estimated premiums.

The sample period is relatively short. In addition, unlike the case of the US, the quality of data from countries other than the US is not guaranteed (Ince and Porter, 2006; Bekaert, Harvey, and Lundblad, 2007). Given these potential problems, I perform the cross-sectional regressions over economic or geographic regions instead of over each country, restricting the coefficients to be equal across stocks in a given region. I run each regression with country dummy variables to provide an interpretation of the coefficient estimates in terms of within-country effects and to control for unknown country-specific effects (McLean, Pontiff, and Watanabe, 2009).

Table 2 shows averages across countries of post-ranking betas for each of the portfolios based on pre-ranking betas. The four columns on the left under the label "Local" are for betas with respect to local factors, and the rest of the columns are for betas with respect to global factors. The market beta and the commonality beta are positive, while $\beta^{3,S}$and $\beta^{4,S}$ are negative regardless of whether they are estimated with respect to local (S=D) or global factors (S = W).

As intended, the betas are sufficiently dispersed and monotonic across the portfolios sorted on the pre-ranking betas. For example, the local commonality beta increases from 0.063 for the lowest commonality beta portfolio to 0.144 for the highest commonality beta portfolio in the overall sample (Panel A). Likewise, $\beta^{3,D}$and $\beta^{4,D}$ grow monotonically from -0.055 and -0.113 to -0.035 and -0.058, respectively. This monotonic relation is observed not only in the overall 38 countries (Panel A), but also in the developed- and emerging-market categories (Panels B and C). Monotonic patterns are generally seen for the global betas as well.

The local risks $\beta^{1,D}$, $\beta^{3,D}$, and $\beta^{4,D}$ are generally larger in absolute value in emerging markets than in developed markets, implying that stocks in emerging market countries generally have high liquidity risk originated in domestic markets. On the contrary, the local commonality beta has larger absolute values in developed markets than in emerging markets. Furthermore, local commonality risk is generally larger than global commonality risk in all pre-ranking beta portfolios. This is consistent with Brockman, Chung, and Pérignon (2009), who show that roughly two-thirds of variation in commonality stems from local, not global, commonality.

Overall, it seems that my goal of estimating post-ranking betas that are sufficiently dispersed and monotonic across pre-ranking beta portfolios is fairly achieved.

5. Asset pricing of liquidity risk: cross-sectional regressions

I present the results of the cross-sectional regressions in this section. The pricing of local liquidity risk and global liquidity risk is presented in Section 5.1 and 5.2, respectively. In Section 5.3, I investigate the importance of US market in the pricing of global liquidity risk. I show the relative importance of local and global liquidity risk in asset pricing in Section 5.4. Robustness tests are presented in Section 5.5.

5.1. Empirical results for local liquidity risks

This subsection reports empirical results of the test of the LCAPM under the assumption that world financial markets are fully segmented. Table 3 shows time series averages of the estimated risk premiums in cross-sectional regressions over all countries, developed markets, and emerging markets in Panels A, B, and C, respectively. US results are also reported in a separate panel. I use the lagged month's zero-return proportion, ZR, as a proxy for the expected illiquidity at time t, $E(C_{i,t})$. In each panel, I first show the results of the specification, where the liquidity net beta is included together with the market beta in a single regression equation. This specification could efficiently show whether liquidity risks are priced factors that are independent of market risk, as modeled in the LCAPM. Subsequently in each panel, I report the result for one liquidity beta at a time, in addition to the level of illiquidity and the market beta. In this way, I avoid a multi-collinearity problem that could arise from including all betas in a single regression equation (Acharya and Pedersen, 2005). To control for size and book-to-market, which potentially could be related to the pricing of liquidity and liquidity risks (Amihud, 2002; Pástor and Stambaugh, 2003; Acharya and Pedersen, 2005), I include in the regressions the log of the market capitalization and the log of the book-to-market ratio of each stock at the end of the previous year.

[11] These are Argentina, Colombia, Czech Republic, Egypt, Hungary, Ireland, Luxembourg, Morocco, Peru, Russia, Sri Lanka, and Venezuela. However, the returns and illiquidity of stocks from these countries do contribute to form global market returns and illiquidity.

Table 2
Average post-ranking betas.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to either market returns or the innovations in market illiquidity. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which the stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into 10 equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the 10 portfolios over the sample period (post-ranking beta). The table shows the averages of these post-ranking betas for each portfolio across the countries in a given region specified in each panel.

	Local				Global			
Portfolio	Beta 1	Beta 2	Beta 3	Beta 4	Beta 1	Beta 2	Beta 3	Beta 4
Panel A: All countries								
1 (Small)	0.460	0.063	−0.055	−0.113	0.692	0.049	−0.021	−0.154
2	0.529	0.062	−0.050	−0.086	0.744	0.038	−0.017	−0.083
3	0.573	0.071	−0.045	−0.071	0.784	0.039	−0.015	−0.082
4	0.607	0.087	−0.043	−0.061	0.848	0.039	−0.010	−0.055
5	0.643	0.097	−0.048	−0.046	0.861	0.037	−0.012	−0.057
6	0.670	0.104	−0.036	−0.042	0.911	0.043	−0.007	−0.050
7	0.726	0.114	−0.038	−0.036	0.923	0.043	−0.007	−0.050
8	0.765	0.121	−0.039	−0.028	1.004	0.051	−0.005	−0.065
9	0.800	0.127	−0.036	−0.036	1.044	0.048	−0.010	−0.062
10 (Large)	0.892	0.144	−0.035	−0.058	1.166	0.063	−0.014	−0.071
Panel B: Developed markets								
1 (Small)	0.391	0.072	−0.049	−0.110	0.524	0.053	−0.022	−0.157
2	0.439	0.072	−0.045	−0.073	0.567	0.038	−0.017	−0.089
3	0.496	0.074	−0.039	−0.059	0.623	0.038	−0.017	−0.061
4	0.550	0.100	−0.037	−0.052	0.681	0.039	−0.011	−0.057
5	0.581	0.107	−0.041	−0.044	0.721	0.038	−0.016	−0.031
6	0.622	0.126	−0.030	−0.032	0.755	0.051	−0.009	−0.042
7	0.682	0.137	−0.030	−0.032	0.792	0.045	−0.006	−0.028
8	0.738	0.144	−0.031	−0.020	0.876	0.061	−0.004	−0.050
9	0.788	0.150	−0.036	−0.039	0.957	0.053	−0.008	−0.039
10 (Large)	0.903	0.176	−0.033	−0.062	1.068	0.070	−0.015	−0.054
Panel C: Emerging markets								
1 (Small)	0.538	0.053	−0.062	−0.116	0.878	0.044	−0.019	−0.150
2	0.629	0.052	−0.056	−0.100	0.940	0.037	−0.017	−0.077
3	0.658	0.067	−0.051	−0.083	0.964	0.040	−0.013	−0.106
4	0.670	0.073	−0.048	−0.070	1.034	0.040	−0.009	−0.054
5	0.712	0.086	−0.056	−0.047	1.016	0.036	−0.008	−0.085
6	0.724	0.080	−0.043	−0.052	1.084	0.035	−0.004	−0.060
7	0.774	0.088	−0.047	−0.041	1.070	0.040	−0.008	−0.075
8	0.796	0.095	−0.048	−0.036	1.147	0.040	−0.006	−0.082
9	0.813	0.101	−0.037	−0.033	1.142	0.043	−0.013	−0.088
10 (Large)	0.879	0.109	−0.039	−0.054	1.275	0.057	−0.014	−0.090

Table 3 shows that the liquidity net beta is significantly priced in both the US and emerging markets, but not in the developed and overall world markets. In the overall world market (Panel A), the premium on the liquidity net beta is positive (0.007), but it is not statistically significant. However, without size and book-to-market controls, the liquidity net beta is priced with a premium of 0.009 and a t-value of 1.83 (unreported). In emerging markets (Panel C), the liquidity net beta is significantly priced at the 1% level, with a premium of 0.027 and a t-value of 3.80. The significant pricing of the liquidity net beta in the US (Panel D) is consistent with Acharya and Pedersen (2005).

It can be seen by observing each liquidity risk separately, that $\beta^{4,D}$, which arises from the covariance of individual stock liquidity with market return, is priced even after controlling for size and book-to-market. The estimated coefficient is -0.010 and the t-value is -1.70 (Panel A). Consistent with the US evidence of Acharya and Pedersen (2005), who find that $\beta^{4,D}$ is most significant among the three liquidity betas that are specified in the LCAPM, $\beta^{4,D}$is significantly priced in the US with a coefficient of -0.052 and a t-value of -2.52. In emerging markets, the same liquidity risk has a coefficient of -0.034 and is highly significant at the 1% level (t-value of -3.69).

The local commonality beta is priced in emerging markets at the 1% level of significance (the premium is 0.048 with a t-value of 2.91). However, the commonality beta is not priced in any other panel. In an unreported specification, I find that the commonality beta is priced at the 10% significance level for the US (a premium of 0.092 with a t-value of 1.75) when the size and book-to-market are not controlled for.

Liquidity risk $\beta^{3,D}$, which is derived from the sensitivity of the return to market-wide illiquidity, is never priced in

Table 3
Cross-sectional regressions of local liquidity risk.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to either local market returns or the innovations in local market illiquidity. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into 10 equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the 10 portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure, the liquidity net beta, beta 5, is computed by Eq. (4). Cross-sectional regressions with country dummies are performed for each month over all the sample countries (Panel A), developed countries (Panel B), emerging markets (Panel C), and the US (Panel D). The table shows the averages of the estimated coefficients together with the t-values in italics. ZR is the previous month's average zero-return proportion. Ln(MV) is the log of the market capitalization in US dollars, and ln(B/M) is the log of the book-to-market ratio at the end of the previous year. The coefficient of ln(MV) is multiplied by 10^6. ZR is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and ***denote significance at the 10%, 5%, and 1% level, respectively.

Intercept	ZR	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	ln(MV)	ln(B/M)
Panel A: All countries								
0.0082	−0.0022	0.0036				0.0067	0.0417	0.0050***
1.27	*−0.93*	*0.84*				*1.45*	*0.66*	*8.88*
0.0083	−0.0020	0.0037	0.0075				0.0393	0.0050***
1.29	*−0.83*	*0.86*	*1.18*				*0.61*	*8.89*
0.0087	−0.0016	0.0038		0.0039			0.0376	0.0050***
1.36	*−0.68*	*0.89*		*0.18*			*0.58*	*8.91*
0.0085	−0.0020	0.0037			−0.0096*		0.0403	0.0050***
1.32	*−0.84*	*0.86*			*−1.70*		*0.63*	*8.88*
Panel B: Developed markets								
0.0079**	0.0000	0.0037				0.0022	0.0392	0.0044***
2.40	*−0.01*	*0.86*				*0.46*	*0.64*	*6.70*
0.0076**	0.0000	0.0037	0.0021				0.0372	0.0045***
2.20	*0.01*	*0.86*	*0.33*				*0.60*	*6.71*
0.0068*	0.0002	0.0038		0.0111			0.0382	0.0044***
1.73	*0.07*	*0.90*		*0.50*			*0.61*	*6.72*
0.0081**	0.0000	0.0037			−0.0037		0.0387	0.0044***
2.49	*0.01*	*0.86*			*−0.61*		*0.62*	*6.70*
Panel C: Emerging markets								
0.0103	−0.0120	0.0008				0.0272***	−0.4982	0.0062***
1.18	*−3.44*	*0.10*				*3.80*	*−0.95*	*8.48*
0.0091	−0.0119	0.0017	0.0481***				−0.5727	0.0062***
1.04	*−3.28*	*0.22*	*2.91*				*−1.09*	*8.48*
0.0108	−0.0095	0.0031		−0.0016			−0.5367	0.0062***
1.29	*−2.91*	*0.39*		*−0.05*			*−1.02*	*8.60*
0.0102	−0.0111	0.0027			−0.0335***		−0.4825	0.0062***
1.17	*−3.35*	*0.33*			*−3.69*		*−0.93*	*8.52*
Panel D: US								
0.0084***	−0.0003	0.0054				0.0458**	−0.0690	0.0038***
2.63	*−0.06*	*1.16*				*2.23*	*−0.83*	*4.01*
0.0077**	−0.0005	0.0054	0.0404				−0.0747	0.0038***
2.08	*−0.10*	*1.18*	*0.79*				*−0.89*	*4.01*
0.0087***	0.0003	0.0053		0.0056			−0.0767	0.0038***
2.75	*0.06*	*1.16*		*0.04*			*−0.92*	*4.05*
0.0094***	0.0001	0.0054			−0.0517**		−0.0739	0.0038***
3.00	*0.02*	*1.17*			*−2.52*		*−0.88*	*4.02*

any panel and the signs of the coefficients are even positive in some cases. This is inconsistent with the US evidence in Pástor and Stambaugh (2003) and the results for developed markets in Liang and Wei (2006). Consistent with the recent findings of Hou, Karolyi, and Kho (2006), the log of market capitalization is not priced, while book-to-market ratio is strongly priced in all specifications and in all regions considered. The market beta is not priced in any specification in Table 3.

The economic significance of liquidity risk is comparable to that in Acharya and Pedersen (2005) in the US market. Table 2 shows that the difference of liquidity risks between the top- and bottom-decile portfolios, ${\beta_{10}}^{4,D}-{\beta_1}^{4,D}$, sorted on pre-ranking beta $\beta^{4,D}$, is 0.055. Combining this with the estimated coefficient of $\beta^{4,D}$ of −0.010 in the overall world market (Panel A), the total annual impact from $\beta^{4,D}$ is 0.66%. Similarly, I obtain annual 0.78% and 0.09% for $\beta^{2,D}$ and $\beta^{3,D}$, respectively. Aggregating all effects from these three liquidity risks produces a total annual effect of 1.53% for the overall world market. The magnitude is larger than what Acharya and Pedersen (2005) find for the US market, viz., a total 1.1%. For emerging markets, the total annual contribution of liquidity risks is 5.58%, which is more than thrice the effect for the overall world market. This is consistent with my conjecture that liquidity risks could be more important in international financial markets than in the US. In Section 7, I present additional evidence of the economic significance of liquidity risks by showing that trading based on liquidity risk generates material trading alphas in the factor model regressions.

To gain more insight into the results in Table 3, I perform cross-sectional regressions over six different geographic regions: Developed Asia (Australia, Hong Kong, Japan, and Singapore), Developed Europe (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and the UK), Emerging Asia (China, India, Indonesia, South Korea, Malaysia, Pakistan, Philippines, Taiwan, and Thailand), Emerging Europe/Middle East/Africa (Greece, Israel, Poland, Portugal, South Africa, and Turkey), North America (Canada and the US), and Latin America (Brazil, Chile, and Mexico). Based on the results in Table 3, which show the significant pricing of liquidity risk in emerging markets, I show results only for emerging market subregions in Table 4. For precision of the estimates, I require at least 30 stocks to be available in a cross section for each month.

$\beta^{4,D}$ is significantly priced in Emerging Asia (coefficient of -0.04 with a t-value of -2.77) and in Emerging Europe/Middle East/Africa (coefficient of -0.04 with a t-value of -2.20). However, this is not the case for Latin America. This finding implies that the pricing of $\beta^{4,D}$ in emerging markets in Table 3 is mostly driven by emerging-market countries in Asia, Europe, Middle East, and Africa. In Emerging Asia, the commonality beta is also priced with a premium of 0.070 and a t-value of 2.99, which is highly significant at the conventional 1% level. The liquidity net beta is highly significant in Panels A and B, largely due to the significant pricing of $\beta^{4,D}$. The local commonality beta also contributes to the pricing of the liquidity net beta in Panel A. However, $\beta^{1,D}$ and $\beta^{3,D}$ are not priced in any panel. In all specifications shown in Table 4, the cross-sectional regression tests are unable to reject the null hypothesis of a zero liquidity premium against the alternative hypothesis of a positive premium.

Table 4

Cross-sectional regressions of local liquidity risk by geographic region.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to either local market returns or the innovations in local market illiquidity. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into ten equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the ten portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure, the liquidity net beta, beta 5, is computed by Eq. (4). Cross-sectional regressions with country dummies are performed for each month over Emerging Asia (Panel A), Emerging Europe, the Middle East, and Africa (Panel B), and Latin America (Panel C). The table shows the averages of the estimated coefficients together with the t-values in italics. ZR is the previous month's average zero-return proportion. Ln(MV) is the log of the market capitalization in US dollars, and ln(B/M) is the log of the book-to-market ratio at the end of the previous year. The coefficient of ln(MV) is multiplied by 10^6. ZR is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Intercept	ZR	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	ln(MV)	ln(B/M)
Panel A: Emerging Asia								
0.0019	−0.0170	0.0017				0.0339***	−0.1478	0.0056***
0.38	*−3.78*	*0.20*				*3.03*	*−0.24*	*6.01*
0.0047	−0.0182	0.0025	0.0699***				−0.2749	0.0056***
1.08	*−3.83*	*0.29*	*2.99*				*−0.46*	*5.96*
0.0111**	−0.0141	0.0052		0.0128			−0.2012	0.0057***
2.00	*−3.43*	*0.60*		*0.31*			*−0.34*	*6.08*
0.0059	−0.0153	0.0040			−0.0402***		−0.1490	0.0056***
1.22	*−3.71*	*0.45*			*−2.77*		*−0.24*	*6.01*
Panel B: Emerging Europe/Middle East/Africa								
0.0420***	−0.0047	−0.0059				0.0296**	−0.6322	0.0077***
3.23	*−0.90*	*−0.49*				*2.41*	*−0.87*	*8.05*
0.0416***	−0.0032	−0.0050	0.0148				−0.6835	0.0077***
3.18	*−0.61*	*−0.41*	*0.74*				*−0.93*	*8.02*
0.0407***	−0.0026	−0.0034		−0.0455			−0.6161	0.0078***
3.10	*−0.51*	*−0.27*		*−1.09*			*−0.84*	*8.12*
0.0426***	−0.0042	−0.0051			−0.0386**		−0.6159	0.0078***
3.28	*−0.81*	*−0.42*			*−2.20*		*−0.85*	*8.11*
Panel C: Latin America								
0.0194**	0.0026	−0.0089				0.0073	0.2974	0.0038***
2.35	*0.44*	*−0.86*				*0.99*	*0.65*	*2.72*
0.0187**	0.0014	−0.0087	0.0275				0.2216	0.0038***
2.25	*0.25*	*−0.84*	*1.55*				*0.49*	*2.71*
0.0181**	0.0053	−0.0072		0.0142			0.2599	0.0036**
2.19	*1.01*	*−0.70*		*0.30*			*0.57*	*2.57*
0.0194**	0.0040	−0.0085			−0.0043		0.2990	0.0037***
2.33	*0.71*	*−0.81*			*−0.44*		*0.65*	*2.62*

In sum, I find strong evidence that investors demand compensation for holding stocks for which liquidity is sensitive to fluctuations in local market return. I also find that the sensitivity of stock liquidity to local market liquidity is priced in emerging markets. However, I cannot find evidence that the expected liquidity, local market risks, and $\beta^{3,D}$ are significantly related to cross-sectional differences in asset prices.

5.2. *Empirical results for global liquidity risks*

With the superscript D replaced by W (world), the LCAPM in Eqs. (2) and (3) shows that, under the assumption of fully integrated world financial markets, only global returns and illiquidity matter, while those of local markets do not. Table 5 shows results of the cross-sectional regression tests based on the assumption of fully integrated world financial markets.

The liquidity net beta is priced in Panels A, B, and C, after controlling for size and book-to-market, while the market beta is not priced in any specification in the table. $\beta^{4,W}$ drives the pricing of the liquidity net beta in the overall world market (Panel A) and in developed markets (Panel B). The driver is $\beta^{2,W}$ in emerging markets (Panel C). Specifically, $\beta^{4,W}$ is priced with a coefficient of -0.008 (a t-value of -2.69) after controlling for size and book-to-market in the overall world market. For developed

Table 5

Cross-sectional regressions of global liquidity risk.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to either global market returns or the innovations in global market illiquidity. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the five-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into ten equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the ten portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure, the liquidity net beta, beta 5, is defined in a manner similar to Eq. (4). Cross-sectional regressions with country dummies are performed for each month over all the sample countries (Panel A), developed markets (Panel B), emerging markets (Panel C) and the US (Panel D). The table shows the averages of the estimated coefficients together with the t-values in italics. ZR is the previous month's average zero-return proportion. Ln(MV) is the log of the market capitalization in US dollars, and ln(B/M) is the log of the book-to-market ratio at the end of the previous year. The coefficient of ln(MV) is multiplied by 10^6. ZR is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Intercept	ZR	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	ln(MV)	ln(B/M)
Panel A: All countries								
0.0092	−0.0020	0.0030				0.0087***	0.0340	0.0050***
1.44	*−0.89*	*0.69*				*2.62*	*0.52*	*8.91*
0.0096	−0.0017	0.0031	0.0124				0.0303	0.0050***
1.52	*−0.73*	*0.72*	*1.09*				*0.46*	*8.91*
0.0104*	−0.0015	0.0028		−0.0259			0.0320	0.0050***
1.66	*−0.66*	*0.68*		*−1.05*			*0.48*	*8.91*
0.0092	−0.0018	0.0030			−0.0081***		0.0317	0.0050***
1.44	*−0.79*	*0.71*			*−2.69*		*0.48*	*8.91*
Panel B: Developed markets								
0.0084**	−0.0003	0.0029				0.0074*	0.0319	0.0044***
2.57	*−0.11*	*0.65*				*1.80*	*0.50*	*6.72*
0.0086**	0.0004	0.0031	−0.0082				0.0268	0.0044***
2.58	*0.15*	*0.68*	*−0.62*				*0.41*	*6.72*
0.0082**	0.0001	0.0025		−0.0505			0.0326	0.0045***
2.51	*0.03*	*0.58*		*−1.41*			*0.50*	*6.73*
0.0088***	−0.0001	0.0030			−0.0072*		0.0301	0.0044***
2.69	*−0.03*	*0.66*			*−1.96*		*0.46*	*6.72*
Panel C: Emerging markets								
0.0104	−0.0096	0.0034				0.0105**	−0.5867	0.0061***
1.43	*−2.89*	*0.60*				*2.15*	*−1.11*	*8.39*
0.0104	−0.0099	0.0034	0.0653***				−0.5744	0.0061***
1.44	*−2.95*	*0.60*	*2.69*				*−1.08*	*8.40*
0.0116	−0.0090	0.0038		0.0083			−0.6020	0.0062***
1.61	*−2.71*	*0.66*		*0.25*			*−1.14*	*8.47*
0.0107	−0.0094	0.0035			−0.0075		−0.5929	0.0061***
1.47	*−2.85*	*0.61*			*−1.53*		*−1.12*	*8.38*
Panel D: US								
0.0094***	−0.0008	0.0057				0.0488	−0.0700	0.0038***
3.24	*−0.15*	*1.09*				*1.64*	*−0.81*	*3.97*
0.0079**	−0.0004	0.0063	0.0801				−0.0888	0.0038***
2.35	*−0.08*	*1.17*	*1.06*				*−0.99*	*3.94*
0.0089***	−0.0007	0.0050		−0.1005*			−0.0774	0.0038***
2.96	*−0.13*	*1.02*		*−1.67*			*−0.89*	*4.00*
0.0096***	0.0002	0.0063			−0.0194		−0.0859	0.0038***
3.38	*0.04*	*1.16*			*−0.84*		*−0.96*	*3.98*

markets, $\beta^{4,W}$ is significant at the 10% level with a coefficient of -0.007, but it is not priced in emerging markets. Although I find weak evidence of pricing of $\beta^{3,W}$ in the US, it is priced in neither developed nor emerging markets.

Consistent with previous research on the integration of financial markets in developed countries (Wheatley, 1988; Korajczyk and Viallet, 1989; Chan, Karolyi, and Stulz, 1992), analyses in this subsection provide some evidence on the integration of developed markets from the perspective of liquidity. Considering that liquidity could be a global phenomenon, as shown in topical examples such as the Asian financial crisis, the meltdown of Long-Term Capital Management, and the ongoing subprime mortgage crisis, it is intuitively appealing that liquidity risks are related to asset pricing in the global context.

One potential problem with the analyses in this subsection arises from the fact that global factors encompass local factors by construction. I resolve this problem in Section 5.3 by investigating the pricing of global liquidity risk when global factors are independent of local factors in a given country.

5.3. Do US markets drive global liquidity risk?

The finding of the pricing of global liquidity risk in Section 5.2 raises an interesting question as to whether the US market, which is allegedly the largest financial market in the world, is a driving force in the pricing of global liquidity risk. In this subsection, I compare the pricing of liquidity risks with respect to US factors with the pricing of liquidity risks with respect to global aggregates that are independent of both local and US factors.

To differentiate the US market from the rest of the world, I decompose global factors into two groups: US factors and the "nonlocal and non-US global" factors that are net of both local and US factors. The nonlocal & non-US global factors are obtained in a manner similar to Jorion and Schwartz (1986). First, I obtain the nonlocal global factors for country j by orthogonalizing the global factors to the local factors of country j. That is, I obtain nonlocal global return of country i, $R_{i,t}^{(W-D)}$, from the residuals of a regression of global market returns on local market return. $C_{i,t}^{(W-D)}$is obtained in a similar way. Subsequently, I regress these nonlocal global factors on the US factors to obtain the nonlocal & non-US global factors, $R_{i,t}^{(W-D)-US}$ and $C_{i,t}^{(W-D)-US}$, from the residuals. I compute betas by Eq. (3) but with respect to these factors as well as US factors. In Eq. (8), the superscripts $(W-D)-US$ and US of each beta indicate that the beta is computed with respect to the nonlocal & non-US global factors and the US factors, respectively. All betas have a common denominator of a variance, $Var\left(R_t{}^W-C_t{}^W\right)$. Finally, I test the LCAPM in Eq. (8) using all stocks in the sample excluding those from the US

$$E(R_{i,t}-R_{f,t})=E(C_{i,t})+\lambda^{*US}(\beta_i^{*1,US}+\beta_i^{*2,US}-\beta_i^{*3,US}-\beta_i^{*4,US})$$
$$+\lambda^{*(W-D)-US}(\beta_i^{*1,(W-D)-US}+\beta_i^{*2,(W-D)-US}$$
$$-\beta_i^{*3,(W-D)-US}-\beta_i^{*4,(W-D)-US}) \tag{8}$$

The time series averages of the estimated premiums in the cross-sectional regressions are shown in Table 6. The liquidity risk that arises from the covariance of illiquidity with the US market return significantly affects the expected returns: $\beta^{*4,US}$ is priced at the 1% significance level in the overall world market (a coefficient of -0.007) and at the 5% level in developed markets (a coefficient of -0.008). However, the liquidity risk with respect to nonlocal & non-US global factors is not statistically significant or is significant with the wrong sign. That is, under the columns labeled "nonlocal & non-US global," all significant $\beta^{*4,(W-D)-US}$s have positive signs. This finding shows that the US market plays a key role in the pricing of global liquidity risk, implying that global investors who need to rebalance their portfolios seek compensation for holding stocks whose liquidity plummets in a US market downturn. A significant $\beta^{*4,US}$ contributes to significant pricing of the liquidity net beta in the overall world market (Panel A) and in developed markets (Panel B). No significant results are found for emerging markets and for different types of liquidity risks.

[Interestingly, the global commonality risk, which is significant in Table 5, is no longer significant in Table 6. This is because the earlier finding is largely due to the pricing of commonality risk with respect to the local market illiquidity, which is infused into global illiquidity in the aggregation process. By extracting the local aggregate of illiquidity from the global aggregate of illiquidity via the orthogonalization process, the pricing of local commonality risk is distinguished from that of global commonality risk. Table 7 also shows that the commonality risk is significantly priced only in local markets.

The exercise in this subsection that distinguishes the effect of global liquidity risk on asset pricing from that of local liquidity risk shows the importance of the US market relative to that of the rest of the world. Global liquidity risk with respect to the US market is shown to be important in developed markets, while this is not the case in emerging markets. In Section 6, I further investigate which variables, other than the developed- and emerging-market categories, help to explain the differences in the pricing of local and global liquidity risk with respect to the US market across countries.

5.4. Asset pricing of liquidity risk under a mildly segmented world financial market

This subsection examines the LCAPM under the assumption that the degree of integration of world financial markets is mild in the sense that the degree lies somewhere between full segmentation and full integration (Errunza and Losq, 1985; Bekaert and Harvey, 1995). Because local and global liquidity risks are jointly tested under this assumption, the analysis in this subsection provides an opportunity to examine the relative importance of local and global risk. My prior is that the importance of global risk is higher in countries with a high degree of integration, and local risks are more important in countries that are segmented.

Tables 7 and 8 summarize results of the cross-sectional regression tests of the model in Eq. (6), which is formed

Table 6

Cross-sectional regressions of global liquidity risk: US versus non-US.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to the returns and the innovations in illiquidity of either the US market or the "nonlocal & non-US" global market. Nonlocal & non-US factors are obtained by orthogonalizing global aggregates against the local and the US markets. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into 10 equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the 10 portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure, the liquidity net beta, beta 5, is defined in a manner similar to Eq. (4). Cross-sectional regressions with country dummies are performed for each month over all the sample countries (Panel A), developed countries (Panel B), and emerging markets (Panel C). The US stocks are dropped from the test. The table shows the averages of the estimated coefficients together with the t-values in italics. ZR is the previous month's average zero-return proportion. Ln(MV) is the log of the market capitalization in US dollars, and ln(B/M) is the log of the book-to-market ratio at the end of the previous year. The coefficient of ln(MV) is multiplied by 10^6. ZR is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

		US					Nonlocal & non-US global						
Intercept	ZR	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	ln(MV)	ln(B/M)
Panel A: All countries (excluding US)													
0.0125*	−0.0024	−0.0019				0.0062***	−0.0031				−0.0043	0.0792	0.0052***
1.81	*−1.06*	*−0.42*				*2.61*	*−0.50*				*−1.03*	*0.96*	*9.22*
0.0131*	−0.0022	−0.0020	−0.0069				−0.0031	0.0034				0.0738	0.0053***
1.88	*−0.96*	*−0.45*	*−0.57*				*−0.51*	*0.51*				*0.90*	*9.26*
0.0126*	−0.0022	−0.0018		0.0152			−0.0031		0.0102			0.0749	0.0052***
1.82	*−0.99*	*−0.42*		*0.56*			*−0.50*		*0.58*			*0.91*	*9.22*
0.0126*	−0.0025	−0.0020			−0.0065***		−0.0029			0.0098**		0.0780	0.0053***
1.81	*−1.12*	*−0.45*			*−2.70*		*−0.48*			*2.20*		*0.94*	*9.26*
Panel B: Developed markets (excluding US)													
0.0132***	−0.0004	−0.0034				0.0066**	−0.0027				−0.0015	0.0801	0.0046***
4.24	*−0.16*	*−0.75*				*2.26*	*−0.33*				*−0.30*	*1.00*	*6.72*
0.0137***	−0.0001	−0.0034	−0.0176				−0.0027	0.0036				0.0752	0.0046***
4.23	*−0.05*	*−0.77*	*−1.21*				*−0.32*	*0.51*				*0.94*	*6.73*
0.0138***	−0.0001	−0.0032		0.0265			−0.0028		0.0172			0.0782	0.0046***
3.77	*−0.04*	*−0.72*		*0.82*			*−0.33*		*0.90*			*0.98*	*6.70*
0.0135***	−0.0004	−0.0033			−0.0077**		−0.0026			0.0037		0.0794	0.0046***
4.31	*−0.16*	*−0.74*			*−2.54*		*−0.31*			*0.73*		*0.98*	*6.72*
Panel C: Emerging markets													
0.0098	−0.0097	0.0031				0.0026	−0.0035				−0.0095	−0.6225	0.0064***
1.21	*−2.86*	*0.48*				*0.54*	*−0.47*				*−1.33*	*−1.20*	*8.25*
0.0115	−0.0103	0.0026	−0.0042				−0.0034	0.0072				−0.6816	0.0065***
1.40	*−2.91*	*0.41*	*−0.16*				*−0.46*	*0.54*				*−1.28*	*8.35*
0.0107	−0.0099	0.0028		0.0103			−0.0030		0.0064			−0.5838	0.0064***
1.32	*−2.97*	*0.44*		*0.32*			*−0.40*		*0.28*			*−1.16*	*8.30*
0.0114	−0.0105	0.0025			−0.0018		−0.0028			0.0284**		−0.6321	0.0065***
1.36	*−3.01*	*0.39*			*−0.35*		*−0.36*			*2.49*		*−1.21*	*8.31*

under the assumption of a mildly segmented world financial market. Based on the earlier results showing that the US plays a key role in the pricing of global liquidity risk, I test global liquidity risks with respect to US factors instead of global liquidity risks with respect to nonlocal global factors. Hence, betas in Eq. (6) with the superscript ($W-D$) are replaced by betas formed with respect to the US market, $\beta^{*k,US}$. I drop US stocks from the tests. Again, based on the earlier results, I omit the results on $\beta^{*3,D}$ and $\beta^{*3,US}$ from the tables to save space.

In Table 7, the liquidity net betas with respect to local and US factors are both priced at the 5% level with premiums of 0.002 (t-value of 2.42) and 0.005 (t-value of 2.24), respectively, in the overall world market. This is supportive of the assumption of a mild degree of world market integration. By examining developed and emerging markets separately, it emerges that the global liquidity net beta is significant in developed markets, but not in emerging markets. On the contrary, the local liquidity net beta is highly significant in emerging markets. This is not the case in developed markets. Generally, global liquidity risks are not priced in emerging markets and local liquidity risks are not priced in developed markets. This finding is consistent with the previous results and implies that the level of financial market integration is relatively higher in developed markets than in emerging markets. This implication is also consistent with Bekaert, Harvey, and Lundblad (2007), which shows that the level of integration of financial markets in emerging countries is relatively low.

It is notable that the local commonality beta is significant at the 1% level (a premium of 0.004 with a t-value of 2.74) in the overall world market (Panel A), which is not the case in the context of a fully segmented world market (Table 3). This could arise from dropping US stocks, for which the local commonality risk is not priced, thereby increasing the

Table 7

Cross-sectional regressions of local liquidity risk and liquidity risk with respect to the US market.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to the returns and the innovations in illiquidity of either local market or the US market. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into ten equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the 10 portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure, the liquidity net beta, beta 5, is defined in a manner similar to Eq. (4). Cross-sectional regressions with country dummies are performed for each month over all the sample countries (Panel A), developed countries (Panel B), and emerging markets (Panel C). The US stocks are dropped from the test. The table shows the averages of the estimated coefficients together with the t-values in italics. *ZR* is the previous month's average zero-return proportion. Ln(*MV*) is the log of the market capitalization in US dollars, and ln(*B*/*M*) is the log of the book-to-market ratio at the end of the previous year. The coefficient of ln(MV) is multiplied by 10^6. ZR is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

		Local					US						
Intercept	ZR	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	ln(MV)	ln(B/M)
Panel A: All countries (excluding US)													
0.0129*	−0.0032	0.0004				0.0023**	−0.0033				0.0053**	0.0904	0.0051***
1.92	*−1.49*	*0.48*				*2.42*	*−0.89*				*2.24*	*1.16*	*9.73*
0.0125*	−0.0031	0.0005	0.0044***				−0.0034	−0.0084				0.0867	0.0051***
1.86	*−1.40*	*0.57*	*2.74*				*−0.92*	*−0.69*				*1.10*	*9.74*
0.0128*	−0.0022	0.0006		−0.0003			−0.0035		0.0138			0.0839	0.0051***
1.92	*−1.00*	*0.70*		*−0.08*			*−0.94*		*0.51*			*1.06*	*9.74*
0.0126*	−0.0028	0.0006			−0.0027**		−0.0033			−0.0060**		0.0891	0.0051***
1.88	*−1.31*	*0.62*			*−2.08*		*−0.90*			*−2.53*		*1.14*	*9.72*
Panel B: Developed markets (excluding US)													
0.0137***	−0.0007	0.0006				0.0012	−0.0049				0.0058**	0.0910	0.0045***
4.41	*−0.32*	*0.39*				*0.89*	*−1.24*				*1.98*	*1.34*	*7.01*
0.0134***	−0.0007	0.0006	0.0033				−0.0049	−0.0228				0.0884	0.0045***
4.09	*−0.31*	*0.42*	*1.39*				*−1.26*	*−1.57*				*1.28*	*7.04*
0.0128***	−0.0001	0.0007		0.0012			−0.0050		0.0194			0.0857	0.0045***
3.87	*−0.06*	*0.47*		*0.17*			*−1.28*		*0.62*			*1.23*	*7.07*
0.0141***	−0.0006	0.0007			−0.0013		−0.0050			−0.0071**		0.0891	0.0045***
4.53	*−0.25*	*0.44*			*−0.72*		*−1.27*			*−2.41*		*1.30*	*7.03*
Panel C: Emerging markets													
0.0116	−0.0122	0.0001				0.0035***	0.0009				0.0011	−0.5658	0.0062***
1.59	*−3.58*	*0.08*				*3.25*	*0.20*				*0.22*	*−1.10*	*8.52*
0.0112	−0.0126	0.0002	0.0066***				0.0008	−0.0022				−0.6489	0.0062***
1.54	*−3.53*	*0.23*	*2.87*				*0.18*	*−0.08*				*−1.25*	*8.52*
0.0113	−0.0100	0.0004		0.0007			0.0009		0.0170			−0.5681	0.0062***
1.56	*−3.08*	*0.46*		*0.17*			*0.19*		*0.51*			*−1.11*	*8.59*
0.0111	−0.0112	0.0003			−0.0041***		0.0011			−0.0026		−0.5519	0.0062***
1.52	*−3.45*	*0.37*			*−2.87*		*0.25*			*−0.50*		*−1.07*	*8.54*

contribution of the priced local commonality risk of emerging markets in the overall cross section. Table 8, which presents empirical results by geographic subregion, shows that the pricing of the local commonality beta in emerging markets largely arises from Developed Asia (Panel A), Emerging Asia (Panel C), and Latin America (Panel E).

Consistent with the results in Table 3, Table 7 shows that the local liquidity risk of $\beta^{*4,D}$ is priced in the overall world market (a coefficient of −0.003 and a t-value of −2.08) and in emerging markets (a coefficient of −0.004 and a t-value of −2.87). Table 8 shows that the significant pricing of $\beta^{*4,D}$ arises mostly from Emerging Asia (Panel C). This implies that investors request compensation for holding stocks whose liquidity is sensitive to the fluctuation of local, not the US, market returns in emerging market countries. In contrast with emerging markets, global liquidity risk seems more important than local liquidity risk in developed markets. In Panel B of Table 7, $\beta^{*4,US}$ is significant at the 5% level with a coefficient of −0.007 in developed markets, but the local liquidity risk $\beta^{*4,D}$ is not significant. Table 8 shows that Developed Europe contributes most to the pricing of $\beta^{*4,US}$ in developed markets. Evidence in this subsection of the pricing of global liquidity risk implies that developed countries have close financial link with the US market.

5.5. Robustness tests

The goal of this subsection is to evaluate the robustness of the empirical results described in the previous subsections in Section 5. First, I use local currency returns instead of US dollar returns in the cross-sectional regressions. Second, I discuss the cross-sectional test results based on the country-by-country analysis. Third, I present the results of cross-sectional regressions using characteristic-based portfolios as test assets.

Table 8

Cross-sectional regressions of local liquidity risk and liquidity risk with respect to the US market by geographic region.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to the returns and the innovations in illiquidity of either local market or the US market. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into 10 equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the 10 portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure, the liquidity net beta, beta 5, is defined in a manner similar to Eq. (4). Cross-sectional regressions with country dummies are performed for each month over Developed Asia (Panel A), Developed Europe (Panel B), Emerging Asia (Panel C), Emerging Europe, the Middle East, and Africa (Panel D), and Latin America (Panel E). The US stocks are dropped from the test. The table shows the averages of the estimated coefficients together with the t-values in italics. ZR is the previous month's average zero-return proportion. Ln(MV) is the log of the market capitalization in US dollars, and ln(B/M) is the log of the book-to-market ratio at the end of the previous year. The coefficient of ln(MV) is multiplied by 10^6. ZR is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

		Local				US					
Intercept	ZR	Beta 1	Beta 2	Beta 4	Beta 5	Beta 1	Beta 2	Beta 4	Beta 5	ln(MV)	ln(B/M)
Panel A: Developed Asia											
0.0095	0.0011	0.0005			0.0007	−0.0029			0.0068	0.1081	0.0064***
1.14	0.35	0.32			0.47	−0.75			0.84	1.09	8.03
0.0116	0.0002	0.0005	0.0046*			−0.0029	−0.0539			0.1093	0.0064***
1.38	0.07	0.30	1.71			−0.75	−1.10			1.09	8.05
0.0102	0.0012	0.0006		−0.0004		−0.0030		−0.0110		0.1061	0.0064***
1.25	0.37	0.35		−0.22		−0.77		−1.42		1.07	8.06
Panel B: Developed Europe											
0.0136***	−0.0033	−0.0019			0.0010	−0.0015			0.0046*	0.0450	0.0026***
3.99	−1.23	−0.88			0.53	−0.47			1.66	0.79	3.72
0.0130***	−0.0031	−0.0019	0.0011			−0.0015	−0.0020			0.0399	0.0026***
3.70	−1.13	−0.86	0.39			−0.47	−0.15			0.70	3.71
0.0138***	−0.0032	−0.0019		−0.0014		−0.0016		−0.0049*		0.0442	0.0026***
4.05	−1.18	−0.83		−0.64		−0.51		−1.74		0.77	3.73
Panel C: Emerging Asia											
0.0003	−0.0176	0.0000			0.0036***	0.0022			0.0057	−0.2137	0.0057***
0.06	−3.98	0.03			3.09	0.44			0.85	−0.36	6.09
0.0033	−0.0187	0.0001	0.0075***			0.0021	−0.0510			−0.3375	0.0058***
0.63	−3.99	0.12	3.00			0.41	−1.19			−0.58	6.10
0.0029	−0.0161	0.0003		−0.0044***		0.0023		−0.0110		−0.1938	0.0057***
0.52	−3.92	0.34		−2.73		0.46		−1.53		−0.33	6.09
Panel D: Emerging Europe/Middle East/Africa											
0.0303	−0.0049	0.0006			0.0057	−0.0027			−0.0016	−0.6501	0.0077***
1.34	−0.89	0.33			1.38	−0.36			−0.22	−0.85	8.12
0.0224	−0.0035	0.0008	0.0075			−0.0004	0.0648			−0.7665	0.0076***
0.92	−0.64	0.41	0.95			−0.05	1.62			−0.95	7.84
0.0371*	−0.0042	0.0006		−0.0075		−0.0047		0.0062		−0.6105	0.0078***
1.68	−0.78	0.31		−1.44		−0.63		0.78		−0.80	8.19
Panel E: Latin America											
0.0190**	0.0014	−0.0019			0.0016	−0.0019			0.0067	0.2795	0.0037***
2.08	0.24	−0.73			0.86	−0.24			0.63	0.65	2.63
0.0193**	0.0002	−0.0019	0.0091*			−0.0028	0.0040			0.2034	0.0037***
2.06	0.04	−0.71	1.77			−0.37	0.08			0.46	2.71
0.0191**	0.0031	−0.0020		−0.0004		−0.0018		−0.0069		0.2626	0.0035**
2.09	0.55	−0.73		−0.17		−0.23		−0.64		0.60	2.46

5.5.1. *Local currency returns*

Table 9 shows the pricing of liquidity risk under the assumption of mildly segmented world markets, with returns, illiquidity, and betas based on local currency. The results in this table are similar to the results in Table 7, which are based on US dollar returns. That is, evidence of priced local and global liquidity risks is maintained.

5.5.2. *Country-by-country analysis*

Under the assumption of a mildly segmented world financial market, I perform the cross-sectional tests separately for each of the 37 countries (excluding the US) that have sufficient numbers of stocks.[12] Similarly to Section 5.4, I jointly test local liquidity risk and liquidity risk formed with respect to US market returns and illiquidity using returns, illiquidity, and betas based on local currencies.

[12] Results for the country-by-country analysis are available upon request.

Table 9
Cross-sectional regressions of liquidity risk based on local currency.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns (in local currency) and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to the returns (in local currency) and the innovations in illiquidity of either local market or the US market. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into 10 equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the 10 portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. With all four betas obtained by repeating this procedure, the liquidity net beta, beta 5, is defined in a manner similar to Eq. (4). Cross-sectional regressions with country dummies are performed for each month over all the sample countries (Panel A), developed countries (Panel B), and emerging markets (Panel C). The US stocks are dropped from the test. The table shows the averages of the estimated coefficients together with the t-values in italics. *ZR* is the previous month's average zero-return proportion. Ln(*MV*) is the log of the market capitalization in US dollars, and ln(*B*/*M*) is the log of the book-to-market ratio at the end of the previous year. The coefficient of ln(*MV*) is multiplied by 10^3. *ZR* is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

		Local					US						
Intercept	ZR	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5	ln(MV)	ln(B/M)
Panel A: All countries (excluding US)													
0.0223 ***	−0.0053	0.0000				0.0017**	−0.0024				0.0037*	−0.4363	0.0048***
4.20	*−2.24*	*0.01*				*2.22*	*−0.79*				*1.79*	*−0.97*	*8.50*
0.0225***	−0.0054	0.0001	0.0035**				−0.0025	−0.0113				−0.4715	0.0048***
4.26	*−2.22*	*0.08*	*2.54*				*−0.81*	*−1.03*				*−1.04*	*8.49*
0.0235***	−0.0047	0.0001		−0.0006			−0.0025		0.0012			−0.4919	0.0048***
4.44	*−1.99*	*0.17*		*−0.15*			*−0.82*		*0.05*			*−1.09*	*8.49*
0.0225***	−0.0050	0.0001			−0.0020*		−0.0025			−0.0043**		−0.4493	0.0048***
4.25	*−2.13*	*0.15*			*−1.72*		*−0.81*			*−2.02*		*−1.00*	*8.50*
Panel B: Developed markets (excluding US)													
0.0144***	−0.0022	0.0002				0.0007	−0.0042				0.0047*	−0.2255	0.0043***
3.83	*−0.85*	*0.17*				*0.66*	*−1.25*				*1.80*	*−0.48*	*6.40*
0.0145***	−0.0022	0.0002	0.0022				−0.0042	−0.0235*				−0.2446	0.0043***
3.74	*−0.85*	*0.18*	*1.17*				*−1.26*	*−1.81*				*−0.51*	*6.40*
0.0138***	−0.0020	0.0003		0.0019			−0.0043		−0.0001			−0.2745	0.0043***
3.70	*−0.77*	*0.25*		*0.31*			*−1.29*		*0.00*			*−0.57*	*6.38*
0.0147***	−0.0021	0.0003			−0.0007		−0.0042			−0.0055**		−0.2366	0.0043***
3.90	*−0.82*	*0.21*			*−0.47*		*−1.28*			*−2.12*		*−0.50*	*6.38*
Panel C: Emerging markets													
0.0274***	−0.0143	−0.0004				0.0032***	0.0032				−0.0001	−1.4778**	0.0055***
4.09	*−4.16*	*−0.54*				*3.17*	*0.87*				*−0.03*	*−2.46*	*7.14*
0.0284***	−0.0150	−0.0004	0.0062***				0.0030	0.0081				−1.5645**	0.0055***
4.28	*−4.20*	*−0.45*	*2.95*				*0.84*	*0.35*				*−2.59*	*7.13*
0.0285***	−0.0124	−0.0002		0.0007			0.0031		0.0082			−1.4957**	0.0055***
4.34	*-3.79*	*−0.20*		*0.17*			*0.85*		*0.29*			*−2.52*	*7.21*
0.0277***	−0.0134	−0.0002			−0.0038***		0.0031			−0.0002		−1.4697**	0.0055***
4.14	*−4.09*	*−0.22*			*−2.83*		*0.87*			*−0.04*		*−2.46*	*7.21*

Country-by-country analyses reveal substantial variations across countries in the pricing of liquidity risk. Out of the 37 countries considered, the local liquidity net beta is priced for five countries (Canada, Hong Kong, India, Pakistan, and South Africa), and the global liquidity net beta is significant for six countries (Canada, France, Greece, Netherlands, Poland, and Portugal).

Local liquidity risk of $\beta^{*4,D}$ is negative in 30 countries and significantly negative in six countries (Canada, Hong Kong, India, Pakistan, South Africa, and Switzerland). Twenty-two countries have negative coefficients for $\beta^{*4,US}$ and, for six of them (Canada, Greece, Italy, Netherlands, Poland, and Sweden), the beta is also significant at least at the 10% level.

The local commonality beta is priced with a positive sign at the 1% significance level (Hong Kong and India), at the 5% level (Italy and Singapore), or at the 10% level (Pakistan). But no significant pricing is found of the global commonality risk $\beta^{*2,US}$ in countries other than Turkey.

Country-by-country analysis yields some evidence of the pricing of local and global liquidity risk. Nevertheless, the pervasiveness of the effect of liquidity risk on asset pricing in the overall world financial market seems unclear at the country-level analysis. It is likely that the low quality of international stock-level data (Ince and Porter, 2006; Bekaert, Harvey, and Lundblad, 2007) and the relatively short sample period could have reduced the power of the test for many countries considered in this subsection. On the contrary, the regional-level analyses in the earlier subsections seem to provide a relatively clearer picture of the pervasive effect of liquidity risk on asset pricing in international financial markets.

5.5.3. *Portfolio-level analysis*

In the literature on asset pricing, it is not uncommon to use portfolios as test assets that are sorted on firm characteristics such as size and book-to-market. The use of portfolios as test assets is particularly popular when the reduction of noise in the estimated loadings is an important issue. In addition, it could mitigate the potential dominating influence of a few countries that have large numbers of sample stocks on cross-sectional regressions that are performed over stocks from multiple countries. However, empirical results of portfolio-based tests could be sensitive to the characteristic that is used to sort stocks (Brennan, Chordia, and Subrahmanyam, 1998; Berk, 2000). Nevertheless, given the popularity of using portfolios as test assets in the literature, I show in this subsection the results of cross-sectional tests in relation to portfolios based on size, book-to-market, and illiquidity.

For each year, I sort stocks into 10 or 25 equally weighted portfolios within a country on the basis of previous year-end market capitalization, previous year-end book-to-market ratio, or previous year-average illiquidity. If the total number of stocks in a country in Table 1 is between 100 and 300, the stocks are sorted into 10 portfolios. If the number is larger than 300, the country has 25 portfolios.[13] Market returns and illiquidity are obtained as value-weighted aggregates of returns and illiquidity, respectively, at the local and global market levels. The betas of year t are estimated using portfolio returns (in US dollars) and innovations in illiquidity over the years $t-5$ to $t-1$. Consistent with the case of individual stock-level tests, innovations in illiquidity are obtained from AR(1) filtering of the first-differences of portfolio illiquidity. In this exercise, local risks are based on the LCAPM of fully segmented world markets, and global risks are obtained on the basis of the model of fully integrated world financial markets. Given the market beta as well as liquidity betas, cross-sectional regressions with country dummies are performed for each month over portfolios across countries.

Tables A1 and A2 in the Appendix separately report time series averages of the coefficient of local and global risks for three different portfolios. To save space, I do not report t-values, but the significance of the coefficients are indicated by asterisks. Consistent with earlier results, the local liquidity risk of $\beta^{4,D}$ is significantly priced in both the overall world market and emerging markets regardless of portfolios used in the tests Table A1. In particular, the emerging-market results look fairly strong. However, contrary to the case of results based on individual stocks, the significant coefficients of the local commonality betas are all negative. Some evidence shows that $\beta^{3,D}$is priced when book-to-market portfolios are used as test assets (Panel B), but this is not the case when other test assets are used.

Turning to global liquidity risk (Table A2), there is some evidence that $\beta^{4,W}$ is priced (Panels B and C) in the overall world market. This finding is consistent with the earlier result. However, regional analysis shows that the pricing of $\beta^{4,W}$ is somewhat sensitive to the selected test assets. The results based on size portfolios and book-to-market portfolios show that $\beta^{4,W}$ is priced in emerging markets but not in developed markets. On the contrary, the results based on illiquidity portfolios in Panel C show the opposite.

Overall, portfolio-level analyses provide some evidence to further support the earlier results. However, some results appear to be sensitive to the choice of the firm characteristic used to sort stocks into portfolios.

6. What drives the relative importance of local and global liquidity risks in asset pricing?

Given the findings in the earlier sections, it would be interesting to see what drives the relative importance of local and global liquidity risks. The results in Section 5 show that the categorization of financial markets as developed and emerging markets plays a role in this regard. In this section, I examine the effect of country-level proxies for transparency, political risk, and

[13] Stocks from Austria, Belgium, Brazil, Chile, Denmark, Finland, Indonesia, Israel, Mexico, Netherlands, New Zealand, Norway, Pakistan, Philippines, Poland, Portugal, Spain, and Turkey are sorted into 10 portfolios in each country. The countries with 25 portfolios are Australia, Canada, China, France, Germany, Greece, Hong Kong, India, Italy, Japan, Malaysia, Singapore, South Africa, South Korea, Sweden, Switzerland, Taiwan, Thailand, the UK, and the US. Switzerland has 299 stocks but is included in the 25 portfolio group.

global investment flows on the pricing of local and global liquidity risks. My prior expectation is that the relative importance of global liquidity risk is higher in countries with high transparency, low political risk, and large cross-border investments. It is because global investors could be more prevalent in such countries (Chan, Covrig, and Ng, 2005; Gelos and Wei, 2005) and their global rebalancing of portfolios could have an effect on the pricing of liquidity risk. Based on the assumption of mildly segmented world financial markets and the earlier finding that the US market drives the pricing of global liquidity risk, I jointly test both local risk and risk with respect to the US market in the regressions. I focus only on the commonality beta and $\beta^{*4,S}$(S=D or S=US), both of which are shown to be priced in Section 5. In this section, I use stocks from the 37 countries (excluding the US) that are used in the preceding cross-sectional regressions.

I employ two measures of transparency. One is the index of accounting standards from La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998), which is constructed based on the coverage of items in companies' 1990 annual reports. Out of the 37 countries considered, four countries do not have this variable and hence are dropped from the test (China, Indonesia, Pakistan, and Poland). The index varies from 36 (Portugal) to 83 (Sweden) in the sample, with higher values indicating higher accounting standards. The other measure of transparency is the index of credibility of disclosure from Bushman, Piotroski, and Smith (2004), which is the percentage of firms in a country that are audited by the big five accounting firms. This variable has a value of one, two, three, or four if the percentage falls in the range of 0–25%, 25–50%, 50–75%, or 75–100%, respectively. Stocks from three countries in our sample are dropped due to lack of this variable (China, Indonesia, and Poland).

I use the index of expropriation risk from La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998) as a proxy for political risk. This measure assesses the threat of outright confiscation or forced nationalization. The scale ranges from zero to ten, with higher values indicating smaller risk of expropriation. For 35 countries in the sample (excluding China and Poland) for which the variable is available, the index ranges from 5.22 (Philippines) to 9.98 (Netherlands and Switzerland).

I also consider measures of cross-border investment flows. The first measure is the market value of US stock holdings (in millions of US dollars, as of June 30, 2007) held by foreign investors. I obtain these data for all 37 countries from the website of the Department of US Treasury.[14] I also use the market value of stock holdings (in billions of US dollars, as of December 2005) in a country held by US institutions. I collect these data for 23 countries from Ferreira and Matos (2008), who originally obtain the data for 27 countries from the FactSet/LionShare database.[15] According to Griffin, Nardari, and Stulz (2004), investment flows are sometimes "pushed" by the US market returns and "pulled" by local market returns. Variables for cross-border holdings could shed some lights on how shifts in investment flows triggered by changes in the US or local market returns affect the pricing of liquidity risk.

To examine the effect of each country-level proxy on the pricing of liquidity risk, I perform cross-sectional regressions of the expected returns on the set of explanatory variables: liquidity level, market risk, liquidity risk, and the two interaction terms incorporating the country-level proxy, X. The two interaction terms are liquidity risk and liquidity level, both of which are interacted with X. I also include size and book-to-market to control for firm characteristics.

The interaction terms of $\beta^{*4,US}$ and X are significant for all five country-specific variables considered in Table 10, showing that the global liquidity risk of $\beta^{*4,US}$is significantly priced in countries with high accounting standards, high credibility of disclosure, low political risk, a large amount of holdings of US stocks, and a large amount of stocks held by US institutions. For example, the coefficient for $\beta^{*4,US}$ is positive, 0.040, when the index of credibility of disclosure is unity (the lowest transparency). However, it is negative, -0.023, as specified in the LCAPM, when the index is 4 (the highest transparency). On the contrary, the local liquidity risk of$\beta^{*4,D}$is significantly priced in countries with lower transparency. These results are consistent with the prior expectation that global liquidity risk is important in countries with high transparency, low political risk, and large cross-border investments, because global investors, who request compensation for bearing liquidity risk, could be more prevalent in such countries. However, in opaque countries where global investors are uncommon, local liquidity risk is shown to be more important than global liquidity risk.

The table also reports empirical results for commonality risk. The significant pricing of local commonality risk shows that stocks that become more liquid in low local market liquidity are valued by investors in opaque markets. This provides additional insight to Karolyi, Lee, and van Dijk (2009), who show that the commonality in liquidity is greater in opaque countries than in transparent countries. However, global commonality risk with respect to the US market is important in countries with large cross-border investments into and from the US. This highlights the importance of US market liquidity, which could be more pronounced when there are sizable US-related cross-border investments.

Taken together, global liquidity risk is more important than local liquidity risk in countries that are more open, that is, in countries with high transparency, low political risk, and large cross-border investment flows. However, in countries with the contrary properties, and hence where global investors are rare, the importance of local liquidity risk increases.

[14] The website is http://www.treas.gov/tic/shl2007r.pdf. I use Table 22 in the document.

[15] These 23 countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, India, Italy, Japan, Netherlands, Norway, Poland, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, and the UK.

Table 10
Cross-sectional regressions of liquidity risk interacted with country-specific variable.

For each individual stock i, pre-ranking beta k (k=1,…,4) of year t is estimated using the monthly returns and innovations in illiquidity over the years $t-5$ to $t-1$ with respect to the returns and the innovations in illiquidity of either local market or the US market. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity over the 5-year window. The 5-year window starts at either January 1988 or the first month in which stocks are present in the sample. Stocks should have at least 36 monthly returns and innovations in illiquidity within the given window to have pre-ranking beta k of year t. Then, at the beginning of year t, stocks are sorted into 10 equally weighted portfolios in a given country based on the pre-ranking beta k of year t. Beta k is estimated for each of the 10 portfolios over the sample period (post-ranking beta). The post-ranking beta k of portfolio p is assigned to an individual stock i, which belongs to portfolio p in a given year. Cross-sectional regressions are performed for each month over the sample countries. The US stocks are dropped from the test. The table shows the averages of the estimated coefficients together with the t-values in italics. *ZR* is the previous month's average zero-return proportion. The interaction variable X is as follows. The index of accounting standards denotes the coverage of items in companies' 1990 annual reports (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1998). The index of credibility of disclosure denotes the percentage of firms in the country that are audited by the big five accounting firms (Bushman, Piotroski, and Smith, 2004). The index of expropriation risk measures the threat of outright confiscation or forced nationalization by the state (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1998), with a higher value indicating lower risk. Foreign portfolio holdings of US stocks is the market value of US stocks (in millions of US dollars) held by foreign investors as of June 30, 2007 (epartment of Treasury). Amount of stocks held by US institutions is the market value of stock holdings (in billions of US dollars) in a country held by US institutions (Ferreira and Matos, 2008). Ln(MV) is the log of the market capitalization in US dollars, and ln(B/M) is the log of the book-to-market ratio at the end of the previous year. N is the number of stocks included in the regression. The coefficient of ln(MV) is multiplied by 10^6. All the coefficients of the interaction terms of Foreign portfolio holdings of US stocks and the coefficient of *ZR* interacted with amount of stocks held by US institutions are multiplied by 10^4. *ZR* is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

			Local					US							
Intercept	*ZR*	*ZR**X	Beta 1	Beta 2	Beta 2*X	Beta 4	Beta 4*X	Beta 1	Beta 2	Beta 2*X	Beta 4	Beta 4*X	ln(MV)	ln(B/M)	N
X=Accounting standards															
0.0034	−0.0828	0.0012***	−0.0003	0.0543**	−0.0007*			0.0114*	0.3061	−0.0040			0.0513	0.0057***	15,290
0.63	*−3.15*	*3.05*	*−0.45*	*2.11*	*−1.96*			*1.81*	*1.37*	*−1.22*			*0.65*	*6.00*	
0.0036	−0.0418	0.0006*	0.0001			−0.0493*	0.0008*	0.0113*			0.0641	−0.0011*	0.0394	0.0056***	15,290
0.72	*−1.82*	*1.86*	*0.14*			*−1.69*	*1.74*	*1.79*			*1.36*	*−1.69*	*0.50*	*5.57*	
X=Credibility of disclosure															
0.0044	−0.0476	0.0124***	−0.0009	0.0332**	−0.0092**			0.0135**	0.1739	−0.0432			0.0424	0.0058***	15,369
0.90	*−2.87*	*2.81*	*−1.03*	*2.05*	*−2.03*			*2.14*	*0.88*	*−0.87*			*0.55*	*6.90*	
0.0042	−0.0133	0.0033	−0.0001			−0.0158*	0.0059**	0.0118*			0.0609**	−0.0209**	0.0377	0.0056***	15,369
0.89	*−0.68*	*0.66*	*−0.14*			*−1.66*	*2.02*	*1.88*			*2.21*	*−2.42*	*0.49*	*5.87*	
X=Risk of expropriation															
0.0047	−0.0269	0.0024	−0.0003	0.0208	−0.0021			0.0106*	0.0386	−0.0024			0.0338	0.0056***	15,460
1.00	*−0.99*	*0.85*	*−0.43*	*0.91*	*−0.84*			*1.86*	*0.11*	*−0.06*			*0.45*	*5.83*	
0.0045	0.0007	−0.0004	0.0000			−0.0202	0.0024	0.0108*			0.1716***	−0.0199***	0.0398	0.0055***	15,460
0.96	*0.02*	*−0.13*	*0.02*			*−1.27*	*1.26*	*1.79*			*2.81*	*−2.83*	*0.53*	*5.62*	
X=Foreign portfolio holdings of US stocks															
0.0083*	−0.0039	0.0001	0.0000	0.0060	−0.0011**			0.0049	−0.0211	0.0067**			0.0314	0.0055***	16,643
1.95	*−0.82*	*0.26*	*−0.02*	*1.05*	*−2.11*			*0.86*	*−0.34*	*2.05*			*0.42*	*5.75*	
0.0078*	−0.0041	0.0002	0.0002			−0.0014	0.0010**	0.0065			0.0035	−0.0019***	0.0146	0.0055***	16,643
1.81	*−0.93*	*0.94*	*0.23*			*−0.34*	*2.15*	*1.06*			*0.41*	*−2.82*	*0.20*	*5.53*	
X=Amount of stocks held by US institutions															
0.0078*	−0.0027	0.0850	−0.0001	0.0175***	−0.0002***			0.0044	−0.0991	0.0014***			0.0409	0.0050***	12,263
1.97	*−0.62*	*0.42*	*−0.08*	*2.76*	*−2.69*			*0.81*	*−1.58*	*2.72*			*0.56*	*6.68*	
0.0069*	0.0010	−0.0949	−0.0002			−0.0091	0.0001**	0.0077			0.0136	−0.0002**	0.0127	0.0045***	12,263
1.93	*0.22*	*−0.48*	*−0.20*			*−1.60*	*2.14*	*1.35*			*1.45*	*−2.37*	*0.18*	*5.80*	

7. Asset pricing of liquidity risk: factor model regressions

In addition to a cross-sectional regression framework in which I have presented empirical results so far, the factor model regressions have been used in the previous literature to show the pricing of liquidity risk (Pástor and Stambaugh, 2003; Sadka, 2006). In this section, I show how much trading alpha can be generated by trading on the basis of local or global liquidity risk. Using stocks from the 37 countries (excluding the US) that are used in the cross-sectional tests, I perform factor model regressions for the liquidity risks that are shown to be priced in the preceding sections.[16]

In each year t, a stock is ranked into one of ten groups in a given country on the basis of its pre-ranking beta, which is estimated over the years $t-5$ to $t-1$. Subsequently, stocks with the same rank are combined to form 10 equally weighted portfolios across countries in the regions specified in the first column of Table 11. The US dollar-return, in excess of the risk-free rate R_{ft}, of portfolio p (p=1,…,10), $R^k_{p,t}$, is regressed on global factors as specified in the following factor models:

$$R^k_{p,t}-R_{f,t}=\alpha^{1,k}_p+\delta^k_p(R^W_t-R_{f,t})+\xi^k_{p,t} \tag{9}$$

and

$$R^k_{p,t}-R_{f,t}=\alpha^{3,k}_p+\varphi^{M,k}_p(R^W_t-R_{f,t})+\varphi^{S,k}_p SMB_t+\varphi^{H,k}_p HML_t+\eta^k_{p,t} \tag{10}$$

The superscript k indicates that the portfolio is sorted on pre-ranking beta k (k=1,…,4). The Fama and French factors of *SMB* (small cap minus big) and *HML* (high book-to-market minus low) are formed in the global context as in Griffin (2002). A difficulty arises, however, in the use of the factor model in the global financial market because, unlike the US, there is as yet no commonly accepted global factor model.[17] In addition, as Griffin (2002) shows, the Fama and French factors per se are local, not global. However, given the popularity of factor model regression, I use global factors as well as US factors, which are obtained from K. French's data library, in the regressions. The results using the US factors are generally stronger than those using global factors in the sense that the former generally produce higher alphas with higher levels of significance than the latter. In Table 11, however, I report the more conservative results, which are based on global factor models.

Table 11 shows the estimated intercepts (alphas) from the regression of each of the 10 portfolios formed based on local commonality risk (Panel A), liquidity risk from the covariance of illiquidity with local market return (Panel B), and liquidity risk from the covariance of illiquidity with US market return (Panel C). Rows labeled "Global one-factor alpha" and "Global three-factor alpha" signify that the intercepts are from the models in Eqs. (9) and (10), respectively. The last column of the table (labeled "10-1") shows the difference in the estimated intercepts that are obtained from the regressions of the portfolios with the highest beta (p=10) and of those with the lowest beta (p=1). Henceforth, I call this difference the "10-1 spread." Economically, the 10-1 spread denotes the excess return relative to the given factors that can be earned by simultaneously taking a long position in the highest-decile portfolio and a short position in the lowest-decile portfolio.

Panel A of Table 11 shows the intercepts of portfolios based on local commonality risk. The 10–1 spread produces significant monthly excess returns of 0.39% and 0.24% from the one-factor model and the three-factor model, respectively. On an annual basis, these returns are approximately 4.72% and 2.87%, respectively. The alphas in general are monotonically increasing from the lowest-beta portfolio to the highest-beta portfolio. In emerging markets, the 10–1 spread is 0.58% for the one-factor alpha and 0.55% for the three-factor alpha. The numbers are annual 7.23%, and 6.87%, respectively, and are highly significant both statistically and economically.

In Panel B, the portfolios are formed based on the local liquidity risk of $\beta^{*4,D}$. The 1–10 spread, which is formed by going long the lowest-decile portfolio and shorting the highest-decile portfolio, is 0.24% (annual 2.87%) over all countries in the one-factor model, and it is highly significant at the 1% level (t-value of 2.81). Consistent with the preceding results for emerging markets, the 1–10 spreads from the one-factor model and the three-factor model are 0.55% and 0.62%, respectively, and are highly significant at the conventional 1% level in emerging markets. These returns are annual 6.39% and 7.12%, respectively. Again, there are monotonic patterns of the alphas along with the portfolios. The results of the one-factor model in the first two panels show that an annual excess return of 7.59% (=4.72+2.87%), which is highly significant both statistically and economically, can be obtained in the overall world market by trading on the basis of both the local commonality risk and $\beta^{*4,D}$. If the regression is performed only for stocks from emerging markets, the sum of the one-factor alphas obtained from trading based on these liquidity risks has the much higher value of 13.62%.

Regarding global liquidity risk with respect to US market (Panel C), a significant 1–10 spread of 0.15% (annual 1.75%) emerges from the one-factor model, which is significant at the 5% level. However, this spread is not significant in the three-factor models. In an unreported result, I find that the trading alpha is 0.17%, which is highly significant at the 1% level, when the US three factors are used in the factor model. In developed markets, where a significant pricing of global liquidity risk is shown in the previous cross-sectional analysis, the 1–10 spread from the one-factor model is 0.14%, which is significant at the 10% level. When the US factors are used, the 1–10 spread from the one-factor model and the three-factor model are 0.159% and 0.161%, respectively, both of which are significant at the 5% level (unreported).

In this section, I present in a factor model regression framework supporting evidence of the pricing of liquidity risk by showing that trading based on liquidity risk

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[16] The assumption on the degree of world market integration does not affect the results of the factor model regressions because only the rank, which is not affected by the assumption, of each beta matters in the sorting of stocks.

[17] The exception is an unpublished work of Hou, Karolyi, and Kho (2006), which suggests a global factor model that is based on global market return, cash flow to price ratio, and momentum.

Table 11
Factor model regressions of liquidity risk.

In each year t, a stock is ranked into one of 10 groups in a given country on the basis of its pre-ranking beta k (k=1,…,4) of year t, which is estimated over the years $t-5$ to $t-1$. Subsequently, stocks with the same rank are combined to form 10 equally weighted portfolios across countries in the regions specified in the first column of the table. Each portfolio return (in US dollars) in excess of the risk-free rate is regressed on global factors as specified in the following factor models:

$$R^k_{p,t}-R_{f,t}=\alpha^{1,k}_p+\delta^k_p(R^W_t-R_{f,t})+\xi^k_{p,t} \quad (9)$$

and

$$R^k_{p,t}-R_{f,t}=\alpha^{3,k}_p+\phi^{M,k}_p(R^W_t-R_{f,t})+\phi^{S,k}_p SMB_t+\phi^{H,k}_p HML_t+\eta^k_{p,t}. \quad (10)$$

The *SMB* (small cap minus big) and *HML* (high book-to-market minus low) are formed in the global context as in Griffin (2002). The table shows the estimated alphas with the t-values in italics from the regression of each of the 10 portfolios that are formed based on local commonality risk (Panel A), liquidity risk from the covariance of illiquidity with local market return (Panel B), and liquidity risk from the covariance of illiquidity with US market returns (Panel C). The US stocks are dropped from the test. Rows labeled "Global one-factor alpha" and "Global three-factor alpha" denote that the intercepts are from the models in Eqs. (9) and (10), respectively. The last column of the table (labeled "10–1") shows the difference in the estimated intercepts that are obtained from the regressions of the portfolios with the highest beta (p=10) and of those with the lowest beta (p=1). *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Region	1 (small)	2	3	4	5	6	7	8	9	10 (large)	10–1
Panel A: Portfolios sorted on local liquidity risk, beta 2											
All countries (excluding US)											
Global one-factor alpha	0.545**	0.563**	0.634***	0.581**	0.612**	0.706***	0.651**	0.696***	0.829***	0.929***	0.385***
	2.28	*2.40*	*2.62*	*2.35*	*2.42*	*2.77*	*2.48*	*2.60*	*3.08*	*3.42*	*5.02*
Global three-factor alpha	−0.491**	−0.441**	−0.436**	−0.515**	−0.520**	−0.432**	−0.517**	−0.512**	−0.395*	−0.256	0.235***
	−2.35	*−2.14*	*−2.10*	*−2.43*	*−2.42*	*−2.00*	*−2.30*	*−2.30*	*−1.76*	*−1.10*	*3.00*
Emerging markets											
Global one-factor alpha	0.848**	0.868**	0.975**	0.891**	0.953**	1.070***	0.992**	1.032**	1.270***	1.430***	0.582***
	2.20	*2.17*	*2.48*	*2.20*	*2.37*	*2.65*	*2.44*	*2.58*	*3.15*	*3.51*	*4.58*
Global three-factor alpha	−0.673*	−0.691*	−0.592*	−0.702*	−0.658*	−0.551	−0.689*	−0.607*	−0.339	−0.119	0.554***
	−1.93	*−1.89*	*−1.66*	*−1.91*	*−1.83*	*−1.52*	*−1.91*	*−1.71*	*−0.94*	*−0.32*	*3.87*
Panel B: Portfolios sorted on local liquidity risk, beta 4											
All countries (excluding US)											
Global one−factor alpha	0.901***	0.747***	0.683***	0.622**	0.602**	0.620**	0.641***	0.658***	0.610**	0.660***	−0.241***
	3.24	*2.82*	*2.62*	*2.45*	*2.34*	*2.52*	*2.66*	*2.67*	*2.48*	*2.62*	*−2.81*
Global three-factor alpha	−0.323	−0.418*	−0.487**	−0.543**	−0.536**	−0.457**	−0.435**	−0.402*	−0.456**	−0.462**	−0.138
	−1.38	*−1.85*	*−2.21*	*−2.57*	*−2.44*	*−2.16*	*−2.13*	*−1.86*	*−2.13*	*−2.14*	*−1.60*
Emerging markets											
Global one-factor alpha	1.404***	1.275***	1.123***	1.073***	0.937**	0.978**	0.960**	0.852**	0.909**	0.853**	−0.551***
	3.35	*3.19*	*2.80*	*2.67*	*2.28*	*2.43*	*2.39*	*2.18*	*2.35*	*2.07*	*−3.56*
Global three-factor alpha	−0.165	−0.250	−0.508	−0.531	−0.780**	−0.631*	−0.633*	−0.711**	−0.600*	−0.780**	−0.615***
	−0.43	*−0.68*	*−1.42*	*−1.47*	*−2.16*	*−1.75*	*−1.77*	*−2.00*	*−1.70*	*−2.09*	*−3.58*
Panel C: Portfolios sorted on global liquidity risk with respect to US market, beta 4											
All countries (excluding US)											
Global one-factor alpha	0.850***	0.729***	0.626**	0.671***	0.614**	0.625***	0.558**	0.684***	0.683***	0.702***	−0.147**
	3.11	*2.85*	*2.38*	*2.68*	*2.49*	*2.62*	*2.27*	*2.69*	*2.67*	*2.71*	*−2.44*
Global three-factor alpha	−0.369	−0.400*	−0.541**	−0.439**	−0.482**	−0.439**	−0.505**	−0.435**	−0.463**	−0.447**	−0.078
	−1.60	*−1.83*	*−2.41*	*−2.05*	*−2.29*	*−2.16*	*−2.36*	*−1.99*	*−2.14*	*−2.02*	*−1.19*
Developed markets (excluding US)											
Global one-factor alpha	0.660**	0.506*	0.435	0.498**	0.457*	0.448*	0.386	0.555**	0.512**	0.518*	−0.142*
	2.34	*1.95*	*1.64*	*1.98*	*1.86*	*1.87*	*1.54*	*2.18*	*1.97*	*1.97*	*−1.88*
Global three-factor alpha	−0.346	−0.414*	−0.496*	−0.354	−0.389	−0.347	−0.439*	−0.285	−0.396	−0.426*	−0.080
	−1.28	*−1.66*	*−1.94*	*−1.43*	*−1.63*	*−1.47*	*−1.78*	*−1.13*	*−1.58*	*−1.69*	*−1.00*

generates material trading alphas that are significant both statistically and economically.

8. Conclusion

This paper empirically investigates an equilibrium asset pricing relation with liquidity, as specified in the LCAPM of Acharya and Pedersen (2005), using a large sample of assets covering 30,000 stocks from 50 countries around the world for the period of 1988–2007.

The empirical evidence presented in this paper is supportive of the LCAPM in that liquidity risks are priced independently of market risk in international financial markets, even after controlling for liquidity level, size, and book-to-market. Specifically, it is shown that a security's required return depends on the covariance of its own liquidity with the aggregate local market liquidity, as well as on the covariance of its own liquidity with local and global market returns. These findings imply that liquidity is an important concern when investors rebalance their portfolios in the face of down markets or illiquid markets. Therefore, the findings have implications for international portfolio diversification, because liquidity risk is another dimension to consider in addition to traditional market risk.

By providing evidence that expected returns of stocks from around the world are affected by the covariance of liquidity with US market returns, I also show that the US market is a driving force of global liquidity risk.

Table A1

Cross-sectional regressions of local liquidity risk at the portfolio level.

Each year, stocks are sorted into 10 or 25 equally weighted portfolios within a country on the basis of the previous year-end market capitalization, the previous year-end book-to-market ratio (*B*/*M*), and the previous year-average illiquidity. If the total number of stocks in a country shown in Table 1 is between 100 and 300, the stocks are sorted into 10 portfolios. If the number is larger than 300, the country has 25 portfolios. Market return and illiquidity are the value-weighted averages of the returns and illiquidity, which are aggregated at the local market level. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of the illiquidity. Each beta k (k=1,...,4) of year t is estimated using the portfolio returns (in US dollars) and innovations in illiquidity over the years $t-5$ to $t-1$. The liquidity net beta, beta 5, is computed by Eq. (4). Local risks are obtained on the basis of the liquidity-adjusted capital asset pricing model of fully segmented world financial markets. Given the market beta as well as three liquidity betas, cross-sectional regressions with country dummies are performed for each month. The table shows the averages of the estimated coefficients. *ZR* is the previous month's average zero-return proportion. *ZR* is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Region	Intercept	*ZR*	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5
Panel A: Size portfolios							
All countries	0.0049	0.0224***	0.0029	−0.0068**			
	0.0030	0.0236***	0.0025		0.0051		
	0.0044	0.0227***	0.0022			−0.0034*	
	0.0042	0.0231***	0.0024				0.0007
Developed	−0.0060	0.0208***	0.0096***	−0.0067*			
	−0.0058	0.0212***	0.0091***		−0.0096		
	−0.0067	0.0219***	0.0093***			0.0017	
	−0.0066	0.0215***	0.0095***				−0.0021
Emerging	0.0118*	0.0292***	−0.0081**	−0.0050			
	0.0074	0.0312***	−0.0076*		0.0215		
	0.0114*	0.0271***	−0.0095**			−0.0202***	
	0.0107	0.0296***	−0.0094**				0.0079**
US	0.0179***	0.0242**	−0.0102**	−0.1400**			
	0.0131***	0.0264**	−0.0079*		0.0268		
	0.0174***	0.0223*	−0.0109**			−0.0165*	
	0.0171***	0.0218*	−0.0106**				0.0116
Panel B: B/M portfolios							
All countries	0.0041	0.0266***	0.0025	−0.0060**			
	0.0043	0.0269***	0.0021		−0.0131**		
	0.0038	0.0264***	0.0020			−0.0071***	
	0.0034	0.0267***	0.0019				0.0050***
Developed	0.0053	0.0230***	−0.0029	−0.0079***			
	0.0040	0.0236***	−0.0032		0.0003		
	0.0055	0.0230***	−0.0034			−0.0040***	
	0.0048	0.0233***	−0.0033				0.0015
Emerging	−0.0047	0.0286***	0.0149***	0.0017			
	−0.0033	0.0291***	0.0138***		−0.0287***		
	−0.0046	0.0277***	0.0148***			−0.0159***	
	−0.0049	0.0280***	0.0136***				0.0137***
US	−0.0069	0.0980***	0.0078	−0.0349			
	−0.0064	0.0758***	0.0121**		−0.1331***		
	−0.0057	0.0905***	0.0057			−0.0281***	
	−0.0060	0.0873***	0.0069				0.0293***
Panel C: Illiquidity portfolios							
All countries	0.0123*	0.0168***	−0.0072***	−0.0117***			
	0.0105*	0.0171***	−0.0074***		0.0053		
	0.0112*	0.0160***	−0.0076***			−0.0050**	
	0.0113*	0.0168***	−0.0076***				0.0008
Developed	0.0125***	0.0142***	−0.0066**	−0.0201***			
	0.0105***	0.0150***	−0.0068**		0.0061		
	0.0112***	0.0148***	−0.0069**			−0.0011	
	0.0105***	0.0155***	−0.0070**				−0.0034**
Emerging	0.0135**	0.0209***	−0.0125***	0.0103			
	0.0128*	0.0218***	−0.0117***		−0.0007		
	0.0135**	0.0179***	−0.0117***			−0.0153***	
	0.0144**	0.0192***	−0.0128***				0.0118***
US	0.0249***	−0.0071	−0.0127**	−0.2630***			
	0.0188***	−0.0003	−0.0068		−0.0839**		
	0.0200***	0.0002	−0.0108**			−0.0286**	
	0.0184***	0.0030	−0.0095*				0.0297***

Table A2
Cross-sectional regressions of global liquidity risk at the portfolio level.

Each year, stocks are sorted into 10 or 25 equally weighted portfolios within a country on the basis of the previous year-end market capitalization, the previous year-end book-to-market ratio (B/M), and the previous year-average illiquidity. If the total number of stocks in a country shown in Table 1 is between 100 and 300, the stocks are sorted into 10 portfolios. If the number is larger than 300, the country has 25 portfolios. Market return and illiquidity are the value-weighted averages of the returns and illiquidity which are aggregated at the global level. The innovations in illiquidity are obtained from AR(1) filtering of the first-differences of illiquidity. Each beta k (k=1,…,4) of year t is estimated using portfolio returns (in US dollars) and innovations in illiquidity over the years $t-5$ to $t-1$. The liquidity net beta, beta 5, is defined in a manner similar to Eq. (4). Global risks are obtained on the basis of the liquidity-adjusted capital asset pricing model of fully integrated world financial markets. Given the market beta as well as three liquidity betas, cross-sectional regressions with country dummies are performed for each month. The table shows the averages of the estimated coefficients. ZR is the previous month's average zero-return proportion. ZR is tested against the alternative hypothesis of positive coefficients, while the others are two-tailed tests. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Region	Intercept	ZR	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5
Panel A: Size portfolios							
All countries	0.0080	0.0224***	−0.0018	−0.0069			
	0.0085	0.0223***	−0.0014		−0.0097		
	0.0081	0.0225***	−0.0019			−0.0014	
	0.0082	0.0226***	−0.0018				0.0012
Developed	0.0011	0.0199***	0.0020	−0.0009			
	0.0018	0.0193***	0.0023		−0.0086		
	0.0010	0.0201***	0.0020			0.0000	
	0.0011	0.0202***	0.0020				−0.0001
Emerging	0.0094	0.0304***	−0.0042**	−0.0143			
	0.0094	0.0310***	−0.0036*		−0.0208		
	0.0094	0.0311***	−0.0042**			−0.0029*	
	0.0093	0.0313***	−0.0041**				0.0028
US	0.0079	0.0348**	−0.0087	−0.0095			
	0.0082	0.0312**	−0.0098		0.0580		
	0.0103*	0.0272**	−0.0105			−0.0160**	
	0.0100*	0.0280**	−0.0102				0.0134*
Panel B: B/M portfolios							
All countries	0.0063	0.0268***	−0.0014	−0.0052			
	0.0060	0.0265***	−0.0017		0.0187**		
	0.0065	0.0265***	−0.0015			−0.0023***	
	0.0064	0.0264***	−0.0015				0.0019**
Developed	0.0049	0.0230***	−0.0038**	−0.0085			
	0.0036	0.0227***	−0.0040**		0.0245***		
	0.0044	0.0233***	−0.0036**			−0.0001	
	0.0042	0.0234***	−0.0036**				−0.0003
Emerging	0.0035	0.0297***	0.0013	0.0018			
	0.0039	0.0294***	0.0007		0.0140		
	0.0041	0.0292***	0.0008			−0.0031*	
	0.0042	0.0292***	0.0008				0.0030*
US	−0.0026	0.0896***	0.0012	0.0088			
	−0.0045	0.0892***	0.0023		0.0140		
	0.0002	0.0774***	−0.0003			−0.0263***	
	0.0003	0.0791***	−0.0002				0.0243***
Panel C: Illiquidity portfolios							
All countries	0.0096	0.0173***	−0.0040**	−0.0280***			
	0.0095	0.0187***	−0.0042***		0.0008		
	0.0097	0.0179***	−0.0042***			−0.0025**	
	0.0097	0.0182***	−0.0042***				0.0011
Developed	0.0090**	0.0150***	−0.0042*	−0.0319***			
	0.0071*	0.0164***	−0.0046**		0.0143		
	0.0077**	0.0157***	−0.0043**			−0.0031**	
	0.0073**	0.0160***	−0.0043**				0.0013
Emerging	0.0098	0.0203***	−0.0063***	−0.0276***			
	0.0098	0.0222***	−0.0061***		−0.0024		
	0.0100	0.0212***	−0.0063***			−0.0021	
	0.0100	0.0217***	−0.0065***				0.0010
US	0.0160**	0.0060	−0.0052	−0.0502			
	0.0176***	0.0023	−0.0071		−0.0356		
	0.0168**	0.0030	−0.0070			−0.0199**	
	0.0172***	0.0017	−0.0077				0.0183**

Furthermore, the empirical results presented in this paper show that the world price of liquidity risk is more important than its local counterpart in countries where more global investors are present—specifically, in developed countries and in countries with high transparency, low political risk, and large cross-border investment flows. This finding sheds some lights on the importance of global investment and on the relatively high degree of integration in these countries.

An important limitation of this study is that only the unconditional version of the global LCAPM has been tested. An interesting extension would be to test the conditional version of the LCAPM, in which liquidity risks vary over time in a way that depends on predetermined information variables. Such an extension could allow for investigation of the determinants of the time-varying liquidity risk premium in international financial markets. Based on the results in this paper, it is plausible that the economic variables that affect US market returns would also influence time-varying liquidity risk in world financial markets.

9. Appendix A

Cross-sectional regressions of local liquidity risk at the portfolio level is shown in Table A1 and cross-sectional regressions of global liquidity risk at the portfolio level is shown in Table A2.

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