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Liquidity risk and stock returns around the world

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ABSTRACT

The recent global financial crisis demonstrates that market liquidity is a prominent systematic risk globally. We find that *local* liquidity risk, in addition to the *local* market, value and size factors, demands a systematic premium across stocks in 11 developed markets. This local pricing premium is smaller in countries where the country-level corporate boards are more effective and where there are less insider trading activities. We also discover that *global* liquidity risk is a significant pricing factor across all developed country market portfolios after controlling for *global* market, value, and size factors. The contribution of this risk to the return on a country market portfolio is economically and statistically significant within and across regions.

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1. Introduction

The recent financial crisis has had a severe and prolonged impact on equity markets and economies around the world. It first started hitting the equity markets in July 2007 after investment banks and commercial banks reported substantial write-downs related to mortgage-backed securities caused by the US subprime crisis. Initially, the market participants and governments around the world played down the severity of the crisis until the US government refused to rescue Lehman Brothers, which was forced to file for bankruptcy protection on September 15, 2008, creating the domino effect of the global liquidity crisis. The shocks of market liquidity wiped out Lehman Brothers, and also resulted in Washington Mutual, Merrill Lynch, and Wachovia being taken over by their competitors.[1] The shortage of market liquidity quickly spread all over the world and interbank lending rates surged across the globe.[2] In Europe, governments had to bail out big lenders such as HBOS, Hypo Real Estate, and B&B. The credit crunch enlarged the impact of market liquidity risk on asset values and led to investors' fears of severe global economic recessions.[3]

More significantly, the dry-out of liquidity and fears of recessions caused a 20% drop in the equity markets around the world in the second week of October 2008.[4] This was the worst week in the recent history of stock markets worldwide. Due to investors' continued fears of market illiquidity and recessions, global equity markets continued to drop until March 2009. The equity market at one point lost over $7 trillion in the US and $30 trillion worldwide during this global crisis period. In percentage terms, the US equity market dropped by over 46% while other major stock markets dropped by between 40% and 60% during the period from September 2008 to March 2009. While a dry-out of liquidity can reduce asset values, an ample supply of market liquidity can help asset prices recover from their distress.[5] However, Huang and Wang (2010) show theoretically that the market force can fail to lead the supply of liquidity and suggest that there is a need for intervention from policy makers. This is demonstrated by the fact that global equity markets surged

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[1] The failure of Washington Mutual is the biggest banking failure in US history. Bear Stearns was taken over much earlier (March 2008) by JPMorgan Chase with the US Federal Reserve asset guarantees. Other financial institutions including Freddie Mac, Fannie Mae, and Citigroup were either bailed out by or received substantial fund injections from the US government.

[2] The Euro overnight inter-bank lending rate, Euribor, peaked at 5.09% even after the European Central Bank cut the interest rate to 3.75% and the Federal Reserve cut the interest rate to 1.5%. The Yen interbank lending rate also surged to 0.9%, an 0.4% spread over the Japanese central bank's 0.5% overnight lending rate. Furthermore, on September 30, 2008, the US dollar overnight inter-bank borrowing cost, Libor, surged to 7.88%, a 5.88% spread over the Federal Reserve's 2% overnight funding rate on September 30, 2008.

[3] A Japanese insurer, Yamato Life Insurance, also declared bankruptcy after the largest American insurer, American Insurance Group (AIG), received a $100 billion bailout from the US government.

[4] The US stock market lost over $2.3 trillion in this week while the global stock market suffered a loss of over $6 trillion. In percentage terms, the Dow Jones index and the S&P 500 index each dropped by more than 20% and the Morgan Stanley Capital Indicator (MSCI) world index also dropped by more than 20%.

[5] Fang et al. (2009) show that a firm's liquidity level can improve its valuation as measured by the market-to-book ratio.

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more than 6% on October 12, 2008, after central banks around the world promised unlimited access to liquidity through providing unlimited dollar auctions to banks and guaranteed all deposits in banks. The global equity markets recovered by over 70% as of March 31, 2010 from the trough of the crisis on March 9, 2009, after the central banks of developed countries decided to coordinately supply market liquidity and reduce market-wide liquidity risk.

Market liquidity has become an important issue since the collapse of Long-Term Capital Management (LTCM), a large hedge fund, in 1998. When the Russian debt crisis precipitated a widespread deterioration in liquidity across countries and markets, LTCM's over-leveraged portfolio dropped sharply in value and the company had to liquidate its illiquid assets to meet margin calls.[6] The anticipation of a costly liquidation in a low-liquidity environment further eroded LTCM's position and caused a short-term market crash around the world before the Federal Reserve stepped into stabilize the financial markets. Ever since there has been a wide range of studies on liquidity in the US market that captured investors' attention. For example, Pástor and Stambaugh (2003) use a complex regression to estimate the market liquidity level and find that the pricing premium of market liquidity risk is higher than the market premium in the US. Bekaert et al. (2007) employ the portion of the zero daily returns over a month as their illiquidity measure and find that it significantly predicts stock returns in 18 emerging markets. They also document that unexpected illiquidity shocks are positively correlated with stock returns and negatively correlated with dividend yields. Amihud (2002) proposes a market-wide illiquidity measure that has a negative correlation with market returns. Acharya and Pedersen (2005) develop a liquidity-based capital asset pricing model (LCAPM) to illustrate how the covariance between the stocks' trading cost, namely illiquidity, and market return, the covariance between stock return and market illiquidity, and the covariance between a stock's illiquidity and market illiquidity jointly determine stock returns. Lee (2011) uses zero return ratios as the stock illiquidity and takes the simple average of stock illiquidity as the local market-wide illiquidity. He finds that the sum of the above covariance as the liquidity net betas at the local market level is priced at the stock level in the US market but not in the developed and overall world markets. However, he finds the sensitivity of stock returns to the market-wide illiquidity based on his measure is not locally priced in emerging markets, developed markets and the overall market. In addition, Lee (2011) replaces the local market illiquidity with global market illiquidity, namely the simple average trading cost of stocks in the world, and finds that the net liquidity beta, namely the sum of the abovementioned covariance, is priced across stocks. He finds that the covariance between the trading cost of a stock and the global market return is the driving force of this result while the covariance between a stock's return and the global market illiquidity is not priced in developed and emerging markets. He also decomposes global factors into US factors and non-local and non-US factors and finds that the covariance between a stock's illiquidity and the US market return significantly affects that stock's expected return and that the liquidity risk is not priced with respect to the non-local and non-US factors. He argues that these findings suggest that the US market plays a key role in the pricing of global liquidity risk, namely the unexpected component of the average stock trading cost in the overall world market.

The above episodes demonstrate that market liquidity can be a prominent systematic risk across stocks and other securities around the world. However, there is still a lack of empirical studies on whether the local market liquidity risk, i.e., the local market liquidity shock, is a systematic pricing factor across stocks in addition to Fama and French's (1998) market and value factors within each of the developed markets. It is also unclear whether the covariance between a stock's return and the local market liquidity risk as the liquidity risk beta is priced across stocks in a country. Further nobody knows how the *local* market liquidity risk affects the returns of individual stocks within a developed country and how the *global* liquidity risk is priced across the portfolio returns of developed markets if investors invest in market portfolios that are locally diversified. It is also unknown to investors how the market liquidity risk premium is related to country-wide corporate governance. The purpose of this paper is to fill this gap by using two widely used market-wide liquidity measures.

Investors can benefit from investing abroad. First, if they invest in countries with higher economic growth, they can potentially enjoy higher returns. Second, these investors can also enjoy the benefits of international diversification as documented by De Satis and Gerard (1997). However, by investing globally, investors must bear two levels of systematic risk: one on the individual stocks within a country and the other on the market portfolios at the global level. Fama and French (1998) find that the market and value factors are common risk factors for stocks in several developed markets. After the recent financial crisis, global investors are eager to find out whether or not the shock in market liquidity is globally a systematic risk factor and if yes, how it affects equity returns around the world. It is crucial for global investors to understand how market-wide liquidity risk is priced for stocks at the local level (i.e., local liquidity risk) and for locally diversified market portfolios at the global level (i.e., global liquidity risk).[7]

Due to diverse cultures, international investors behave differently in various markets. As documented by Leuz et al. (2003) and La Porta et al. (1998), legal systems and corporate governance mechanisms have important influences on stock markets. Bekaert et al. (2007) document that investors' perception of a country's legal system and political risk can have an influence on the liquidity pricing and asset returns in emerging markets. Chung et al. (2010) find that good corporate governance of firms improves their liquidity as measured by the bid-ask spread and the price impact. We therefore investigate whether the pricing premium of the liquidity risk factor is related to country-level corporate governance and market regulations.

The recent literature has given at least two market-wide liquidity measures. The market liquidity risk measure proposed by Pástor and Stambaugh (2003) is the unexpected increase or decrease in market-wide liquidity. This liquidity measure captures the price reversal of underlying assets. Easley and O'Hara (2010) show in their model that illiquidity of assets arises from uncertainty. Chordia et al. (2009) show that their theoretically estimated illiquidity is cross-sectionally priced in the US market. We therefore investigate whether Amihud's (2002) market-wide illiquidity measure is a pricing factor across stock markets. Amihud's (2002) measure captures the price pressure of underlying assets.[8] He shows that a decrease in *market* liquidity has a negative impact on stock prices, with a greater effect on illiquid stocks than on liquid stocks. This phenomenon is known as the "flight-to-liquidity" effect. He also documents that an unexpected increase in market illiquidity has a negative impact on stock returns in the US market.

We start off with the two market-wide liquidity measures suggested by Pástor and Stambaugh (2003) and Amihud (2002). To

[6] LTCM had a position of over US$ 1 trillion and managed a fund worth just under US$ 5 billion.

[7] Investors can avoid costly idiosyncratic risk at the stock level by investing in locally diversified market portfolios through exchange-traded funds (ETFs). It is noted that the liquidity of the markets where the assets are traded is more important than that of the traded ETFs, because the prices of EFTs should reflect the liquidity risk of the underlying assets rather than the liquidity risk of ETFs.

[8] The dollar trading volume can cause the price of a stock to go up or down when it is illiquid.

make these measures consistent, we multiply Amihud's unexpected illiquidity measure by negative one because market illiquidity is an undesirable characteristic.[9] The modified Amihud liquidity risk measure, which we refer to here as the alternative measure, captures the opposite of aggregate price pressure in the equity market. These two measures are idiosyncratic components of market-wide liquidity, which is the liquidity shock in the equity market.

Using stock market data from 21 developed markets, we find that local liquidity risk is a priced factor for individual stocks in 11 developed markets even after controlling for the local market, value, and size risk factors. In particular, the pricing premium for the local liquidity risk based on Pástor and Stambaugh's (2003) measure is positively significant in Australia, France, Hong Kong, Ireland, Japan, and Norway. The pricing premium for the local liquidity risk based on Amihud's (2002) liquidity measure is significantly positive in Canada, Denmark, Finland, France, Germany, Ireland, Japan, New Zealand, and Sweden. In each of these markets, stocks with higher sensitivities to local liquidity risk have significantly higher expected returns. We also find that global liquidity risk is a common pricing factor across country market portfolios after controlling for the global Fama–French three factors. We discover that country market portfolios with higher sensitivities to global liquidity risk earn significantly higher expected returns across and within economic regions.

Our study contributes to the limited literature on the relation between the liquidity risk factor and stock returns in international markets. The focus of our study on developed markets distinguishes our work from that of Bekaert et al. (2007), who document the importance of liquidity in the emerging markets. Our results suggest that investors should be compensated for bearing local liquidity risk in many developed countries in addition to Fama and French's (1993) three risk factors when they invest in stocks in both domestic and foreign markets. These results are also distinct from those of Lee (2011) who finds that local liquidity is not priced across stocks in developed markets but fails to investigate whether global liquidity risk is cross-sectionally priced across developed country market portfolios that are locally diversified. Our findings suggest that investors are compensated for bearing global liquidity risk even when they invest in locally diversified market portfolios. In addition, our results on the determinants of cross-country differences in the liquidity premium illustrate that the improvement of country-level corporate governance and the restrictions of insider trading can effectively reduce the liquidity premium, and in turn, enhance firm valuation.

The remainder of this paper is organized as follows. Section 2 describes the data. Section 3 constructs country market-wide liquidity and global liquidity risk factors. Section 4 outlines our empirical methods. Section 5 presents the pricing premiums for local liquidity risk. Section 6 describes our analysis at the global level. Section 7 concludes the paper.

2. Data description

We choose to study developed markets where foreign investors can freely exchange their currencies so that we can specifically test how market liquidity risk influences equity returns without currency constraints around the world. The data on the trading volumes in most emerging markets documented by Bekaert et al. (2007) are not sufficient for conducting a study on the pricing premium which needs a long history of data for reliable empirical tests. Our sample countries are classified by both the International Financial Corporation of the World Bank Group and the International Monetary Fund. They are also constituent countries in the MSCI world index. They are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Italy, Ireland, Japan, the Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States. We test whether local liquidity risk is priced in these 21 developed countries and whether the global liquidity risk is priced across these locally diversified market portfolios.

The market portfolios make use of daily data—total market return index values, turnover by value in local currencies, market value in local currencies, and exchange rates—retrieved from Datastream. For individual stocks, the frequency of data used is monthly. The daily turnover and volume of most stocks are not available from Datastream. We therefore construct the market-wide liquidity from daily market data. We also retrieve stock returns, the total dollar trading volume of each market, and market capitalization from Datastream for all markets except for the US market. We obtain data for the US market from CRSP.

Since the stock market data obtained from Datastream is not as reliable as that from CRSP, we adopt data clearing procedures. We treat days of trading with a daily dollar trading volume of less than US$100,000 in a country's market as non-trading days, since US$100,000 is more than three standard deviations below the mean within each market. In addition, if the daily dollar trading volume in a country's market on a particular day is below 0.2% of its time-series mean, then that day is also treated as a non-trading day.[10] As shown in Table 1, we find that Finland has the highest daily returns. The US market has the highest daily dollar trading volume and the largest market capitalization in the world. Japan is the second and the UK is the third largest market. Austria, Ireland, and New Zealand each had a market capitalization of less than US$100 billion as of June 2005, but Austria and Ireland exceeded that amount shortly after June 2005.

We retrieve valid volume and turnover data for both Canada and the US to construct measures of country market liquidity from January 1975 to June 2005. The test period for local liquidity risk in these two markets is from January 1977 June 2005. We also retrieve valid volume and turnover data for or before January 1989 for Australia, Austria, Belgium, Denmark, Finland, France, Germany, Hong Kong, Italy, the Netherlands, Norway, Singapore, Sweden, Switzerland, and the United Kingdom. We obtain valid volume and turnover data for or before January 1991 for the remaining countries except Ireland which has valid turnover data and volume for constructing measures of the market liquidity from January 2001 onwards. We then conduct an empirical test on whether local liquidity risk is a systematic pricing factor across stocks within each country's stock market from the earliest observation of local market liquidity in each country. Although we consider all 21 countries in our empirical test for global liquidity risk, we construct our global liquidity measures based only on those markets for which turnover data are available. As there are 17 countries for which valid market liquidity data are available in January 1989, we set the period from January 1989 to June 2005 as our test period for the global liquidity risk.

2.1. Local market factors

We use individual stocks to test whether local liquidity risk is a systematic pricing factor in each market after controlling for the

[9] When a risk factor has a negative impact on stock returns, it is undesirable. Ang et al. (2006) find that stocks that have high sensitivities to aggregate volatility risk have low average expected returns in the US market.

[10] For example, there was one day when the daily dollar trading volume was US$19 million in the US market while the average of the daily dollar trading volume was US$22.8 billion for the period from January 1988 to June 2005. We treat that day as a non-trading day.

Table 1
Summary statistics of market portfolio daily data.

Country	Country code	Average daily return in US dollars (%)	Average daily return in local currency (%)	Average daily dollar trading volume	Market value in June 2005
Australia	AU	0.061	0.056	55.81	648.09
Austria	OE	0.050	0.050	5.02	97.36
Belgium	BG	0.049	0.052	9.78	239.23
Canada	CN	0.050	0.046	53.21	986.33
Denmark	DK	0.063	0.060	12.00	146.92
Finland	FN	0.089	0.073	30.96	173.23
France	FR	0.057	0.054	199.48	1426.44
Germany	BD	0.048	0.044	68.63	1073.72
Hong Kong	HK	0.067	0.067	58.22	705.16
Ireland	IR	0.027	0.042	16.53	97.58
Italy	IT	0.043	0.037	121.58	743.86
Japan	JP	0.011	0.013	604.12	3335.53
Netherlands	NL	0.050	0.052	148.23	597.85
New Zealand	NZ	0.038	0.038	3.10	38.10
Norway	NW	0.084	0.081	13.25	142.54
Singapore	SG	0.031	0.036	11.49	166.79
Spain	ES	0.069	0.056	91.32	616.74
Sweden	SD	0.081	0.072	44.95	323.69
Switzerland	SW	0.053	0.052	114.22	806.46
United Kingdom	UK	0.047	0.049	530.08	2667.30
United States	US	0.056	0.056	2280.32	13324.74

This table reports the summary statistics of the market portfolio daily returns and dollar trading volume by country and of the market capitalization in billions of US dollars in June 2005. The average daily return of each market portfolio is its time-series average. The average daily dollar trading volume is the equally weighted average of total market dollar trading volume in ten million US dollars within the sample period. The sample period of market i is from either January 1975 or the month of the first available observation to June 2005.

local market, value and size factors. We follow Fama and French (1993) to construct the local size factor (*SMB*) in each market. In particular, all traded stocks in each market are firstly sorted into the top 30% (big), the bottom 30% (small), and the middle 40% (medium) according to their market capitalization at the end of the previous year. The local size factor in market i (SMB_i) is the value-weighted return on the local small-minus-big portfolio. The local value factor in market i (HML_i) is also constructed for each country. All stocks in each country are sorted according to their book-to-market ratios at the end of the previous year into the top 30% (high), the bottom 30% (low), and the middle 40% (middle). The local value factor is the value-weighted return on the local high-minus-low portfolio. The local value factors are retrieved from French's Data Library.[11] We convert all stock and local factor returns into US dollars so that our local analysis is consistent across all countries. Hence we use the 1-month US Treasury bill rate as the local risk-free rate.

2.2. Global market factors

When empirically testing the global liquidity risk premium, we control for the global market, size, and value factors. The global market factor (*MKTX*) is the value-weighted return on the 21 market portfolios minus the US risk-free rate proxied by the interest rate on the 1-month Treasury bills. We then follow Fama and French (1998) to construct the global size factor (*SMB*) from all stocks in the world. Specifically, all stocks in our full sample are first sorted into the top 30% (big), the bottom 30% (small), and the middle 40% (medium) based on their market value at the end of the previous year. The global size factor (*SMB*) is the value-weighted return on the global small-minus-big portfolio. We construct the global value factor (*HML*) in a similar manner. In particular, all stocks in our full sample are sorted into the top 30% (high), the bottom 30% (low), and the middle 40% (middle) based on their book-to-market ratios at the end of the previous year. The global value factor is computed from the value-weighted return on the global high-minus-low portfolio.

[11] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

2.3. Country-level corporate governance indices

As will be shown later, the local liquidity risk is priced differently across countries. One possible explanation for the cross-country differences in the pricing of local liquidity risk may be the diversity of corporate governance practices, as documented by Bekaert et al. (2007) and Chung et al. (2010). We therefore investigate whether country-level corporate governance mechanisms affect the cross-country difference in the pricing premium of the local liquidity risk. This paper uses a number of country-level corporate governance indices. The earnings management index is the aggregate earnings management score reported by Leuz et al. (2003). A higher score indicates more earnings management. We obtain values of the anti-director rights index for 2005 from Spamann (2010) who provides a detailed revision of the data reported by La Porta et al. (1998). A higher value on this index indicates better shareholder protection. We also obtain the accounting standards index from La Porta et al. (1998) who examine the annual reports of a country's companies in 1990. A higher score on this index indicates higher accounting quality. The Institution for Management Development International (IMD) compiles the corporate board index and the insider trading index. We take the values of these indices for 2004. A higher score on the corporate board index indicates a more effective board while a higher score on the insider trading index indicates less insider trading activities. We also include the gross domestic product (GDP) in US dollars in 2004 in our regressions to control for economic development.

3. Liquidity risk measures

Previous studies, based on a variety of liquidity measures indicating the characteristics of firms, generally find that less liquid stocks have higher expected returns.[12] In this study, we focus on whether market-wide liquidity risk is a systematic pricing risk factor

[12] See, for example, Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), Brennan et al. (1998), and Datar et al. (1998). Chordia et al. (2005) find that market liquidity is related to money flows between the equity and bond markets in the US.

for local individual stocks and for country market portfolios that are locally diversified. Therefore, we do not consider other liquidity measures that capture the transaction cost, bid-ask spread, or market depth (see detailed discussions made by Harris (2003)). As discussed earlier, there are two commonly used market-wide liquidity measures in the literature: Pástor and Stambaugh's (2003) measure and Amihud's (2002) measure. Pástor and Stambaugh's measure represents liquidity in a positive way, which investors like. Amihud's measure captures liquidity in a negative way, which investors dislike. These measures are also different in terms of liquidity dimensions. Pástor and Stambaugh's measure captures an asset's price reversal. Amihud's measure describes liquidity as an asset's price pressure.

There are differences in country-wide corporate governance mechanisms and market regulations across developed markets. The legal systems and cultures are also diverse. Hence, investors may behave differently and have different expectations for stock returns depending on their exposure to a country's market-wide liquidity risk. Even if the pricing premium for one measure of local liquidity risk is not significant in a country, we still cannot conclude that local liquidity risk is not priced in this market since investors in each market may perceive liquidity risk differently. As a result, in order to conduct a thorough study on market-wide liquidity risk around the world, we construct measures of market-wide liquidity risk from Pástor and Stambaugh's measure and Amihud's measure at both the local and global levels.

3.1. Pástor and Stambaugh's liquidity risk measure

Pástor and Stambaugh (2003) define liquidity as being associated with temporary price fluctuations induced by order flows. We define a global version of Pástor and Stambaugh's definition of liquidity as the equally weighted average of the liquidity of a country's stock market portfolios. This measure captures temporary aggregate market price fluctuations induced by total market order flows in each country. This implies that lower liquidity corresponds to stronger volume-related market return reversal against the global market return. A reversed future return is expected, which is constructed with the signed volume, when a country has low market liquidity. The signed volume is negative if a country's market portfolio has lower return than the global market portfolio. Consistent with Campbell et al. (1993), Pástor and Stambaugh (2003) find that investors require compensation for the liquidity demands of others. This means that the higher the reversal for dollar trading volume, the lower the country's market liquidity. This market liquidity measure also reflects the cost of trades where trade size is relatively compensated by the market dollar trading volume.

We use the price reversal method suggested by Pástor and Stambaugh (2003) to construct measures of country market portfolio liquidity using a country's market portfolio excess return and its total market dollar trading volume. The liquidity of a market portfolio i in a country in month t is the coefficient $\gamma_{i,t}$ in the following ordinary least squares (OLS) regression:

$$r^e_{i,d+1,t} = \alpha_{i,t} + \beta_{i,t} r_{i,d,t} + \gamma_{i,t} \times sign(r^e_{i,d,t}) \times \upsilon_{i,d,t} + \varepsilon_{i,d+1,t}, \quad d = 1, \ldots, D, \tag{1}$$

where $r_{i,d,t}$ is the return in US dollars in market i on day d in month t; $r^e_{i,d,t} = r_{i,d,t} - r_{m,d,t}$ is the return on market portfolio i over and above the global market return $r_{m,d,t}$; $\upsilon_{i,d,t}$ is the trading volume (measured in ten million US dollars) of market portfolio i on day d in month t; and $sign(r^e_{i,d,t})$ is equal to 1 if $r_{i,d,t} > 0$, -1 if $r_{i,d,t} < 0$, and 0 if $r_{i,d,t} = 0$.[13]

[13] Pástor and Stambaugh (2003) delete stocks whose price is less than US$5. We cannot do the same as it would dramatically reduce our sample size. Alternatively, we delete stocks whose market capitalization is less than US$10 million.

Our liquidity measure $\gamma_{i,t}$ of market i is the country's market portfolio liquidity. If we assume that stock k's return is independent of stock j's dollar trading volume, we can view this market portfolio liquidity as one constructed from the value-weighted individual stock j's liquidity in market i. The global market liquidity $\gamma_{m,t}$ is equally averaged across markets according to the following:

$$\gamma_{m,t} = (1/N_t)\sum_{i=1}^{N_t} \gamma_{i,t}, \tag{2}$$

where N_t is the total number of countries in month t.

3.1.1. The local liquidity risk measure

We measure the liquidity innovation in market i as follows:

$$\Delta\gamma_{i,t} = (m_{i,t}/m_{i,1}) \times (\gamma_{i,t} - \gamma_{i,t-1}), \quad i = 1, \ldots, N_t, \tag{3}$$

where $m_{i,1}$ is the market value of market i in its first observation month and $m_{i,t}$ is its capitalization in month t. This scaling will incorporate the time value of liquidity. In other words, it is inflation adjusted. Following Pástor and Stambaugh (2003), we regress a country's market liquidity innovation in an AR(1) process as follows:

$$\Delta\gamma_{i,t} = \alpha + \beta\Delta\gamma_{i,t-1} + c(m_t/m_1) \times \gamma_{i,t-1} + \delta_{i,t}. \tag{4}$$

The local liquidity risk ($L_{i,t}$) is defined as the residual ($\delta_{i,t}$) estimated from Eq. (4) divided by 100:

$$L_{i,t} = \delta_{i,t}/100. \tag{4a}$$

This local liquidity risk is serially uncorrelated or in other words, independently and identically distributed (i.i.d.). This AR(1) regression allows the predicted change to rely on the most recent change. At the same time, it is the deviation of the most recent level from its long-run mean. As shown in the Appendix, this market-wide liquidity measure can be an approximate market liquidity measure constructed from individual stocks within an equity market.

3.1.2. The global liquidity risk measure

We construct the global liquidity risk measure in a similar fashion. We first measure global liquidity by aggregating the monthly difference in the country's liquidity across the N_t markets and then scale it as follows:

$$\Delta\gamma_{m,t} = (M_t/M_1) \times (1/N_t)\sum_{i=1}^{N_t} \Delta\gamma_{i,t}, \tag{5}$$

where M_t is the total value of all markets in month t, and month 1 corresponds to January 1989. We equally weight the liquidity of each country market in our global liquidity measure, as Pástor and Stambaugh (2003) equally weight the liquidity of each stock in their market liquidity measure. We then regress $\Delta\gamma_{m,t}$ on its lag as well as the lagged value of the scaled level series as follows:

$$\Delta\gamma_{m,t} = \alpha + \beta\Delta\gamma_{m,t-1} + c(M_t/M_1) \times \gamma_{m,t-1} + \delta_{m,t}. \tag{6}$$

The global liquidity risk ($L_{m,t}$) is defined as the residual ($\delta_{m,t}$) estimated from Eq. (6) divided by 100:

$$L_{m,t} = \delta_{m,t}/100. \tag{7}$$

3.2. Amihud's liquidity risk measure

Amihud (2002) uses a different measure to determine the illiquidity of a stock and finds that this stock illiquidity requires extra returns as compensation and that the market-wide unexpected illiquidity has a contemporaneous negative impact on a stock's returns. We also construct a measure of a country's market illiquidity based on Amihud's measure in the global setting. We first define the country's market illiquidity as follows:

A country's market illiquidity :

$$ILLIQ_{i,t} = \frac{1}{D_t}\sum_{d=1}^{D_t}|r_{i,t,d}|/(v_{i,t,d}/N_{i,t}), \quad i = 1,\ldots,N_t, \tag{8}$$

where D_t is the number of days in month t and $N_{i,t}$ is the number of stocks in market i in month t. The market portfolio return ($r_{i,t,d}$)is the value-weighted average stock return in market i. The term $v_{i,t,d}/N_{i,t}$ is the average dollar trading volume per stock in market i in month t. This measure captures the average pricing pressure for stocks in market i.

A stock is illiquid if it has moved up or down by its dollar trading volume on average in a month. In other words, there is price pressure for trading this stock. As shown in Eq. (8), *ILLIQ* is the market portfolio's illiquidity in terms of its price pressure calculated using the value-weighted average stock return and average dollar trading volume per stock. We can then construct the corresponding global illiquidity in month t as follows:

$$\textit{Global illiquidity} : MILLIQ_{m,t} = \frac{1}{N_t}\sum_{i=1}^{N_t} ILLIQ_{i,t}, \tag{9}$$

where N_t is the number of countries in month t. This global illiquidity is the average of market illiquidity across all developed markets in our sample.

In Table 2, we report the time-series average of Pástor and Stambaugh's market liquidity measure and that of Amihud's market illiquidity measure. We also report the month in which market liquidity is first observed in a country. We find that our measure of market liquidity constructed based on Pástor and Stambaugh's measure is negative in most countries. This means that daily dollar trading volume tends to reverse the outperformance of a country's market portfolio returns against the global market returns when the country's market liquidity is negative. However, the dollar trading volume tends to push Demark, Finland, and Norway's portfolio returns to levels above the global market returns. These three markets also outperform most of the other 18 markets in our study.

Denmark, Finland, and Norway also have the highest market illiquidity based on Amihud's market illiquidity measure. In addition to their high daily market portfolio returns, their low average daily dollar trading volume per stock also contributes to this phenomenon. This suggests that their market portfolios are likely to move up or down; the direction depends on a given dollar trading volume per stock in the market. This simple statistic suggests that market liquidity or illiquidity is a broad and elusive concept and can vary wildly across different markets.

3.2.1. Amihud's local liquidity risk measure

We follow Amihud (2002) to decompose our country market illiquidity and global illiquidity measures into two components: the expected component and the unexpected component. We obtain our local unexpected illiquidity using the following AR (1) process:

$$ILLIQ_{i,t} = \alpha_i + \phi_i ILLIQ_{i,t-1} + \eta_{i,t}, \quad i = 1,\ldots,N_t, \tag{10}$$

where $ILLIQ_{i,t}$ is the local market illiquidity in market i in month t as defined in Eq. (8) The idiosyncratic unexpected component ($\eta_{i,t}$) is the local unexpected illiquidity in market i. We then construct our alternative local liquidity risk measure ($L^A_{i,t}$) by rescaling the local unexpected illiquidity ($\eta_{i,t}$) estimated from Eq. (10) as follows:

$$L^A_{i,t} = -1 \times \eta_{i,t}/100, \quad i = 1,\ldots,N_t. \tag{11}$$

In an unreported study, we find unexpectedly that the pooled correlation between the local liquidity risk measure ($L_{i,t}$) and its alternative ($L^A_{i,t}$) is 0.04. Their highest correlation in a country is 0.19. This low correlation suggests that the Pástor and Stambaugh's (2003) pricing reversal measure and Amihud's (2002) liquidity measure of pricing pressure capture different market phenomena across developed markets. We expect investors to demand different levels of compensation in different markets, depending on the liquidity measure used, due to the cross-country differences in insider trading activities and corporate governance.

3.2.2. Amihud's global liquidity risk measure

We construct our global unexpected illiquidity as follows:

$$MILLIQ_t = \alpha_m + \phi_m MILLIQ_{t-1} + \eta_{m,t}, \tag{12}$$

where $MILLIQ_t$ is the global illiquidity measure for the current period defined in Eq. (9). The idiosyncratic unexpected component ($\eta_{m,t}$) is the global market unexpected illiquidity. We then construct our alternative global market liquidity risk measure ($L^A_{m,t}$) by rescaling the global market unexpected illiquidity ($\eta_{m,t}$) as follows:

$$L^A_{m,t} = -1 \times \eta_{m,t}/100. \tag{13}$$

This measure of global liquidity risk is unexpected and serially uncorrelated. In contrast, the expected market-wide liquidity or illiquidity ($\alpha_m + \phi_m MILLIQ_{t-1}$) is the market force and not the market risk. We focus on investigating whether investors demand a risk premium for bearing this type of market-wide risk ($L^A_{m,t}$) at the global level.[14]

4. Empirical methodology

Our liquidity risk measure constructed based on the work of Pástor and Stambaugh (2003) is an unexpected innovation of market-wide liquidity. It is not an asset or a portfolio that an investor can trade; rather it is the return sensitivity to dollar trading volume. Similarly, our alternative liquidity risk measure constructed based on the work of Amihud (2002) is not a tradable asset either. The expected values of these two liquidity risk measures are not equal to their pricing premiums. We follow Pástor and Stambaugh in using the generalized method of moments (GMM) to estimate the pricing premiums and contributions to expected returns for any pair of portfolios. We briefly describe the procedures below.

4.1. Estimation of the past liquidity risk betas

When testing the liquidity pricing premiums at the stock level, we form 10 stock portfolios for each country based on the stocks' past betas for local liquidity risk. We employ the following OLS regression using the past 3 years of data to estimate the past betas for each stock in each market:[15]

$$R_{i,j,\tau} = \alpha_{i,j} + \beta^L_{i,j,t-1} L_{i,\tau} + \beta^m_{i,j,t-1} MKTX_{i,\tau} + \beta^h_{i,j,t-1} HML_{i,\tau} + \varepsilon_{i,j,\tau}, \quad i = 1,\ldots,21, \quad \tau = t-36,\ldots,t-1, \tag{14}$$

where $R_{i,j,\tau}$ is the monthly excess return of stock j in market i in month τ (the stock return minus the risk-free rate); $L_{i,\tau}$ is the local liquidity risk in market i; $MKTX_{i,\tau}$ is the local market factor in market i; and $HML_{i,\tau}$ is the local value factor in market i. By replacing $L_{i,\tau}$ with $L^A_{i,\tau}$, we can estimate a stock's past beta for our alternative local liquidity risk measure. We can also obtain each market portfolio's past beta for global liquidity risk in the same way by replacing local factors with global factors and by substituting local liquidity risk with global liquidity risk from Eq. (14).

[14] We find the correlation between these two measures of global liquidity risk ($L_{m,t}$ and $L^A_{m,t}$) to be 0.37.

[15] Fama and French (1998) find that the market factor and the HML value factor are common factors across stocks in major developed markets.

Table 2
Summary statistics of country market liquidity.

Country	Market liquidity	Market illiquidity	Average dollar trading volume per stock	Number of traded stocks in June 2005	Month of the first available observation of market liquidity
Australia	–0.0260	0.2806	0.0553	1015	01/1984
Austria	0.0166	0.7838	0.0392	93	08/1986
Belgium	–0.1024	1.3202	0.0297	234	01/1986
Canada	0.0393	0.9176	0.0399	1175	01/1975
Denmark	0.4774	5.4944	0.0487	165	04/1988
Finland	0.3535	2.3532	0.1843	139	03/1988
France	–0.0413	0.5223	0.2311	808	06/1988
Germany	–0.0053	0.1461	0.0989	838	06/1988
Hong Kong	–0.0153	0.1643	0.0903	745	06/1988
Ireland	–0.0088	0.3723	0.2891	50	01/2001
Italy	–0.0080	0.4575	0.3611	273	07/1986
Japan	–0.0004	0.0743	0.2025	2759	12/1990
Netherlands	–0.0020	0.0479	0.6888	143	02/1986
New Zealand	–0.1591	0.7444	0.0217	126	01/1990
Norway	–0.7446	3.1172	0.0640	151	02/1980
Singapore	–0.0453	1.1324	0.0271	341	01/1983
Spain	0.0004	0.0547	0.5451	140	02/1990
Sweden	–0.0790	0.9494	0.1100	328	01/1982
Switzerland	–0.0087	0.2611	0.2610	322	01/1989
United Kingdom	–0.0002	0.0660	0.3146	1186	10/1986
United States	0.0000	0.1299	0.3004	6686	01/1975

This table reports the summary statistics of market liquidity and market illiquidity by country. The country market liquidity based on Pástor and Stambaugh's (2003) measure is $(m_{i,t}/m_{i,1})$ multiplied by the slope coefficient $(\gamma_{i,t})$ in the following regression: $r^e_{i,d+1,t} = \alpha_{i,t} + \beta_{i,t} r_{i,d,t} + \gamma_{i,t} \times sign(r^e_{i,d,t}) \times \upsilon_{i,d,t} + \varepsilon_{i,d+1,t}, d = 1, \ldots, D$, where $r_{i,d,t}$ is the return in US dollars of market i on day d in month t; $r^e_{i,d,t} = r_{i,d,t} - r_{m,d,t}$ is the return of market portfolio i over and above the global market return $r_{m,d,t}$; $\upsilon_{i,d,t}$ is the trading volume (measured in ten million US dollars) of market portfolio i on day d in month t; and $m_{i,t}$ is the capitalization of market portfolio i in month t. The market illiquidity measure based on Amihud's (2002) measure is $ILLIQ_{i,t} = \frac{1}{D_t}\sum_{d=1}^{D_t} |r_{i,d,t}|/(\upsilon_{i,d,t}/N_{i,t})$, where $r_{i,d,t}$ is the daily return on day d in market i in month t, $\upsilon_{i,d,t}$ is the daily dollar trading volume on day d in market i in month t, and $N_{i,t}$ is the total number of stocks traded in market i in month t. The market liquidity is the time-series average of the market liquidity by country. The market illiquidity is also the time-series average of market illiquidity. The average dollar trading volume per stock is the equally weighted average of the dollar trading volume per stock in ten million US dollars, which is the total daily dollar trading volume in market i divided by the total number of traded stocks in month t.

4.2. GMM estimation

In each market i, we sort stocks into ten portfolios based on their past local liquidity risk betas $(\beta^L_{i,j,t-1})$ estimated from Eq. (14). When we estimate the pricing premium of a market's liquidity risk based on the ten past liquidity beta-sorted portfolios, we need to control for Fama and French's three factors as follows:

$$R_{i,j,t} = \beta^0_{i,j} + \beta^L_{i,j} L_{i,t} + \beta^m_{i,j,t} MKTX_{i,t} + \beta^h_{i,j,t} HML_{i,t} + \beta^s_{i,j,t} SMB_{i,t} + \varepsilon_{i,j,t},$$
$$i = 1, \ldots, 21, \quad j = 1, \ldots, 10, \tag{15}$$

where $SMB_{i,\tau}$ is the local market factor in market i, and other variables are defined in Eq. (14) except that excess returns are on portfolios instead of on individual stocks.

We rewrite Eq. (15) in a matrix form:

$$R_{i,t} = \beta^0_i + \beta^L_i L_{i,t} + \beta^F_i F_{i,t} + \varepsilon_{i,t}, \tag{16}$$

where $R_{i,t}$ is a 10×1 vector containing the excess returns on the 10 stock portfolios in market i. β^0_i and β^L_i are 10×1 vectors. $F_{i,t}$ is a 3×1 vector containing the realizations of the local market ($MKTX$), value (HML) and size (SMB) factors. β^F_i is a 10×3 matrix. Assuming that the ten local stock portfolios are priced by the tradable factors and the non-tradable liquidity risk factor, we have the following:

$$E(R_i) = \beta^L_i \lambda_{i,L} + \beta^M_i \lambda_{i,M} + \beta^H_i \lambda_{i,H} + \beta^S_i \lambda_{i,S}, \quad i = 1, \ldots, 21. \tag{17}$$

In a matrix form, we have

$$E(R_i) = \beta^L_i \lambda_{i,L} + \beta^F_i \lambda_{i,F}, \tag{18}$$

where $E(.)$ denotes the unconditional expectation and $\lambda_{i,L}$ (a scalar) and $\lambda_{i,F}$ (a 3×1 vector) are the pricing premiums. After taking expectations on both sides of Eq. (16) and substituting it into Eq. (18), we have the following constraint:

$$\beta^0_i = \beta^L_i [\lambda_{i,L} - E(L_{i,t})]. \tag{19}$$

The premiums on the tradable factors $(\lambda_{i,F})$ are equal to $E(F_t)$. Since the liquidity risk factor $(L_{i,t})$ is not the payoff on a tradable position, the pricing premium $(\lambda_{i,L})$ of liquidity risk estimated using Hansen's (1982) GMM is not equal to $E(L_{i,t})$.

We then follow Pástor and Stambaugh (2003) and apply the optimal weighting matrix in GMM to estimate the pricing premium $(\lambda_{i,L})$ of the local liquidity risk in market i. The stock portfolios' betas for local liquidity risk are estimated at the same time with the restriction that the pricing premium must be the same across stock portfolios. Using the same procedure and replacing Pástor and Stambaugh's (2003) market liquidity risk measure with Amihud's (2002) local liquidity risk measure, we can also estimate the pricing premium for Amihud's measure. When estimating the pricing premium of the global liquidity risk ($\lambda_{Liqrisk}$ or $\lambda^A_{Liqrisk}$), we replace the local factors with global factors and the ten stock portfolios in each market with the market portfolios of the 21 developed countries in our sample.

5. Results on local liquidity risk premiums

As discussed earlier, we believe that our two measures of local liquidity risk are not consistently priced in the same country. We hence investigate how the pricing premium is related to country-level corporate governance mechanisms and insider trading activities.

We follow Pástor and Stambaugh (2003) and remove stocks in which most investors have no interest because such stocks can create noise in testing market-wide liquidity risk. We also remove stocks whose market capitalization is less than US$10 million in a month in a country. We form ten value-weighted portfolios sorted on the remaining stocks' past betas for the local liquidity risk estimated using Eq. (14) in each market.[16] We then use GMM to estimate the pricing premium for local liquidity risk in each market from Eq. (15), subject to the constraint of Eq. (19).

5.1. Local liquidity risk premiums based on Pástor and Stambaugh's measure

As reported in Table 3, we find that the pricing premium for local liquidity risk based on Pástor and Stambaugh's measure is positive in 13 out of the 21 developed markets under study. In addition, the liquidity premium is significantly positive in Australia, France, Hong Kong, Japan, and Norway even after controlling for the local market, value, and size factors. However, the pricing premiums are significantly negative in Denmark and Singapore. One should note that the market capitalization of these two countries was a little more than US$100 billion in June 2005. Australia, France, Hong Kong, and Japan have much larger developed markets. In addition, our unreported results show that the local liquidity risk pricing premium in Ireland is also significantly positive with a value of 0.68 and a t-statistic of 2.30 when the ten stock portfolios are equally weighted. These results show that Pástor and Stambaugh's (2003) local liquidity risk measure is a common pricing risk factor for stocks in several major developed markets over and above Fama and French's three local factors.

5.2. Local liquidity premiums based on Amihud's liquidity risk measure

We then form ten value-weighted stock portfolios sorted the stocks' past betas for Amihud's local liquidity risk measure. We use the same GMM methodology to estimate the pricing premium for this liquidity risk measure. As shown in Table 4, we find that the pricing premium for this alternative local liquidity risk measure is positive in 14 out of the 21 developed markets under study. In addition, the liquidity premium is significantly positive in Canada, Denmark, Finland, France, Germany, Ireland, Japan, New Zealand, Sweden, and the US after controlling for the local market, value, and size factors. However, the liquidity risk premium is significantly negative in Austria, which has less than 100 traded stocks and was the third smallest market among our 21 developed markets in the sample period. Canada, France, Germany, Japan and Sweden are all large developed markets and account for more than half of the stocks in our sample. Our findings show that the alternative local liquidity risk measure is an important common risk factor for stocks in many major developed markets.

5.3. Local liquidity risk premiums and country-level corporate governance

We find that local liquidity risk is positively priced in Australia, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Japan, New Zealand, Norway, Sweden, and the US based on at least one of our liquidity risk measures. Based on both measures, the local liquidity risk is commonly priced in France, Ireland, and Japan. This means that two different dimensions of liquidity risk are common factors in these countries. The two different measures of liquidity risk are exhibited differently in many developed markets because they capture different dimensions of liquidity, i.e., price reversal versus price pressure. In addition, stocks respond differently to market-wide liquidity risk because investors behave differently and have various expectations on stocks in different markets. One possible economic explanation would be the cross-sectional differences in country-level corporate governance. Chung et al. (2010) find that the change in a firm-level corporate governance index significantly correlated with the change in the corresponding firm's liquidity as measured by bid-ask spread and pricing impact. Next, we explore the interesting issue of how the market-wide liquidity risk premium is related to country-level corporate governance mechanisms.

We first separately regress the pricing premium of local liquidity risk on various country-level corporate governance indices discussed earlier.[17] We then perform a multivariate regression by controlling for the GDP in each country. As shown in Table 5, we find that the insider trading index has a significant and negative coefficient even after controlling for GDP. This means that investors demand a higher liquidity risk premium in a market where there are more insider trading activities.[18] This is because the market liquidity is more important to investors in such markets.

The corporate board index is also significantly and negatively related to the premium for both local liquidity risk measures. A higher score on the corporate board index means that the corporate board is more effective in a market. Such a market has better corporate governance and a lower market monitoring risk. Therefore, investors demand a low pricing premium for local liquidity risk in such a market. On the other hand, we do not find any significant relationship between accounting standards, earnings management, or anti-director rights and the pricing premium of local liquidity risk.

There might be other economic reasons behind the cross-country differences in the pricing of local liquidity risk, such as the diversity of culture, religion, legal systems, psychological traits, and other investor behaviors and market regulations. However, they are beyond the scope of this study.

6. Results on global liquidity risk premiums

We have revealed that local liquidity risk is a systematic risk factor for stocks in 11 developed markets around the world. We now investigate whether global liquidity risk is a systematic pricing factor across the portfolios of all developed country markets. If it is, international investors cannot diversify this risk away simply by holding locally diversified market portfolios or exchange-traded funds (ETFs).

6.1. Market portfolios sorted by Pástor and Stambaugh's predicted global liquidity risk beta

Pástor and Stambaugh (2003) use seven characteristics of a stock to predict the liquidity risk betas in the US market. We also use seven characteristics of market portfolios to predict their sensitivities to global liquidity risk. These characteristics are based on variables whose values are also retrieved from Datastream. These characteristics include: (1) $C^1_{i,t-1}$, the liquidity risk beta linearly estimated using Eq. (14) from month 1 to month $t-1$; (2) $C^2_{i,t-1}$, the natural log of the country's stock index value in US dollars; (3) $C^3_{i,t-1}$, the natural log of the market value of the country's stock index in millions of US dollars; (4) $C^4_{i,t-1}$, the average value of the market liquidity ($\gamma_{i,t}$) from month t-6 to month $t-1$; (5) $C^5_{i,t-1}$, the natural log of the average turnover by value in thousands of US dollars from month t-6 to month $t-1$; (6), $C^6_{i,t-1}$, the accumulative country market portfolio return in US dollars from month t-6 to month $t-1$; and (7) $C^7_{i,t-1}$, the standard deviation of the monthly market portfolio returns in the past 6 months.

[16] The results are virtually the same if we employ the predicted liquidity betas suggested by Pástor and Stambaugh (2003) to form test portfolios.

[17] These various corporate governance indices are highly correlated. We therefore do not include all of them in the regression at the same time.

[18] A higher score on the insider trading index means a lower level of insider activity in a country market.

Table 3
Local liquidity risk premiums based on Pástor and Stambaugh's measure.

Countries	$\lambda_{i,L}$	t-Value	Volatility	Maximum	Minimum
Australia	0.79	2.28	0.071	0.436	−0.188
Austria	−3.18	−1.16	0.677	2.452	−3.911
Belgium	7.40	1.08	0.323	1.304	−0.724
Canada	−8.99	−1.54	0.435	2.110	−3.799
Denmark	−79.01	−2.10	6.426	21.024	−37.768
Finland	−2.96	−0.36	2.727	10.338	−19.970
France	1.02	3.08	0.423	4.290	−0.231
Germany	1.96	0.16	0.017	0.067	−0.068
Hong Kong	0.79	2.77	0.052	0.131	−0.217
Italy	4.79	0.99	0.030	0.144	−0.052
Ireland	−1.14	−1.25	0.075	0.325	−0.300
Japan	0.01	2.34	0.001	0.003	−0.003
Netherlands	0.17	1.51	0.009	0.041	−0.041
New Zealand	−8.76	−1.41	0.380	1.228	−1.743
Norway	31.77	1.84	8.153	76.988	−57.441
Singapore	−2.39	−1.65	0.402	1.157	−2.067
Spain	0.02	0.37	0.012	0.063	−0.027
Sweden	0.02	0.01	0.530	2.423	−1.952
Switzerland	0.27	1.49	0.016	0.106	−0.032
United Kingdom	−0.03	−0.62	0.002	0.007	−0.010
United States	0.024	0.50	0.002	0.009	−0.011

This table reports the pricing premium ($\lambda_{i,L}$) for market liquidity risk ($L_{i,t}$) based on Pástor and Stambaugh's (2003) measure. The market liquidity risk premium ($\lambda_{i,L}$) is estimated from the GMM regression on ten portfolios sorted by past liquidity beta in each country: $R_{i,t} = \beta_i^0 + \beta_i^L L_{i,t} + \beta_i^m MKTX_{i,t} + \beta_i^h HML_{i,t} + \beta_i^s SMB_{i,t} + \varepsilon_{i,t}$ with the restriction of $\beta_i^0 = \beta_i^L[\lambda_{i,L} - E(L_{i,t})]$, where $R_{i,t}$ is a 10×1 vector containing the excess returns on the 10 portfolios; all β_is are 10×1 vectors and *MKTX*, *HML*, and *SMB* are the country market, value and size factors. The liquidity risk of market *i* ($L_{i,t}$) is $\delta_{i,t}$ divided by 100 from the regression: $\Delta\gamma_{i,t} = \alpha + \beta\Delta\gamma_{i,t-1} + c(m_{t-1}/m_1) \times \gamma_{i,t-1} + \delta_{i,t}$, where $\gamma_{i,t}$ is market liquidity estimated from the regression: $r^e_{i,d+1,t} = \alpha_{i,t} + \beta_{i,t} r_{i,d,t} + \gamma_{i,t} \times sign(r^e_{i,d,t}) \times v_{i,d,t} + \varepsilon_{i,d+1,t}, d = 1, \ldots, D$, where $r_{i,d,t}$ is the return in US dollars of market *i* on day *d* in month *t*; $r^e_{i,d,t} = r_{i,d,t} - r_{m,d,t}$ is the return of market portfolio *i* over and above the global market return $r_{m,d,t}$; $v_{i,d,t}$ is the trading volume (measured in ten million US dollars) of market portfolio *i* on day *d* in month *t*; and $m_{i,t}$ is the capitalization of market portfolio *i* in month *t*. The past beta of local liquidity risk is estimated from the following regression: $R_{i,j,\tau} = \beta^0_{i,j} + \beta^L_{i,j} L_{i,\tau} + \beta^m_{i,j} MKTX_{i,\tau} + \beta^h_{i,j} HML_{i,\tau} + \varepsilon_{i,j,\tau}, \tau = t-36, \ldots, t-1$. The pricing premium ($\lambda_{i,L}$) is annualized by multiplying it by 12×100. The volatility is the standard deviation of the local liquidity risk. The maximum (minimum) market liquidity is the maximum (minimum) value of local liquidity risk in the sample period.

Table 4
Local liquidity risk premiums based on Amihud's measure.

Countries	$\lambda^A_{i,L}$	t-Value	Volatility	Maximum	Minimum
Australia	−2.58	−0.59	0.137	−0.876	0.420
Austria	−11.75	−2.12	0.684	−4.405	3.782
Belgium	−5.78	−1.12	1.087	−6.151	4.851
Canada	13.45	2.44	0.694	−7.064	2.968
Denmark	112.93	1.86	6.033	−45.285	28.384
Finland	32.87	1.94	4.008	−36.810	19.480
France	22.86	2.24	0.531	−3.300	3.433
Germany	0.87	1.71	0.053	−0.229	0.133
Hong Kong	0.30	1.06	0.074	−0.394	0.282
Italy	−6.72	−1.02	0.807	−3.040	1.668
Ireland	6.00	1.90	0.254	−0.892	0.942
Japan	0.35	1.83	0.031	−0.135	0.113
Netherlands	−0.16	−1.00	0.023	−0.173	0.125
New Zealand	17.68	1.77	0.488	−4.149	1.401
Norway	46.69	0.98	3.123	−17.464	12.992
Singapore	−4.72	−0.66	0.775	−5.797	2.726
Spain	−1.27	−0.03	0.034	−0.232	0.100
Sweden	8.37	2.51	0.614	−3.132	2.806
Switzerland	4.76	1.50	0.293	−2.154	1.280
United Kingdom	0.70	1.21	0.032	−0.214	0.142
United States	0.004	2.06	0.057	−0.606	0.229

This table reports the pricing premiums ($\lambda^A_{i,L}$) for the alternative local liquidity risk measure ($L^A_{i,t}$) based on Amihud's (2002) measure. The procedures are the same as those described in Table 3 except $L_{i,t}$ is now replaced by $L^A_{i,t}$. The alternative local liquidity risk measure ($L^A_{i,t}$) of market *i* is $\eta_{i,t}$ multiplied by (−1/100), where $\eta_{i,t}$ is from the regression: $Illiq_{i,t} = \alpha_i + \phi_i Illiq_{i,t-1} + \eta_{i,t}$. $Illiq_i$ is the market illiquidity and is defined as $ILLIQ_{i,t} = \frac{1}{D_t}\sum_{d=1}^{D_t} |r_{i,d,t}|/(v_{i,d,t}/N_{i,t})$, where $r_{i,d,t}$ is the daily market return on day *d* in market *i* in month *t*, $v_{i,d,t}$ is the market daily dollar trading volume on day *d* in market *i* in month *t*, and $N_{i,t}$ is the total number of stocks traded on market *i* in month *t*. The volatility is the standard deviation of the alternative local liquidity risk measure. The maximum (minimum) market liquidity is the maximum (minimum) value of the alternative local liquidity risk measure in the sample period.

The predicted liquidity risk beta is a linear function of these seven characteristics as given in the following equation:

$$\beta^L_{i,t} = \psi_{1,i,t-1} + \psi'_{i,t-1} C_{i,t}, \tag{20}$$

where $C_{i,t}$ is a 7×1 vector containing the seven characteristics in market *i* at time *t*, and the time-series value of $\psi'_{i,t-1}$ is estimated from the following regression:

$$e_{i,\tau} = \psi_{0,i,t-1} + (\psi_{1,i,t-1} + \psi'_{i,t-1} C_{i,\tau}) L_\tau + v_{i,\tau}, \tau = 0, \ldots, t-1, \quad i = 1, \ldots, N, \tag{21}$$

where the historical residual ($e_{i,\tau}$) is calculated from the following formula:

$$e_{i,\tau} = R_{i,\tau} - \alpha_{i,t-1} - \beta^m_{i,t-1} MKTX_\tau - \beta^h_{i,t-1} HML_\tau, \quad \tau = t-36, \ldots, t-1, \quad i = 1, \ldots, N, \tag{22}$$

in which the global market betas ($\beta^m_{i,t-1}$) and the global value betas ($\beta^h_{i,t-1}$) are estimated from Eq. (14).

We sort the country market portfolios into eight test portfolios based on their predicted global liquidity risk betas ranked from low (*L*) to high (*H*). Portfolio-*H* consists of country market portfolios that have the highest global liquidity risk betas, while Portfolio-*L* has the country market portfolios with the lowest betas. We obtain the abnormal portfolio returns (α_i) from the following regression for the sample period from January 1989 to June 2005:

$$R_{i,\tau} = \alpha_i + \sum_{j=1}^{J} \beta^j_{i,t-1} GF^j_\tau + \varepsilon_{i,\tau}, \tag{23}$$

where GF^j_τ is the global factor *j*, which is one of the global market, value, and size factors.

As reported in Table 6, equally weighted portfolio returns generally increase with their predicted global liquidity risk betas. The high-minus-low raw monthly return is 0.98% with a *t*-statistic of 2.05. Furthermore, the abnormal returns increase in general as the predicted global liquidity risk betas increase. The abnormal returns of the zero-cost hedge portfolio are 0.88% per month with a *t*-statistic of 1.75, 0.95% per month with a *t*-statistic of 1.85, and 0.99% per month with a *t*-statistic of 1.92 based on the world CAPM, the global Fama and French two-factor model, and the global Fama and French three-factor model, respectively. These findings confirm that the differences in abnormal returns generated by the global liquidity risk are statistically and economically significant. They suggest that the global liquidity risk is positively priced for country market portfolios. The following section tests this suggestion.

6.2. Market portfolios sorted by Amihud's past global liquidity risk beta

We also estimate the past betas of the global liquidity risk based on Amihud's (2002) measure using the following regression:

$$R_{i,t} = \beta^0_i + \beta^L_i L^A_{m,t} + \beta^m_i MKTX_t + \beta^h_i HML_t + \beta^s_i SMB_t + \varepsilon_{i,t} \quad \tau = t-36, t-1, \quad i = 1, \ldots, N \tag{24}$$

where *MKTX*, *HML*, and *SMB* are the global market, value and size factors. We then sort the developed market portfolios into seven portfolios according to their past betas. As shown in Table 7, we find that the market illiquidity increases with the past betas. However,

Table 5
Local liquidity risk premiums and country-level corporate governance indices.

Independent variables	Local liquidity risk premium ($\lambda_{i,L}$)	Alternative local liquidity risk premium ($\lambda^A_{i,L}$)	Local liquidity risk premium ($\lambda_{i,L}$)	Alternative local liquidity risk premium ($\lambda^A_{i,L}$)
	Univariate regression		Multivariate regression controlling for GDP	
Earnings management	−0.31	0.49	0.27	1.01
	(−0.54)	(0.60)	(0.37)	(0.82)
Anti-director rights	−0.51	−4.38	−3.52	−5.67
	(−0.11)	(−0.65)	(−0.71)	(−0.68)
Accounting standards	0.59	−0.03	1.45	1.54
	(0.96)	(−0.04)	(1.81)	(1.15)
Corporate boards	−10.99	−11.47	−3.48	−14.60
	(−1.99)	(−1.40)	(−0.43)	(−1.06)
Insider trading	−11.90	−5.99	−12.33	−0.27
	(−3.07)	(−0.91)	(−2.07)	(−0.03)

This table reports the coefficients and their *t*-statistics of various corporate governance indices and domestic GDP to explain the differences in market liquidity risk premiums across countries. GDP is the average gross domestic product per capita in US dollars. The earnings management index is the aggregate earnings management score reported by Leuz et al. (2003), where a higher score indicates more earnings management. The anti-director rights index is obtained from La Porta et al. (1998), where a higher score indicates better protection of shareholders. The accounting standards index is also taken from La Porta et al. (1998), where a higher score indicates higher accounting quality. The corporate board index is constructed by the Institution for Management Development International (IMD), where a higher score indicates more effective boards. The insider trading index is also compiled by IMD, where a higher score indicates less insider trading. The univariate regression is as follows: $X_i = \alpha + \beta CGI_i + \varepsilon_i$, where X_i is the dependant variable and is either the local liquidity risk premium ($\lambda_{i,L}$) or the alternative local liquidity risk premium ($\lambda^A_{i,L}$) and *CGI* is one of the corporate governance indices described. In the multivariate regression: $X_i = \alpha + \beta CGI_i + \gamma GDP + \varepsilon_i$. The local liquidity risk premium ($\lambda_{i,L}$) and the alternative local liquidity risk premium ($\lambda^A_{i,L}$) are estimated from Tables 3 and 4, respectively.

Table 6
The Jensen alphas and properties of portfolios sorted by the predicted global liquidity risk beta based on Pástor and Stambaugh's (2003) measure.

	L	2	3	4	5	6	7	H	H–L
Panel A: The characteristics of the portfolios sorted by predicted beta									
Liquidity	−0.117	−0.017	−0.011	0.252	−0.215	0.035	−0.011	0.003	
MV	936	1791	509	297	297	251	368	1022	
Raw return	0.89	1.13	1.18	1.11	1.47	1.09	1.33	1.88	0.98
	(2.23)	(3.19)	(3.24)	(3.24)	(3.16)	(2.66)	(2.86)	(3.62)	(2.05)
Panel B: The alpha of the sorted portfolios									
One factor	−0.11	0.20	0.16	0.08	0.30	−0.07	0.07	0.77	0.88
	(−0.38)	(0.82)	(0.77)	(0.35)	(1.24)	(−0.28)	(0.30)	(1.84)	(1.75)
Two factors	−0.17	0.22	0.14	0.06	0.27	−0.01	0.15	0.77	0.95
	(−0.60)	(0.86)	(0.64)	(0.25)	(1.09)	(−0.04)	(0.62)	(1.80)	(1.85)
Three factors	−0.23	0.19	0.12	0.03	0.26	−0.06	0.13	0.76	0.99
	(−0.78)	(0.74)	(0.54)	(0.14)	(1.04)	(−0.28)	(0.52)	(1.76)	(1.92)

This table reports the properties and Jensen alphas of equally weighted portfolios sorted by the predicted global liquidity risk beta of a market portfolio based on Pástor and Stambaugh's (2003) measure. The predicted liquidity risk beta is estimated from the regression: $\beta^L_{i,t} = \psi_{1,i,t-1} + \psi'_{i,t-1}C_{i,t}$, where $C_{i,t}$ is a 7×1 vector that contains seven characteristics to be described and the time-series value of $\psi'_{i,t-1}$ is estimated from the regression: $e_{i,\tau} = \psi_{0,i,t-1} + (\psi_{1,i,t-1} + \psi'_{i,t-1}C_{i,\tau})L_\tau + \upsilon_{i,\tau}, \tau = 0,\ldots,t-1, i = 1,\ldots,N$, and the historical residual ($e_{i,\tau}$) is calculated from the regression: $e_{i,\tau} = R_{i,\tau} - \beta^m_{i,t-1}MKTX_\tau - \beta^h_{i,t-1}HML_\tau, i = 1,\ldots,N$, where the global market betas and global value betas are estimated from the following regression on excess country market portfolio returns ($R_{i,\tau}$):

$$R_{i,\tau} = \alpha_i + \beta^L_{i,t-1}L_\tau + \beta^m_{i,t-1}MKTX_\tau + \beta^h_{i,t-1}HML_\tau + \varepsilon_{i,\tau}, i = 1,\ldots,N, \quad \tau = 0,\ldots,t-1.$$

The seven characteristics of $C_{i,t}$ are as follows: $C^1_{i,t-1}$ is the estimated past liquidity beta from the above regression; $C^2_{i,t-1}$ is the natural log of the country index value in US dollars; $C^3_{i,t-1}$ is the log market value of country *i* in million US dollars; $C^4_{i,t-1}$ is the average value of market liquidity ($\gamma_{i,t}$) from month $t-6$ to month $t-1$; $C^5_{i,t-1}$ is the log average dollar trading volume in thousand US dollars from month $t-6$ to month $t-1$; $C^6_{i,t-1}$ is the accumulative return of the past 6 months and $C^7_{i,t-1}$ is the standard deviation of monthly returns. Market value (MV) is the simple average of the market capitalization within each portfolio in billions of US dollars, and the portfolio liquidity is the value-weighted average of each country's liquidity, value-weighted by the portfolio's total market capitalization over time. The country liquidity is the slope coefficient ($\gamma_{i,t}$) multiplied by $(m_{i,t}/m_{i,1})$ in the regression $r^e_{i,d+1,t} = \alpha_{i,t} + \beta_{i,t}r_{i,d,t} + \gamma_{i,t} \times sign(r^e_{i,d,t}) \times \upsilon_{i,d,t} + \varepsilon_{i,d+1,t}, d = 1,\ldots,D$, across time, where $r_{i,d,t}$ is the return in US dollars of market *i* on day *d* in month *t*, $r^e_{i,d,t} = r_{i,d,t} - r_{m,d,t}$ is the return of market portfolio *i* over and above the global market return $r_{m,d,t}$, and $\upsilon_{i,d,t}$ is the trading volume of market portfolio *i* on day *d* in month *t*. The global liquidity risk ($L_{m,t}$) is $\delta_{m,t}$ which is estimated from the regression divided by 100: $\Delta\gamma_{m,t} = \alpha + \beta\Delta\gamma_{m,t-1} + c(M_t/M_1) \times \gamma_{m,t-1} + \delta_{m,t}$, where the global market liquidity ($\gamma_{m,t}$) is a simple average across markets, the innovation of the global liquidity ($\Delta\gamma_{m,t}$) is the aggregate of the monthly difference in the country liquidity across markets scaled by M_{t-1}/M_1, and M_t is the total value of all markets in month *t*, and month 1 corresponds to January 1989. The one-factor model includes only *MKTX* as the global market excess return. The two-factor model additionally includes *HML* as the global value factor. The three-factor model contains *SMB* as the global size factor besides the other two factors. The *t*-statistics are in parentheses.

the raw returns of the sorted portfolios do not exhibit an increasing trend like those of the portfolios sorted by the predicted beta of the global liquidity risk based on Pástor and Stambaugh (2003). But that does not necessarily imply that the global liquidity risk based on Amihud's (2002) measure is not a global pricing factor. We will employ the GMM adopted by Pástor and Stambaugh (2003) to estimate the pricing premium and its contributions across the developed countries' market portfolios.

6.3. The premium of global liquidity risk based on Pástor and Stambaugh's measure

We find that the pricing premium ($\lambda_{Liqrisk}$) of global liquidity risk based on Pástor and Stambaugh's (2003) measure is significant with a value of 0.60 and a *t*-statistic of 2.11 for the 21 developed countries' market portfolios from January 1989 to June 2005. This indicates that the global liquidity risk is a systematic global pricing

Table 7
The Jensen alphas and properties of portfolios sorted by the past global liquidity risk beta based on Amihud's (2002) measure.

	L	2	3	4	5	6	7	H	H–L
Panel A: The characteristics of the portfolios sorted by past beta									
Liquidity	0.535	0.260	0.363	0.535	0.392	1.165	0.822	2.153	
MV	656	688	823	1102	714	415	567	527	
Raw return	0.78	1.10	1.25	0.99	1.34	1.09	1.12	1.27	0.49
	(2.14)	(2.94)	(3.26)	(2.43)	(3.57)	(2.73)	(2.87)	(2.57)	(1.21)
Panel B: The alpha of the sorted portfolios									
One factor	−0.21	0.05	0.18	−0.13	0.24	−0.02	0.04	−0.01	0.20
	(−0.87)	(0.21)	(0.81)	(−0.57)	(1.36)	(−0.12)	(0.17)	(−0.05)	(0.50)
Two factors	−0.22	0.05	0.26	−0.20	0.19	−0.05	0.15	−0.06	0.16
	(−0.88)	(0.21)	(1.17)	(−0.85)	(1.08)	(−0.26)	(0.65)	(−0.20)	(0.39)
Three factors	−0.23	0.04	0.22	−0.22	0.19	−0.08	0.15	−0.09	0.14
	(−0.92)	(0.20)	(0.99)	(−0.97)	(1.07)	(−0.41)	(0.63)	(−0.30)	(0.34)

This table reports the properties and Jensen alphas of equally weighted portfolios sorted by the past beta of a country market portfolio of the global liquidity risk $L^A_{m,t}$ based on Amihud's (2002) measure. The $L^A_{m,t}$ is the global unexpected illiquidity ($\eta_{m,t}$) multiplied by (−1/100), where $\eta_{m,t}$ is estimated from the regression:

$$MILLIQ_{m,t} = \alpha_m + \phi_m MILLIQ_{m,t-1} + \eta_{m,t},$$

where $MILLIQ_{m,t}$ is Amihud's (2002) global illiquidity measure. $MILLIQ_{m,t}$ is defined as

$$MILLIQ_{m,t} = \frac{1}{N_t}\sum_{i=1}^{N_t} ILLIQ_{i,t}.$$

$ILLIQ_{i,t}$ is the market portfolio's illiquidity based on Amihud's (2002) measure in market i and is defined as

$$ILLIQ_{i,t} = \frac{1}{D_t}\sum_{d=1}^{D_t} |r_{i,d,t}|/(v_{i,d,t}/N_{i,t}),$$

where $r_{i,d,t}$ is the daily return on day d in market i in month t, $v_{i,d,t}$ is the daily dollar trading volume on day d in market i in month t, and $N_{i,t}$ is the total number of stocks traded on market i in month t. The past betas of the global liquidity risk of market portfolios i are calculated from the regression:

$$R_{i,t} = \beta_i^0 + \beta_i^L L^A_{m,t} + \beta_i^m MKTX_t + \beta_i^h HML_t + \beta_i^s SMB_t + \varepsilon_{i,t},$$

where MKTX, HML, and SMB are the global market, value and size factors. The sample period is from January 1989 to June 2005. The illiquidity is 100 multiplied by the simple average of a market portfolio's illiquidity across time within each sorted portfolio. The market value (MV) is the simple average of the market capitalization within each sorted portfolio in billions of US dollars. The raw return is the simple average of a market portfolio's return within each sorted portfolio and across time. The one-factor model includes only MKTX as the excess return on the global market. The two-factor model additionally includes HML as the global value factor. The three-factor model contains SMB as the global size factor besides the other two factors. The t-statistics are in parentheses.

factor for the locally diversified market portfolios of all developed countries. We also report the contribution of this global liquidity risk premium to the difference of country market portfolios within and across economic regions in Table 8. In the European economic region, this global liquidity risk premium significantly contributes to the difference in market portfolio return between 26 pairs of countries: Belgium and Norway, Finland and Austria, Finland and Belgium, Denmark and Norway, Finland and Denmark, Finland and Germany, Finland and France, Finland and Ireland, Finland and Italy, Finland and the Netherlands, Finland and Norway, Finland and Spain, Finland and Switzerland, Finland and UK, France and Norway, Germany and Ireland, Germany and Norway, Italy and Ireland, Ireland and Norway, Italy and Norway, Italy and Switzerland, the Netherlands and Norway, Spain and Norway, Sweden and Norway, Switzerland and Norway, and UK and Norway. Finland outperforms Norway annually by 15.3% with a t-statistic of 2.19 and the United Kingdom annually by 9.3% with a t-statistic of 2.09, which goes to highlight the contribution of this global liquidity risk to market portfolio returns.

Across the North American and European economic regions, this global liquidity risk premium significantly contributes to the difference in market portfolio return between five pairs of countries: Finland and the US, Finland and Canada, the US and Denmark, the US and Norway, and Canada and Norway. Across the European and Asia Pacific economic regions, this premium also significantly contributes to 15 pairs of countries: Finland and Australia, Finland and Hong Kong, Finland and Japan, Finland and Singapore, Finland and New Zealand, Ireland and Japan, Italy and Australia, Italy and New Zealand, the Netherlands and Australia, the Netherlands and Japan, Australia and Norway, Hong Kong and Norway, New Zealand and Norway, Singapore and Norway, and Spain and Japan. In particular, Finland's market portfolio has the highest global liquidity beta and Japan's market portfolio has the lowest beta during the sample period. The global liquidity risk premium contributes an annualized return of 11.8% (t-statistic = 2.15) to a zero-cost hedge portfolio that longs Finland's market portfolio and shorts Japan's market portfolio. Across the North American and Asia Pacific economic regions, this global liquidity risk premium significantly contributes to the difference in market portfolio return between Canada and Japan. In the Asia Pacific economic region, this premium significantly contributes to the difference in market portfolio return between four pairs of countries: Australia and Singapore, Hong Kong and Japan, New Zealand and Japan, and Singapore and Japan. These results show that this global liquidity risk premium contributes prominently to the market portfolio returns within and across economic regions.

6.4. The premium of global liquidity risk based on Amihud's measure

We now investigate the pricing premium of global liquidity risk with the added dimension of price pressure at the global level. We find that the pricing premium for this alternative global liquidity risk measure is significant at the 5% level with a value of 12.57 and a t-statistic of 2.42 for the period from January 1989 to June 2005.

Across the North American and Asia Pacific economic regions, this global liquidity risk premium significantly contributes to the outperformance of the US market portfolio against the Japanese

Table 8
The contribution of global liquidity risk premium to market portfolio returns based on Pástor and Stambaugh's (2003) measure.

	America		Europe														Asia Pacific				
	US	CN	OE	BG	DK	FN	FR	BD	IR	IT	NL	NW	ES	SD	SW	UK	AU	HK	JP	NZ	SG
US	–	0.0	−1.2	4.0	**7.5**	**−8.7**	−4.7	−1.5	0.9	−2.4	−0.9	**6.5**	−0.0	−5.6	0.4	0.6	1.8	1.4	3.0	−1.0	−0.4
		(0.04)	(0.49)	(1.57)	**(2.14)**	**(2.00)**	(0.79)	(1.08)	(0.80)	(1.51)	(1.39)	**(2.14)**	(0.02)	(0.93)	(0.37)	(0.77)	(1.08)	(0.86)	(1.64)	(0.50)	(0.26)
CN		–	−1.3	−1.0	0.1	**−8.8**	0.1	−1.2	0.8	−2.5	−1.0	**6.5**	−1.0	−5.7	0.4	0.6	1.8	−1.5	**3.0**	−1.0	−0.4
			(0.74)	(0.57)	(0.06)	**(2.12)**	(0.08)	(0.70)	(0.94)	(1.49)	(0.73)	**(1.83)**	(0.48)	(0.88)	(0.56)	(0.41)	(1.56)	(1.04)	**(1.79)**	(0.44)	(0.59)
OE			–	0.3	1.4	**−7.5**	1.4	0.1	2.1	−1.2	0.3	7.8	0.3	−4.4	1.7	1.8	3.1	−0.2	4.3	0.3	0.9
				(0.12)	(0.50)	**(1.86)**	(0.52)	(0.04)	(0.93)	(0.64)	(0.14)	(1.55)	(0.09)	(0.59)	(1.03)	(0.66)	(1.21)	(0.13)	(1.38)	(0.07)	(0.52)
BG				–	1.1	**−7.8**	1.1	−0.2	1.8	−1.5	0.0	**7.4**	0.0	−4.7	1.4	1.5	2.8	−0.5	3.9	−0.0	0.6
					(0.98)	**(1.86)**	(1.53)	(0.38)	(1.08)	(1.08)	(0.04)	**(2.14)**	(0.00)	(0.79)	(0.86)	(1.18)	(1.67)	(0.24)	(1.57)	(0.02)	(0.32)
DK					–	**−8.9**	0.0	−1.3	0.7	−2.5	−1.0	**6.4**	−1.1	−5.8	0.3	0.5	1.7	−1.5	2.9	−1.1	−0.5
						(2.06)	(0.04)	(1.15)	(0.69)	(1.34)	(1.13)	**(2.24)**	(0.81)	(1.02)	(0.19)	(0.70)	(1.37)	(0.68)	(1.57)	(0.74)	(0.34)
FN						–	**8.9**	**7.6**	**9.6**	**6.3**	**7.8**	**15.3**	**7.8**	3.1	**9.2**	**9.3**	**10.6**	**7.3**	**11.8**	**7.8**	**8.4**
							(1.95)	**(1.92)**	**(2.14)**	**(1.81)**	**(1.96)**	**(2.19)**	**(2.02)**	(0.58)	**(2.11)**	**(2.09)**	**(2.12)**	**(1.79)**	**(2.15)**	**(1.85)**	**(2.09)**
FR							–	−1.3	0.7	−2.6	−1.1	**6.3**	−1.1	−5.8	0.2	0.4	1.7	−1.6	2.8	−1.2	−0.6
								(1.46)	(0.45)	(1.64)	(1.47)	**(2.07)**	(0.59)	(0.96)	(0.16)	(0.39)	(1.27)	(0.76)	(1.29)	(0.53)	(0.31)
BD								–	**4.3**	−1.3	0.2	**7.7**	0.2	−4.5	1.0	1.8	3.0	−0.3	4.2	1.5	0.8
									(2.08)	(0.98)	(0.39)	**(2.10)**	(0.12)	(0.77)	(0.64)	(1.28)	(1.69)	(0.14)	(1.59)	(0.62)	(0.46)
IR									–	**−3.3**	−1.8	**5.7**	−1.8	−6.5	−0.4	−0.3	1.0	−2.3	**2.2**	−1.8	−1.2
										(1.69)	(1.28)	**(1.88)**	(0.99)	(1.03)	(0.46)	(0.27)	(1.15)	(1.17)	**(1.67)**	(0.92)	(1.34)
IT										–	1.5	**8.9**	1.5	−3.2	**2.8**	3.0	**4.3**	1.0	**5.4**	1.4	2.9
											(1.24)	**(2.03)**	(0.62)	(0.51)	**(1.97)**	(1.57)	**(2.08)**	(0.64)	**(1.82)**	(0.52)	(1.30)
NL											–	**7.4**	−0.0	−4.7	1.3	1.51	**2.8**	−0.5	**3.9**	−0.1	0.5
												(2.15)	(0.01)	(0.80)	(1.05)	(1.35)	**(1.89)**	(0.29)	**(1.71)**	(0.03)	(0.37)
NW												–	**−7.4**	**−12.2**	**−6.1**	**−5.9**	**−4.6**	**−7.9**	−3.5	**−7.5**	**−6.9**
													(2.25)	**(1.76)**	**(1.72)**	**(2.20)**	**(1.72)**	**(1.78)**	(1.45)	**(2.35)**	**(1.84)**
ES													–	−4.7	1.3	1.5	2.8	−0.5	**3.9**	−0.0	0.6
														(0.97)	(0.59)	(1.05)	(1.26)	(0.17)	**(1.66)**	(0.04)	(0.26)
SD														–	6.1	6.2	7.5	4.2	8.7	4.7	5.3
															(0.90)	(1.06)	(1.13)	(0.60)	(1.28)	(0.97)	(0.82)
SW															–	0.2	1.5	−1.8	2.6	−1.4	−0.8
																(0.13)	(1.49)	(1.29)	(1.42)	(0.55)	(0.99)
UK																–	1.3	−2.0	2.4	−1.6	−1.0
																	(1.19)	(0.87)	(1.46)	(0.99)	(0.68)
AU																	–	−3.3	1.1	−2.9	**−2.2**
																		(1.55)	(0.83)	(1.23)	**(1.68)**
HK																		–	**4.4**	0.4	1.0
																			(1.68)	(0.14)	(0.72)
JP																			–	**−4.0**	**−3.4**
																				(1.65)	**(1.82)**
NZ																				–	0.6
																					(0.26)

This table reports the contribution of the pricing premium ($\lambda_{Liqrisk}$) for the global liquidity risk based on Pástor and Stambaugh's (2003) measure to market portfolio returns, calculated using GMM, among the developed countries after controlling for the global market, value and size factors. $L_{m,t}$, the global liquidity risk, is defined as $L_{m,t} = \delta_{m,t}/100$, where $\delta_{m,t}$ is estimated from the following regression:

$$\Delta\gamma_{m,t} = \alpha + \beta\Delta\gamma_{m,t-1} + c(M_t/M_1) \times \gamma_{m,t-1} + \delta_{m,t},$$

where the global market liquidity $\gamma_{m,t}$ is a simple average of country liquidity across markets, the innovation of the global liquidity ($\Delta\gamma_{m,t}$) is the aggregate of the monthly differences in country liquidity across markets scaled by M_{t-1}/M_1, and M_t is the total value of all markets in month t, and month 1 corresponds to January 1989. The country liquidity is the slope coefficient $\gamma_{i,t}$ multiplied by ($m_{i,t}/m_{i,1}$), which is in the regression $r^e_{i,d+1,t} = \alpha_{i,t} + \beta_{i,t}r_{i,d,t} + \gamma_{i,t} \times sign\left(r^e_{i,d,t}\right) \times v_{i,d,t} + \varepsilon_{i,d+1,t}, d = 1, \ldots, D$, across time, where $r_{i,d,t}$ is the return in US dollars of market i on day d in month t, $r^e_{i,d,t} = r_{i,d,t} - r_{m,d,t}$ is the return of market portfolio i over and above the global market return $r_{m,d,t}$, and $v_{i,d,t}$ is the trading volume (measured in tens of millions of US dollars) of country market portfolio i on day d in month t. The global liquidity risk premium ($\lambda_{Liqrisk}$) is multiplied by 12×100 and is found to be 0.60 with a t-statistic of 2.11. It is estimated from the GMM regression based on excess returns on the portfolios of developed markets ($R_{i,t}$): $R_{i,t} = \beta^0_i + \beta^L_i L_{m,t} + \beta^m_i MKTX_t + \beta^h_i HML_t + \beta^s_i SMB_t + \varepsilon_{i,t}$ with the restriction of $\beta^0_i = \beta^L_i[\lambda_{m,L} - E(L_{m,t})]$. *MKTX*, *HML*, and *SMB* are the global market, value and size factors.The contribution to market portfolio returns, $(\beta^L_{High} - \beta^L_{Low}) \times \lambda_{Liqrisk}$, is also expressed as an annual percentage (multiplied by 12) after it is adjusted for these three global factors. The negative sign means that the market portfolio return in the row is lower than the market portfolio return in the column. The sample period is from January 1989 to June 2005. Significant t-statistics at the 10% level are in bold.

Table 9
The contribution of the alternative global liquidity risk premium to market portfolio returns based on Amihud's (2002) measure.

	America		Europe														Asia Pacific				
	US	CN	OE	BG	DK	FN	FR	BD	IR	IT	NL	NW	ES	SD	SW	UK	AU	HK	JP	NZ	SG
US	–	0.7	6.5	**9.3**	−1.0	6.9	−5.8	0.9	2.6	6.1	6.0	4.3	−4.0	−0.6	6.3	5.0	−2.7	1.0	**14.6**	1.2	**7.5**
		(0.20)	(1.34)	(**1.98**)	(0.21)	(1.03)	(0.98)	(0.18)	(0.67)	(1.25)	(1.59)	(0.90)	(0.88)	(0.10)	(1.96)	(1.30)	(0.69)	(0.33)	(**3.05**)	(0.27)	(**1.73**)
CN		–	2.5	1.3	1.8	2.9	0.6	2.5	−1.4	2.1	2.0	0.3	−2.1	−4.6	2.3	1.0	−**7.2**	−5.3	**10.6**	−2.8	3.5
			(0.54)	(0.35)	(0.46)	(0.44)	(0.16)	(0.71)	(0.30)	(0.45)	(0.58)	(0.06)	(0.55)	(0.80)	(0.81)	(0.29)	(**1.95**)	(0.97)	(**2.33**)	(0.64)	(0.86)
OE			–	−1.3	−0.7	0.4	−1.9	0.0	−3.9	−0.4	−0.5	−2.2	−4.6	−7.1	−0.2	1.5	−**9.7**	−7.9	8.1	−5.3	1.0
				(0.26)	(0.14)	(0.05)	(0.40)	(0.00)	(0.81)	(0.07)	(0.11)	(0.40)	(0.91)	(1.07)	(0.05)	(0.31)	(**1.97**)	(1.22)	(1.46)	(0.97)	(0.19)
BG				–	0.6	1.6	−0.7	1.3	−2.7	0.9	0.7	−1.0	−3.4	−5.8	1.0	−0.22	−**8.5**	−6.6	**9.3**	−4.0	2.2
					(0.13)	(0.24)	(0.18)	(0.33)	(0.69)	(0.18)	(0.20)	(0.21)	(0.82)	(0.98)	(0.33)	(0.06)	(**2.13**)	(1.15)	(**1.98**)	(0.88)	(0.52)
DK					–	1.1	−1.2	0.7	−3.2	0.3	0.2	−1.5	−3.9	−6.4	0.5	−0.8	−**9.0**	−7.2	**8.8**	−4.6	1.7
						(0.15)	(0.29)	(0.17)	(0.76)	(0.06)	(0.05)	(0.31)	(0.88)	(1.03)	(0.13)	(0.19)	(**2.08**)	(1.20)	(**1.75**)	(0.94)	(0.36)
FN						–	−2.3	−0.4	−4.3	−0.8	−0.9	−2.6	−5.0	−7.5	−0.6	−1.8	−10.1	−8.2	7.7	−5.6	0.6
							(0.34)	(0.05)	(0.64)	(0.10)	(0.13)	(0.36)	(0.73)	(0.92)	(0.09)	(0.28)	(1.49)	(1.04)	(1.07)	(0.79)	(0.09)
FR							–	1.9	−2.0	1.5	1.4	−0.3	−2.7	−5.2	1.7	0.4	−**7.8**	−5.9	**10.0**	−3.4	2.9
								(0.51)	(0.52)	(0.32)	(0.38)	(0.06)	(0.65)	(0.87)	(0.54)	(0.12)	(**1.96**)	(1.04)	(**2.12**)	(0.74)	(0.68)
BD								–	−**9.3**	−0.4	−0.5	−2.2	−4.6	−7.1	−7.5	−1.5	−**9.7**	−7.8	**8.1**	−4.2	1.0
									(**1.87**)	(0.08)	(0.14)	(0.48)	(1.12)	(1.20)	(1.16)	(0.39)	(**2.45**)	(1.38)	(**1.73**)	(0.83)	(0.23)
IR									–	3.5	3.4	1.7	−0.7	−3.2	3.7	2.4	−5.8	−3.9	**12.0**	−1.4	4.9
										(0.72)	(0.90)	(0.36)	(0.17)	(0.53)	(1.16)	(0.63)	(1.46)	(0.69)	(**2.51**)	(0.30)	(1.14)
IT										–	−0.1	−1.8	−4.2	−6.7	0.2	−1.1	−9.3	−7.5	8.5	−4.9	1.4
											(0.02)	(0.33)	(0.83)	(1.01)	(0.04)	(0.22)	(1.87)	(1.16)	(1.52)	(0.89)	(0.26)
NL											–	−1.7	−4.1	−6.6	0.3	−1.0	−**9.2**	−7.4	**8.6**	−4.8	1.5
												(0.37)	(1.01)	(1.12)	(0.09)	(0.26)	(**2.36**)	(1.29)	(**1.85**)	(1.06)	(0.35)
NW												–	−2.4	−4.9	2.0	0.7	−7.5	−5.6	**10.3**	−3.1	3.2
													(0.48)	(0.74)	(0.48)	(0.16)	(1.55)	(0.89)	(**1.88**)	(0.57)	(0.63)
ES													–	−2.5	4.4	3.2	−5.1	−3.2	**12.7**	−0.6	5.6
														(0.40)	(1.25)	(0.76)	(1.19)	(0.55)	(**2.54**)	(0.13)	(1.23)
SD														–	6.9	5.6	−2.6	−0.8	**15.5**	1.8	8.1
															(1.24)	(0.94)	(0.44)	(0.11)	(**2.30**)	(0.28)	(1.29)
SW															–	−1.3	−**9.5**	87.6	**8.3**	85.1	1.2
																(0.40)	(**2.84**)	(1.44)	(**1.99**)	(1.26)	(0.33)
UK																–	−**8.2**	−6.4	**9.5**	−3.8	2.5
																	(**2.06**)	(1.11)	(**2.03**)	(0.83)	(0.57)
AU																	–	1.9	**17.8**	4.4	**10.7**
																		(0.32)	(**3.61**)	(0.95)	(**2.41**)
HK																		–	**15.9**	2.6	8.9
																			(**2.47**)	(0.42)	(1.46)
JP																			–	−**13.3**	−7.1
																				(**2.49**)	(1.40)
NZ																				–	6.3
																					(1.26)

This table reports the pricing premium ($\lambda^{A}_{Liqrisk}$) for the alternative global liquidity risk measure ($L^{A}_{m,t}$) based on Amihud's (2002) measure and its contribution to market portfolio returns, calculated using GMM, among the developed countries. $L^{A}_{m,t}$ is the global unexpected illiquidity ($\eta_{m,t}$) multiplied by (−1/100), where $\eta_{m,t}$ is estimated from the regression: $MILLIQ_{m,t} = \alpha_m + \phi_m MILLIQ_{m,t-1} + \eta_{m,t}$, where $MILLIQ_{m,t}$ is Amihud's (2002) global illiquidity measure defined as $MILLIQ_{m,t} = \frac{1}{N_t}\sum_{i=1}^{N_t} ILLIQ_{i,t}$. $ILLIQ_{i,t}$ is Amihud's market illiquidity measure in market i and is defined as $ILLIQ_{i,t} = \frac{1}{D_t}\sum_{d=1}^{D_t} |r_{i,d,t}|/(v_{i,d,t}/N_{i,t})$, where $r_{i,d,t}$ is the daily market return on day d in market i in month t, $v_{i,d,t}$ is the daily dollar trading volume on day d in market i in month t, and $N_{i,t}$ is the total number of stocks traded on market i in month t. The alternative global liquidity risk premium ($\lambda^{A}_{Liqrisk}$) is annually 12.57 with a t-statistic of 2.42 which are estimated from the GMM regression based on country market portfolios: $R_{i,t} = \beta^0_i + \beta^L_i L^A_{m,t} + \beta^m_i MKTX_t + \beta^h_i HML_t + \beta^s_i SMB_t + \varepsilon_{i,t}$. $MKTX$, HML, and SMB are the global market, value and size factors. The contribution of the alternative premium to market portfolio returns, $(\beta^L_{High} - \beta^L_{Low}) \times \lambda^{A}_{Liqrisk}$, is also expressed as an annual percentage (multiplied by 12) after it is adjusted for these three global factors. The sample period is from January 1989 to June 2005. Significant t-statistics at the 10% level are in bold.

market portfolio of 14.6% annually (t-statistic = 3.05) and against the Singaporean market portfolio of 7.5% annually (t-statistic 1.73). It also contributes to the 10.6% (t-statistic = 2.33) annual outperformance of the Canadian market against the Japanese market, and to the 7.2% (t-statistic = 1.95) annual outperformance of the Australian market against the Canadian market. Across the European and Asia Pacific economic regions, this global liquidity risk premium also significantly contributes to the performance difference between nineteen pairs of market portfolios: Australia and Austria, Australia and Belgium, Belgium and Japan, Australia and Denmark, Denmark and Japan, Australia and France, France and Japan, Australia and Germany, Germany and Japan, Ireland and Japan, Australia and the Netherlands, the Netherlands and Japan, Norway and Japan, Spain and Japan, Sweden and Japan, Australia and Switzerland, Switzerland and Japan, Australia and the UK, and the UK and Japan. In particular, this premium contributes to the difference in the annualized market portfolio return of 12.7% (t-statistic = 2.54) between Spain's market portfolio and Japan's market portfolio. This premium also contributes to a zero-cost hedge portfolio that longs Sweden's market portfolio and shorts Japan's market portfolio, delivering an annualized return of 15.5% (t-statistic = 2.30). In addition, the contribution of this premium to a zero-cost hedge portfolio that longs Australia's market portfolio and shorts Belgium's market portfolio or Germany's market portfolio leads to the annual performance of 8.5% (t-statistic = 2.13) and 9.7% (t-statistic = 2.45), respectively (see Table 9)

Within the Asia Pacific economic region, the contribution of this premium to a zero-cost hedge portfolio that longs Australia's market portfolio and shorts Japan's market portfolio is an annualized return of 17.8% with a t-statistic of 3.61. This premium contributes to the outperformance of Australia's market portfolio return of 10.7% annually with a t-statistic of 2.41 relative to Singapore's market portfolio return. It also contributes to New Zealand's market portfolio outperforming Japan's market portfolio by 13.3% with a t-value of 2.49. With the contribution from this pricing premium, Hong Kong's market portfolio also outperforms Japan's market portfolio by 15.9% with a t-statistic of 2.47. Within the European economic region, this global liquidity risk premium contributes to the difference in market portfolio return between Germany and Ireland of 9.3% annually with a t-statistic of 1.87 at the 10% level.

We can infer from our results that the global liquidity risk based on Pástor and Stambaugh's (2003) measure plays a more prominent role within the European economic region and across the European, North American and Asia Pacific economic regions. The global liquidity risk based on Amihud's (2002) measure plays a more prominent role within the Asian Pacific economic region and across the Asia Pacific, North American and European economic regions. Overall, the global liquidity risk is an important global systematic risk factor for all developed market portfolios. It also significantly contributes to the return differences between markets within and across economic regions around the world.

7. Conclusion

We find that local liquidity risk is a systematic pricing factor for stocks in most developed markets, including the US market, after controlling for the local market, value and size factors. We use two measures of market-wide liquidity to determine liquidity risk in conducting our comprehensive and robust study. We discover that the expected returns of stocks systematically reflect these two measures of local liquidity risk to different extents although they are commonly priced in stocks in France, Ireland, and Japan. In particular, local liquidity risk based on Pástor and Stambaugh's (2003) measure is positively priced in Australia, France, Hong Kong, Ireland, Japan, and Norway. Local liquidity risk based on Amihud's (2002) measure is positively priced in Canada, Denmark, Finland, France, Germany, Ireland, Japan, New Zealand, Sweden, and the US.

We also find that the pricing premium for local liquidity risk is lower in markets where corporate boards at the country level are more effective and where there are less insider trading activities. These findings help explain how market-wide liquidity is related to corporate governance and local market regulations. They also provide us with an overall understanding of why local liquidity risk is priced differently across developed markets around the world. Our study focuses on the pricing of liquidity risk. We rely on future studies to investigate other underlying economic forces that drive this phenomenon.

At the global level, global liquidity risk is a systematic pricing factor across all developed market portfolios that are locally diversified after controlling for the global market, value, and size factors. The liquidity risk premium significantly contributes to differences in expected returns between market portfolios within and across economic regions. Our results are robust as our two measures of global liquidity risk produce similar results. These global liquidity measures are the simple averages of liquidity or illiquidity across all developed countries' markets. Our findings suggest that there is a liquidity spillover effect across open markets.

Our study provides evidence that investors do in fact demand a pricing premium for bearing market-wide liquidity risk at both the local and global levels. International investors expect high returns from stocks (market portfolios) that are sensitive to local (global) liquidity risk. They should be aware of liquidity risk from around the world even when they invest in country market portfolios that are locally diversified.

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Appendix A

A.1. Pástor and Stambaugh's measure of global market liquidity

We state the mathematical approximation of the country liquidity of Pastor and Stambaugh's (2003) measure as follows:

$$\gamma_{i,t} = \frac{\partial r^{e}_{i,d+1,t}}{\partial(sign(r^{e}_{i,d,t}) \times \sum_{j=1}^{M_i} v^{j}_{i,d,t})} = \sum_{j=1}^{M_i} w^{j}_{i} \frac{\partial r^{j,e}_{i,d+1,t}}{\partial\left(sign(r^{e}_{i,d,t}) \times v^{j}_{i,d,t}\right)} \approx \gamma'_{i,t}$$

$$= \frac{1}{M_i}\sum_{j=1}^{M_i}\gamma^{j}_{i,t} = \frac{1}{M_i}\sum_{j=1}^{M_i}\frac{\partial r^{j,e}_{i,d+1,t}}{\partial\left(sign(r^{j,e}_{i,d,t}) \times v^{j}_{i,d,t}\right)},$$

where $r^{e}_{i,d+1,t} = \sum_{j=1}^{M_i}(w^{j}_{i} r^{j,e}_{i,d+1,t})$ is the value-weighted return of market i; $r^{j,e}_{i,d+1,t}$ is the return of stock j in market i over and above the global market return $r_{m,d,t}$; $w^{j}_{i} = MV^{j}_{i}/(\sum_{j=1}^{M_i} MV^{j}_{i})$ is the weight of stock j in market i which has M_i stocks; MV_i^j is the market value of stock j in market i; $\upsilon_{i,d,t}^j$ is the dollar trading volume of stock j in market i and the dollar trading volume of market i, $\upsilon_{i,d,t} = \sum_{j=1}^{M_i} \upsilon_{i,d,t}^j$; and the sign of country market portfolio i, $sign(r_{i,t}^e) = \sum_{j=1}^{M_i} w_i^j sign(r_{i,t}^{j,e})$,is the value-weighted sign of stock j in market i. In terms of capturing the country liquidity, $\gamma_{i,t}$ should be better than $\gamma_{i,t}'$ constructed from individual stocks because it reflects the outperformance of the market portfolio return against the global market return instead of the sign of individual stock j.

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