How is Liquidity Priced in Global Markets?[*]

Ines Chaieb
University of Geneva and Swiss Finance Institute

Vihang Errunza
McGill University

Hugues Langlois
HEC Paris

Abstract

We develop a new global asset pricing model to study how illiquidity interacts with market segmentation and investability constraints in 42 markets. Non-investable stocks that can only be held by foreign investors earn higher expected returns compared to freely investable stocks due to limited risk sharing and higher illiquidity. In addition to world market premium, on average, developed and emerging market non-investables earn annual unspanned local market risk premium of 1.17% and 9.04% and liquidity level premium of 1.06% and 2.39% , respectively. These results are robust across developed and emerging markets as well as to the choice of liquidity measure.

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It has long been acknowledged in the financial economics literature that both liquidity level and liquidity risk matter for asset pricing, within and across financial markets. ~~A debate~~ Debate remains as to the measurement, whether premiums for either are significant, and whether either interacts with other related frictions to price formation.

We enter this debate by first developing and then estimating an international asset pricing model (IAPM) that takes into account cross-border investability constraints as well as random transaction costs.[1] Formally modeling a realistic market structure is important to uncover the channels through which liquidity is priced in a global context and to quantify the role of liquidity level and liquidity risk premiums in the presence of investability constraints. Our empirical validation shows that across different liquidity measures, a partially segmented market delivers a significant liquidity ~~(level) cost~~ level premium but ~~an~~ insignificant global and local liquidity risk premiums. The empirical set up applies to many global markets characterized by explicit or implicit barriers to portfolio flows.[2]

In our model, domestic (for example, the U.S.) and foreign (for example, an emerging market EM) stocks are subject to random transaction costs and some foreign assets are non-investable in that only foreign investors can hold positions in them.[3] At equilibrium, the investable securities, that can be held by all investors, command a liquidity level premium and global market and liquidity risk premiums. The market risk and liquidity shocks are aggregated at the world level and the prices of global market and liquidity risks are the same. Except for Jensen's inequality term, our pricing equation for investables is an extension of Acharya and Pedersen (2005) (hereafter, AP) to an international setup.

Non-investable securities command, in addition, a risk premium for the unspanned local market and local liquidity risks. Both the local market risk and local liquidity risk are conditional on returns on the substitute assets net of liquidity costs. Substitute assets consist of all assets that can be freely traded by all investors, including ~~such as~~ cross-listings, mutual funds, and Exchange Traded Funds (ETFs). The unspanned local risk is a residual risk that stems from imperfect spanning of

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[1] Most of the asset pricing models under cross-border investment restrictions do not take into account liquidity concerns, see for example, Stulz (1981), Errunza and Losq (1985), Eun and Janakiramanan (1986), de Jong and Roon (2005), and Chaieb and Errunza (2007).

[2] Explicit barriers include legal restrictions on ownership, foreign exchange transactions, repatriation of profits, whereas implicit barriers encompass institutional, informational, governance, and market development variables.

[3] Liquidity could be endogenously determined by other implicit barriers such as asymmetric information (see Johnson, 2006; Huang and Wang, 2009, among others).

the returns on the non-investable segment of the foreign market by returns on substitute assets. The prices of unspanned local market and local liquidity risks are the same.

~~We take a different approach. Our formal asset pricing model delivers a significant world market and unspanned local market risk premium, a large significant liquidity level premium, and a small insignificant liquidity risk premium in a conditional setup. These results are robust across developed markets (DMs) and emerging markets (EMs) as well as to the choice of the liquidity measure.~~ Our empirical tests show that non-investables are more illiquid than investables and that their liquidity level is priced. When unspanned local risk is priced, it is triggered by market risk rather than liquidity risk. Substitute assets allow partial spanning of local market risk, but there remain a significant liquidity level premium and unspanned local market risk premium that drive a wedge between pricing of investables and non-investables. Specifically, non-investables earn higher expected returns than investables because of two effects. First, as in EL, local market risk that cannot be spanned by ~~investables~~ substitute assets entails a risk premium due to limited risk sharing. Second, non-investables are more illiquid than investables and their liquidity level is priced. These results are robust across developed markets (DMs), and emerging markets (EMs) as well as to the choice of the liquidity measure. On average, DM and EM non-investables earn a premium of 2.23% and 11.43%, respectively, in addition to the world market premium. This premium is attributed to an unspanned local market risk premium of 1.17% and 9.04% and ~~an~~ a liquidity level premium of 1.06% and 2.39%, respectively. Hence, liquidity level plays an important role for pricing segmented assets and a source of extra return in addition to the unspanned local market risk premium. These results are new and important for further understanding sources of segmentation and how liquidity is priced in a global context.

Our empirical tests are organized as follows. First, we empirically test the liquidity-adjusted IAPM on a broad cross-section of DMs and EMs. Second, we measure the contributions of the liquidity level premium and the global and local systematic liquidity risk premiums on ~~to~~ expected returns. Third, we investigate using panel regressions the determinants of the variation across countries and over time of the liquidity level premium and the unspanned local market risk premium.

To test our asset pricing model, we need criteria to categorize stocks into investables and non-investables, a measure of liquidity costs, and a methodology to form diversification portfolios that are the most highly correlated with non-investables.

NEW PARAGRAPH We follow Karolyi and Wu (2018) and use cross-listings to characterize investable stocks. We also use country-specific filters detailed in Section 3. As a sanity check, we measure the proportion of stocks held by domestic and foreign investors. As expected, we find that foreign holdings are higher for investables than for non-investables whereas the differences in domestic holdings are negligible.

In the theoretical set up, the exogenous liquidity cost of a security is modeled as the per trade cost. The liquidity cost could then be measured with a percent-cost type of measure. Alternatively, we could use the Amihud (2002) absolute return to dollar volume ratio, which is related to measures of price impact and fixed trading costs, or the incidence of zero returns of Lesmond, Ogden, and Trzcinka (1999), which could proxy for search costs. See Fong, Holden, and Trzcinka (2017) (hereafter, FHT) for a recent review of the different liquidity proxies used in international studies. As we require a measure of the cost of trade to test our asset pricing model, we need to scale these two proxies as in, for example, AP. The paucity of effective bid-ask spread data for our sample of countries limits such computation.[4]

In their comparative analysis of different liquidity proxies used in international studies, FHT show that the closing-percent quoted spread is the best percent-cost proxy when available, followed by their FHT measure and the Corwin and Schultz (2012) (hereafter, CS) High-Low measure. Since the closing-percent quoted spread is not sufficiently available for our sample of countries, we use the FHT measure, which is an increasing function of the return volatility and of the proportion of zero returns. Because liquidity is positively correlated with market volatility, we run robustness checks with the FHT measure orthogonalized on volatility. We also use CS and Abdi and Ranaldo (2017) (hereafter, AR) as alternative measures for robustness tests. CS and AR use the low, close, and high prices over two consecutive days to construct a measure that disentangles the bid-ask spread from daily volatility. Across all liquidity measures, we find that non-investable stocks are more illiquid and have on average an expected bid-ask spread higher by a range of 0.1% to 0.3% compared to investable stocks. ~~Therefore, a firm's increased investability through cross-listing is associated with lower bid-ask spread relative to firms that do not cross-list.~~ ***Removed also the footnote***

We estimate a diversification portfolio (DP) for each country. Held long by the domestic investor to gain exposure to the foreign market, the DP dynamically replicates the set of non-investable

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[4] See Bekaert, Harvey, and Lundblad (2007) ~~BHL~~ for a detailed discussion of trading costs data issues in EMs.

stocks using substitute assets. We develop a novel and flexible empirical methodology that allows us to examine how the pricing relation changes over time as the set of substitute assets used to span the ~~local~~ foreign market risk evolves. Our methodology has two important features. First, the DP weights are time-varying and computed from the conditional covariance matrices. The conditional covariance dynamics are the same as those used in the tests of the IAPM, and hence the construction of the DPs is consistent with the asset pricing framework. Second, our methodology can account for the variation over time in the set of substitute assets as cross-listings (direct listings, ADRs, and GDRs), Country Funds (mutual funds and investment trusts), and ETFs are issued or delisted.[5]

To estimate the conditional covariance matrices, we proceed in two steps. In the first step, we fit an AR-NGARCH on net-of-transaction-cost returns for non-investable securities and all substitute assets to estimate time-varying variances. In the second step, we estimate a dynamic normal copula by using all available assets at each point in time as in Christoffersen, Jacobs, Jin, and Langlois (2018). We then use the dynamic variances from the first step estimations and correlations from the second step estimation to compute the DP weights.

Next, we test the asset pricing implications of our liquidity-adjusted IAPM using weekly returns on 22 DMs and 20 EMs in a conditional setup with time-varying market and liquidity risk. Our key empirical findings can be summarized as follows.

First, liquidity level is significantly priced in about half of the DMs and EMs, averages 1.06% and 2.39% per year for DM and EM non-investables, respectively, and spikes during crises. In contrast, the liquidity level premium is not significant for investable stocks in open markets. Hence, the liquidity level premium has a significant positive effect on expected returns for non-investable stocks. On average across EMs, the unspanned local market risk premium is at 9.04% per year and spikes during market turmoil. However, the unspanned local market risk premium is smaller at 1.17% for DMs and spikes only during the 2008 global financial crisis.

Second, we conduct the Vuong (1989) test for non-nested models to see whether the model with liquidity risk estimated using net returns has a significantly better fit than a model with no liquidity risk estimated using gross returns. We do not find any evidence that liquidity risk, whether global

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[5] To estimate DP weights, the past literature has used stepwise regressions with forward and backward threshold criteria that preserve assets with the most significant coefficients. In these regressions, some asset returns are interacted with dummy variables equal to one when new cross-listings become available, and hence their coefficients allow for a limited amount of time-variations in the weights (see, for example, Carrieri, Errunza, and Hogan, 2007).

or local, significantly improves model fit for markets in our sample. Hence the evidence on the pricing of world risk and unspanned local risk stems from market risk rather than liquidity risk.

Third, we use alternative bid-ask spread proxies as robustness checks to ascertain that our results are not an artifact of the liquidity measure. These tests confirm that the liquidity cost is significantly positively priced for non-investables, liquidity risk does not matter, and unspanned local market risk is significantly priced for many EMs and a few DMs. Nevertheless, the size of the liquidity level premium and its contribution to the expected excess returns are sensitive to the liquidity measure. Additional robustness checks on investability provide further support to our main findings.

We then study the economic drivers of the unspanned local market risk premium and the liquidity level premium ~~these two components~~ . We examine the link with country-level measures of political risk, investor protection, information quality, corporate transparency, institutional foreign holdings, the role of investment advisors, short-selling regulation, other differences in exchange trading rules, and local and global market conditions. We examine these effects with panel data that vary across countries and over time. We find that higher information quality and transparency and investor sentiment are related to both lower liquidity level premium and unspanned local market risk premium. Further, foreign institutional ownership holdings, rules allowing short selling and prohibiting insider exchange trading, and loose global or local funding conditions are associated with lower liquidity level premiums, whereas better local market conditions are related to lower unspanned local market risk premium.

Our work ~~paper~~ extends the well-established theoretical asset pricing literature regarding the importance of liquidity for the U.S., and other integrated developed markets (see, for example, Amihud and Mendelson, 1986; Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005) and the significance of partial segmentation for emerging markets (see, for example, Stulz, 1981; Errunza and Losq, 1985; Eun and Janakiramanan, 1986). Specifically, our model nests the AP model in the absence of investability constraints, the Errunza and Losq (1985) (hereafter, EL) model in the absence of liquidity costs and the Grauer, Litzenberger, and Stehle (1976) perfect world market model in the absence of both the investability constraints and liquidity.

Our work also adds to the vast U.S. empirical literature on the relation between average ~~U.S.~~ stock returns and liquidity (see, for example, Brennan, Chordia, and Subrahmanyam, 1998), commonality in liquidity (Chordia, Roll, and Subrahmanyam, 2000; Hasbrouck and Seppi, 2001; Huberman and Halka, 2001; Koch, Ruenzi, and Starks, 2016), and liquidity level and risk pricing (Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005; Sadka, 2006; Korajczyk and Sadka, 2008; Kim and Lee, 2014). Given the diverse and at times conflicting evidence, some recent studies replicate and extend the findings of the seminal papers of Amihud (2002), Pastor and Stambaugh (2003), and Acharya and Pedersen (2005). See, for example, Drienko, Smith, and von Reibnitz (2019), Harris and Amato (2019), Amihud (2019), Pontiff and Singla (2019), Li, Novy-Marx, and Velikov (2019), Ben-Rephael, Kadan, and Wohl (2015), and Holden and Nam (2019). Although one can surmise the importance of liquidity measurement and model specification, there is evidence that the contribution of liquidity level is robust whereas the contribution of liquidity risk has declined over time.

Several empirical papers also investigate liquidity effects in international markets (see, for example, Domowitz, Glen, and Madhavan, 2001; Lesmond, 2005; Bekaert et al., 2007; Lee, 2011; Liang and Wei, 2012; Goyenko and Sarkissian, 2014; Karolyi, Lee, and van Dijk, 2012; Amihud, Hameed, Kang, and Zhang, 2015). Specifically, work by Bekaert et al. (2007) (hereafter, BHL), Lee (2011), and Amihud et al. (2015) are closely related to our own. BHL derive stylized pricing equations under market integration and segmentation. They also test a mixed model which combines the two polar cases of perfect integration and segmentation to allow for both global and local risk sources. In their model, in addition to the world market risk factor, liquidity is a second risk factor that affects the world pricing kernel and hence triggers its own price of liquidity risk. BHL find that for their sample of 19 EMs, only local liquidity risk is priced but liquidity level, global liquidity risk and market risk are not priced. Lee (2011) adopts an unconditional econometric specification to study the pricing of liquidity risk. He finds that liquidity risk is globally priced in developed markets and locally priced in emerging markets. Amihud et al. (2015) present evidence on the liquidity level premium worldwide, using a return factor constructed as the differential return on illiquid-minus-liquid stock portfolios for each country. They find that the average liquidity return premium across countries is positive and significant. However, they examine the pricing of the liquidity level but not liquidity risk. As with the U.S. studies, these papers use different liquidity measures and model specifications and deliver different results.

We take a different approach. In particular, the novelty of our work is that the joint effect of illiquidity and partial segmentation and their interaction are analytically determined as part of our theoretical model. Our empirical validation shows that across different liquidity measures, the higher expected return on non-investable stocks stems from unspanned local market risk premium due to limited risk sharing and their higher and priced illiquidity level. These two components play an important role for segmented securities and are sources of extra return for non-investable portfolios.

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The paper is organized as follows. Section 1 models the effect of liquidity on expected returns in partially segmented markets. Section 2 outlines the empirical methodology. Section 3 presents data and summary statistics. Section 4 reports the results of our liquidity-adjusted IAPM, examines the statistical and economic significance of the liquidity level and risk premiums, and presents robustness checks of our main findings using alternate liquidity proxies and specifications of the non-investable set. Section 5 presents results on the economic sources of the liquidity level premium and of the unspanned local market risk premium. Section 6 concludes. A separate appendix available online reports additional statistics, diagnostics, and robustness checks.

1. The Asset Pricing Model

We postulate a two-country global capital market: the domestic country D and the foreign country F. We label all securities that can be freely traded by all investors as investable and those that can be held by only foreign investors as non-investable. We can view the domestic market as a well-developed market (such as the United States) that is open to all investors and the foreign market as an EM where foreign participation is limited due to explicit and implicit barriers. In this setting, domestic (U.S.) investors can hold domestic securities and the investable segment of the foreign market, whereas foreign (EM) investors can freely trade in the domestic and the foreign market. This characterization of the global market is fairly realistic. Of course, a market structure, in which both countries face some segmentation, is more attractive. However, our simplification makes understanding the forces at work easier without much loss of generality.[6]

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[6] As shown by Chaieb and Errunza (2007), the results carry through to the more general market structure with the addition of another premium at equilibrium. Appendix A presents the liquidity adjusted IAPM when each market features investable and non-investable stocks.

1.1 Assumptions and notations

We use the subscript i and n as a generic index to represent the investable and non-investable securities, respectively, bold letters to denote vectors, and capital letters to denote matrices or portfolio level variables.

- **A1: Market Structure.** There are N risky assets partitioned as follows: The first N_I securities are investable securities and the last N_N assets are non-investable securities. The vector of log-returns can be partitioned as $\boldsymbol{r}_t \equiv \begin{pmatrix} \boldsymbol{r}_{i,t} \\ \boldsymbol{r}_{n,t} \end{pmatrix}$. The vector of market values at time t, $\mathbf{M}_t$, is similarly partitioned as $\mathbf{M}_t \equiv \begin{pmatrix} \mathbf{M}_{i,t} \\ \mathbf{M}_{n,t} \end{pmatrix}$. $M_{N,t}$ is the market capitalization of non-investables at time t defined as $M_{N,t} = \sum_{n=1}^{N_N} M_{n,t}$. Agents can also borrow and lend at the domestic risk-free log-rate of return r_f, which is exogenous.

- **A2: Agents.** Every period, the economy has two agents with CRRA preferences. The first agent is domestic and is restricted to investing only in investable securities. The second agent is foreign and can invest in both non-investable and investable securities. Agents live for one period, invest at time t, and consume at $t+1$. Hence both investors have the same one-period trading horizon and holding period, i.e., the trading frequency and holding period are set exogenously. This is a strong assumption. Allowing for endogenous trading frequency will result in less trading for illiquid assets. Constantinides (1986) shows that transaction costs might then have second-order effects on liquidity premiums.[7]

- **A3: Transaction costs.** Transaction costs denoted by the N-by-1 vector C_t are random and include bid-ask spread as well as search costs. They are modeled as the proportional cost of buying and selling an investable or non-investable security j. Short-selling is allowed. Both long and short holders pay transaction costs. As in AP, the one-period investors investing at t pay transaction costs proportional to the current price when closing the position at time $t+1$. The net log-returns of the agents can then be written as $r_{j,t+1}^{net} = r_{j,t+1} - c_{j,t+1}$ for

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[7] Beber, Driessen, Neuberger, and Tuijp (Forthcoming) derive asset pricing implications for investors with heterogeneous investment horizons as in Amihud and Mendelson (1986) and in the presence of random transaction costs. Depending on the covariance matrix of the returns and the level of transaction costs, their model could result in endogenous segmentation which may substantially reduce the liquidity risk premium.

the investors who are long in asset j and as $r_{j,t+1}^{net} = -r_{j,t+1} - c_{j,t+1}$ for investors who are short in asset j, where $c_{j,t+1} = -ln\left(1 - C_{j,t+1}\right)$ (see Bongaerts, Jong, and Driessen, 2011, for a similar assumption). We assume that the vector of net log-returns $\boldsymbol{r}_t^{net}$ is normally distributed and denote Σ_t as its N-by-N conditional variance-covariance matrix which can be partitioned as $\Sigma_t \equiv \begin{pmatrix} \Sigma_{ii,t} & \Sigma_{in,t} \\ \Sigma_{in,t}^{\top} & \Sigma_{nn,t} \end{pmatrix}$, where $\Sigma_{ii,t}$ is the variance-covariance matrix of the investable assets, $\Sigma_{nn,t}$ is the variance-covariance matrix of the non-investable securities, and $\Sigma_{in,t}$ is the covariance matrix between investable and non-investable securities.

- **A4:** The returns are measured in domestic currency, the reference currency. We follow the asset pricing literature on barriers to cross-border investments and assume that the purchasing power parity holds (see, for example, Stulz, 1981).

1.2 Asset demands

The domestic investor d can invest in the riskless bond and the N_I investable risky assets. Let the vector $\boldsymbol{\omega}_{d,t}$ denote the fraction of his wealth invested in the risky assets at time t and γ^d his coefficient of relative risk aversion. Investor d maximizes at time t the utility of his terminal wealth W_{t+1}^d, that is,

$$\max_{\boldsymbol{\omega}_{d,t}} E_t\left[\left(\frac{W_{t+1}^d}{1-\gamma^d}\right)^{1-\gamma^d}\right]$$

subject to the budget constraint $W_{t+1}^d = \left(1 + R_{P,t+1}^d\right) W_t^d$ where $R_{P,t+1}^d = \boldsymbol{\omega}_{d,t}^{\top}\left(e^{\boldsymbol{r}_{i,t+1}^{net}} - e^{r_f}\boldsymbol{\iota}_{N_I}\right) + e^{r_f}$ is the simple net return on the portfolio of investor d and $\boldsymbol{\iota}_{N_I}$ is an $(N_I \times 1)$ vector of ones. Assuming the portfolio return is log-normal and using the Campbell and Viceira (2002) discrete-time approximation to relate asset log-returns to portfolio log-returns[8], the optimization can be restated as,

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[8] Campbell and Viceira (2002) use a second-order Taylor approximation of the non-linear function relating log asset returns to log portfolio returns. In the limit of continuous time, the approximation is exact and can be derived using Ito's Lemma. If portfolio returns are not log-normal, the CRRA investor should also price skewness and kurtosis in returns. Modeling the higher order moments in addition to time-varying liquidity risk and market segmentation will result in additional risk premiums and render empirical estimation quite complex. In the empirical tests, we partially address non-normality by using the Student-t distribution to capture the high kurtosis present in the weekly log-returns.

$$\max_{\boldsymbol{\omega}_{d,t}} \boldsymbol{\omega}_{d,t}^{\top} E_t \left[\boldsymbol{r}_{i,t+1} - \boldsymbol{c}_{i,t+1} - r_f \boldsymbol{\iota}_{N_I} + \frac{1}{2} \boldsymbol{\sigma}_{i,t+1}^2 \right] - \frac{1}{2} \gamma^d \boldsymbol{\omega}_{d,t}^{\top} \Sigma_{ii,t+1} \boldsymbol{\omega}_{d,t}$$

where $\boldsymbol{\sigma}_{i,t+1}^2$ is the vector containing the variance of investable asset net log-returns, i.e., the diagonal elements of $\Sigma_{ii,t+1}$. From first order conditions, the solution for the vector of optimal portfolio weights is,

$$\boldsymbol{\omega}_{d,t} = \frac{1}{\gamma^d} \Sigma_{ii,t+1}^{-1} E_t \left[\boldsymbol{r}_{i,t+1} - \boldsymbol{c}_{i,t+1} - r_f \boldsymbol{\iota}_{N_I} + \frac{1}{2} \boldsymbol{\sigma}_{i,t+1}^2 \right].$$

A foreign investor f can invest in the riskless bond, the domestic securities, and the foreign securities. Given his investment opportunity set, he solves a similar optimization problem as the domestic investor. The vector $\boldsymbol{\omega}_{f,t}$ of optimal portfolio weights for the foreign investor can be written as,

$$\boldsymbol{\omega}_{f,t} = \frac{1}{\gamma^f} \Sigma_{t+1}^{-1} E_t \left[\boldsymbol{r}_{t+1} - \boldsymbol{c}_{t+1} - r_f \boldsymbol{\iota}_{N} + \frac{1}{2} \boldsymbol{\sigma}_{t+1}^2 \right]$$

where $\boldsymbol{\sigma}_{t+1}^2$ is the vector containing the variance of investable and non-investable asset net log-returns (i.e., the diagonal elements of Σ_{t+1}), γ^f is the coefficient of relative risk aversion of the foreign investor, and $\boldsymbol{\iota}_N$ is an $(N \times 1)$ vector of ones.

Using market-clearing conditions and assuming that equities are in net positive supply equal to their market capitalization and the bonds are in zero net supply, we obtain the equilibrium asset pricing relationships.

1.3 Equilibrium risk and return

1.3.1 Investable set The investable securities are priced as if the market is fully integrated. The expected net excess return for an investable security $i \in \{1, ..., N_I\}$ is given by,

$$E_t \left[r_{i,t+1}^{net} - r_f \right] + \frac{1}{2} var_t \left(r_{i,t+1}^{net} \right) = \gamma cov_t \left(r_{i,t+1}^{net}, r_{W,t+1}^{net} \right) \tag{1}$$

where $W \equiv W^d + W^f$ is the aggregate global wealth, the world price of risk $\gamma = W \left(\frac{W^d}{\gamma^d} + \frac{W^f}{\gamma^f} \right)^{-1}$ is equal to the aggregate relative risk aversion coefficient, and $r_{W,t+1}^{net}$ is the net log-return on the world market portfolio. We then express the model in terms of gross returns,

$$\begin{aligned} E_t\left[r_{i,t+1}-r_f\right] &= -\frac{1}{2}var_t\left(r_{i,t+1}^{net}\right)+E_t\left[c_{i,t+1}\right]+\gamma[cov_t\left(r_{i,t+1},r_{W,t+1}\right) \\ &\quad +cov_t\left(c_{i,t+1},c_{W,t+1}\right)-cov_t\left(c_{i,t+1},r_{W,t+1}\right)-cov_t\left(r_{i,t+1},c_{W,t+1}\right)]. \end{aligned} \tag{2}$$

Except for Jensen's inequality term, the asset pricing equation of investable securities is similar to the liquidity-adjusted CAPM of AP but the market risk premium and liquidity risk premiums are aggregated at the world level. Jensen's inequality term, which is equal to one-half the variance of excess net returns, implies that local liquidity variables affect expected returns even under full integration as in BHL. However, the asset pricing equation under full market integration of BHL is not identical to ours as they assume that liquidity is a second risk factor that affects the world pricing kernel in addition to the world market risk factor and hence triggers its own price of liquidity risk.

1.3.2 Non-investable set

For a non-investable security $n \in \{1,...,N_N\}$, the expected net excess return at equilibrium is given by,

$$\begin{aligned} E_t\left[r_{n,t+1}^{net}-r_f\right]+\frac{1}{2}var_t\left(r_{n,t+1}^{net}\right) &= \gamma cov_t\left(r_{n,t+1}^{net},r_{W,t+1}^{net}\right) \\ &\quad +\pi_N cov_t\left(r_{n,t+1}^{net},r_{N,t+1}^{net}\mid \boldsymbol{r}_{i,t+1}^{net}\right) \end{aligned} \tag{3}$$

where $\pi_N=\left(\frac{\gamma^f}{W^f}-\frac{\gamma}{W}\right)M_N$ is the price of unspanned local risk.

We can express the model in terms of gross returns,

$$\begin{aligned} E_t\left[r_{n,t+1}-r_f\right] &= -\frac{1}{2}var_t\left(r_{n,t+1}^{net}\right)+E_t\left[c_{n,t+1}\right]+\gamma[cov_t\left(r_{n,t+1},r_{W,t+1}\right)+cov_t\left(c_{n,t+1},c_{W,t+1}\right) \\ &\quad -cov_t\left(c_{n,t+1},r_{W,t+1}\right)-cov_t\left(r_{n,t+1},c_{W,t+1}\right)] \\ &\quad +\pi_N[cov_t\left(r_{n,t+1},r_{N,t+1}\mid \boldsymbol{r}_{i,t+1}^{net}\right)+cov_t\left(c_{n,t+1},c_{N,t+1}\mid \boldsymbol{r}_{i,t+1}^{net}\right) \\ &\quad -cov_t\left(c_{n,t+1},r_{N,t+1}\mid \boldsymbol{r}_{i,t+1}^{net}\right)-cov_t\left(r_{n,t+1},c_{N,t+1}\mid \boldsymbol{r}_{i,t+1}^{net}\right)]. \end{aligned} \tag{4}$$

The conditional local liquidity risks are

1. $cov_t\left(c_{n,t+1},c_{N,t+1}\mid \boldsymbol{r}_{i,t+1}^{net}\right)$: the conditional commonality in transaction risk between a secu-

rity n and the local non-investable market N;

2. $cov_t\left(c_{n,t+1}, r_{N,t+1} \mid \boldsymbol{r}_{i,t+1}^{net}\right)$: the conditional covariance between a security's transaction cost and the local non-investable market return;

3. $cov_t\left(r_{n,t+1}, c_{N,t+1} \mid \boldsymbol{r}_{i,t+1}^{net}\right)$: the conditional covariance between a security's return and the local non-investable market transaction cost.

As in AP, (1) affects required returns positively because investors want to be compensated for holding securities with higher transaction costs when the local market transaction costs increase; (2) and (3) affect required returns negatively because investors are willing to accept a lower return on an asset with lower transaction costs in a down local market, or an asset with higher return when local market transaction costs are high.

Note that the equilibrium asset pricing model implies that global risk is measured vis-à-vis the world market return (and aggregate world liquidity) as the world market portfolio is the correct portfolio to measure risk sharing.

To gain further insight into the price of unspanned local risk, we write the conditional covariance as,

$$cov_t\left(r_{n,t+1}^{net}, r_{N,t+1}^{net} \mid \boldsymbol{r}_{i,t+1}^{net}\right) = cov_t\left(r_{n,t+1}^{net}, r_{N,t+1}^{net}\right) - cov_t\left(r_{n,t+1}^{net}, r_{DP,t+1}^{net}\right) \tag{5}$$

where $r_{DP,t+1}^{net}$ is the net return on the diversification portfolio DP with weights,

$$\omega_{DP,t} = \Sigma_{ii,t+1}^{-1}\Sigma_{in,t+1}\boldsymbol{M}_{n,t}/M_{N,t},$$

which is the portfolio of investable assets that is most highly correlated with the market portfolio of non-investable securities. The DP portfolio is held long by the domestic investor as the best substitute for the non-investable segment, but short by the foreign investor to reduce his local risk exposure.

If the correlation between returns on the value-weighted market portfolio of non-investable securities and its diversification portfolio, $\rho_{N,DP,t}$, is one, the market is effectively integrated, all of the premiums for unspanned local market and liquidity risk disappear, and only global market and liquidity risks are priced as in AP. Hence perfect spanning would eliminate the local market valuation premium or discount due to local market and liquidity risk but would not eliminate the global premiums or discounts that result from co-variation of the asset return and its transaction cost with the global market return and global transaction costs. Under complete segmentation, only local market and local liquidity risks are priced. Under partial segmentation, both global and local market and liquidity risks are priced.

By aggregating Equation (5) over the set of non-investable securities, we can obtain the conditional expected gross excess return on the local non-investable market portfolio, $r_{N,t+1}$ as,

$$\begin{aligned} E_t\left[r_{N,t+1} - r_f\right] &= -\frac{1}{2} var_t\left(r^{net}_{N,t+1}\right) + E_t\left[c_{N,t+1}\right] + \gamma cov_t\left(r^{net}_{N,t+1}, r^{net}_{W,t+1}\right) \\ &\quad + \pi_N[var_t\left(r^{net}_{N,t+1}\right) - cov_t\left(r^{net}_{N,t+1}, r^{net}_{DP,t+1}\right)]. \end{aligned} \tag{6}$$

Let $II_{N,t}$ be the time-varying integration index of the non-investable segment defined as,

$$II_{N,t} = \frac{cov_t\left(r^{net}_{N,t+1}, r^{net}_{DP,t+1}\right)^2}{var_t\left(r^{net}_{N,t+1}\right) var_t\left(r^{net}_{DP,t+1}\right)}.$$

We can write Equation (6) as,

$$\begin{aligned} E_t\left[r_{N,t+1} - r_f\right] &= -\frac{1}{2} var_t\left(r^{net}_{N,t+1}\right) + E_t\left[c_{N,t+1}\right] + \gamma cov_t\left(r^{net}_{N,t+1}, r^{net}_{W,t+1}\right) \\ &\quad + \pi_N var_t\left(r^{net}_{N,t+1}\right)(1 - II_{N,t}). \end{aligned} \tag{7}$$

This is the fundamental asset pricing equation that we will use in the empirical analysis.

2. Econometric Specification

We describe in this section our empirical methodology. First, we estimate the price of world (market and liquidity) risk and examine the extent of liquidity level and risk pricing for major developed markets that are deemed open to foreign investors. Second, we discuss our new methodology to construct the diversification portfolios for each country. Third, we impose the world risk price estimate in the country estimations and test whether liquidity level is priced for the non-investable portfolio of developed markets and emerging markets and whether unspanned local (market and liquidity) risk is priced.

2.1 Asset pricing tests for the world and open markets

Since the theory predicts that the price of world (market and liquidity) risk should be the same for each country, we estimate in a first step the price of world risk, (see, for example, Bekaert and Harvey, 1995), and impose in a second step the estimated world price of risk in the country estimations. We estimate the following system of equations for the world market portfolio and all open markets,

$$\begin{aligned}
r_{W,t+1} - r_{f,t+1} &= \alpha_W - \frac{1}{2} var_t\left(r^{net}_{W,t+1}\right) + \kappa E_t\left[c_{W,t+1}\right] + \gamma var_t\left(r^{net}_{W,t+1}\right) + \epsilon_{1,t+1}, \\
r_{k,t+1} - r_{f,t+1} &= \alpha_k - \frac{1}{2} var_t\left(r^{net}_{k,t+1}\right) + \kappa E_t\left[c_{k,t+1}\right], \\
&\quad + \gamma cov_t\left(r^{net}_{k,t+1}, r^{net}_{W,t+1}\right) + \epsilon_{1+k,t+1}, \\
c_{W,t+1} &= E_t[c_{W,t+1}] + \epsilon_{OM+2,t+1}, \\
c_{k,t+1} &= E_t[c_{k,t+1}] + \epsilon_{OM+2+k,t+1},
\end{aligned} \tag{8}$$

where k denotes each of the OM open markets. We follow Karolyi and Wu (2018) and consider the following major developed markets as fully open: the U.S., the U.K., France, Germany, Netherlands, Belgium, Singapore, and Hong Kong.

To account for the autocorrelation in the transaction costs time series, we first estimate an auto-regressive (AR(P)) process, $c_{j,t+1} = \phi_{j,0} + \sum_{p=1}^{P} \phi_{j,p} c_{j,t+1-p} + \epsilon_{j,t+1}$, for $j = W, k_1, ..., k_{OM}$. We then set the expected transaction cost as $E_t\left[c_{j,t+1}\right] = \phi_{j,0} + \sum_{p=1}^{P} \phi_{j,p} c_{j,t+1-p}$.[9]

We model the covariance matrix H_t of all shocks $\boldsymbol{\epsilon}_t$ as a multivariate GARCH (MGARCH) process in which the variances depend only on past squared residuals and an autoregressive component while the covariances depend on the past cross-product of residuals and an autoregressive component. To reduce the number of parameters to be estimated, the model imposes that the parameters that govern the conditional variance of $k's$ market return are equal across the M markets, where $M = 1 + OM$ is the total number of markets. Likewise, the parameters that govern the conditional variance of the $k's$ market bid-ask spread are equal across the M markets. We also allow a free (unconstrained) parameter for the conditional covariances. This specification ensures that the dynamics of the conditional covariance of the transaction costs are not constrained by the

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[9] We choose the order of the AR(P) process as the smallest P for which the p-value of a Ljung-Box test on the residuals is larger than 5%.

dynamics of the return covariances and vice versa.

$$H_t = H_0 \circ \Big(\boldsymbol{\iota}_{2M} \boldsymbol{\iota}_{2M}^\top - B - A \Big) + B \circ H_{t-1} + A \circ \boldsymbol{\epsilon}_{t-1} \boldsymbol{\epsilon}_{t-1}^\top, \tag{9}$$

where $\boldsymbol{\iota}_{2M}$ is a $(2M) \times 1$ vector of ones, $B = \left(\bar{B}\bar{B}^\top\right) \otimes \left(\boldsymbol{\iota}_M \boldsymbol{\iota}_M^\top\right)$, $A = \left(\bar{A}\bar{A}^\top\right) \otimes \left(\boldsymbol{\iota}_M \boldsymbol{\iota}_M^\top\right)$, the matrices $\bar{A}$ and $\bar{B}$ are 2×2 lower triangular and each contain only three parameters, $\circ$ is the Hadamard (element by element) matrix product, and $\otimes$ is the Kronecker product. The matrix H_0 is set using the sample covariance matrix of $\boldsymbol{\epsilon}$. The advantage of this restricted MGARCH parameterization is that it ensures positive definiteness of the covariance matrix while reducing the number of parameters to be estimated.

Finally, bid-ask spreads overestimate the true cost of trading as we assume that investors have the same investment horizon as the return frequency we use in our econometric tests, an assumption unlikely to be verified in reality. Therefore, we estimate $\kappa = (\bar{\kappa})^2$ to account for the fact that the investment horizon may differ in reality. AP similarly estimate κ in some of their specifications.

We allow for two other levels of model misspecifications. First, we use an intercept α_j for each portfolio in the estimation, but the model implies that the intercepts are zero. Second, we use a Student t distribution for the shocks $\boldsymbol{\epsilon}_{t+1}$. Our model assumes log-normal returns, but given that the weekly log-returns we use in our empirical tests display high levels of kurtosis, we use the Student t distribution to ensure that the estimation of risk premiums parameters are not too impacted by large shocks.

Finally, our system of equations (8) is well-suited for testing the implication of the asset pricing model. First, we can test for the importance of the liquidity level premium and of world (market and liquidity) risk by testing whether $\kappa > 0$ and $\gamma > 0$, respectively. Second, we can test for the importance of liquidity risk using the Vuong (1989) test for non-nested models by comparing the log-likelihood of the model (8) to the log-likelihood of the model in which we replace the net returns $r_{W,t+1}^{net}$ and $r_{k,t+1}^{net}$ on the right-hand side of the return equations by the gross returns $r_{W,t+1}$ and $r_{k,t+1}$, respectively.

2.2 Estimation of the diversification portfolio

The set of substitute assets, $\boldsymbol{S^k}$, used to construct the diversification portfolio for country k is composed of (i) value-weighted portfolios of investable stocks in each of the open markets, OM, (ii) value-weighted portfolios of investable stocks in country k, and (iii) all the funds of country k, $F_n^k, n = \{1, ..., N_F^k\}$, where N_F^k is the number of funds of country k. Funds include Country Funds as well as ETFs of country k and its region. We define Country Funds as mutual funds, investment trusts, and regional funds, i.e., all funds except ETFs. We discuss in Section 3 our construction methodology for each of these portfolios.

We form a dynamic replicating portfolio whose allocation at time t uses conditional covariances as,

$$\boldsymbol{\omega}_{DP^k,t} = \Sigma_{S^k,t}^{-1} \Sigma_{S^k - N^k,t} \tag{10}$$

where $\Sigma_{S^k,t}$ is the covariance matrix at time t of the vector

$$\boldsymbol{r}_{S^k,t}^{net} = \left[\boldsymbol{r}_{OM,t}^{net}, r_{I^k,t}^{net}, r_{F_1^k,t}^{net}, r_{F_2^k,t}^{net}, ..., r_{F_{N_F^k}^k,t}^{net} \right]^\top$$

and $\Sigma_{S^k - N^k,t}$ is the vector of covariances between the net return on the value-weighted portfolio of non-investable securities $r_{N^k,t}^{net}$ and the vector $\boldsymbol{r}_{S^k,t}^{net}$.

Estimating conditional covariances is complicated because the replicating assets have different time series length, with some series not overlapping at all. Also, there is a large number of replicating assets, which further complicates the estimation of conditional covariances. To address these issues, we use the methodology of Christoffersen et al. (2018). We estimate one volatility model for each asset and then obtain the correlations from a dynamic normal copula (DNC) estimated on the residuals. We use the conditional variances, $\boldsymbol{\sigma}_{t+1}$, obtained from the volatility models and the conditional correlations, C_{t+1}, obtained from the DNC model to obtain the conditional covariances, $\Sigma_{t+1} = diag\left(\boldsymbol{\sigma}_{t+1}\right) C_{t+1} diag\left(\boldsymbol{\sigma}_{t+1}\right)$, needed to estimate the diversification portfolio weights (see Equation 10).[10]

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[10] To prevent extreme weights in the DP portfolio, we examine at each period t the full correlation matrix. For each pair of replicating assets whose cross-correlation in absolute term at time t is higher than a threshold (e.g., 0.85), we keep only the one with the highest correlation with the non-investable portfolio. We repeat the exercise with a lower correlation threshold (e.g., 0.8) until the condition number of the correlation matrix is below 15. The condition number is the square root of the ratio of the maximum eigenvalue to the minimum eigenvalue of the correlation

To estimate the conditional covariances, Σ_{t+1}, we proceed in two steps. In a first step, we estimate for each asset j a simplified version of Equation (8) in which we directly model net returns, $r_{j,t+1} - c_{j,t+1}$. In our asset pricing tests, we examine the impact of liquidity level and risk on expected gross returns and therefore have a separate equation for gross returns, $r_{j,t+1}$, and transaction costs, $c_{j,t+1}$. Here we form the best replicating portfolio and separating gross returns from transaction costs would complicate the estimation without much benefit.***In footnote IC replaced AR(p) by AR(P)*** [11]

In a second step, we estimate a dynamic normal copula on the standardized shocks, $u_{j,t+1} = \frac{\epsilon_{j,t+1}}{\sigma_{j,t+1}}$. The conditional correlations follow the same dynamic as in Equation (9),

$$\Gamma_{t+1} \quad = \quad \Omega_C \left(1 - b_C - a_C\right) + b_C \Gamma_t + a_C u_t u_t^\top,$$

where Ω_C is the long-run correlation matrix of u_t, a_C and b_C are scalar parameters for the correlation dynamic. We obtain the dynamic correlation through the standardization $C_{j,l,t+1} = \frac{\Gamma_{j,l,t+1}}{\sqrt{\Gamma_{j,j,t+1}\Gamma_{l,l,t+1}}}$.

To account for the unequal length of the time series, we estimate the parameters by maximizing the composite log-likelihood (i.e., pair-wise log-likelihood) using all available assets each period. This estimation procedure allows us to estimate one correlation model on an unbalanced panel of asset returns. Once an asset j becomes available, we set its first conditional correlations with other available assets l to its long-run parameter $\Omega_{C,j,l}$.

Our approach has several advantages. First, the covariance dynamic used to form the diversification portfolio is the same as the one used in asset pricing tests. As barriers to investment fall and the composition of the non-investable portfolio changes, our dynamic approach captures the changing nature of the diversification portfolio. A second advantage is that our approach allows for a large number of replicating assets. Previous studies use a selected number of portfolios and cross-listings and usually estimate weights in a sequential regression approach. We estimate directly over the full set of replicating assets.

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matrix. Working with a set of replicating assets whose correlation matrix's condition number is below 15 ensures that we do not work with redundant assets.

[11] We also use an AR(P) process for the conditional expectation of net returns. The focus here is on conditional covariances and all we need is to remove autocorrelation in net returns. Our estimation of the vector of weights is robust to alternative specifications for the conditional expectation of net returns.

2.3 Asset pricing tests for segmented markets

The final step consists of estimating the pricing model for the non-investable portfolio of each country k as,

$$\begin{aligned}
r_{W,t+1} - r_{f,t+1} &= \hat{\alpha}_W - \frac{1}{2} var_t\left(r^{net}_{W,t+1}\right) + \hat{\kappa} E_t\left[c_{W,t+1}\right] + \hat{\gamma} var_t\left(r^{net}_{W,t+1}\right) + \epsilon_{1,t+1}, \\
r_{N^k,t+1} - r_{f,t+1} &= \alpha_{N^k} - \frac{1}{2} var_t\left(r^{net}_{N^k,t+1}\right) + \kappa_{N^k} E_t\left[c_{N^k,t+1}\right] + \hat{\gamma} cov_t\left(r^{net}_{N^k,t+1}, r^{net}_{W,t+1}\right) \\
&\quad + \pi_{N^k} var_t\left(r^{net}_{N^k,t+1}\right)\left(1 - II_{N^k,t}\right) + \epsilon_{2,t+1}, \\
c_{W,t+1} &= E_t[c_{W,t+1}] + \epsilon_{3,t+1}, \\
c_{N^k,t+1} &= E_t[c_{N^k,t+1}] + \epsilon_{4,t+1}. \qquad (11)
\end{aligned}$$

We test for the importance of the liquidity level premium and of the pricing of the unspanned local risk by testing whether $\kappa_{N^k} > 0$ and $\pi_{N^k} > 0$, respectively. Also, we test for the importance of liquidity risk, both at the world and at the local levels, using the test of Vuong (1989) for non-nested models by comparing the log-likelihood of model (11) to the log-likelihood of the model in which we replace the net returns $r^{net}_{W,t+1}$ and $r^{net}_{N^k,t+1}$ on the right-hand side of the return equations by the gross returns $r_{W,t+1}$ and $r_{N^k,t+1}$, respectively.

3. Data

This section describes the securities used to construct the test assets, i.e., the investable and non-investable portfolios and the securities used to form the set of substitute assets and build the diversification portfolios. We also describe how we classify securities into investable and non-investable. Further, we detail the liquidity measures and report basic statistics on portfolio returns and liquidity measures.

3.1 Distribution of securities

From S&P Compustat (xpressFeed), we retrieve daily data for $69,724$ stocks from 42 countries listed on major stock exchanges.[12] For most countries, we identify one major stock exchange on

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[12] There are 94 countries with listed securities on Compustat. 52 countries are excluded because of data limitations, notably, a short period with less than five years of data or a small number of securities with less than ten stocks.

which the majority of stocks are listed, but we use more than one exchange for a few countries.[13] We also obtain daily data for 3,475 cross-listings, 163 Country Funds (mutual funds and investment trusts), and 470 ETFs. We define cross-listings as direct listings, American Depositary Receipts (ADRs), or Global Depositary Receipts (GDRs).

We test our asset pricing model on international equity markets that we categorize into DMs and EMs. We proxy the world market portfolio with a market cap-weighted portfolio of all local common stocks. In addition, we use cross-listed firms in other markets to determine the investability of local stocks. Following Karolyi and Wu (2018), we use only cross-listings and funds listed on open stock exchanges to ensure that they are investable for global investors. We use their list of stock exchanges considered to be open to foreign investors.[14] Finally, we use portfolios of open markets, investable portfolios, cross-listings, and funds as substitute assets to build the diversification portfolios. We discuss further in Section 3.4 how we construct the set of substitute assets.

Table 1 presents the start dates and number of securities per country. As detailed below, we use FHT as the main bid-ask spread proxy and CS and AR for robustness. For the sake of comparison across the different bid-ask spread proxies, we set the same start date across the different bid-ask spread proxies. The start dates of the time series are mainly determined by the availability of data needed to compute bid-ask spread proxies, particularly high and low prices required for the CS and AR proxies. Data for Canada and U.S. start as early as 1984. Data for 17 DMs and 12 EMs start in the mid 1990s, while they start in the 2000s for the rest of DMs and EMs. Notably, our time series for Chile starts only in 2009, as few high and low prices are available before. Colombia (U.S.) has the smallest (largest) number of stocks at 84 (14,197). All DMs and EMs have cross-listings in our sample. ~~Note that one~~ A company may have more than one cross-listing at any point in time. Therefore, ~~their~~ the number of cross-listings is not a direct indication of the number of investable

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[13] Countries with multiple stock exchanges are: Brazil (Rio de Janeiro, BM and F Bovespa SA Bolsa De Valores Mercadorias E Futuros), Canada (Toronto Stock Exchange, TSX Venture Exchange), China (Shanghai Stock Exchange, Shenzhen Stock Exchange, Shanghai-Hong Kong Stock Connect (NB), Shenzhen-Hong Kong Stock Connect (NB)), France (Paris, NYSE Euronext Paris), Germany (Deutsche Boerse AG, XETRA), India (BSE Ltd, National Stock Exchange of India), Japan (Osaka Securities Exchange, Tokyo Stock Exchange), South Korea (Korea Exchange Stock Market, Korea Exchange KOSDAQ), Switzerland (Swiss Exchange, Zurich), Taiwan (TAIPEI EXCHANGE, Taiwan Stock Exchange), Thailand (Stock Exchange of Thailand, Stock Exchange of Thailand Foreign Board), United Arab Emirates (Abu Dhabi Securities Exchange, Dubai Financial Market), United States of America (New York Stock Exchange, NYSE American, NASDAQ, NYSEArca).

[14] The set of open stock exchanges include the United States (NYSE, AMEX, NASDAQ, NYSE Arca, and OTC), United Kingdom (London Stock Exchange, SEAQ International, London OTC, and London Plus Markets), Europe (NYSE Euro next Amsterdam, Brussels, Lisbon, and Paris, Deutsche Boerse, XETRA, Luxembourg Stock Exchange, and OTC), Singapore, and Hong Kong.

local stocks. Most emerging markets have at least one fund. There are a lot more ETFs than Country Funds.[15]

For each security, we retrieve daily low, high, and closing prices, adjustment and total return factors, trading volumes, and market capitalizations in U.S. dollars. We apply filters and a list of data corrections for Compustat stock data provided in Griffin, Kelly, and Nardari (2010) and in Chaieb, Langlois, and Scaillet (2020). All returns are weekly using Wednesdays, denominated in U.S. dollars, and are in excess of the U.S. Treasury bill rate. We use weekly returns instead of monthly returns to have enough observations to capture the time-dynamics in covariances, and use weekly returns instead of daily to alleviate the problem of non-synchronous trading. We use the longest time series available for each security, and our sample ends in October 2018.

3.2 The bid-ask spread proxy

To test our asset pricing model, we need a direct measure of transaction costs such as the bid-ask spread. However, the data on bid-ask spreads are not available for many stocks in our sample of markets. Therefore, we use proxies for the bid-ask spread that rely only on daily prices. Our main proxy is the FHT measure defined as,

$$C_{i,t}^{FHT} = 2\sigma_{i,t} N^{-1}\left(\frac{1 + ZR_{i,t}}{2}\right), \tag{12}$$

where $\sigma_{i,t}$ is the volatility of daily returns for stock i, $N^{-1}(.)$ is the inverse function of the cumulative normal distribution, $ZR_{i,t}$ is the empirical proportion of zero returns for stock i during week t. We require that there is at least one non-zero return during a week to compute the proportion $ZR_{i,t}$. We use non-zero returns during a rolling window of 21 days to estimate the volatility $\sigma_{i,t}$.

We use the FHT measure as the main measure for three reasons. First, FHT is intuitive and straightforward and can be computed using only return data. Second, we find that the FHT measure for most market portfolios exhibits a downward trend and liquidity-like features as it spikes during crisis periods. Third, FHT measure is especially appropriate for markets with a large fraction of infrequently-traded stocks, which is the case for many EMs.

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[15] Figure 1 in the Online Appendix shows the growth of Country Funds and ETFs over time and across all countries. The growth of Country Funds stops in the early 2000s when ETFs' growth takes off. Of the more than 700 funds at the beginning of 2017, less than 100 are mutual funds or investment trusts. Some ETFs such as iShares MSCI Denmark (EDEN) are not included because they are not listed on the set of open stock exchanges.

Given the small number of daily observations in a week, this measure is a noisy estimate of the bid-ask spread. In our empirical analysis, we aggregate the stock estimates at the portfolio level, which reduces noise in the bid-ask spread proxy. While it is a reasonable estimate for the cost of a round-trip transaction of small size, this measure may not capture other dimensions of liquidity such as market depth, resilience, and search costs. This is also a shortcoming of alternative measures of bid-ask spreads.

Our main results are based on the FHT measure. A common concern about any liquidity measure is its positive correlation with volatility. In Section 4.3, we verify that our results are robust to orthogonalizing the liquidity measure to return volatility. In addition, we provide evidence that our results are robust to the choice of measure by estimating models using the CS and AR bid-ask spread proxies.

We classify a security as a local stock when its issue type is common or ordinary share, it is listed on a major stock exchange in the same country as the issuing company is incorporated, and is classified by S&P Compustat as a primary issue. Each week, we use all local stocks with a valid market capitalization and for which all liquidity proxies are available during the last month. We refer to these securities as available stocks. Using all available stocks listed in 42 markets, we build value-weighted return and bid-ask spread time series for the world market portfolio, W.

3.3 Classifying securities

To test our liquidity-adjusted IAPM, we focus on 22 DMs and 20 EMs for which data are available.

Each week, we classify available local stocks as investable or non-investable. Our primary filter for investability follows Karolyi and Wu (2018). Each week, we characterize a stock as investable if a related available cross-listed stock is traded on an open stock exchange. Second, we use country-specific filters listed in Table 2. For example, B shares in China since 2001 and Philippines are classified as investables. The set of investable stocks can change every week.

To verify that the investability filters produce the expected results, we run two sets of analyses on the constructed portfolios of investables and non-investables. First, we compute the MSCI foreign inclusion factors (FIF) for the investable and the non-investable portfolios. FIFs are an estimate of the proportion of a stock's market capitalization available to foreign investors.[16] We

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[16] We use MSCI foreign inclusion factors (FIF) for large- and mid-cap stocks. MSCI started to adjust its indexes

find that the investable portfolios have a higher foreign inclusion factor compared to non-investables (see top graph of Figure 1). Second, we compute the value-weighted average holdings of foreign institutional investors for investable stocks and non-investable stocks. Then, we compute cross-country average holdings for countries in which both investable and non-investable average holdings are available. We find that investables have higher foreign institutional holdings compared to non-investables (see middle graph of Figure 1). As a sanity check, we repeat this analysis with domestic institutional ownership of investables and non-investables in the bottom graph of Figure 1. We find no major differences between the investable and non-investable holdings suggesting that the strong link between investability and institutional ownership is driven by foreign rather than domestic holdings.

Alternative determinants of investability include the investability weight factor (IWF) computed by S&P/IFC and the foreign ownership holdings used in Errunza and Ta (2015). The foreign ownership holdings data from Lionshare start in 1999 and the sample of investable stocks does not change significantly over time compared to the use of depository receipts (ADRs, GDRs) and direct listings as in Karolyi and Wu (2018). Carrieri, Chaieb, and Errunza (2013) show that investable stocks are not effectively integrated with the world market because of implicit barriers to foreign investment. Therefore, we use as a robustness check the market portfolio of all local stocks as the non-investable portfolio and use all eligible cross-listings when forming the diversification portfolio (see Section 4.3).

Next, we compute the return and bid-ask spread proxies for two value-weighted portfolios: one with all investable stocks, and one with all non-investable stocks. Tables 3 and 4 report summary statistics for the two portfolios for each EM and each DM, respectively. We report the number of stocks at the end of the sample period, the annualized average and volatility of portfolio returns, and the average and volatility of bid-ask spreads.

As of October 2018, the split of non-investable versus investable stocks varies greatly across countries. The average proportion of non-investable stocks is 65% (not reported). For example, all of the Mexican stocks are investable, while all of the U.A.E. stocks are non-investable. EM portfolios display higher average returns and volatilities compared to DMs, a well-documented pattern. In

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for free-float in two steps in November 2001 and May 2002. Before June 2002, the foreign inclusion factors reported by MSCI are often 100%. We therefore use FIFs starting in June 2002.

EMs, the average bid-ask spread varies from 0.02% (Indian Investable) to 1.46% (Indonesian Non-investable). But most importantly, according to the FHT bid-ask spread proxy, across all countries except China, non-investable portfolios are more illiquid than investable stock portfolios. In the column "Ratio of avg.", we report the percentage difference in average bid-ask spread between non-investables and investables relative to the bid-ask spread of investables. For the FHT measure, the difference is positive in all countries except China. The (unreported) cross-country average of the percentage difference is 106%. We obtain a similar pattern when using the AR measure. However, investables display higher illiquidity than non-investables in five markets when we use the CS measure instead.

Figure 2 shows the difference between the value-weighted cross-sectional average expected bid-ask spread of non-investable and the value-weighted cross-sectional average expected bid-ask spread of investable stocks in our sample of countries across DMs and EMs. We obtain expected bid-ask spreads by fitting an AR(P) process on each time-series. We use the beginning of week total market capitalization in U.S. dollars to compute the value-weighted average. Across all liquidity measures, non-investable stocks have, on average, a bid-ask spread higher by a range of 0.1% to 0.3% compared to investable stocks.

3.4 The set of substitute assets

For each country k, we build its diversification portfolio using the portfolios of open markets, the portfolio of investable stocks of country k, and all the funds of country k, which include country and regional mutual funds and investment trusts as well as country and regional ETFs.[17] Hence, we obtain a replicating portfolio that is as close as possible to the portfolio of non-investable local stocks.

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[17] We search for all securities whose issue type is mutual fund, investment trust, or ETF, that are listed on an open stock exchange and whose company name includes the country name. We also use region keywords for some countries (Latin America, Asia Pacific, Central European, BRIC, Emerging Asia, Middle East & Africa, and Eastern Europe). We manually add the Lyxor ETF FTSE Athex 20 for Greece. We remove any short or levered ETFs and sector funds. The complete list of funds is available from the authors.

4. Results

In this section, we estimate our asset pricing model and test for the relative importance of the liquidity level premium and the world and unspanned local risk premiums. We use our main bid-ask spread proxy, the FHT estimator. Our methodology tests the joint hypothesis that liquidity is priced and that we have the right measure of bid-ask spread. A rejection of this joint hypothesis could be driven by the fact that the bid-ask spread proxy is inadequate. The use of alternative measures detailed in Section 4.3 alleviates this concern.

4.1 Liquidity level and risk in open markets

We first estimate the system of equations (8) using the world and all open markets' returns and bid-ask spreads over the period 1997-2018. Panel A of Table 5 contains the estimates. The price of world covariance risk, γ, is significantly greater than zero at 2.45 with a t-ratio of 1.98 (see column (ii)). The price of world risk is equal to the aggregate risk aversion. Hence, a value of 2.45 is economically meaningful.

In contrast, the estimated liquidity level premium coefficient κ is virtually 0 (see column (i)). The asset pricing model implies that this parameter is one, but we allow for a different value to account for the fact that investors' trading horizon may not align in reality with the data frequency used in our empirical tests. An insignificant κ is in line with the results of Amihud et al. (2015). Using price impact as a liquidity measure, they find that the average return of their illiquid-minus-liquid portfolio is significant at the 10% only for three of these open markets; Hong Kong, Singapore, and the U.K. (see their Table A.2). When estimating an unconstrained κ, AP similarly find a negative but insignificant value for the U.S. market. Holden and Nam (2019) find that the coefficient of expected liquidity cost is positive for the U.S. market when using the Amihud (2002) measure. However, the evidence is weaker over the more recent period or when using alternative liquidity measures, such as the CS measure.

As argued in the literature (see, for example, Holden and Nam, 2019; Kazumori, Fang, Sharman, Takeda, and Yu, 2019), rejecting the null hypothesis that the price of world covariance risk, γ, is zero cannot distinguish whether liquidity risks are priced or rather that the world market risk is priced and liquidity risk is irrelevant. Therefore, the test of $\gamma = 0$ does not allow us to isolate the pricing effect of liquidity risk over and above the liquidity level and world market covariance risk. Past studies propose different specifications that allow for a different price of risk for the market beta vs. the liquidity betas (see, e.g., Acharya and Pedersen, 2005; Lee, 2011; Holden and Nam, 2019; Kazumori et al., 2019). These tests suffer from high multicollinearity among betas.

To identify the separate effect of liquidity risk, we propose a different approach. We re-estimate the model using returns gross of transaction costs on the right-hand side of the system of equations instead of the returns net of transaction costs. A higher log-likelihood of the model with net returns indicates that liquidity risk plays an important role in explaining expected returns. Using the Vuong (1989) test for non-nested models, we find a p-value of 0.37 for the null hypothesis that the two models' fits are equal. Using the FHT bid-ask spread proxy, we do not find any evidence that liquidity risk is important for the world and open markets. Holden and Nam (2019) and Kazumori et al. (2019) find weak evidence on the pricing of net liquidity betas and show that incorporating liquidity risk adds very little to the R-squares of the liquidity adjusted CAPM for the U.S. market and the U.S. and Japan markets, respectively.

4.2 Liquidity level and risk in segmented markets

Next, we estimate the system of equations (11) for each non-investable portfolio. We report in Panel B of Table 5 the coefficient estimates and specification tests. We average estimates across DMs (columns (i) and (iii)) and across EMs (columns (ii) and (iv)). Below the cross-country averages, we also report the proportion of countries for which the coefficient is significant at the 10% level. Note that the standard errors of our estimates ignore the sampling error associated with the earlier stage estimation.

We find that the average price of unspanned local risk, π_{N^k}, is equal to 2.16 and is significant for 53% of EMs. The price of unspanned local risk is proportional to the differential in risk aversion between a country's average investor and the world average investor and hence the size seems economically plausible. In contrast, the average price is about ten times smaller for DMs at 0.26 and is significant for only 18% of countries. Our sample period is more recent than other studies given our data requirements for liquidity proxies. We find that unspanned local risk remains an important determinant of expected returns in partially segmented markets over this sample period.

As shown in Figure 2, the FHT measure is higher for non-investable than for investable stocks.

In Table 5, we additionally find that the impact of liquidity level on expected return captured by the coefficient κ_{N^k} is higher for EMs than for DMs. We find a cross-country average coefficient of 0.21 for EMs and 0.08 for DMs. These coefficients are significant for 58% of EMs and 45% of DMs. This result contrasts with the zero κ coefficient obtained for open markets in Panel A. Hence, liquidity level is a significant determinant of expected returns for non-investable stocks. At the aggregate level, Lee (2011) finds a negative but insignificant value of the expected liquidity coefficient for his sample of 28 EMs, whereas BHL find a positive but insignificant value of the expected liquidity coefficient in the case of full integration or segmentation for 19 EMs.

We provide another perspective on this result in Figure 3. In the top graph, we report the annualized cross-country average of the liquidity level premium ~~measured~~ (LLP) measured as,

$$LLP_{k,t} = \kappa_{N^k} E_t \left[c_{N^k,t+1} \right], \tag{13}$$

whereas the bottom graph reports on the annualized cross-country average of the unspanned local market risk premium (LMRP) measured as,

$$LMRP_{k,t} = \pi_{N^k} var_t \left(r^{net}_{N^k,t+1} \right) \left(1 - II_{N^k,t} \right). \tag{14}$$

The average EM unspanned local risk premium (continuous line, bottom graph) is usually between 5% and 10% per year but spikes during market turmoil. The average DM unspanned local risk premium (dashed line), in contrast, is close to zero and spikes only during the 2008 financial crisis. The average DM liquidity level premium is stable at around 1% per year, but spikes twice during our sample period to around 2% in 2003 and 2008. The average EM liquidity level premium is consistently higher at around 2% per year in the first part of the sample and around 3% during the later part when more EMs are included in the sample. While smaller in magnitude than the unspanned local risk premium, liquidity level is an economically large determinant of total risk premiums for non-investable stocks.

Finally, we test for the importance of liquidity risk in explaining expected returns. The coefficients for the model with liquidity risk (see row *On net returns* in Table 5) are largely unchanged compared to the model estimates without liquidity risk (see row *On gross returns*) and the proportions of countries with significant κ_{N^k} and π_{N^k} coefficients remain constant. Also, the Vuong (1989) test for non-nested models (see row *Model Selection* in Table 5) show that the null hypothesis that the two models' fits are equal is rejected at 10% level only in 5.26% of EMs. Using the FHT bid-ask spread proxy, we do not find evidence that liquidity risk is an important determinant of expected returns for non-investable stocks.

The analysis of risk premiums contribution for non-investable stocks show two effects: (1) local market risk that cannot be spanned by investables entails a risk premium due to limited risk sharing, and (2) a liquidity level premium. In the next section, we run different robustness checks. In Section 5, we empirically investigate the economic sources of the liquidity level premium and the unspanned local market risk premium.

4.3 Robustness

In this section, we run several robustness checks. First, we investigate whether the results are robust to controlling for the correlation between the bid-ask spread proxy and volatility. Second, we examine the extent to which results are sensitive to the choice of bid-ask spread proxy. Finally, we assess the impact of categorizing all stocks as non-investable.

4.3.1 Volatility adjusted FHT measure Illiquidity and return volatility are positively correlated. The positive relationship between expected illiquidity and expected returns that we find could stem from the effect of stock market volatility on expected stock returns. In our model, the systematic world and unspanned local risk, which are both functions of the non-investable portfolio volatility, are priced. However, in the data, the impact of liquidity may still be intertwined with return volatility.

To address this concern, we orthogonalize the FHT measure to return volatility. We first estimate a GARCH model on the weekly returns of the non-investable market portfolio to obtain its conditional volatility $\sigma_{N^k,t}$. Then, we run the regression,

$$FHT_{N^k,t} = \beta_0 + \beta_1 \tilde{\sigma}_{N^k,t} + \upsilon_{N^k,t},$$

where $\tilde{\sigma}_{N^k,t} = \sigma_{N^k,t} - \frac{1}{T}\sum_{s=1}^{T} \sigma_{N^k,s}$ are demeaned conditional volatilities, β_0 and β_1 are regression coefficients, and $\upsilon_{N^k,t}$ are residuals. Finally, we compute the measure,

$$FHT^{\perp}_{N^k,t} = FHT_{N^k,t} - \beta_1 \tilde{\sigma}_{N^k,t}.$$

Table 6 shows the model estimates and Figure 4 reports the liquidity level and unspanned local risk premiums averaged across countries.

The results in Table 6 are qualitatively similar to those in Table 5 with an even higher liquidity level coefficient κ_{N^k} estimated at 0.35 for EMs and 0.24 for DMs (compared to 0.21 and 0.08 with FHT) and significant at the 10% level for all markets. Whereas the unspanned local risk premiums in the bottom graph of Figure 4 are largely unchanged, the liquidity level premiums in the top graph are drastically higher than before at around 5% per year for EMs and 4% for DMs. Hence, we find that adjusting the bid-ask spread proxy for its correlation with return volatility enhances the effect of the liquidity level premium on expected stock returns.

4.3.2 Alternative liquidity measures To ascertain that our results are not an artifact of the bid-ask spread proxy, we use two alternative estimates, namely, the CS and AR measures.

Corwin and Schultz (2012) develop the high-low percent-cost proxy. The measure uses the high-low price range for two consecutive days and their two-day high-low price range to disentangle volatility from the bid-ask spread. We obtain daily estimates of the bid-ask spread and set negative daily spreads to zero. For each stock, we calculate the weekly spread measure as the average of daily spreads within the week for weeks with at least two daily spreads available. We then aggregate these stock estimates at the portfolio level and obtain time series of portfolio bid-ask spread proxies.

Building on Roll (1984) and Corwin and Schultz (2012), Abdi and Ranaldo (2017) derive two equations linking the bid-ask spread and daily volatility to functions of the close, low, and high log-prices. Isolating the bid-ask spread produces the estimator

$$c_t = \sqrt{4E\left[\left(p_t - \frac{l_t + h_t}{2}\right)\left(p_t - \frac{l_{t+1} + h_{t+1}}{2}\right)\right]} \tag{15}$$

where p_t, l_t, and h_t are respectively the close, low, and high log-prices at time t. Their methodology produces estimates of the log bid-ask spread, c_t, needed to test our asset pricing model (see Assumption A3). We obtain daily estimates of the bid-ask spread and set negative daily spreads to zero. For each stock, the weekly AR spread is the average of daily AR spreads within a week for weeks with at least two daily spreads available. Given the small number of daily observations in a week, these averages are noisy estimates of the bid-ask spread proxy. Since we aggregate these stock estimates at the portfolio level, we obtain less noisy time series of portfolio bid-ask spread proxies. Also, we orthogonalize the CS and AR measures to volatility in a similar way as with FHT measure.

Online Appendix Tables 1-2 and Online Appendix Figures 2-3 report on the volatility-adjusted CS and AR measures. The significance and magnitude of the effect of liquidity on expected returns vary across the different liquidity measures. Overall, the volatility-adjusted CS measure has similar power to the FHT measure for capturing the relation between liquidity and stock returns but shows a smaller liquidity level premium for EMs. However, the evidence is weaker with the volatility-adjusted AR measure. The smaller size of the liquidity level premium with the CS and AR measures, especially for EMs, could be due to the fact that these measures are less appropriate for markets with large fraction of non-trading days. As argued by Corwin and Schultz (2012), with infrequently observed prices, the observed high and low price may not reflect the true high and low, leading to a misestimation of the true spread.

The price of world risk, γ, is significantly positive and of similar size across the three alternative liquidity measures. Also, similar to findings with FHT, the price of unspanned local risk, π_{N^k}, is significantly positive in about 50% of non-investable EMs and 18% of non-investable DMs when using the volatility-adjusted CS measure. The volatility-adjusted AR measure shows a similar fraction of significant π_{N^k} for EMs but a lower fraction for DMs. Overall, the dynamics and size of the unspanned local risk premium are comparable across the different liquidity measures. We also do not find evidence that liquidity risk has a significant effect on expected returns for non-investable stocks with the alternative liquidity measures.

4.3.3 Alternate securities classification Past studies suggest that although investables are freely available to a non-local investor, they still command a local risk premium (see, for example, Carrieri et al., 2013). Therefore, as a robustness check, we assume that a given country's whole stock market is non-investable. We form the diversification portfolios for the local market portfolio that includes both investables and non-investables.

When forming the diversification portfolio, we cannot use the portfolio of investable local stocks anymore. Instead, we build for each country a portfolio of securities, DR^k, that contains all eligible cross-listings. The objective is to obtain the best replicating asset for the portfolio of local non-investable stocks. Hence, for each stock j of country k with a cross-listing, $DR^k_{i,j}$, we form a value-weighted portfolio, DR^k_j, of all I cross-listings, $DR^k_{i,j}, i = 1, ..., I$ using their respective market capitalizations, $w^k_{DR,i}, i = 1, ..., I$. That is, DR^k_j allocates more to larger depository receipts and direct listings. The weight, w^k_j, of each portfolio, DR^k_j, in the portfolio of securities, DR^k, is proportional to the market capitalization of their respective local stock $j = 1, ..., J$, that is,

$$DR^k = \sum_{j=1}^{J} w^k_j DR^k_j = \sum_{j=1}^{J} w^k_j \sum_{i=1}^{I} w^k_{DR,i} DR^k_{i,j}. \tag{16}$$

Table 7 shows the estimated coefficients, κ_{N^k} and π_{N^k}, and the fraction of their significance across DMs and EMs for the FHT measure and the volatility adjusted FHT measure. Figures 5 and 6 plot the estimated percent annualized liquidity level premium and unspanned local market risk premium for the two liquidity measures. Online Appendix Table 3 and Online Appendix Figures 4-5 report these results and plots with the alternative volatility-adjusted CS and AR measures. The results are very similar to our previous findings. With the FHT measure, κ_{N^k} is significantly positive in 33% of DMs and 55% of EMs. With the volatility-adjusted FHT, κ_{N^k} is significantly positive in all DMs and most EMs. With the FHT measure, the liquidity level premium varies between 1% and 3% and is higher for EMs than for DMs. With the volatility-adjusted FHT measure, the liquidity level premium is even higher. It varies between 2% and 6% and is higher for EMs than DMs. As expected, these estimates are somewhat lower compared to results reported in Section 4.2 where securities were classified into investables and non-investables.

Overall, the liquidity level is significantly priced in partially segmented markets, but the size of the liquidity level premium is sensitive to the bid-ask spread proxy. The unspanned local market risk is priced for about half of our sample of EMs and the average π_{N^k} varies between 2.10 and 2.8 across the different liquidity measures. The fraction of significant π_{N^k} is much lower for DMs. The average π_{N^k} across DMs is small and varies between 0.26 and 0.34 across the different liquidity measures.

5. Economic Sources of the Liquidity Level Premium and the Unspanned Local Market Risk Premium

The key and novel finding presented in Section 4 is that the higher expected return on non-investable stocks stems from unspanned local market risk premium due to limited risk sharing and their higher and priced illiquidity level. These two components play an important role for segmented securities and are sources of extra return for non-investable portfolios. In this section, we study the economic sources of both the liquidity level and the unspanned local market risk premiums. We examine the role of factors that have been identified in earlier studies as sources of market segmentation as well as factors that enhance market quality and market liquidity coming from the market microstructure literature. Indeed, better market quality would lower the cost of trading and enable more efficient risk sharing.

5.1 Analysis of the variables

We first describe the variables that have been found in the extant literature to be useful determinants of segmentation and liquidity. Bekaert, Harvey, Lundblad, and Siegel (2011) identify a country's political risk profile, stock market development, and financial and trade openness as key local segmentation factors. Bekaert et al. (2007) find that liquidity risk is not priced in countries with little political risk, whereas it is strongly priced in countries with substantial political risk. Carrieri et al. (2013) find that institutional environment, governance, and the quality of information are key drivers of equity market integration. These variables could segment markets because foreign investors shy away from markets with high political risk, poor governance, and low information quality and transparency, thereby limiting international risk sharing and increasing the impact of liquidity on expected returns. Lee (2011) finds that the pricing of liquidity risk varies across countries according to geographic, economic, and political environments and that the global liquidity risk is more important than local liquidity risk in countries with larger cross-border investment, lower political risk and higher transparency.[18] Karolyi et al. (2012) relate commonality in liquidity to funding liquidity of financial intermediaries, correlated trading behavior of international and

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[18] Ng (2011), Lang and Maffett (2011) and Sadka (2011) find lower liquidity risk among firms with higher information quality and greater transparency.

institutional investors, incentives to trade individual securities, and investor sentiment. Amihud et al. (2015) find that the commonality in liquidity is greater in globally integrated markets. We use these variables and some others that can potentially explain the time series and cross-sectional variations in the liquidity level and unspanned local market risk premiums.

For each of the liquidity level premium LLP from Equation (13) and the unspanned local market risk premium LMRP from Equation (14), we examine their relationship with the institutional environment (political stability, governance, information quality and transparency), institutional ownership type (by foreign institutions and by institutional advisors), market quality including short selling and insider exchange trading rules, and investor sentiment. We control for global and local market conditions and market and economic development.

5.1.1 Institutional environment We expect liquidity level premium and the unspanned local market risk premium to be higher in markets with higher political risk, and lower information quality, transparency, and governance. We use the political risk index (POL) computed by the Political Risk Services' International Country Risk Guide that combines several components, such as quality of institutions, conflict, democratic tendencies, and government actions. The range of the rating index goes from 0 to 1. A higher number indicates lower political risk. We proxy information quality and transparency with a measure of the disclosure practices ($DISC$) in a country from Bushman, Piotroski, and Smith (2004). This measure is an aggregation of the practices observed in the annual reports collected by the Center for International Financial Analysis and Research. It represents the average ranking across specific disclosure categories that include R&D, CAPEX, product and geographic segment data, and accounting standards. These disclosures are useful to outside investors for valuation and monitoring. We use the anti-director rights index (A-DIR) as a measure of investor protection that proxies the quality of governance. The index varies between 0 and 6 with a higher score for those countries that show better protection of minority shareholders. It is based on laws and regulations applicable to publicly traded firms in May 2003 (see Djankov, la Porta, de Silanes, and Shleifer, 2008).

5.1.2 Institutional ownership and its type Several studies document a significant role of institutional ownership and its type (foreign vs. domestic, the role of investment advisors) on the level of market liquidity and liquidity risk. Chordia, Roll, and Subrahmanyam (2011) show that stocks with larger levels of institutional holdings experienced the greatest increase in turnover. Karolyi et al. (2012) show that commonality in liquidity is significantly related to commonality in turnover and the fraction of the local equity market capitalization held by foreign institutional investors. Amihud et al. (2015) show that liquidity return premium decreases with more open equity markets. Tesar and Werner (1995) and Vagias and van Dijk (2012) find that increases in foreign holdings improve local stock market liquidity. We expect the liquidity level premium and unspanned local market risk premium to be higher in less open markets with lower foreign ownership holdings. We use the fraction of the local equity market capitalization held by foreign institutional investors (FIO) as a proxy for market openness and cross-border flows.

Kamara, Lou, and Sadka (2008) show that commonality in liquidity increases with ownership by investment companies and investment advisors (as they tend to trade more often), but not with ownership by other types of institutions. Koch et al. (2016) show that stocks with higher mutual fund ownership, stocks owned by mutual funds with high turnover, or funds that experience liquidity shocks have higher liquidity commonality. Koijen, Richmond, and Yogo (2019) find a dominant role of investment advisors in the price formation process because of their size. We then examine how the liquidity level premium and the unspanned local market risk premium vary with the participation of institutional investors. We construct the fraction of market capitalization held by investment advisors and investment companies (IOI) using data from Factset.

5.1.3 Short selling regulation and practice Bris, Goetzmann, and Zhu (2007) find slower adjustment to negative information in countries with more severe shorting restrictions as predicted by Diamond and Verrecchia (1987). Boehmer, Jones, and Zhang (2013) show a large reduction in liquidity and a large increase in price volatility following the market-wide short-selling bans imposed in September 2008. Beber and Pagano (2013) use country-specific differences in the type of restrictions and their implementation dates to show that the bans decreased liquidity. We examine the effect of short selling restrictions on the liquidity level premium and the unspanned local market risk premium. While short selling restrictions could increase market volatility, the existence of ADRs and ETFs that are shortable might alleviate the effect of short selling restrictions. Our analysis considers their role in mitigating short-selling restrictions since we measure the local market risk as the residual market risk that cannot be spanned by substitute assets. We expect countries where short selling is prohibited and not practiced to have higher liquidity level premium and a higher unspanned local market risk premium. Based on Charoenrook and Daouk (2009), Bris et al. (2007), Saffi and Sigurdsson (2011), Jain, Jain, McInish, and McKenzie (2013), Beber and Pagano (2013), Deng and Mortala (2016) (see Appendix B for more details), we construct a dummy (D_{SSL}) equal to one if short selling is allowed and a dummy (D_{SSP}) equal to one if short selling is practiced. Online Appendix Table 4 summarizes global shifts in short selling regulations and activity.

5.1.4 Exchange trading rules Cumming, Johan, and Li (2011) show that differences in exchange trading rules over time and across markets significantly affect liquidity. We expect countries with explicit trading rules to facilitate trading by domestic and foreign investors to be associated with lower liquidity level premium and lower unspanned local market risk premium. We use the insider trading rules index (ITR) from Cumming et al. (2011). ITR is the sum of dummy variables for front-running, client precedence, trading ahead of research reports, separation of research and trading, broker ownership limit, restrictions on affiliation, restrictions on communications, investment company securities, influencing or rewarding the employees of others, and anti-intimidation / coordination.[19] *** Could move footnote into text**

5.1.5 Investor sentiment Various studies relate investor sentiment to the cross-section of stock returns (see, for example, Baker and Wurgler, 2006) and to commonality in liquidity (see, for example, Huberman and Halka, 2001; Karolyi et al., 2012). When global investors face higher volatility in the equity market and lose their general appetite for risk, they may reallocate to more liquid and safer stocks reflecting a "flight-to-liquidity and a flight-to-quality" phenomenon. We expect low sentiment to lead to higher liquidity level premium and higher unspanned local market risk premium. We use Baker and Wurgler (2006) U.S. sentiment index (SENT), which is based on the first principal component of five sentiment proxies.

5.1.6 Global and local market conditions We control for the level of market development proxied with market capitalization to GDP (MC/GDP) and for the degree of trade openness proxied with the sum of monthly exports and imports of goods and services measured as a share

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[19] See Cumming et al. (2011) for a detailed description of this index.

of GDP ($TRADE/GDP$). Since currency is an important factor for cross-border capital flows, we control for the monthly exchange rate changes (Δ_{FX}), and the volatility of exchange rate changes (σ_{FX}) measured by cumulating daily squared changes in foreign exchange rate (as per Andersen, Bollerslev, Diebold, and Labys, 2003). We then take a 12-month moving average of the monthly FX volatility measures. An appreciating currency and lower currency volatility could attract foreign institutional investors lowering both the liquidity level premium and the unspanned local market risk premium.

Brunnermeier and Pedersen (2009) show theoretically that both the level and the price of market liquidity vary over time as a function of funding liquidity. Borrowing constraints of financial intermediaries are more likely to be binding when local market volatility and/or interest rates are high. We expect the liquidity level premium and the unspanned local market risk premium to be higher in down markets with stricter borrowing conditions. We proxy for local market funding conditions using local stock market volatility (LVOL) and local interest rate (INT).

Bekaert et al. (2011) identify the U.S. corporate credit spread as a global segmentation factor for equity markets. Karolyi et al. (2012) report a link between global funding constraints and commonality in liquidity.[20] We expect the liquidity level premium and the unspanned local market risk premium to increase during periods of tight global funding liquidity proxied with the option volatility index (VIX). In some specifications, we also add a dummy set to 1 for emerging market countries (D_{EM}).

Some explanatory variables are correlated, which is not surprising. For example, short sales regulation and exchange trading rules are highly correlated with the development of financial markets. ~~Note that~~ The panel is unbalanced since not all of the variables are available over the full sample period and for all countries. In addition, some variables are available only with a cross-section dimension, while others with only a time-series dimension.

Before we run the panel regressions, we examine the time-series correlations between LLP and LMRP. A high correlation indicates a strong commonality between the two premiums and hence similar economic drivers. In comparison, a low correlation suggests that different economic sources drive each of the two premiums. The median correlation is 0.34 and the highest correlation is

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[20] Karolyi, Lee, and van Dijk (2019) find a link between shifts in U.S. monetary policy and liquidity risk premiums around the world through the global lending activity of the U.S. banks. However, they find no evidence that U.S. monetary policy shocks affect the liquidity level premium.

smaller than 0.7. Therefore, we expect some economic sources to be related differently to the two premiums.

5.2 Panel results

We run the following panel regressions,

$$Y_{k,t} = \beta_0 + \beta_1 IE_{k,t-1} + \beta_2 IO_{k,t-1} + \beta_3 MQ_{k,t-1} + \beta_4 SENT_{t-1} + \beta_5 X_{k,t-1} + \upsilon_{k,t}, \tag{17}$$

where Y is either the LLP or the LMRP, β_0 is a constant, IE is the vector of variables proxying the institutional environment (POL, DISC, A-DIR), IO is the vector of variables proxying the institutional ownership type (FIO, IIO), MQ is the vector of variables proxying market structure quality (D_{SSL}, D_{SSP}, ITR), $SENT$ is the variable proxying investor sentiment, X is the vector of control variables $(MC/GDP,\ TRADE/GDP,\ \Delta_{FX}, \sigma_{FX}, LVOL, INT, VIX, D_{EM})$. We do not allow for country fixed effects as some of the variables have only cross-sectional variation. Likewise, we do not include time fixed effects as $SENT$ and VIX, have only time-series variations. All regressors are lagged to reduce endogeneity issues. We run unbalanced panel regressions with robust standard errors clustered by country and week to account for serial and cross-country correlations (see, for example, Petersen (2009)). The use of the estimated premiums as dependent variables in the panel yields consistent estimates of the coefficients. However, the reported standard errors ignore the sampling error and hence likely understate the true standard errors.

We first estimate a model (not reported) with only country and time fixed effects to determine an upper bound for R-squares in our regressions. The fixed-effect model accounts for unspecified country and time characteristics. We can explain up to 87% and 45% of the total variation for LLP and LMRP. For both LLP and LMRP, the country-only fixed-effect models have a much higher explanatory power than the time-only fixed-effect models. Therefore, the cross-sectional variations are a lot more significant for both premiums.

Panel results for LLP: Table 8 reports the panel results for LLP and LMRP for different model specifications. Model 1 examines the role of the institutional environment and the institutional ownership type. The coefficient of POL is positive and significant at the 1% level suggesting that countries with higher political stability have a higher liquidity level premium for their non-investable segment.[21] The coefficient on $DISC$ is negative and significant at the 1% level, indicating that countries with better information quality and higher transparency exhibit lower liquidity level premiums. The coefficient on A-DIR is of the wrong sign but insignificant. The coefficient on FIO is negative and significant at the 1% level, suggesting that higher foreign institutional ownership is associated with lower liquidity level premiums. The coefficient on IIO is positive as expected but insignificant.

Model 2 examines the role of market quality. The liquidity level premium is lower when short selling is allowed. The practice of short selling increases it, but the coefficient is insignificant with additional variables as per model (4). The coefficient of the dummy on insider exchange trading rules is negative as expected but insignificant.

Model 3 examines the role of investor sentiment. The coefficient on investor sentiment is negative as expected and significantly associated with LLP, suggesting that higher investor sentiment reduces the liquidity level premium.

Model 4 examines the joint role of the institutional environment, institutional ownership type, market quality, and investor sentiment. The coefficients on $DISC$, FIO, D_{SSL}, and ITR are all significant at the 5% level. Model 4 shows that the explanatory power of all these variables amounts to 53%.

In all specifications, we see that at least one of the local and/or global market condition proxies (MC/GDP, local market volatility, interest rate, and VIX) is significantly associated with LLP.

Panel results for LMRP: In model (1), the coefficient on $DISC$ is negative and significant at the 5% level, suggesting that LMRP is higher in more opaque countries with lower information quality. The coefficients on POL, FIO, and IIO are of the expected sign but are insignificant. The coefficient on A-DIR is of the wrong sign. In model (2), the coefficients on market quality proxies are of the expected sign but are insignificant. In model (3), the coefficient on investor sentiment is negative and significant at the 5% level, indicating that LMRP is lower when investor sentiment is high. Model (4) confirms the main findings on the significance of $DISC$ and $SENT$. The coefficient on D_{SSL} turns marginally significant. Model (4) also shows that the explanatory power of all the variables amounts to 44%. In all specifications, we see that at least one of the

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[21] We also examine how the expected liquidity cost varies with POL. We run model (1) using the expected transaction costs as the dependent variable instead of the liquidity level premium. The coefficient of POL is positive but insignificant.

local market conditions proxies (FX level, FX volatility, local market volatility, and interest rate) is significantly associated with ~~the~~ LMRP. However, the coefficient on VIX is insignificant.

Economic sources of the liquidity level premium and the unspanned local market risk premium differ to some extent. We find that higher information quality and transparency and investor sentiment are related to both lower liquidity level premiums and unspanned local market risk premiums. Further, foreign institutional ownership holdings, rules allowing short selling and prohibiting insider exchange trading, and loose global or local funding conditions are associated with lower liquidity level premiums, whereas better local market conditions are related to lower unspanned local market risk premium.

We run model (4) for LLP and LMRP when liquidity is measured with the alternative liquidity measures. Results (see Online Appendix Table 5) are overall robust across the two alternative liquidity measures, vol-adjusted FHT or volatility-adjusted CS. However, results for LLP with the volatility-adjusted AR measure are not in line with the results we obtain with the FHT and CS measures. Although the estimation noise in ~~the~~ LLP and LMRP would contaminate our panel results, the robustness through FHT and CS measures is comforting while results with AR signal either lack of robustness or noise in the AR liquidity measure.

6. Conclusion

We develop a formal international asset pricing model that takes into account cross-border investment barriers as well as random transaction costs to analyze the effects of liquidity cost and systematic liquidity risk factors on the pricing of securities. In our model, the freely traded securities command a premium for liquidity level and global market and liquidity risk premiums, whereas the securities that can be held by only a subset of investors command additional premiums for unspanned local market and liquidity risks.

We estimate the model in a conditional setup allowing for quantities of risk to vary over time for 42 countries using weekly returns. Our empirical tests show that non-investables are more illiquid than investables and that the liquidity level is priced. When unspanned local risk is priced, it is triggered by market risk rather than liquidity risk. Substitute assets, such as cross-listings, country funds, and ETFs, partially span local market risk. However, a significant liquidity level premium and unspanned local market risk premium drive a wedge between the pricing of investables and non-investables.

On average, DM and EM stocks that can only be held by local investors are associated with a premium of 2.23% and 11.43% , respectively, in addition to the world market premium. This additional premium is attributed to an unspanned local market risk premium of 1.17% and 9.04% and liquidity level premium of 1.06% and 2.39% , respectively. These results are robust to alternative measures of liquidity.

We find that higher information quality and transparency and investor sentiment are related to both lower liquidity level premiums and unspanned local market risk premiums. Further, foreign institutional ownership holdings, rules allowing short selling and prohibiting insider exchange trading, and loose global or local funding conditions are associated with lower liquidity level premiums, whereas better local market conditions are related to lower unspanned local market risk premium.

In conclusion, our model provides a formal framework for testing liquidity level and risk pricing effects and dynamics in a realistic world market setting and for examining the interaction between investability constraints and liquidity. Our empirical results shed light on the channels through which liquidity affects asset prices in partially segmented markets and how this pricing relation changes over time and across countries.

Appendix A. Liquidity Adjusted IAPM in Partially Symmetric Segmented Markets

We derive the asset pricing equations assuming a symmetric market structure where investables and non-investables trade in each market and are subject to random transaction costs.

Specifically, a foreign investor F can invest in the riskless bond, the N_I investable securities and the N_F foreign non-investable securities that can only be traded by him. We denote by n_F a non-investable security from the foreign market. The vector $\boldsymbol{\omega}_{F,t}$ of optimal portfolio weights for the investor F can be written as,

$$\boldsymbol{\omega}_{F,t} = \frac{1}{\gamma^F} \Sigma^{-1}_{F,t+1} E_t \left[\boldsymbol{r}_{F,t+1} - \boldsymbol{c}_{F,t+1} - r_f \boldsymbol{\iota}_{(N_I+N_F)} + \frac{1}{2} \boldsymbol{\sigma_F}^2_{t+1} \right]$$

where the vector of log-returns is partitioned as $\boldsymbol{r}_{F,t} \equiv \begin{pmatrix} \boldsymbol{r}_{i,t} \\ \boldsymbol{r}_{n_F,t} \end{pmatrix}$, $\boldsymbol{\sigma}_{\boldsymbol{F}}{}^2_{t+1} \equiv \begin{pmatrix} \boldsymbol{\sigma}^2_{ii,t} \\ \boldsymbol{\sigma}^2_{n_F n_F,t} \end{pmatrix}$ is the vector containing the variance of investable and foreign non-investable asset net log-returns, i.e., the diagonal elements of the covariance matrix of investables and foreign non-investables, $\Sigma_{F,t+1}$, which can be partitioned as $\Sigma_{F,t} \equiv \begin{pmatrix} \Sigma_{ii,t} & \Sigma_{in_F,t} \\ \Sigma^{\top}_{in_F,t} & \Sigma_{n_F n_F,t} \end{pmatrix}$, where $\Sigma_{n_F n_F,t}$ is the variance-covariance matrix of the foreign non-investable securities, and $\Sigma_{in_F,t}$ is the covariance matrix between investable and foreign non-investable securities. The parameter γ^F is the coefficient of relative risk aversion of the foreign investor F, and $\boldsymbol{\iota}_{(N_I+N_l)}$ is an $((N_I + N_F) \times 1)$ vector of ones.

By symmetry of the market structure, we can replace F by D to obtain the optimal portfolio weights for the domestic investor. Aggregating the asset demands and taking into account market-clearing conditions, i.e., equities are in net positive supply equal to their market capitalization and the bond is in zero net supply, we obtain the equilibrium asset pricing relationships.

Investable securities are priced with only global risk factors as in Equation (1) in net returns and can also be written as Equation (2) in gross returns.

Non-investable *foreign* securities command additional local risk factors. Their pricing equation is,

$$\begin{aligned} E_t\left[r^{net}_{n_F,t+1} - r_f\right] + \frac{1}{2} var_t\left(r^{net}_{n_F,t+1}\right) &= \gamma cov_t\left(r^{net}_{n_F,t+1}, r^{net}_{W,t+1}\right) \\ &\quad + \pi_F cov_t\left(r^{net}_{n_F,t+1}, r^{net}_{N_F,t+1} \mid \boldsymbol{r}^{net}_{i,t+1}\right) \\ &\quad - \delta_F cov_t\left(r^{net}_{n_F,t+1}, r^{net}_{N_D,t+1} \mid \boldsymbol{r}^{net}_{i,t+1}\right) \end{aligned} \tag{18}$$

where $\pi_F = \left(\frac{\gamma^f}{W^f} - \frac{\gamma}{W}\right) M_{N_F}$ is the price of unspanned local risk in the foreign market and $\delta_F = \left(\frac{\gamma}{W}\right) M_{N_D}$ is the price of the conditional cross-market risk of the foreign non-investable security n_f. We can replace F by D to obtain the pricing equation of domestic non-investables.

The additional risk premiums are (1) the unspanned local risk premium which is proportional to the risk aversion difference between *foreign* and average world investors and the local risk that cannot be spanned by the substitute investable assets, and (2) a local conditional cross-market risk discount which is proportional to aggregate risk aversion and the sensitivity of the non-investable *foreign* security net return to the *domestic* market net return conditional on the vector of substitute assets' net returns. To the extent that the *foreign* non-investable security has some positive correlation with *domestic* non-investable securities, foreign investors will accept a lower local risk premium because of the risk diversification benefits provided by the non-investable security.

The unspanned local market risk premium is a premium that induces foreign investors to hold their local non-investable securities. The conditional cross-market risk discount results from the diversification benefits conveyed by holding the local non-investable security, assuming its return is positively correlated with the domestic non-investable portfolio.

The conditional cross-market risk discount vanishes when we consider the pricing of any market in a global context, that is, when we consider a market set-up that consists of the fully accessible global market (such as the U.S.) and any other market. The conditional cross-market discount plays a role only when the two market segments are both not fully investable. Chaieb and Errunza (2007) use a similar argument to derive an equilibrium asset pricing model when markets are symmetrically partially segmented and purchasing power parity does not hold.

Appendix B. Short Selling Rules Legality and Practice

We use different sources of information to find when short selling was allowed and when it was practiced. We start with the information provided in Bris et al. (2007) ~~(hereafter, BGZ)~~ and Charoenrook and Daouk (2009) ~~(hereafter, CD)~~ . We update the information on "when short selling was first allowed" using Jain et al., 2013 (hereafter, JJMM), Gregoriou (2012), and Deng and Mortala (2016) ~~(hereafter, DM)~~ . We use information on the extent of stock borrowing from JJMM over 07/2006 to 01/2010 to examine whether short selling was practiced over that period.

In response to the disclosure measures and short selling restrictions imposed by the U.K. Financial Services Authority and the U.S. Securities and Exchange Commission following the 2008 global financial ~~crises~~ crisis , regulators around the world have continued to either ban short selling, add restrictions on short selling or add disclosure requirements concerning short positions in their home jurisdiction. If the ban was on all stocks, we consider that short-selling was not allowed during the ban period. Likewise, if a ban on all stocks was effective and no short selling was practiced before the ban, we consider that short selling was not practiced during the ban. When the ban was imposed only on financial institutions or on naked short selling, while still permissible on other stocks or covered short selling was allowed, we consider that short selling was permissible and practiced in the country. We use Beber and Pagano (2013), Gregoriou (2012), JJMM, and other sources listed in the Online Appendix Table 5 to find the dates of the bans during the crisis periods.

Short selling rules and practices differ significantly across countries, but we do not have enough information across countries to form a more precise index that measures the difficulty of shorting and distinguishes bans on naked shorting, bans on covered shorting, use of an uptick rule, etc. Also, we acknowledge some limitations of the dating of short-selling regulation changes. We make every effort to cross-check several sources. We detail the sources and choices made in the Online Appendix Table 5, which summarizes global shifts in short selling regulations and activity for our sample of 22 DMs and 20 EMs.

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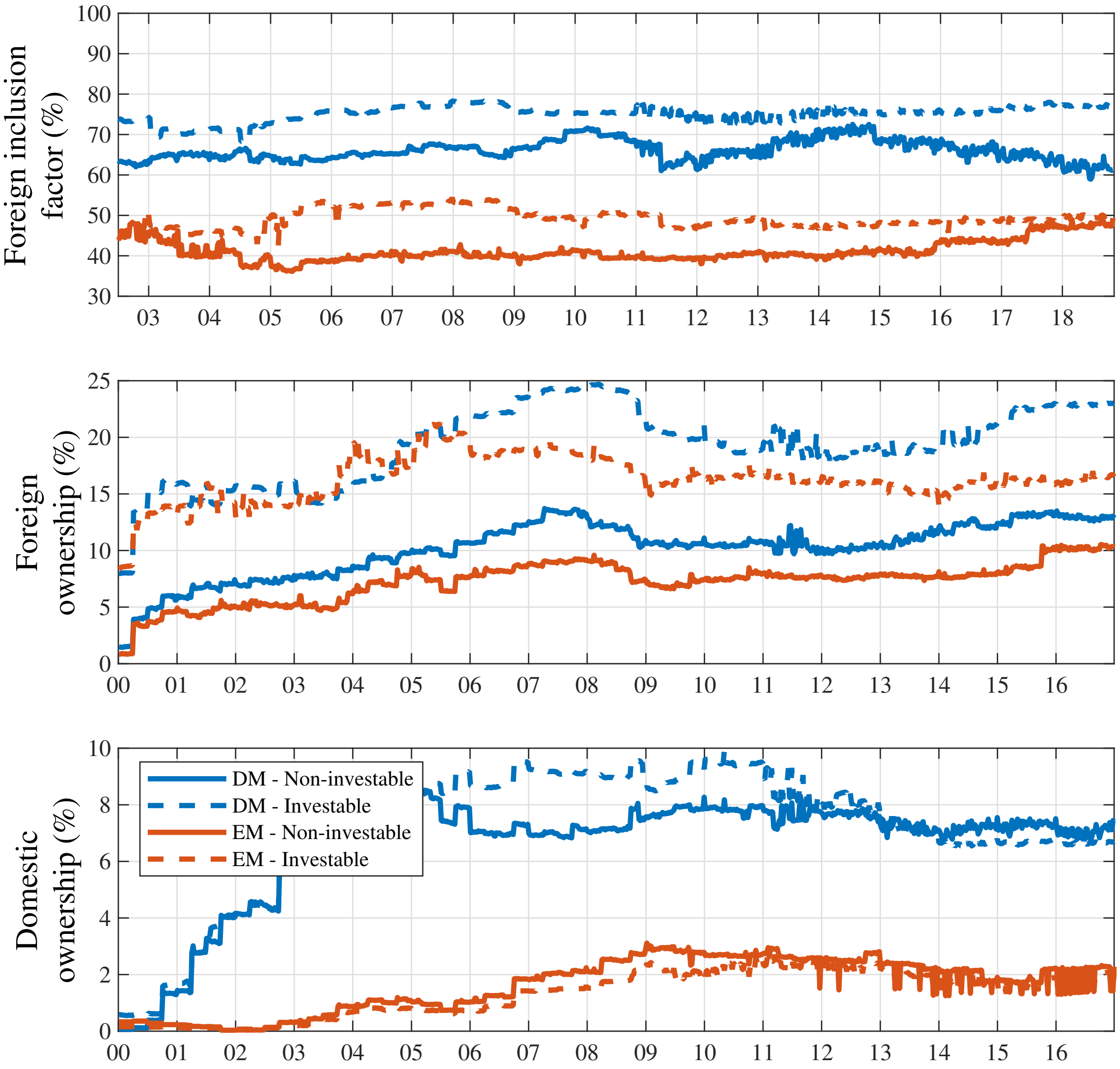

Figure 1

Foreign inclusion factors and foreign and domestic institutional holdings for investable and non-investable stocks

To evaluate the classification between non-investable and investable stocks, we compute two measures of foreign investability for each portfolio. The top graph reports on the cross-country average of the MSCI foreign inclusion factor (FIF) and the middle graph on the foreign institutional holding (FIH). As a benchmark for foreign institutional holdings, we also report the cross-country average domestic institutional holding (DIH) in the bottom graph. For each country, we compute the value-weighted measure for investable stocks and non-investable stocks. We then compute the cross-country average measure for countries for which both the investable and the non-investable measures are available. We compute the cross-country averages across developed markets and emerging markets. FIFs are available starting in 2002. FIH and DIH are available starting in 2000.

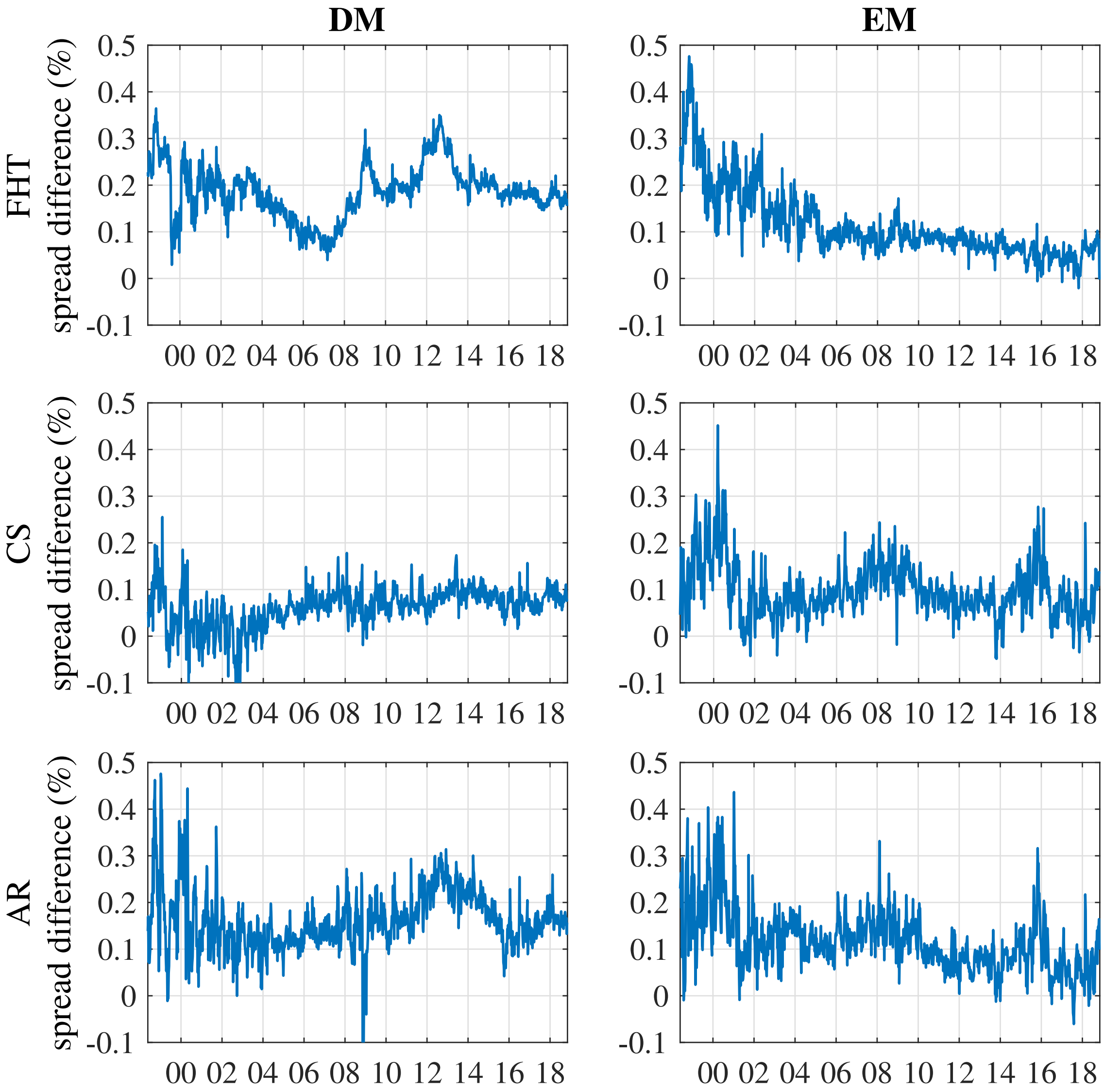

Figure 2

Difference in expected bid-ask spread between non-investable versus investable stocks

We report the difference in expected bid-ask spread between portfolios of non-investable and portfolios of investable stocks. The first row reports on our main bid-ask spread proxy, the FHT measure. The second row reports on the high-low proxy of Corwin and Schultz (2012) and the third row on the high-low proxy of Abdi and Ranaldo (2017). The left (right) column reports the value-weighted spread difference across DMs (EMs). For each market and week, we classify a local stock as investable if there exists an available direct listing or a depositary receipt listed on an open market with a valid price at the end of the previous week. We then build the non-investable portfolio and the investable portfolio as value-weighted portfolios of the non-investable and investable stocks, respectively. For each bid-ask spread proxy and each portfolio, we fit an AR(P) process on the time-series of bid-ask spreads and compute the difference in fitted values. We report the differences when at least five markets are available.

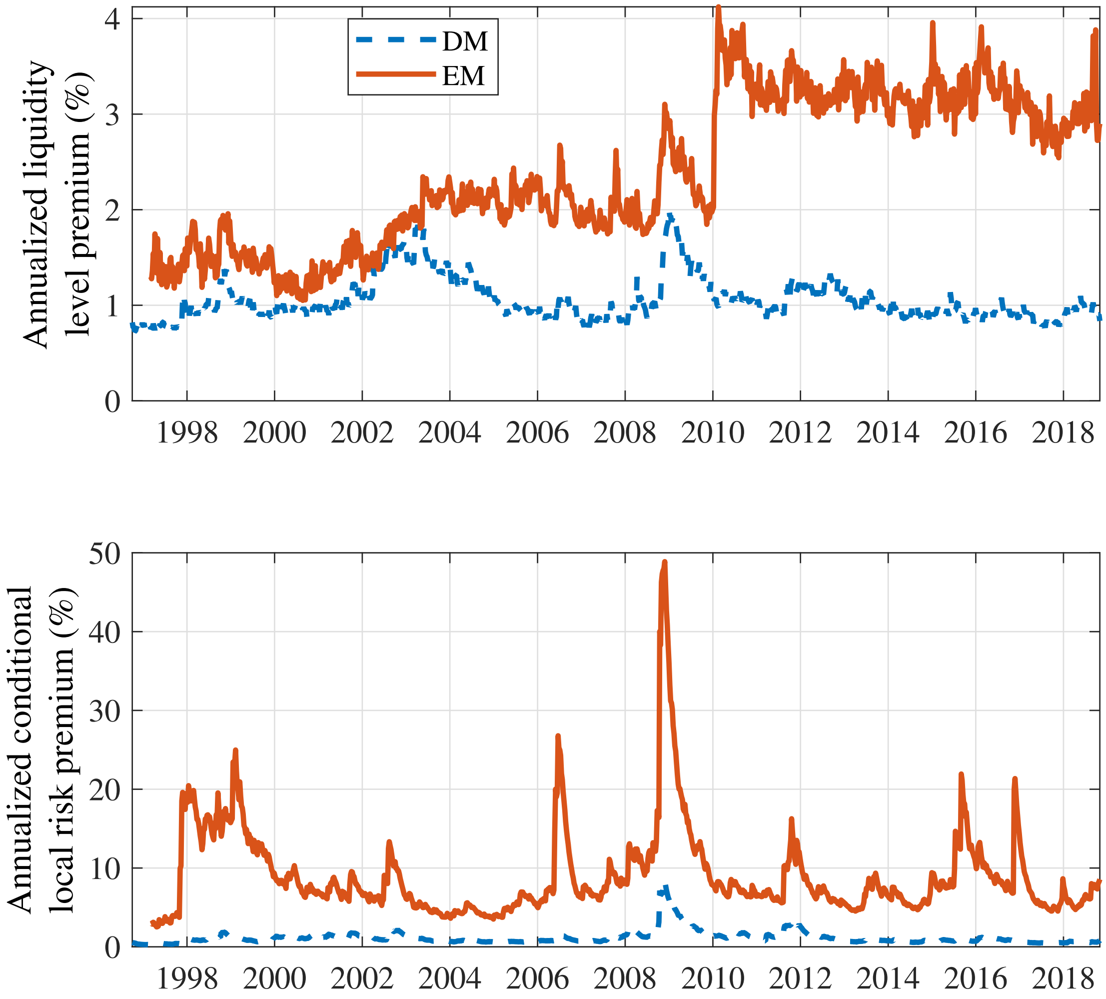

Figure 3
Cross-sectional average risk premiums using FHT as a bid-ask spread proxy
We report liquidity level and unspanned local risk premiums over time. The top graph reports on the annualized liquidity level premium

$$52 \times \kappa_{N^k} E_t \left[c_{N^k,t+1} \right],$$

in percent. The bottom graph reports on the annualized unspanned local risk premium

$$52 \times \pi_{N^k} var_t \left(r^{net}_{N^k,t+1} \right) \left(1 - II_{N^k_t} \right)$$

in percent. In each graph, we compute the cross-sectional equal-weighted average each week across DMs (dashed line) and EMs (continuous line). We report the cross-sectional averages when at least five countries are available. Model estimates are reported in Table 5. The data are weekly from 1997 to 2018.

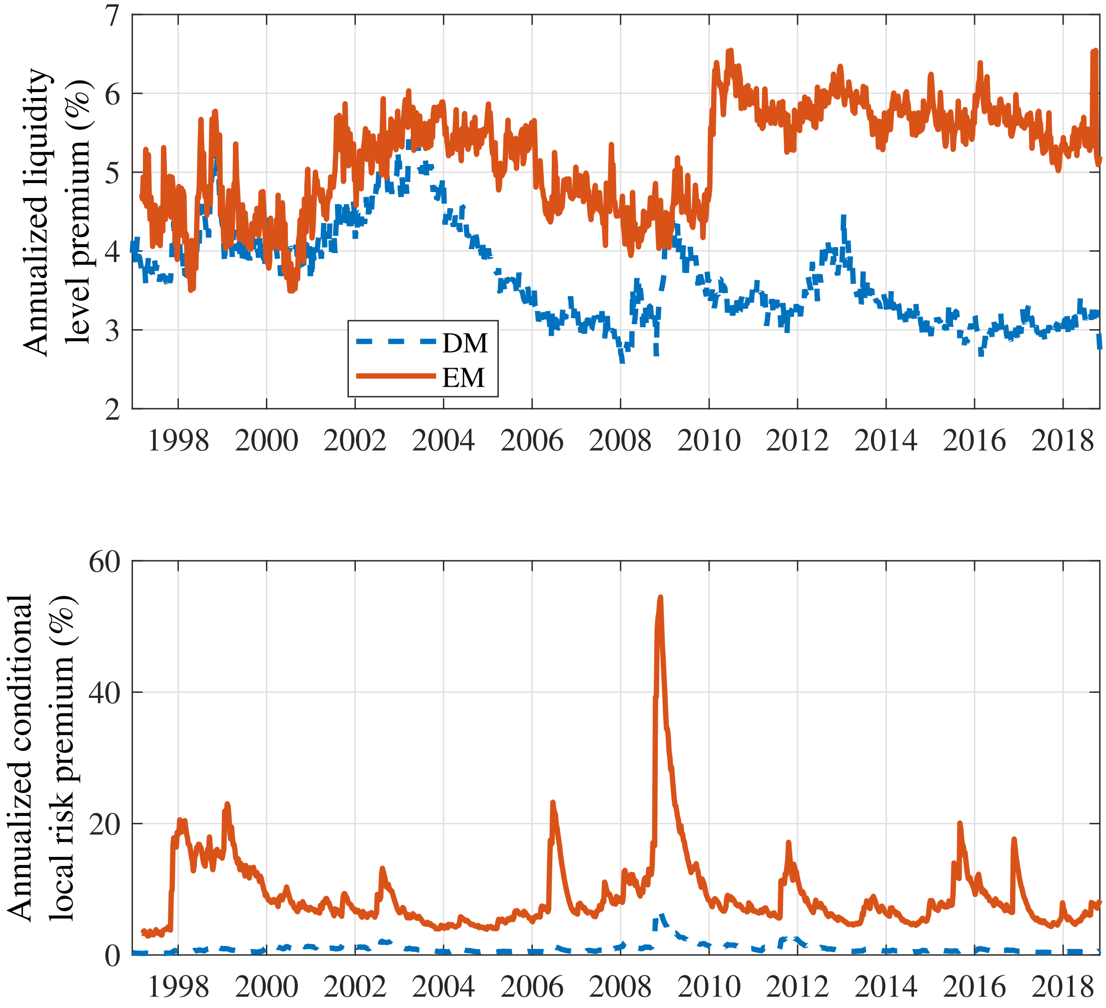

Figure 4
Cross-sectional average risk premiums using the volatility-adjusted FHT as a bid-ask spread proxy
We report liquidity level and unspanned local risk premiums over time. The top graph reports on the annualized liquidity level premium

$$52 \times \kappa_{N^k} E_t \left[c_{N^k,t+1} \right],$$

in percent. The bottom graph reports on the annualized unspanned local risk premium

$$52 \times \pi_{N^k} var_t \left(r^{net}_{N^k,t+1} \right) \left(1 - II_{N^k_t} \right)$$

in percent. In each graph, we compute the cross-sectional equal-weighted average each week across DMs (dashed line) and EMs (continuous line). We report the cross-sectional averages when at least five countries are available. Model estimates are reported in Table 6. The data are weekly from 1997 to 2018.

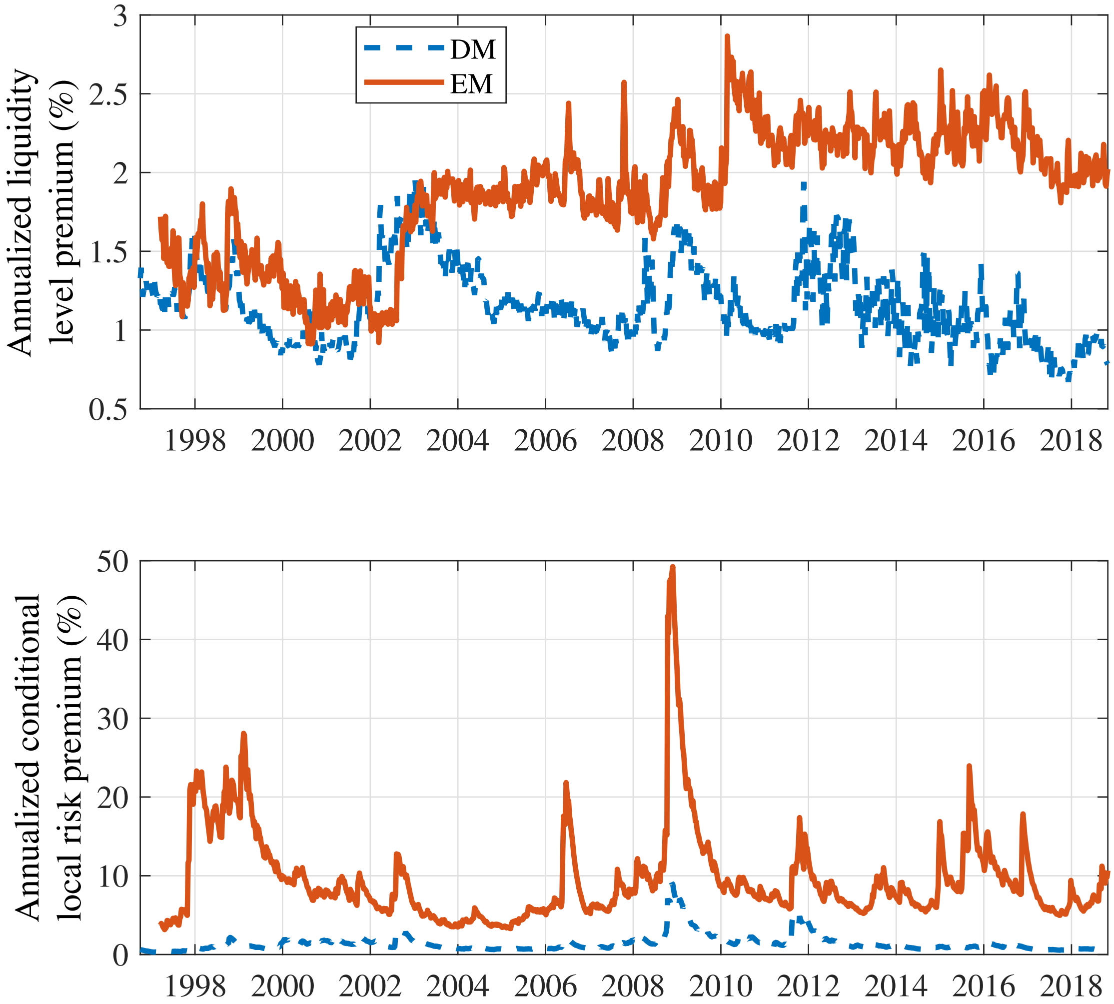

Figure 5

Cross-sectional average risk premiums using FHT as a bid-ask spread proxy and all stocks

We report liquidity level and unspanned local risk premiums over time. The top graph reports on the annualized liquidity level premium

$$52 \times \kappa_{N^k} E_t \left[c_{N^k,t+1} \right],$$

in percent. The bottom graph reports on the annualized unspanned local risk premium

$$52 \times \pi_{N^k} var_t \left(r^{net}_{N^k,t+1} \right) \left(1 - II_{N^k_t} \right)$$

in percent. In each graph, we compute the cross-sectional equal-weighted average each week across DMs (dashed line) and EMs (continuous line). We report the cross-sectional averages when at least five countries are available. Model estimates are reported in Table 7. The data are weekly from 1997 to 2018.

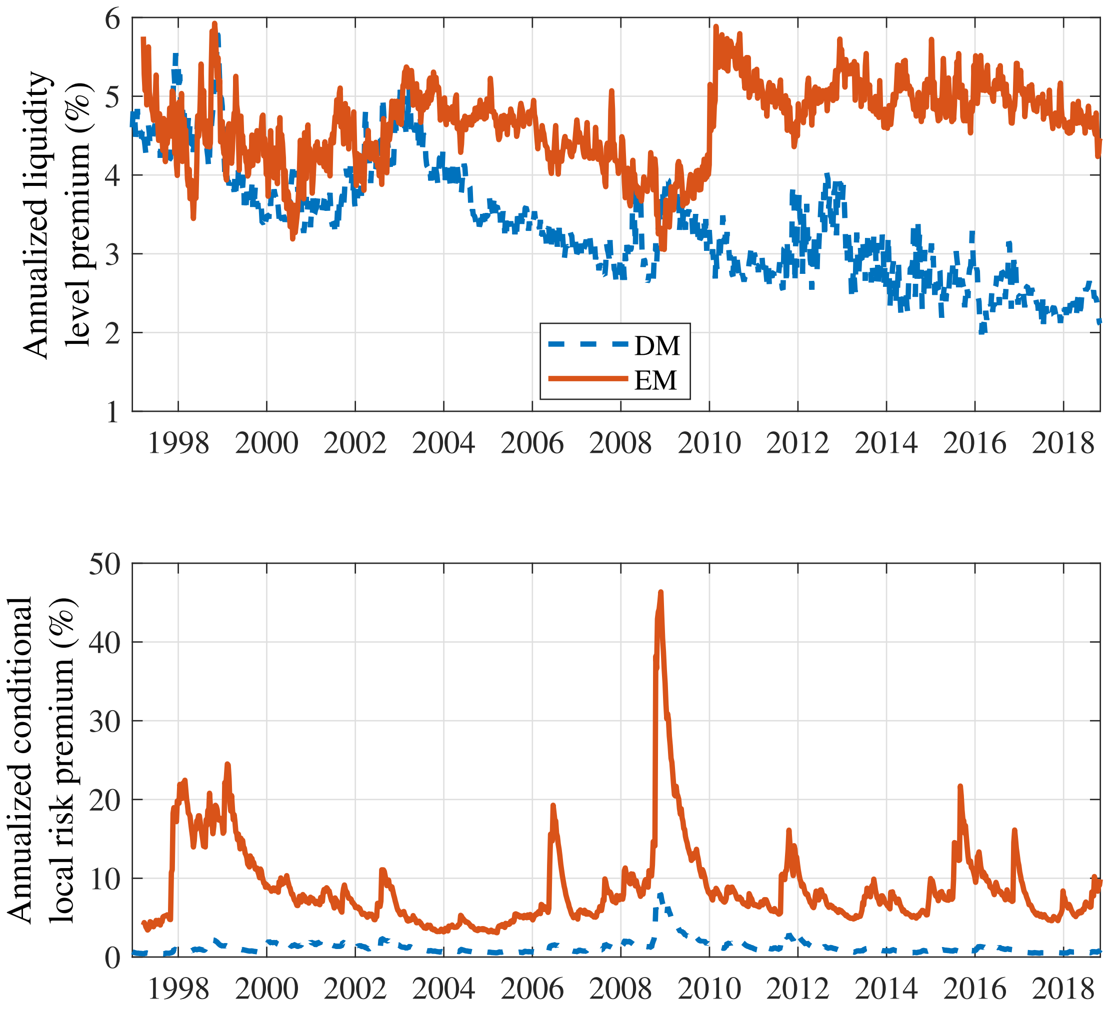

Figure 6

Cross-sectional average risk premiums using the volatility-adjusted FHT as a bid-ask spread proxy and all stocks

We report liquidity level and unspanned local risk premiums over time. The top graph reports on the annualized liquidity level premium

$$52 \times \kappa_{N^k} E_t\left[c_{N^k,t+1}\right],$$

in percent. The bottom graph reports on the annualized unspanned local risk premium

$$52 \times \pi_{N^k} var_t\left(r^{net}_{N^k,t+1}\right)\left(1 - II_{N^k_t}\right)$$

in percent. In each graph, we compute the cross-sectional equal-weighted average each week across DMs (dashed line) and EMs (continuous line). We report the cross-sectional averages when at least five countries are available. Model estimates are reported in Table 7. The data are weekly from 1997 to 2018.

Table 1
Number of securities by country

Country	Start Date	Local Stocks	Depositary Receipts	Direct Listings	Country Funds	ETFs
Argentina	August 94	171	45	69	5	17
Australia	September 96	3,478	175	386	5	9
Austria	March 01	199	7	64	1	1
Belgium	May 96	360	16	110	0	1
Brazil	August 94	525	84	71	5	27
Canada	January 84	5,852	31	5,011	2	33
Chile	January 09	279	37	14	5	16
China	January 96	5,637	41	761	15	73
Colombia	June 04	84	9	10	4	18
Denmark	August 94	323	24	86	0	1
Egypt	March 05	269	16	3	0	2
Finland	August 94	229	27	90	0	1
France	August 94	1,890	114	160	1	6
Germany	August 94	1,399	108	413	1	9
Greece	August 94	419	11	9	2	9
Hong Kong	August 94	2,534	425	1,723	1	10
Hungary	May 01	114	8	33	2	7
India	July 97	4,751	141	40	6	24
Indonesia	August 96	811	15	122	2	11
Ireland	June 00	136	49	231	1	1
Italy	March 04	669	38	189	1	2
Japan	August 94	4,886	213	788	13	43
Malaysia	February 97	1,379	7	134	2	9
Mexico	June 96	111	89	127	7	21
Netherlands	August 94	369	61	279	0	1
New Zealand	August 94	257	16	146	0	1
Norway	August 94	473	22	149	0	2
Philippines	January 98	379	10	14	1	7
Poland	August 01	1,168	7	206	0	3
Portugal	July 96	153	8	20	1	1
Singapore	December 95	1,005	39	89	2	5
South Africa	June 96	1,075	55	134	1	6
South Korea	January 96	3,020	51	15	0	6
Spain	August 94	398	38	82	2	2
Sweden	August 94	701	55	647	0	1
Switzerland	August 95	528	53	270	0	4
Taiwan	March 02	2,285	82	40	4	23
Thailand	December 95	1,593	719	52	3	8
Turkey	December 03	560	21	198	1	5
U.A.E.	December 08	125	4	17	0	1
U.K.	August 94	4,933	372	1,184	67	14
U.S.	January 84	14,197	132	19,887	0	29

We report the start date and the number of local stocks, depositary receipts, direct listings, country funds, and ETFs by country. The start date reflects the starting date of availability of high and low prices used to compute the high-low proxies of the bid-ask spreads. We define a local stock as a common or ordinary stock traded on a major stock exchange in the same country as its issuing company is incorporated and classified as a major security by S&P Compustat. Depositary receipts include ADRs and GDRs for local stocks traded on an open stock exchange. Direct listings are common or ordinary shares of local companies cross-listed on an open stock exchange. Country funds are any mutual or investment trust traded on an open stock exchange whose long name include either the country name or one of its key region name (Latin America, Asia Pacific, Central European, BRIC, Emerging Asia, Middle East & Africa, and Eastern Europe). ETFs are Exchange Traded Funds traded on an open stock exchange whose long name include either the country name or one of its key region name. Open stock exchange are the following: United States (NYSE, AMEX, NASDAQ, NYSE Arca, and OTC), United Kingdom (London Stock Exchange, SEAQ International, London OTC, and London Plus Markets), Europe (NYSE Euro next Amsterdam, Brussels, Lisbon, and Paris, Deutsche Boerse, XETRA, Luxembourg Stock Exchange, and OTC), Singapore, and Hong Kong.

Table 2
Country-specific investability filters

Country	Investable to all investors	Non-Investable by foreign investors
China	Class B shares from February 19th, 2001	Class A shares
Finland	Free shares	Restricted (RES) shares
Indonesia	Alien Market	
Malaysia	Alien Market and CLOB shares	
Mexico	Class B, C, L, CPO	Class A
Netherlands	CVA shares	
Norway	Free shares	Restricted (RES) shares
Philippines	Class B	Class A
Singapore	Alien Market	
Sweden	Free shares	Bunda and Restricted (RES) shares
Thailand	Alien Market	

We report country-specific name filters used to determine whether a stock is investable or non-investable. The second column reports keywords (along with the time period during which it is applied, if any) for investable stocks. The third column reports keywords (along with the time period during which it is applied, if any) for non-investable stocks. We search for these keywords in the issue description on Compustat (*dsci*).

Table 3
Summary statistics for emerging market portfolios

			Return		*FHT*			*CS*			*AR*		
Country	Portfolio	Nb of stocks	Avg.	St.Dev.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.
Argentina	Non-investable	35	7.48	34.98	0.70	0.51	43.74%	0.55	0.31	-6.23%	1.06	0.48	5.78%
	Investable	11	12.54	38.70	0.48	0.46		0.59	0.34		1.00	0.51	
Brazil	Non-investable	138	15.06	35.92	0.42	0.44	60.24%	0.78	0.33	-1.77%	1.12	0.49	9.14%
	Investable	29	19.35	42.08	0.27	0.56		0.80	0.44		1.03	0.70	
Chile	Non-investable	46	11.84	20.02	0.19	0.15	413.93%	0.45	0.14	-14.02%	0.61	0.21	3.97%
	Investable	8	8.68	20.23	0.04	0.10		0.53	0.21		0.58	0.25	
China	Non-investable	3,323	8.88	28.94	0.14	0.06	-18.91%	0.86	0.30	5.46%	0.90	0.39	-1.28%
	Investable	73	14.90	31.64	0.18	0.15		0.81	0.32		0.92	0.42	
Colombia	Non-investable	12	17.89	25.67	0.49	0.35	82.02%	0.34	0.20	-23.08%	0.71	0.35	3.79%
	Investable	3	20.38	31.86	0.27	0.48		0.44	0.36		0.68	0.58	
Egypt	Non-investable	150	6.46	28.23	0.31	0.24	168.55%	0.82	0.31	11.91%	0.74	0.30	31.76%
	Investable	3	6.14	32.12	0.12	0.24		0.73	0.36		0.56	0.35	
Greece	Non-investable	90	-1.56	33.84	0.43	0.23	56.65%	0.86	0.34	2.54%	1.15	0.56	4.19%
	Investable	2	-6.10	49.46	0.28	0.51		0.84	0.57		1.11	0.86	
Hungary	Non-investable	23	13.90	24.78	0.52	0.36	285.76%	0.59	0.29	0.86%	1.17	0.47	49.86%
	Investable	3	14.85	33.03	0.13	0.21		0.59	0.31		0.78	0.41	
India	Non-investable	2,233	13.55	28.30	0.07	0.07	208.38%	0.96	0.32	18.18%	0.96	0.34	15.54%
	Investable	19	13.99	30.86	0.02	0.06		0.81	0.38		0.83	0.43	
Indonesia	Non-investable	435	22.38	35.80	1.46	1.00	104.38%	0.61	0.22	9.97%	1.41	0.68	50.13%
	Investable	8	23.07	42.11	0.71	0.76		0.55	0.34		0.94	0.57	
Malaysia	Non-investable	646	12.26	18.89	0.78	0.27	24.24%	0.42	0.15	6.32%	0.82	0.27	18.09%
	Investable	6	12.57	22.70	0.63	0.61		0.40	0.23		0.70	0.41	
Mexico	Non-investable												
	Investable	37	10.16	29.30	0.24	0.34		0.61	0.30		0.82	0.36	
Philippines	Non-investable	163	13.34	27.71	1.13	0.72		0.42	0.16		1.05	0.31	
	Investable												
Poland	Non-investable	346	13.63	27.81	0.40	0.19		0.67	0.20		0.98	0.27	
	Investable												

			Return		*FHT*			*CS*			*AR*		
Country	Portfolio	Nb of stocks	Avg.	St.Dev.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.
Continued...													
South Africa	Non-investable	173	11.21	27.49	0.47	0.26	161.39%	0.67	0.31	-5.04%	0.92	0.32	8.55%
	Investable	30	13.57	31.07	0.18	0.24		0.71	0.33		0.84	0.37	
South Korea	Non-investable	2,013	13.89	34.94	0.40	0.18	45.38%	0.99	0.31	40.04%	1.21	0.45	27.16%
	Investable	14	21.97	34.55	0.27	0.29		0.70	0.33		0.95	0.55	
Taiwan	Non-investable	1,685	7.94	21.85	0.42	0.18	10.98%	0.57	0.16	18.85%	0.88	0.27	13.31%
	Investable	9	9.53	24.04	0.38	0.29		0.48	0.19		0.78	0.34	
Thailand	Non-investable	508	14.89	28.14	0.92	0.41	34.47%	0.54	0.22	5.60%	1.00	0.46	11.01%
	Investable	10	17.28	31.21	0.68	0.62		0.51	0.29		0.90	0.57	
Turkey	Non-investable	374	12.18	33.30	0.65	0.33	25.61%	0.73	0.21	4.04%	0.91	0.31	4.76%
	Investable	9	15.95	40.45	0.52	0.60		0.70	0.33		0.87	0.48	
U.A.E.	Non-investable	46	14.32	23.08	0.55	0.27		0.47	0.24		0.79	0.36	
	Investable												

We report summary statistics for portfolios in each emerging market; one that includes all available non-investable local stocks and one that contains all available investable local stocks. For each portfolio, we report the number of stocks at the end of our sample period in October 2018, the annualized average and volatility of weekly returns, the average and volatility of all bid-ask spread proxies, and the percentage difference in average bid-ask spread between non-investable and investable portfolios relative to the average bid-ask spread of the investable portfolio. We report on our main bid-ask spread proxy, the FHT measure, and the high-low proxy of Corwin and Schultz (2012) and the high-low proxy of Abdi and Ranaldo (2017). Each week, we classify a local stock as investable if there exists an available direct listing or a depositary receipt listed on an open market with a valid price at the end of the previous week. Start dates, reported in Table 1, differ across countries.

Table 4
Summary statistics for developed market portfolios

			Return		*FHT*			*CS*			*AR*		
Country	Portfolio	Nb of stocks	Avg.	St.Dev.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.
Australia	Non-investable	1,001	10.01	21.86	0.44	0.11	283.43%	0.52	0.18	26.67%	0.84	0.27	44.02%
	Investable	77	10.96	22.83	0.11	0.12		0.41	0.17		0.58	0.30	
Austria	Non-investable	25	12.25	23.93	0.15	0.13	85.55%	0.61	0.25	-7.76%	0.85	0.40	-0.27%
	Investable	12	14.43	27.14	0.08	0.17		0.67	0.32		0.86	0.48	
Belgium	Non-investable												
	Investable	90	9.45	21.11	0.12	0.12		0.56	0.27		0.70	0.36	
Canada	Non-investable	391	11.17	16.84	0.68	0.28	124.90%	0.55	0.26	9.20%	0.90	0.31	30.97%
	Investable	1,168	9.26	19.52	0.30	0.28		0.50	0.28		0.69	0.33	
Denmark	Non-investable	86	12.50	19.51	0.39	0.24	125.34%	0.56	0.22	-4.25%	0.83	0.36	16.43%
	Investable	12	12.75	23.38	0.17	0.27		0.59	0.40		0.71	0.49	
Finland	Non-investable	96	8.66	24.93	0.38	0.24	384.42%	0.64	0.26	-5.96%	1.01	0.42	18.48%
	Investable	8	13.75	36.18	0.08	0.21		0.68	0.43		0.85	0.58	
France	Non-investable												
	Investable	522	9.76	20.81	0.11	0.07		0.64	0.27		0.77	0.40	
Germany	Non-investable												
	Investable	401	8.86	21.89	0.08	0.12		0.58	0.32		0.72	0.38	
Hong Kong	Non-investable												
	Investable	1,471	9.86	24.24	0.39	0.19		0.64	0.25		0.87	0.36	
Ireland	Non-investable												
	Investable	21	6.99	29.96	0.31	0.40		0.86	0.55		1.18	0.77	
Italy	Non-investable	220	6.71	21.34	0.10	0.08	77.51%	0.67	0.22	13.94%	0.75	0.29	9.80%
	Investable	19	3.93	26.37	0.06	0.09		0.59	0.29		0.68	0.42	
Japan	Non-investable	3,351	6.06	18.68	0.25	0.10	45.65%	0.60	0.19	8.92%	0.90	0.36	10.61%
	Investable	176	4.83	20.89	0.17	0.13		0.56	0.21		0.81	0.39	
Netherlands	Non-investable												
	Investable	89	10.31	20.57	0.09	0.08		0.53	0.26		0.63	0.34	
New Zealand	Non-investable	81	13.48	17.72	0.72	0.33		0.22	0.09		0.63	0.20	
	Investable												

			Return		*FHT*			*CS*			*AR*		
Country	Portfolio	Nb of stocks	Avg.	St.Dev.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.	Avg.	St.Dev.	Ratio of avg.
Continued...													
Norway	Non-investable	130	12.41	27.96	0.54	0.23	195.60%	0.67	0.25	29.96%	1.09	0.38	54.02%
	Investable	12	13.77	28.50	0.18	0.29		0.51	0.28		0.71	0.44	
Portugal	Non-investable												
	Investable	30	6.71	22.83	0.26	0.23		0.52	0.23		0.70	0.32	
Singapore	Non-investable												
	Investable	263	8.04	21.37	0.65	0.26		0.47	0.20		0.88	0.35	
Spain	Non-investable	99	6.21	22.64	0.20	0.13	148.62%	0.69	0.24	12.41%	0.80	0.33	18.12%
	Investable	20	7.35	26.21	0.08	0.12		0.61	0.30		0.68	0.40	
Sweden	Non-investable	359	11.89	25.90	0.46	0.28	95.11%	0.66	0.27	18.97%	0.95	0.38	28.59%
	Investable	7	14.99	27.44	0.24	0.43		0.56	0.33		0.74	0.48	
Switzerland	Non-investable	155	11.71	18.10	0.23	0.12	151.92%	0.53	0.22	15.65%	0.73	0.32	37.42%
	Investable	28	8.26	19.05	0.09	0.14		0.46	0.25		0.53	0.31	
U.K.	Non-investable												
	Investable	1,169	8.07	18.59	0.15	0.09		0.69	0.28		0.71	0.33	
U.S.	Non-investable												
	Investable	3,881	12.13	15.91	0.21	0.20		0.57	0.26		0.73	0.33	

We report summary statistics for portfolios in each developed market; one that includes all available non-investable local stocks and one that contains all available investable local stocks. For each portfolio, we report the number of stocks at the end of our sample period in October 2018, the annualized average and volatility of weekly returns, the average and volatility of all bid-ask spread proxies, and the percentage difference in average bid-ask spread between non-investable and investable portfolios relative to the average bid-ask spread of the investable portfolio. We report on our main bid-ask spread proxy, the FHT measure, and the high-low proxy of Corwin and Schultz (2012) and the high-low proxy of Abdi and Ranaldo (2017). Each week, we classify a local stock as investable if there exists an available direct listing or a depositary receipt listed on an open market with a valid price at the end of the previous week. Open markets contain only investable stocks. Start dates, reported in Table 1, differ across countries.

Table 5
Model estimates using FHT as a bid-ask spread proxy

Panel A: Models for world and open markets

		Liquidity level κ *(i)*	World price of risk γ *(ii)*
On gross returns	coefficient	0.00	2.45
	t-ratio	(0.00)	(1.98)
On net returns	coefficient	0.00	2.46
	t-ratio	(0.00)	(1.99)
Model selection	p-value	0.37	

Panel B: Models for partially segmented markets

		Liquidity level κ_{N^k}		Price of unspanned local risk π_{N^k}	
		DM *(i)*	EM *(ii)*	DM *(iii)*	EM *(iv)*
On gross returns	average coefficient	0.08	0.21	0.26	2.16
	proportion	45.45%	57.89%	18.18%	52.63%
On net returns	average coefficient	0.08	0.21	0.26	2.18
	proportion	45.45%	57.89%	18.18%	52.63%
Model selection	proportion	0%	5.26%		

We report model estimates using FHT as a bid-ask spread proxy. In Panel A, we report model estimates of the system of equations (8) for the world and open markets. We report coefficients as well as their t-ratios below in parentheses. In Panel B, we report average model estimates of the system of equations (11). We report the average coefficient across DMs and across EMs as well as the proportion of countries for which each coefficient is significant at the 10% level. In both panels, we estimate the system of equations with returns gross of transaction costs (i.e., no liquidity risk) on the right-hand side of the return equations and with returns net of transaction costs (i.e., with liquidity risk). We use the Vuong (1989) test for non-nested models to see whether the model with liquidity risk has a significantly better fit. We report the test p-value in the row *Model selection* in Panel A and the proportion of countries with a p-value smaller than 10% in Panel B. Data are weekly from 1997 to 2018.

Table 6
Model estimates using the volatility-adjusted FHT as a bid-ask spread proxy

Panel A: Models for world and open markets

		Liquidity level κ *(i)*	World price of risk γ *(ii)*
On gross returns	coefficient	0.00	3.28
	t-ratio	(0.00)	(2.62)
On net returns	coefficient	0.00	3.34
	t-ratio	(0.01)	(2.66)
Model selection	p-value	0.44	

Panel B: Models for partially segmented markets

		Liquidity level κ_{N^k}		Price of unspanned local risk π_{N^k}	
		DM *(i)*	EM *(ii)*	DM *(iii)*	EM *(iv)*
On gross returns	average coefficient	0.24	0.35	0.21	2.18
	proportion	100.00%	100.00%	18.18%	57.89%
On net returns	average coefficient	0.24	0.35	0.21	2.14
	proportion	100.00%	100.00%	18.18%	57.89%
Model selection	proportion	0%	5.26%		

We report model estimates using the volatility-adjusted FHT as a bid-ask spread proxy. To orthogonalize the bid-ask spread proxy, we (i) estimate a GARCH model on weekly returns, (ii) regress the proxy on a constant and the demeaned conditional return volatilities, and (iii) compute the difference between the FHT measure and the product of demeaned conditional volatility and its regression coefficient. In Panel A, we report model estimates of the system of equations (8) for the world and open markets. We report coefficients as well as their t-ratios below in parentheses. In Panel B, we report average model estimates of the system of equations (11). We report the average coefficient across DMs and across EMs as well as the proportion of countries for which each coefficient is significant at the 10% level. In both panels, we estimate the system of equations with either returns gross of transaction costs (i.e., no liquidity risk) on the right-hand side of the return equations and with returns net of transaction costs (i.e., with liquidity risk). We use the Vuong (1989) test for non-nested models to see whether the model with liquidity risk has a significantly better fit. We report the test p-value in the row *Model selection* in Panel A and the proportion of countries with a p-value smaller than 10% in Panel B. Data are weekly from 1997 to 2018.

Table 7
Model estimates with all stocks as non-investables

		Liquidity level κ_{N^k}		Price of unspanned local risk π_{N^k}	
		DM	EM	DM	EM
		(i)	*(ii)*	*(iii)*	*(iv)*
Panel A: Using FHT					
On net returns	average coefficient	0.14	0.22	0.29	2.78
	proportion	33.33%	55.00%	16.67%	60.00%
Panel B: Using volatility-adjusted FHT					
On net returns	average coefficient	0.33	0.41	0.26	2.22
	proportion	100.00%	90.00%	16.67%	55.00%

We report average model estimates of the system of equations (11). We report the average coefficient across DMs and across EMs as well as the proportion of countries for which each coefficient is significant at the 10% level. Panels A-B report these results with the FHT, and volatility-adjusted FHT, respectively. Data are weekly from 1997 to 2018.

Table 8

Economic sources of the liquidity level premium and the unspanned local market risk premium

	Model (1) Institutional Environment & Institutional Ownership		**Model (2)** Market quality		**Model (3)** Investor sentiment		**Model (4)** Full model	
Dependent variable	*LLP*	*LMRP*	*LLP*	*LMRP*	*LLP*	*LMRP*	*LLP*	*LMRP*
POL	7.57***	−7.17					7.78***	−8.01
	(4.52)	(−1.00)					(6.87)	(−1.14)
DISC	−0.05***	−0.14**					−0.03**	−0.10**
	(−2.60)	(−2.31)					(−2.49)	(−1.96)
A-DIR	−0.26	1.24					−0.16	1.53
	(−1.08)	(1.40)					(−0.68)	(1.62)
FIO	−9.52***	−24.12					−10.86**	−29.92
	(−2.67)	(−1.30)					(−2.27)	(−1.64)
IIO	1.58	12.13					1.00	11.98
	(0.55)	(1.14)					(0.49)	(1.16)
D_{SSL}			−1.07*	−4.04			−1.28**	−3.64*
			(−1.70)	(−1.45)			(−2.32)	(−1.84)
D_{SSP}			1.15**	−1.02			0.53	0.60
			(2.33)	(−0.39)			(1.07)	(0.37)
ITR			−0.13	−1.07			−0.36**	−0.78
			(−0.88)	(−1.31)			(−2.34)	(−1.39)
SENT					−0.37***	−1.05**	−0.52***	−1.45**
					(−3.07)	(−2.09)	(−3.34)	(−2.36)
Control variables								
MC/GDP	1.59***	2.81*	0.74*	−0.11	0.06	−0.57	1.49***	3.24*
	(3.61)	(1.70)	(1.80)	(−0.07)	(0.16)	(−0.49)	(4.47)	(1.96)
TRADE/GDP	−0.50	1.49	−0.20	−1.70	0.94	−6.74**	0.03	3.06
	(−0.85)	(0.56)	(−0.22)	(−0.34)	(1.31)	(−2.32)	(0.06)	(0.98)
Δ_{FX}	−0.48	−34.82***	0.23	−10.62	0.52	−7.35	−0.90	−40.52***
	(−0.48)	(−3.09)	(0.56)	(−1.24)	(1.14)	(−1.23)	(−0.80)	(−2.95)
σ_{FX}	−7.29	229.07***	10.18	120.70**	1.45	23.50	−2.56	289.68***
	(−0.52)	(3.78)	(0.80)	(2.12)	(0.13)	(0.38)	(−0.18)	(4.43)
LVOL	20.27**	203.33*	1.55	227.49**	8.01	241.34***	14.18**	190.96*
	(2.22)	(1.79)	(0.16)	(2.15)	(0.84)	(2.62)	(2.35)	(1.69)
INT	0.06	0.66***	0.01	0.00	0.00	0.02	0.09*	0.77***
	(1.07)	(4.32)	(0.53)	(−0.04)	(0.21)	(0.24)	(1.66)	(5.06)
VIX	0.01	0.00	0.04***	−0.02	0.02**	−0.09	0.01	−0.04
	(0.78)	(−0.05)	(2.86)	(−0.28)	(2.06)	(−1.60)	(0.64)	(−0.53)
is EM			1.40***	4.61	0.56	5.11***		
			(2.66)	(1.51)	(1.02)	(2.84)		
Nb. obs.	18, 182	18, 182	24, 837	24, 837	25, 727	25, 727	15, 850	15, 850
Adj. R^2	0.35	0.44	0.17	0.35	0.03	0.29	0.50	0.45

The table reports the estimated coefficients from panel regressions of LLP and LMRP on proxies for institutional environment and institutional ownership type, market quality, investor sentiment, and other controls. LLP and LMRP are estimated from the system of equations (11). The panel regressions are based on the general equation below,

$$Y_{k,t} = \beta_0 + \beta_1 IE_{k,t-1} + \beta_2 IO_{k,t-1} + \beta_3 MQ_{k,t-1} + \beta_4 SENT_{t-1} + \beta_5 X_{k,t-1} + \upsilon_{k,t},$$

where Y is either LLP or LMRP, β_0 is a constant, IE is the vector of variables proxying the institutional environment (POL, DISC, A-DIR), IO is the vector of variables proxying the institutional ownership type (FIO, IIO), MQ is the vector of variables proxying market quality (D_{SSL}, D_{SSP}, ITR), $SENT$ is the variable proxying investor sentiment, X is the vector of control variables $(MC/GDP,\ TRADE/GDP,\ \Delta_{FX}, \sigma_{FX}, LVOL, INT, VIX, D_{EM})$. We run unbalanced panel regressions as not all the explanatory variables are available for all countries. All explanatory variables are lagged. t-ratios appear below their corresponding coefficients and are obtained from standard errors that are clustered by country and time. The sample period is weekly from 1997 to 2018. Definition of variables and data source are in Section 5.1.