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The determinants and pricing of liquidity commonality around the world ☆

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ABSTRACT

In this paper, we examine the determinants and pricing of liquidity commonality using intraday data from 39 markets over 15 years. We show that liquidity commonality is driven by both market-level and firm-level factors. Liquidity commonality is higher in weaker and more-volatile economic and financial environments, in areas with poor investor protection, and in opaque information environments. Liquidity commonality is also affected by cultural and behavioral factors, including individualism and uncertainty avoidance. Moreover, we find that liquidity commonality is priced in the world's stock markets and that the pricing effect is stronger in developed markets.

1. Introduction

The determinants and pricing of stock liquidity commonality have important implications for international asset pricing (Chordia et al., 2000, 2011). Recent research using single-market and multiple-market datasets finds that liquidity commonality is a pervasive global phenomenon (e.g., Karolyi et al., 2012). However, research to discover the determinants of liquidity commonality and revealing its pricing effects is still in its infancy. Following Chordia et al. (2000), who first recognized the existence of liquidity commonality, two new research questions have become relevant with regard to the determinants and pricing of liquidity commonality.[1]

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[1] Chordia et al. (2008, 2011) highlight how the timely reactions of investors to new information depend on market liquidity. They propose that the inventory risk of market makers with limited risk-bearing capacity creates temporary mispricing and that arbitrage trading depends on the cost of trading (e.g., bid-ask spreads). Chordia et al. (2000) argue that liquidity has common components arising from systematic changes in trading volume, volatility, and

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First, what market- and firm-level factors have contributed to the variations in liquidity commonality around the world? Answers to this question will help us understand the driving forces behind liquidity commonality and help explain how and why it varies between markets and firms. The second important question concerns whether and how liquidity commonality is priced. A better understanding of the role of liquidity commonality in asset pricing would change the paradigm of asset pricing models (e.g., Acharya and Pedersen, 2005) and the trading strategies of investors.

Using transaction data from 39 markets over the 1996–2010 period, we investigate the determinants and pricing of liquidity commonality. First, we examine what drives liquidity commonality around the world and identify both market-level and firm-level factors. Specifically, these factors include economic and financial conditions, the quality of investor protection, the information environment, and the cultural and behavioral characteristics of investors. Second, we examine whether liquidity commonality is priced. As a component of liquidity risk, the pricing of liquidity commonality has important implications for asset pricing, as it adds an additional dimension of risk for international investors to consider when investing in international portfolios. In addition, we explore how the pricing of liquidity commonality varies across markets.

We distinguish our paper from previous studies in the following ways. First, we extend the valuable work of Chordia et al. (2000) to international markets. Using one-year transaction data from U.S. markets, Chordia et al. (2000) document co-movements in liquidity. Because of data limitations with respect to international markets, studies of liquidity commonality in international markets primarily use liquidity proxies that are estimated with daily data. For example, Lee (2011) uses the share of zero return days out of all trading days, a measure first proposed by Lesmond et al. (1999). Karolyi et al. (2012) use the ratio of absolute daily returns to daily trading volume, an illiquidity measure proposed by Amihud (2002). Although these low-frequency measures are good proxies, they may capture only part of the liquidity effect.[2] In contrast, our illiquidity measure is calculated from the intraday quote and trade data, which capture the investors' transaction costs more precisely than the low-frequency proxies. Because of the debates on how efficiently and accurately daily liquidity measures can measure liquidity (Goyenko et al., 2009), we show the determinants of commonality of liquidity calculated from transaction data. Using liquidity measured by the bid-ask spread, our results complement the findings of Chordia et al. (2000) and Karolyi et al. (2012). Our results are also consistent with the work of Brockman et al. (2009), who investigate liquidity commonality around the world using transaction data. However, our sample period covers 15 years, from January 1996 through December 2010, whereas their sample only includes data for 21 months, from October 2002 through June 2004. Our longer sample period produces more-robust results that are less likely to be influenced by short-lived economic conditions.

Second, Karolyi et al. (2012) test market-level determinants from two perspectives: funding supply and investors' demand. Our market-level tests show the effects of the economic and financial environment, investor protection and the information environment, and investors' behavioral measures. In Karolyi et al. (2012), the economic and financial environment generally affects funding supply and is close to the supply-side determinants, while investor protection and the information environment are discussed among the demand-side determinants—but our measures do not repeat theirs. We include many different measures to show the effect of these determinants. Moreover, the effect of investors' behavior on liquidity commonality was not tested in the previous studies, to the best of our knowledge. We find that liquidity commonality is higher in markets that are characterized by weaker and more-volatile economic and financial conditions, lower investor protection, and opaque information environments. Most importantly, our study is the first to provide evidence of the effects of behavioral factors on liquidity commonality. We find that commonality is greater in markets in which investors are characterized by lower levels of individualism and masculinity and greater levels of power distance and uncertainty avoidance.

In addition, we investigate the firm-level determinants of liquidity commonality. We show that correlated trading, firm-level transparency, and stock performance all have a significant association with liquidity commonality. The correlated trading captured by domestic institutional ownership is positively related to liquidity commonality, whereas there is no such effect for foreign institutional ownership. Firms with greater transparency have lower levels of liquidity commonality, suggesting that information asymmetry increases co-movements in liquidity. We find that liquidity commonality is positively associated with analyst forecast error and negatively associated with analyst coverage.

Third, we provide evidence that the liquidity risk arising from liquidity commonality is priced, which complements the studies of liquidity risk pricing by Acharya and Pedersen (2005) for the U.S. market and by Lee (2011) for the international market. In fact, researchers have shown an increasing interest in the pricing effects of liquidity risk. However, most papers focus on the pricing effect of covariance between stock returns and market liquidity (e.g., Pastor and Stambaugh, 2003). Acharya and Pedersen (2005), who employ a liquidity-adjusted capital asset pricing model (CAPM), propose three sources of liquidity risk: the covariance of stock liquidity and market liquidity, the covariance of stock return and market liquidity, and the covariance of stock liquidity and market return. They argue that investors require compensation for holding a security that becomes illiquid (more difficult to trade) when the market in general is illiquid. In other words, investors would prefer stocks whose liquidity has low levels of covariance with market liquidity. However, empirical tests do not support this prediction. Acharya and Pedersen (2005) find that most of the pricing effect is derived from the sensitivity of liquidity to market returns and that the covariance of stock liquidity and market liquidity has no effect on pricing.

(*footnote continued*)
the participants' risk preferences.

[2] Goyenko et al. (2009) provide a thorough discussion of the effectiveness of various low-frequency liquidity proxies.

Lee (2011) extends the study to international markets and still finds little evidence that co-movements in liquidity affect future stock returns. These empirical results are surprising, given Acharya and Pedersen's (2005) theoretical work. In this paper, we retest the asset pricing of liquidity commonality. We set up our tests differently than Acharya and Pedersen (2005) and Lee (2011) in that we use bid-ask spreads rather than low-frequency liquidity proxies. As previously discussed, the bid-ask spread will capture total transaction costs more directly and accurately than low-frequency liquidity proxies. We find that liquidity commonality is priced in the world stock markets and that the pricing effect is stronger in developed markets.

Our paper contributes to the literature in several significant ways. First, in this study we apply high-frequency liquidity measures to international markets and provide evidence of co-movements in liquidity in the global stock markets with a long sample period. Second, we show that liquidity commonality is priced, and we provide complementary evidence of the pricing of liquidity risk. Third, we consolidate tests of the patterns of commonality, its determinants, and the pricing of liquidity commonality. Finally, we find that liquidity commonality is affected by behavioral factors and by a firm's earning opacity. Therefore, our results complement Chordia et al. (2000), Karolyi et al. (2012), and other previous studies on liquidity commonality, and we offer a comprehensive analysis of the market-level and firm-level determinants and the pricing impact of liquidity commonality.

The remainder of the paper is organized as follows. In Section 2, we outline the research hypotheses derived from the previous literature. In Section 3, we describe the data and empirical methodologies used. In Section 4, we present the results of the determinants and pricing of liquidity commonality. We conclude in Section 5.

2. Related literature and development of hypotheses

2.1. Liquidity and liquidity commonality

One important function of financial markets is to provide liquidity. Bid and ask prices are established by providers of trading immediacy (e.g., market makers), and a bid-ask spread is a direct measure of the cost of an immediate transaction. Microstructure theories have illuminated several factors that determine the bid-ask spread of a security, such as inventory cost, asymmetric information, and order processing cost (e.g., Garman, 1976; Stoll, 1978; Amihud and Mendelson, 1980; Ho and Stoll, 1981, 1983; Kyle, 1985; Easley and O'Hara, 1987; Admati and Pfleiderer, 1988). However, these costs arise from the transaction processing of individual assets.

Chordia et al. (2000) are among the first to study the common determinants and correlated movements of liquidity. They document that the bid-ask spreads for individual stocks co-move with market- and industry-wide liquidity. Hasbrouck and Seppi (2001) find a single common factor behind the liquidity of the Dow 30 stocks. Huberman and Halka (2001) use 254 daily observations of 240 randomly selected NYSE stocks to document the presence of a systematic component in both spread and depth, which is a commonality that cannot be explained by inventory risk or asymmetric information.

For the international markets, Brockman et al. (2009) study 21 months of transaction data from 47 stock exchanges, finding both exchange-level and global commonality in liquidity. Using daily data from a longer sample period, Karolyi et al. (2012) find commonality in liquidity in most stock markets around the world. In this paper, we study liquidity commonality around the world using transaction data from 39 markets over 15 years. We thus contribute to the literature by documenting the importance of liquidity commonality in international stock markets.

2.2. The determinants of liquidity commonality

Researchers offer various hypotheses of why liquidity co-moves. Such hypotheses involve noise trading effects (Huberman and Halka, 2001), liquidity demand heterogeneity (Fernando, 2003), macroeconomic announcements (Brockman et al., 2009), market volatility (Hameed et al., 2010), institutional stock ownership (Kamara et al., 2008), and country-level supply-side and demand-side factors (Karolyi et al., 2012). However, these papers primarily focus on market-level determinants. In this paper, we hypothesize that liquidity commonality is determined by specific market-level factors and firm-specific characteristics.

2.2.1. Market-level determinants

We study market-level determinants from three perspectives: the economic and financial environment, the information environment and investor protection, and culture and behavioral factors.

First, the economic and financial environment affects liquidity commonality due to its effect on both funding supply and investor trading behavior. When economic and financial risk increases, financial intermediaries shift their investments from higher-risk to lower-risk securities because of funding constraints—a phenomenon known as the "flight to quality" effect (Brunnermeier and Pedersen, 2009; Comerton-Forde et al., 2010; Naes et al., 2011). Vayanos (2004) argues that increased market volatility increases the correlated trading of institutions and exerts pressure on market makers' inventories across many stocks. Furthermore, Hameed et al. (2010) find that market declines decrease stock liquidity and increase liquidity commonality. Brockman et al. (2009) find that macroeconomic announcements increase liquidity commonality. Moreover, Naes et al. (2011) observe a strong relation between stock-market liquidity and the business cycle, and they find that stock-market liquidity evaporates during economic downturns. Using unique data from the German stock market, Rosch and

Kaserer (2013) also find that liquidity commonality increases during market downturns and during periods of decreased funding liquidity. We predict that liquidity commonality will increase when economic and financial environments are volatile and downward moving. In addition, compared with a highly developed banking industry, a less developed banking industry is associated with lower investment and capital allocation efficiency (Levine, 2002), which may entail a less developed stock market (La Porta et al., 1997) and lower economic growth (Beck et al., 2000). In such markets, investors may follow market trends to minimize the risk that arises from inefficiencies in investment and capital allocation. We use the ratio of private credit to GDP as a measure of banking industry development to test this prediction.

Second, liquidity commonality should decrease with the level of informational transparency and investor protection. Chordia et al. (2000) argue that information asymmetry may be a contributory factor to liquidity commonality. In a market with high levels of information asymmetry, private information is restricted to insiders, and general investors have little information on which to base their trading decisions (Lai et al., 2009). The lack of private information could cause investors to engage in herd trading, hence increasing liquidity commonality. Karolyi et al. (2012) find that countries with poor investor protections and low transparency levels have increased liquidity commonality. We hypothesize that liquidity commonality is greater in markets characterized by poor investor protection and poor information environments. Therefore, we test the effect of investor protection on the commonality in liquidity. The adequacy of investor protection plays an important role in the liquidity demands of investors (La Porta et al., 1997, 1998). A reduction in investor protection can lead to a reduction in the quantity and reliability of publicly available information, hence increasing information asymmetry (Brockman and Chung, 2003). Investor protection in a market can be ensured by the presence of a strong securities law system, strong corporate governance transparency, and a low frequency of self-dealing. The presence of a strong securities law system decreases information asymmetry by protecting the securities market against insider expropriation (La Porta et al., 1997, 1998). Strong corporate governance can lead to higher firm valuation (Bebchuk et al., 2009) and lower costs of capital (Shleifer and Vishny, 1997). Transparent corporate governance can help reduce information asymmetry and, hence, reduce liquidity commonality. Furthermore, markets with a high frequency of self-dealing are associated with weaker stock market development (Djankov et al., 2008), which is typically associated with greater information asymmetry, thus leading to increased liquidity commonality.

Third, we are among the first to directly examine the effects of culture and behavioral factors on liquidity commonality. Huberman and Halka (2001) argue that systematic liquidity emerges in the presence of noise traders, who trade on non-information as if they have information. Karolyi, Lee, and van Djik (2012) find that global and local country closed-end fund discounts, an indicator of weak investor sentiment, are negatively associated with commonality in liquidity. We are the first to directly examine the behavioral determinants of liquidity commonality. We use Hofstede's (2001) indices to determine whether higher liquidity commonality is associated with high levels of uncertainty avoidance[3] and collectivistic tendencies[4] and with low levels of masculinity orientation[5] and power distance.[6] First, investors in markets that are characterized by high levels of uncertainty avoidance may be more inclined to trade according to market trends because such investors may view this option as relatively safe, involving minimal uncertainty and risk. Second, an interdependent (independent) self-concept in a collectivistic (individualistic) market could translate into interdependent (independent) trading behavior. Therefore, a collectivistic market may exhibit greater commonality in investor trading behavior and thus higher liquidity commonality. Third, Barber and Odean (2001) show that men tend be more overconfident in financial dealings than women. Therefore, in a market that has higher scores with respect to a masculinity orientation, investors may be more confident about their own decisions, and trading is therefore less highly correlated, compared with markets with weaker masculinity orientation. Fourth, in a market with high levels of power distance, smaller investors may view larger investors as experts and leaders and may thus engage in herding behavior, which results in a higher level of liquidity commonality.

2.2.2. Firm-level determinants

The sensitivity of an individual stock's liquidity to shocks to market liquidity can be firm-specific. Studies of the market-level determinants of liquidity commonality largely ignore firm-level differences in liquidity commonality. Nevertheless, recognizing firm-level differences is important because it facilitates cross-sectional asset pricing tests of liquidity risk. We discuss the pricing effects of liquidity commonality in the next section. In this section, we identify factors that may contribute to variations in cross-sectional liquidity commonality.

[3] Hofstede's (2001) Uncertainty Avoidance Index (*UAI*) measures a society's tolerance for uncertainty and ambiguity, in which cultures with high uncertainty avoidance attempt to minimize situations that create uncertainty, whereas those with low uncertainty avoidance are more tolerant of uncertainty.

[4] Hofstede's (2001) Individualism Index (*IDV*) describes the relationship that prevails between an individual and the collective in a given society. Individuals focus on "being distinct from and better than others, in order to accomplish the culturally mandated task of being independent and standing out," whereas collective entities focus on "being accepted by others in order to accomplish the culturally mandated task of being interdependent and blending in" (Gelfand et al., 2002, p. 835).

[5] Hofstede's (2001) Masculinity Index (*MAS*) refers to a society's relative emphasis on achievement versus nurture; masculinity at one end of the scale is associated with values such as assertiveness, ambition, and wealth acquisition, whereas femininity at the other end refers to modest and caring attributes. Masculinity has been shown to affect a range of investors' investment decisions and portfolio performances (Durand et al., 2008).

[6] Hofstede's (2001) Power Distance Index (*PDI*) refers to the extent to which the less powerful members of organizations and institutions accept and expect power to be distributed unequally. In a country with high levels of power distance, the gap between the superior and the subordinate is large, whereas in a country with less power distance, the gap between superior and subordinate is small.

First, it is believed that the correlated trading of investors is one of the contributing factors of liquidity commonality. Kamara et al. (2008) argue that the divergence of liquidity commonality in cross-sections of stocks can be explained by patterns of institutional ownership. However, these authors test only differences in firm-size portfolios rather than differences in individual stocks. Coughenour and Saad (2004) argue that the common market maker can generate commonality in stock liquidity. Brockman and Chung (2002) find that commonality in liquidity also exists in the purely order-driven market. We use MSCI index membership and institutional ownership as an indicator of correlated trading. Foreign and domestic institutional investors may behave differently and, therefore, have different impacts on the stock market (Gul et al., 2010). We test the impact of both domestic and foreign institutional ownership on liquidity commonality. Through inclusion in the MSCI index, a firm increases its global visibility and the hedging demand of arbitragers, both of which can increase the correlated trading of its stock. However, MSCI inclusion also indicates better informational transparency of the stock as a result of the visibility. Because we expect that transparency decreases the liquidity commonality, the association between MSCI index membership and liquidity commonality is an empirical issue. Second, investors can have differing preferences for stocks with varying levels of economic and financial risk. Such preferences may also change with market conditions. For example, investors may prefer riskier firms in good economic periods but switch to safer firms during difficult times. Thus, the liquidity of relatively risky firms may show extensive co-movement with changes in market liquidity if such firms experience larger fund inflow (outflow) than other firms during good (bad) times. We gauge the economic and financial risk levels of firms by examining debt-to-equity ratios and stock return volatilities.

In addition, the transparency and information asymmetry of an individual firm can affect its liquidity commonality. More firm-specific information can invite more individual trading of the stock and reduce its co-movement with the market. A higher level of disclosure also reduces information asymmetry and thus expands investors' information set (Diamond and Verrecchia, 1991; La Porta et al., 2006). Improvements in accounting standards reduce information asymmetry and liquidity risk (La Porta et al., 1998; Ng, 2011; Sadka, 2011). A higher level of financial transparency reduces information asymmetry and increases stock price informativeness (Gelos and Wei, 2005). More-transparent and more-informative stock prices also reduce liquidity uncertainty and liquidity commonality during financial crises (Lang and Maffett, 2011). We measure the firms' information environments using analysts' forecast coverage and forecast errors. Because analysts can help increase the speed of firm-specific information diffusion across market participants and reduce information uncertainty (Hong et al., 2000), higher levels of analyst coverage can improve transparency. Analyst forecast error indicates imprecision and uncertainty in firm-specific information, with greater forecast errors suggesting greater information asymmetry. We predict that liquidity commonality is relatively high for firms with low analyst coverage and high levels of analyst forecast error.

2.3. Pricing effects of liquidity commonality

Liquidity commonality indicates a form of non-diversifiable risk. Chordia et al. (2000) argue (without testing the proposition) that the sensitivity of an asset to liquidity shocks should be positively related to its expected returns if shocks to the common component of liquidity are unanticipated and if the effect of such shocks on stock returns is unavoidable. The theoretical and empirical finance literature reveals that liquidity and liquidity risk affect expected returns (e.g., Brennan and Subrahmanyam, 1996; Amihud, 2002; Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005; Keene and Peterson, 2007; Korajczyk and Sadka, 2008; Watanabe and Watanabe, 2008; Lee, 2011). In Amihud and Mendelson's (1986, 1988) model, liquidity can affect the required rate of return because the cost of immediate transactions affects investor payoffs. Using the bid-ask spread as a proxy for illiquidity, these researchers obtain evidence that supports their argument. Others examine the pricing of illiquidity using other proxies. Brennan and Subrahmanyam (1996) find a significant return premium associated with an illiquidity measure derived from Kyle's λ, which is the slope term in a regression of the price change on the signed order flow. Amihud (2002) finds a positive cross-sectional correlation between stock returns and the ratios of daily absolute returns to dollar trading volumes.

However, evidence on the pricing of systematic liquidity is mixed. Pastor and Stambaugh (2003) find that the sensitivity of stock returns to aggregated market liquidity is priced. Acharya and Pedersen (2005) propose a liquidity-adjusted CAPM in which three types of liquidity risk should all affect expected returns, namely the covariance of stock liquidity and market liquidity, the covariance of stock return and market liquidity, and the covariance of stock liquidity and market return. However, their empirical results show that only two types of liquidity risk are significantly priced: the covariance of stock returns with market liquidity and the covariance of stock liquidity with market returns. By contrast, liquidity commonality—the covariance of stock liquidity with market liquidity—is found to be insignificantly related to stock returns. This insignificance is inconsistent with their theoretical work, which shows that investors require compensation for holding securities that are more difficult to trade when the market is generally illiquid. Lee (2011) extends this study to the international markets and uses the ratio of the number of zero-return days to the total number of trading days in a given month as a proxy for illiquidity. The author finds that the covariance of stock liquidity and market returns is priced but that the sensitivity of stock illiquidity to local market illiquidity is priced only in emerging markets. We are the first to apply the method of Chordia et al. (2000) to measure liquidity commonality via the relative bid-ask spread to determine whether liquidity commonality is priced and, if so, whether the pricing effect differs under different market conditions.

3. Data, descriptive statistics, and methodologies

3.1. Data and descriptive statistics

We construct our measure of liquidity commonality using extensive TRTH datasets that contain intraday financial information on 29,694 firms across 39 markets in different regions—Asia, Europe, Latin America, the Middle East, Africa, and North America—for a 15-year period from January 2, 1996, to December 31, 2010. Only the main stock exchange in each market is included, except in the cases of China, Japan, and the United States, in which two major exchanges are included for each (Shanghai and Shenzen, Osaka and Tokyo, and the American Stock Exchange and the New York Stock Exchange, respectively). To ensure that there are a sufficient number of observations in each year for each market, we exclude country-year observations for which the coverage is low. Although the majority of the stock exchanges in the datasets are covered for the entire 15-year sample period, there are exceptions because of the reason given above: Argentina (1998–2010), Brazil (1998–2010), Chile (2002–2010), Ireland (2000–2010), South Korea (2003–2010), Mexico (1998–2010), and Poland (2001–2010).

The datasets include a larger number of firms from developed markets (18,251 firms) than from emerging markets (11,443 firms). The Japanese stock exchanges have the greatest number of firms in the sample (2924 firms), followed by the United Kingdom (2412 firms) and the U.S. stock exchanges (2365 firms). The Irish stock exchange has the smallest number of firms (60 firms), primarily because of its relatively short sample period (2000–2010). All stocks in the datasets are primary quote and major stocks. Trading frequency filters are applied to ensure a sufficient number of observations for each firm in each year, with the exclusion of firms with fewer than 50 observations per year. To delete outliers, we exclude trades with relative spreads (*RS*) larger than 0.5 and exclude stock-days with daily proportional *RS* changes larger than 200% or smaller than −200%. After data cleaning, 2.07% of the stocks are excluded, and 29,694 stocks remain in the sample. The list of the stock exchanges used in this study is in Appendix A.

We construct variables from various sources. The return data used in this study are obtained from Datastream. Other firm-level and country-level variables are constructed from I/B/E/S, the International Country Risk Guide (ICRG), TRTH, World Development Indicators (WDI), and Worldscope. We also obtain country-level governance and culture indices from the literature, including La Porta et al. (1998), Hofstede (2001), and Djankov et al. (2008). Descriptions and sources of all of the variables are in Appendix B. The implied cost of the capital models we used are in Appendix C.

Liquidity commonality is measured by Gamma (γ), which is the logarithm transformation of R^2 in regression (1). Gamma is defined as $\gamma = log(R_j^2/(1\text{-}R_j^2))$:

$$\Delta RS_{j,t} = \alpha_{j,t} + \beta_1 \Delta RS_{M,t} + \beta_2 \Delta RS_{M,t-1} + \beta_3 \Delta RS_{M,t+1} + \gamma_1 MktRE_t + \gamma_2 MktRE_{t-1} + \gamma_3 MktRE_{t+1} + r_1 Ret\_sq_{j,t} + \varepsilon_{j,t}, \tag{1}$$

where *MktRE* is the market return and *Ret_sq* is the squared of stock own returns. This model follows Chordia et al. (2000). Stock *j* is omitted in the calculation of market average for the commonality estimation. *RS* is defined as $(P_A\text{-}P_B)/P_t$, where P_A is the ask price, P_B is the bid price, P_t is the stock price, and R^2 in each time-series regression measures the portion of variation in the daily change in stock *j*'s liquidity that is explained by variations in the liquidity of the market in which stock *j* is traded. RS_M is the market liquidity, which is the equal-weighted average of the liquidity of all stocks in that market. Eq. (1) is estimated in each year for each stock *j*. In other words, R^2 measures the portion of the variation in individual stock liquidity that is explained by variations in market liquidity. Following the intuition of French and Roll (1986), Roll (1988) and Morck et al. (2000), higher R^2 values indicate a greater influence of variations in market liquidity on individual stock liquidity variations. We use logarithm transformations of R^2 because it is constrained to have a value between zero and one and thus cannot be used as a dependent variable in subsequent regression analyses.

The summary statistics of the variables are in Table 1. The correlation matrices for market- and firm-level variables are in Table 2. They show that liquidity commonality, as measured by gamma (γ), is more pronounced in markets that are less transparent and more volatile and that have less individualistic investors and fewer rules of law.

3.2. Methodology

3.2.1. Determinants of liquidity commonality

Using panel regressions both with and without control variables, we examine the market- and firm-level characteristics that affect liquidity commonality. The dependent variable is gamma (γ), which is regressed on market- and firm-level variables to test for determinants of liquidity commonality.

3.2.2. The pricing of liquidity commonality

The pricing of liquidity commonality has important implications for international asset pricing. We test the different aspects of the pricing of liquidity commonality. Cross-sectional regressions based on the work of Fama and MacBeth (1973) are performed to examine (i) whether liquidity commonality is priced; (ii) the varying degrees to which liquidity commonality is priced in developed markets, emerging markets, the U.S. market, and the overall world market; and (iii) how liquidity commonality is priced under market conditions that differ in terms of liquidity, returns, and volatility. The *t*-statistics for all Fama-MacBeth regressions are based on Newey and West's (1987) autocorrelation- and heteroscedasticity-consistent standard errors.

Table 1
Summary statistics of market- and firm-level variables.

Panels A and B present the mean values for market- and firm-level variables used to study the determinants of liquidity commonality. In Panel A, market-level variables include the Accounting Standard Index (*AcStd*), the Anti Self-Dealing Index (*AntSel*), the Disclosure Score Index (*Disc*), the Firm Herfindahl Index (*FirmHerf*), the Financial Transparency Index (*FTran*), GDP Growth (g_{GDP}), GDP per capita (*GDPC*), the Governance Transparency Index (*GTran*), Hofstede's Individualism Index (*IDV*), the Industry Herfindahl Index (*IndHerf*), rule of law (*Law*), market's number of stocks (*NoStock*), market geographical size (*GeoSize*), Hofstede's Masculinity Index (*MAS*), the ratio of private credit to GDP (*Credit*), Hofstede's Power Distance Index (*PDI*), stock market return (*MktRE*), GDP growth volatility (σ_{GDP}), and Hofstede's Uncertainty Avoidance Index (*UAI*). In Panel B, firm-level variables include firm age (*Age*), book-to-market ratio (*BM*), earnings correlation (*Corr*), debt-to-equity ratio (*DE*), dividend yield (*DY*), analyst forecast error (*FErr*), MSCI Index Membership (*MSCI*), firm size (*Size*), analyst coverage (*Alyst*), concurrent year returns (*Ret*), return-on-equity ratio (*ROE*), earnings smoothing (*Smth*), and return volatility (σ_{Ret}). Mean values of developed and emerging markets are computed for all market- and firm-level variables. Non-available variables are indicated as NA in Panel A; there are no missing variables in Panel B. Market- and firm-level variables are from CIA World Factbook, Datastream, International Country Risk Guide, International I/B/E/S, World Development Indicators, Worldscope, and indices developed by various researchers. Sources and descriptions for all market- and firm-level variables are in Appendix B.

Panel A: Summary Statistics of Market-Level Variables

Market	***AcStd***	***AntSel***	***DiscP***	***FirmHerf***	***FTran***	g_{GDP}	***GDPC***	***GTran***	***IDV***	***IndHerf***	***Law***	***NoStock***	***GeoSize***	***MAS***	***Credit***	***PDI***	***MktRE***	σ_{GDP}	***UAI***
Developed Markets																			
Australia	75.00	0.76	6.30	30.84	0.36	0.04	9.99	1.08	90	5.62	1.00	7.02	15.86	61	0.95	36	0.23	0.02	51
Austria	54.00	0.21	6.00	2.96	−0.11	0.02	10.10	−0.08	55	4.59	1.00	3.74	11.34	79	1.08	11	0.07	0.02	70
Belgium	61.00	0.54	5.90	7.83	0.50	0.02	10.04	−0.07	75	13.60	1.00	4.82	10.33	54	0.80	65	0.10	0.02	94
Canada	74.00	0.64	6.30	19.53	1.17	0.03	10.08	−0.57	80	5.33	1.00	6.49	16.12	52	1.38	39	0.50	0.02	48
Denmark	62.00	0.46	6.20	9.85	0.48	0.02	10.32	−0.08	74	9.49	1.00	4.99	10.67	16	1.33	18	0.10	0.02	23
Finland	77.00	0.46	6.50	30.64	0.56	0.03	10.11	0.75	63	7.07	1.00	4.34	12.73	26	0.66	33	0.14	0.03	59
France	69.00	0.38	5.90	16.90	1.27	0.02	10.00	−0.63	71	31.17	0.90	6.46	13.37	43	0.92	68	0.12	0.02	86
Germany	62.00	0.28	6.00	20.37	1.62	0.02	10.06	−0.38	67	10.63	0.92	6.29	12.79	66	1.12	35	0.30	0.02	65
Hong Kong	69.00	0.96	5.80	46.57	0.66	0.04	10.23	0.57	25	17.24	0.82	6.55	7.01	57	1.51	68	0.32	0.05	29
Ireland	NA	0.79	5.60	5.12	−0.18	0.04	10.29	1.05	70	5.46	0.78	3.59	11.16	68	1.55	28	0.08	0.03	35
Italy	62.00	0.42	NA	12.07	1.16	0.01	9.86	−0.58	76	18.17	0.83	5.26	12.62	70	0.81	50	0.08	0.02	75
Japan	65.00	0.50	5.60	18.74	0.68	0.01	10.54	0.36	46	103.42	0.90	7.74	12.84	95	1.93	54	0.07	0.04	92
Netherlands	64.00	0.20	6.10	7.92	1.34	0.03	10.10	0.38	80	4.30	1.00	4.32	10.63	14	1.50	38	1.19	0.02	53
New Zealand	70.00	0.95	6.00	10.84	−0.03	0.02	9.54	1.16	79	34.52	1.00	4.43	12.50	58	1.20	22	0.09	0.03	49
Norway	74.00	0.42	5.80	14.01	0.28	0.03	10.56	0.55	69	14.92	1.00	4.97	12.69	8	0.80	31	0.12	0.02	50
Singapore	78.00	1.00	5.90	17.61	0.46	0.05	10.09	1.34	20	27.26	0.86	6.05	6.55	48	1.10	74	0.15	0.04	8
Spain	64.00	0.37	5.60	7.74	0.88	0.03	9.60	0.15	51	36.15	0.78	4.52	13.13	42	1.26	57	0.13	0.03	86
Sweden	83.00	0.33	6.30	14.76	0.80	0.03	10.26	1.06	71	9.17	1.00	5.47	13.02	5	1.03	31	0.11	0.02	29
Switzerland	68.00	0.27	5.70	2.88	0.81	0.02	10.47	0.56	68	1.42	1.00	5.03	10.63	70	1.63	34	0.16	0.03	58
United Kingdom	78.00	0.95	6.30	32.04	0.75	0.03	10.17	1.03	89	13.73	0.86	7.08	12.40	66	1.50	35	0.07	0.02	35
United States	71.00	0.65	NA	13.52	1.59	0.03	10.47	−0.34	91	2.73	1.00	7.28	16.10	62	1.81	40	10.55	0.02	46
Emerging Markets																			
Argentina	45.00	0.34	4.90	8.88	0.22	0.04	9.00	−0.60	46	5.18	0.54	3.99	14.84	56	0.16	49	0.06	0.06	86
Brazil	54.00	0.27	NA	3.13	0.10	0.03	8.28	−0.87	38	1.16	0.63	4.06	15.96	49	0.37	69	0.90	0.04	76
Chile	52.00	0.63	5.80	3.65	−0.09	0.04	8.65	0.21	23	10.79	0.70	4.90	13.54	28	0.85	63	2.29	0.05	86
China	NA	0.76	3.80	10.82	NA	0.10	7.08	NA	20	9.20	NA	7.01	16.08	66	1.11	80	0.36	0.08	30
Greece	55.00	0.22	NA	12.80	−0.87	0.04	9.44	−1.02	35	80.87	0.62	5.42	11.79	57	0.63	60	0.46	0.04	112
India	57.00	0.58	4.80	20.69	−0.64	0.07	6.26	0.04	48	19.67	0.42	7.02	15.01	56	0.35	77	0.33	0.03	40
Indonesia	NA	0.65	NA	11.37	NA	0.04	6.81	NA	14	31.93	0.40	5.67	14.46	46	0.31	78	0.33	0.04	48
Israel	64.00	0.73	NA	20.29	0.09	0.04	9.89	−0.40	54	36.27	0.48	5.85	10.00	47	0.82	13	0.23	0.04	81
Korea	62.00	0.47	4.70	12.42	−0.49	0.04	9.43	−0.25	18	29.26	0.54	4.37	11.51	39	0.91	60	0.27	0.04	85
Malaysia	76.00	0.95	5.10	10.99	0.23	0.05	8.37	1.24	26	26.69	0.68	6.65	12.71	50	1.51	104	0.11	0.03	36
Mexico	60.00	0.17	4.60	5.83	0.39	0.03	8.69	−0.81	30	6.12	0.54	4.07	14.49	69	0.19	81	0.10	0.04	82
Philippines	65.00	0.22	4.60	6.88	−0.12	0.04	6.95	−0.62	32	3.03	0.27	5.22	12.61	64	0.40	94	0.29	0.03	44
Poland	NA	0.29	4.70	12.36	NA	0.04	8.56	NA	60	10.37	NA	5.40	12.65	64	0.34	68	0.28	0.04	93
Portugal	36.00	0.44	5.10	4.93	−0.26	0.02	9.29	−0.34	27	12.38	0.87	3.70	11.43	31	1.34	63	0.20	0.03	104
South Africa	70.00	0.81	5.50	6.64	−0.41	0.04	8.09	1.13	65	14.19	0.44	5.58	14.01	63	1.35	49	0.52	0.03	49
Taiwan	65.00	0.56	5.40	11.84	NA	0.03	9.60	NA	17	19.13	0.85	6.44	10.49	45	1.29	58	0.13	0.09	69
Thailand	64.00	0.81	4.30	11.20	−0.36	0.03	7.70	−0.82	20	14.52	0.63	5.96	13.15	34	1.18	64	0.22	0.04	64
Turkey	51.00	0.43	5.10	9.07	−0.79	0.04	8.37	−0.78	37	4.58	0.52	5.24	13.57	45	0.22	66	0.32	0.04	85

Panel B: Summary Statistics of Firm-Level Variables

Market	*Alyst*	*Age*	*BM*	*Corr*	*DE*	*DY*	*Ferr*	*MSCI*	*Size*	*Ret*	*ROE*	*Smth*	*σRet*	*IO_D*	*IO _F*
Developed Markets															
Australia	4.56	8.15	0.72	−0.62	0.97	0.02	1.95	0.20	10.23	0.37	−0.74	0.89	1.13	0.04	0.04
Austria	5.40	10.43	0.79	−0.88	1.84	0.02	0.85	0.64	12.77	0.16	0.02	0.61	0.46	0.03	0.52
Belgium	5.54	11.58	1.03	−0.83	0.97	0.03	2.65	0.34	12.15	0.14	0.11	0.62	0.57	0.04	0.03
Canada	4.68	10.80	0.75	−0.63	0.61	0.01	0.93	0.31	11.43	0.37	−0.22	0.87	0.95	0.10	0.05
Denmark	5.26	13.47	0.86	−0.80	1.40	0.02	2.24	0.35	11.36	0.18	−0.01	0.68	0.57	0.03	0.04
Finland	6.81	8.91	0.58	−0.75	0.97	0.04	1.41	0.42	11.91	0.20	0.06	0.77	0.59	0.06	0.11
France	6.51	9.54	0.74	−0.83	1.31	0.02	0.96	0.26	11.49	0.21	−0.06	0.69	0.85	0.04	0.05
Germany	6.97	10.25	0.72	−0.77	2.74	0.02	1.28	0.09	11.52	0.15	−0.13	0.77	0.76	0.05	0.07

Table 1 (*continued*)

Hong Kong	7.02	10.51	1.38	−0.79	1.25	0.03	1.73	0.42	11.41	0.40	−0.13	0.73	0.86	0.00	0.05
Ireland	4.37	14.96	0.72	−0.80	2.89	0.02	1.03	0.52	12.34	0.22	0.01	0.67	0.84	0.01	0.14
Italy	7.38	11.13	0.74	−0.85	1.75	0.02	1.59	0.62	12.72	0.11	−0.02	0.67	0.42	0.02	0.04
Japan	4.23	18.07	1.14	−0.87	1.67	0.02	1.26	0.62	12.39	0.09	0.04	0.56	0.48	0.05	0.06
Netherlands	12.01	17.21	0.60	−0.80	1.44	0.03	0.68	0.58	12.75	0.15	0.06	0.73	0.55	0.04	0.11
New Zealand	4.17	9.02	0.78	−0.79	0.66	0.04	2.77	0.27	10.96	0.14	−0.05	0.67	0.71	0.00	0.05
Norway	5.00	8.65	1.12	−0.71	1.73	0.03	1.48	0.37	11.61	0.26	−0.07	0.83	0.74	0.07	0.06
Singapore	5.50	8.98	1.10	−0.79	0.49	0.03	1.50	0.25	11.11	0.20	0.01	0.72	0.86	0.01	0.04
Spain	11.82	10.69	0.61	−0.84	2.06	0.02	1.10	0.79	13.46	0.19	−0.01	0.61	0.39	0.04	0.06
Sweden	5.64	8.56	0.70	−0.68	0.78	0.02	1.43	0.37	11.52	0.20	−0.10	0.92	0.70	0.10	0.06
Switzerland	5.82	14.49	1.10	−0.81	1.42	0.02	1.17	0.51	12.46	0.20	0.06	0.71	0.49	0.05	0.08
United Kingdom	3.97	12.13	0.63	−0.75	0.64	0.02	8.21	0.31	11.20	0.19	−0.17	0.80	0.52	0.15	0.03
United States	8.57	16.57	4.31	−0.75	1.37	0.02	0.50	0.73	13.66	0.52	0.26	0.77	0.47	0.19	0.01
Mean	6.25	11.62	1.01	−0.78	1.38	0.02	1.75	0.43	11.93	0.22	−0.05	0.73	0.66	0.05	0.08
Emerging Markets															
Argentina	4.50	10.24	1.53	−0.76	1.51	0.02	2.94	0.40	11.44	0.17	−0.02	0.78	0.70	0.02	0.02
Brazil	4.99	7.30	1.39	−0.83	1.75	0.17	2.30	0.63	13.07	0.81	0.09	0.76	1.04	0.08	0.12
Chile	2.03	14.58	0.83	−0.85	0.75	0.13	7.54	0.49	12.50	4.56	0.11	0.63	0.49	0.01	0.01
China	2.51	7.11	0.41	−0.89	0.92	0.01	0.95	0.81	12.73	0.38	0.02	0.53	0.49	0.08	0.00
Greece	4.34	8.55	0.84	−0.89	1.27	0.02	3.01	0.34	11.30	0.47	−0.05	0.51	0.60	0.03	0.02
India	4.71	9.49	0.96	−0.85	0.92	0.02	1.10	0.29	11.06	0.51	0.11	0.74	0.96	0.05	0.04
Indonesia	5.29	9.58	0.25	−0.87	1.67	0.02	9.39	0.36	10.47	0.44	−0.10	0.57	1.13	0.00	0.04
Israel	2.85	10.91	0.85	−0.76	0.55	0.07	1.43	0.18	10.97	0.27	−0.40	0.73	0.82	0.00	0.02
Korea	2.67	16.11	1.65	−0.85	1.28	0.02	1.14	0.46	11.56	0.35	−0.01	0.59	0.57	0.00	0.05
Malaysia	5.39	9.85	1.12	−0.82	0.96	0.02	1.62	0.27	10.68	0.12	−0.12	0.70	0.77	0.02	0.02
Mexico	6.14	9.87	1.42	−0.85	0.81	0.02	1.22	0.48	12.72	0.22	0.07	0.64	0.68	0.04	0.05
Philippines	6.58	10.91	2.13	−0.83	1.11	0.02	2.74	0.36	10.56	0.35	−0.06	0.55	1.20	0.00	0.04
Poland	3.69	6.25	0.63	−0.83	0.55	0.01	1.71	0.30	11.05	0.39	−0.05	0.69	0.63	0.09	0.05
Portugal	7.35	10.84	1.08	−0.89	2.29	0.03	0.75	0.56	12.00	0.19	0.05	0.52	0.94	0.03	0.03
South Africa	3.98	10.20	1.00	−0.75	1.36	0.05	1.62	0.36	11.05	0.25	−0.26	0.80	1.03	0.07	0.02
Taiwan	3.58	9.04	0.99	−0.82	0.74	0.03	2.66	0.54	11.86	0.23	0.04	0.64	0.47	0.02	0.03
Thailand	4.98	10.83	0.84	−0.81	0.84	0.04	232.01	0.37	10.63	0.34	−0.15	0.65	0.76	0.01	0.04
Turkey	5.06	8.85	0.70	−0.81	0.83	0.41	3.85	0.40	11.27	0.36	−0.05	0.73	0.72	0.00	0.07
Mean	4.48	10.03	1.03	−0.83	1.12	0.06	15.44	0.42	11.50	0.58	−0.04	0.65	0.78	0.03	0.04

Following Lau et al. (2010), we use two capital asset pricing methods in each regression: the implied cost of capital (*ICOC*) pricing method and the realized returns (*RRet*) pricing method. *ICOC* refers to the internal rate of return, which equates a stock's current price with the present value of its expected future residual income or abnormal earnings. We compute a general *ICOC* estimation using the average of four different *ICOC* estimates: (1) the residual income valuation model of Claus and Thomas (2001); (2) the residual income valuation model of Gebhardt et al. (2001); (3) the abnormal earnings growth valuation model of Ohlson and Juettner-Nauroth (2005); and (4) the *MPEG* ratio (price-to-earnings ratio divided by growth rate) model of Easton (2004). *ICOC* estimation models (1) and (2) above are special cases of the residual income valuation model of Ohlson (1995), while model (4) is a special case of model (3). Details pertaining to these four *ICOC* models are in Appendix C.

RRet estimates are computed for each stock and each month by obtaining $US-denominated stock returns in excess of U.S. Treasury bill monthly returns. Although *RRet* is a popular proxy for the cost of capital, it could be a noisy measure (e.g., Lundblad, 2007).

Gamma (γ), which is the logistic transformation of the regression R^2 in Eq. (1), is used as a proxy for liquidity commonality. The control variables include the market beta (β), the log of a firm's market value (*Size*), the log of a firm's book-to-market ratio (*BM*), and a firm's relative spread (*RS*). β is derived by regressing stock excess returns on market excess returns, in which market monthly returns are based on MSCI/Datastream country return indices. When examining the interaction effect of the overall pricing of liquidity commonality, we also include market volatility (*Vol*), which is computed as the standard deviation of daily market returns for each year. We define a dummy variable that equals one if market volatility is above the time-series average.

4. Results

In Subsection 4.1, we examine the determinants of liquidity commonality at both the market and firm levels. In the Subsection 4.2, we investigate whether liquidity commonality is priced on an international level and whether market conditions affect the pricing of commonality.

Table 2
Cross-correlation matrices for market- and firm-level variables and gamma.

Panels A and B present the cross-correlation matrices for market and firm-level variables and liquidity commonality. Liquidity commonality is measured by Gamma (γ_j), where $\gamma_j = ln(R_j^2/(1\text{-}R_j^2))$. R_j^2 refers to Eq. (1)'s R^2 values and higher R^2 indicates stronger liquidity commonality. R_j^2 values are logistically transformed, as R_j^2 values are constrained to lie between zero and one and, hence, cannot be used as dependent variables. Intraday relative spread values are computed from the bid, ask, and current price for each stock. Daily average Relative Spread values are computed from the intraday spread values. Sources and descriptions for all market- and firm-level variables are in Appendix B. The proxy for liquidity commonality, gamma (γj), is derived from the regression R^2 value from the regressions of relative spread estimated by applying a modified equation from Chordia et al. (2000): $\Delta RS_{j,t} = \alpha + \beta_1 \Delta RS_{M,t} + \beta_2 \Delta RS_{M,t\text{-}1} + \beta_3 \Delta RS_{M,t+1} + \varepsilon_{j,t}$. The proxy for liquidity commonality, gamma (γ_j), is derived from the regression R^2 value from the regressions of relative spread following Chordia et al. (2000).

Panel A: Cross-Correlation Matrices for Market-Level Variables and Gamma

Variable	*AcStd*	*Antsel*	*Disc*	*FTran*	*Gamma*	*GTran*	*IDV*	*Law*	*MAS*	*Credit*	*PDI*	*MktRE*	σ_{GDP}
Disc	0.445												
	(0.00)												
FTran	0.492	0.048											
	(0.00)	(0.29)											
Gamma	0.430	−0.085	0.615										
	(0.00)	(0.06)	(0.00)										
GTran	−0.184	0.014	−0.247	−0.143									
	(0.00)	(0.74)	(0.00)	(0.00)									
IDV	0.647	0.572	0.506	0.101	−0.183								
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)								
Law	0.386	−0.066	0.706	0.563	−0.140	0.253							
	(0.00)	(0.12)	(0.00)	(0.00)	(0.00)	(0.00)							
MAS	0.353	0.005	0.824	0.628	−0.285	0.358	0.602						
	(0.00)	(0.92)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)						
Credit	−0.105	0.091	−0.222	0.009	−0.033	−0.076	0.006	−0.160					
	(0.02)	(0.03)	(0.00)	(0.84)	(0.44)	(0.09)	(0.89)	(0.00)					
PDI	0.342	0.349	0.328	0.394	−0.311	0.427	0.260	0.530	0.083				
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)				
MktRE	−0.159	0.070	−0.682	−0.244	0.084	−0.199	−0.670	−0.569	0.133	−0.294			
	(0.00)	(0.10)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)			
σ_{GDP}	0.036	0.031	0.010	0.168	−0.029	−0.066	0.130	0.076	0.026	0.160	−0.039		
	(0.42)	(0.46)	(0.82)	(0.00)	(0.49)	(0.14)	(0.00)	(0.08)	(0.54)	(0.00)	(0.36)		
UAI	−0.677	−0.530	−0.207	−0.220	0.097	−0.629	−0.132	−0.157	0.139	−0.271	0.064	−0.045	0.047
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.13)	(0.29)	(0.28)

Panel B: Cross-Correlation Matrices for Firm-Level Variables and Gamma

Variable	*Corr*	*DE*	*Ferror*	*Gamma*	*IO_D*	*IO_F*	*MSCI*	*Alyst*	*Ret*	*Smth*
DE	−0.004									
	(0.16)									
Ferror	−0.002	−0.032								
	(0.55)	(0.00)								
Gamma	−0.018	−0.002	0.003							
	(0.00)	(0.25)	(0.33)							
IO_D	0.025	0.000	−0.006	−0.005						
	(0.00)	(0.96)	(0.05)	(0.06)						
IO_F	0.003	0.001	−0.001	−0.009	0.694					
	(0.31)	(0.74)	(0.82)	(0.00)	(0.00)					
MSCI	−0.066	−0.001	0.002	−0.118	0.071	0.030				
	(0.00)	(0.77)	(0.61)	(0.00)	(0.00)	(0.00)				
Alyst	0.010	0.001	−0.003	−0.063	0.045	0.030	0.339			
	(0.00)	(0.82)	(0.33)	(0.00)	(0.00)	(0.00)	(0.00)			
Ret	0.018	0.000	−0.003	0.005	−0.007	−0.001	−0.002	−0.029		
	(0.00)	(0.89)	(0.32)	(0.01)	(0.01)	(0.74)	(0.29)	(0.00)		
Smth	0.510	−0.003	−0.003	−0.008	0.028	0.008	−0.050	0.002	0.010	
	(0.00)	(0.16)	(0.34)	(0.00)	(0.00)	(0.01)	(0.00)	(0.57)	(0.00)	
σ_{Ret}	0.122	−0.001	0.011	0.241	−0.044	−0.008	−0.271	−0.153	0.017	0.089
	(0.00)	(0.55)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

4.1. Determinants of liquidity commonality

In this subsection, we report the market- and firm-level determinants of liquidity commonality around the world. Unlike past research, which mainly focuses on the market conditions and informational environment, we also test the effect of investors' behavior. In addition, past research has usually investigated only market-level determinants of liquidity commonality. We, however, conduct a comprehensive examination of firm-level determinants of liquidity commonality using data from 39 markets.

Table 3
Individual market-level determinants of liquidity commonality.

This table presents cross-country regression results for each individual market-level determinant of liquidity commonality and control variables. Predicted sign indicates the hypothesized relationship between liquidity commonality (proxied by Gamma (γ_j)) and each of the market-level (and control) variables under different categories that measure various dimensions of market-level determinants. Liquidity commonality is measured by gamma (γ_j), where $\gamma_j = ln(R_j^2/(1-R_j^2))$. R_j^2 refers to Eq. (1)'s R^2 values, where higher R^2 indicates stronger liquidity commonality. R_j^2 values are logistically transformed, as R_j^2 values are constrained to lie between zero and one and, hence, cannot be used as dependent variables. Six control variables are also tested independently, namely, the log of a market's geographical size (*GeoSize*), the log of the number of stocks in the market (*NoStock*), the Industry Herfindahl Index (*IndHerf*), the Firm Herfindahl Index (*FirmHerf*), GDP per capita (*GDPC*), and GDP Growth (g_{GDP}). For each market-level and control variable, this table reports the estimated regression coefficient, coefficient *t*-statistics adjusted for heteroscedasticity, regression R^2, and regression adjusted R^2 values. Standard errors are clustered at country-level. The descriptive statistics for market-level (and control) variables are reported in Appendix B (Panel A). The dependent variable, Gamma (γ_j), is derived from the regression R^2 value from regressions of relative spread following Chordia et al. (2000).

Market Variables	Predicted Sign	Coefficient	t-stat	R^2 (%)	Adj. R^2 (%)
Economic and Financial Environment & Returns					
GDP Growth Volatility (σ_{GDP})	+	4.732	2.274	6.6%	4.1%
Private Credit to GDP (*Credit*)	–	−0.318	−6.767	13.1%	10.6%
Stock Market Return (*MktRE*)	–	−0.001	−0.142	4.5%	2.1%
Investor Protection & Information Environment					
Rule of Law (*Law*)	–	−0.686	−4.544	12.8%	10.5%
Governance Transparency Factor (*GTran*)	–	−0.135	−3.267	8.4%	5.9%
Anti Self-Dealing Index (*AntSel*)	–	0.028	0.223	4.6%	2.1%
Disclosure Score Index (*Disc*)	–	−0.165	−4.047	11.0%	8.3%
Accounting Standard Index (*AcStd*)	–	−0.010	−3.662	8.4%	5.8%
Financial Transparency Index (*FTran*)	–	−0.119	−2.680	7.3%	4.6%
Behavioral Variables					
Hofstede's Individualism Index (*IDV*)	–	−0.003	−2.734	6.6%	4.2%
Hofstede's Masculinity Index (*MAS*)	–	−0.001	−0.575	4.6%	2.2%
Hofstede's Power Distance Index (*PDI*)	+	0.002	1.044	5.3%	2.9%
Hofstede's Uncertainty Avoidance Index (*UAI*)	+	0.002	1.645	5.6%	3.2%
Control Variables					
Ln (Geographical Size) (*GeoSize*)	NA	0.012	0.858	4.8%	2.4%
Ln (Number of Stocks) (*NoStock*)	NA	−0.043	−1.750	5.5%	3.1%
Industry Herfindahl Index (*IndHerf*)	NA	0.194	0.891	4.8%	2.4%
Firm Herfindahl Index (*FirmHerf*)	NA	−0.079	−0.655	4.6%	2.1%
GDP per Capita (*GDPC*)	NA	−0.114	−4.915	10.5%	8.1%
GDP Growth (g_{GDP})	NA	2.012	1.988	5.7%	3.1%

4.1.1. Market-level determinants of liquidity commonality

As a preliminary test, we employ simple regression models to examine the effect of each market determinant on liquidity commonality. The results are reported in Table 3. We find significant market-level determinants of liquidity commonality, including the economic environment, the information environment, and behavioral factors. Most variables have significant coefficients with the expected sign. We have shown that liquidity commonality is greater under conditions of high GDP growth volatility (σ_{GDP}), a low private credit to GDP ratio (*Credit*), poor investor protection (*AcStd* and *Law*), lower transparency (*GTran, Disc*, and *FTran*), and less self-confident investors (*IDV*).

We then use multiple regressions to examine the incremental contribution of each factor after controlling for other variables that may affect liquidity commonality. We report the regression results in Table 4. We find greater liquidity commonality in volatile markets with few investor protections and more-opaque information environments. Model (1) includes all variables that are indicative of the economic and financial environment. Consistent with our hypothesis, high levels of liquidity commonality are found in a highly volatile economy (σ_{GDP}) and in markets with less-developed financial systems (*Credit*). Model (2) includes all variables pertaining to investor protection and the information environment. Among these variables, governance transparency (*GTran*) has the strongest effects on liquidity commonality and is negatively related to liquidity commonality, after controlling for market conditions and other variables. This finding is consistent with Karolyi et al. (2012), who argue that liquidity commonality is greater in markets with less investor protection and more-opaque information environments. We then test for the effects of behavioral variables on liquidity commonality in Model (3). Greater liquidity commonality is found in markets that are characterized by high levels of uncertainty avoidance (*UAI*). However, individualism (*IDV*) is no longer statistically significant after controlling other variables. We include all variables in Model (6) and find that the development of financial systems (*Credit*) has the strongest effect on liquidity commonality.

The findings in Tables 3 and 4 support our hypotheses that market factors affect liquidity commonality by means of the economic environment, the information environment, and investor behavior. Our findings lend support to the literature where liquidity commonality is explained in terms of market-level supply-side variables (e.g., Brunnermeier and Pedersen, 2009; Comerton-Forde et al., 2010; Naes et al., 2011; Karolyi et al., 2012) and demand-side variables (e.g., Koch, Ruenzi, and Starks, 2010; Karolyi et al., 2012). We show a high degree of liquidity commonality in markets with poor economic and financial environments, inadequate investor protection, and low-quality information.

Table 4
Market-level determinants of liquidity commonality.

This table presents cross-country coefficient estimates of various categories of market-level determinants of liquidity commonality. *P. Sign* indicates the hypothesized relationship between liquidity commonality (proxied by Gamma (γ_j)) and each of the market-level (and control) variables under different categories that measure various dimensions of market-level determinants. Liquidity commonality is measured by Gamma (γ_j), where $\gamma_j = ln(R_j^2/(1\text{-}R_j^2))$. R_j^2 refers to Eq. (1) R^2 values, and a higher R^2 indicates stronger liquidity commonality. R_j^2 values are logistically transformed, as R_j^2 values are constrained to lie between zero and one and, hence, cannot be used as dependent variables. The control variables are Ln (Geographical Size) (*GeoSize*), Ln (Number of Stocks) (*NoStock*), the Industry Herfindahl Index (*IndHerf*), the Firm Herfindahl Index (*FirmHerf*), GDP per capita (*GDPC*), and GDP Growth (g_{GDP}). The coefficient t-statistics adjusted for heteroskedasticity are reported in parentheses. Standard errors are clustered at country-level. The descriptive statistics for market-level variables and control variables are reported in Appendix B (Panel A). The dependent variable, gamma (γ_j), is derived from the regression R^2 value from regressions of relative spread, following Chordia et al. (2000).

Market Variables	P. Sign	Model 1	Model 2	Model 3	Model 4
Economic and Financial Environment & Returns					
GDP Growth Volatility (σ_{GDP})	+	2.520			6.433
		(1.41)			(1.31)
Private Credit to GDP (*Credit*)	−	−0.249			−0.248
		(−3.52)			(−4.48)
Stock Market Return (*MktRE*)	−	0.010			0.000
		(2.20)			(0.02)
Investor Protection & Information Environment					
Rule of Law (*Law*)	−		−0.236		0.214
			(−0.82)		(0.68)
Governance Transparency Factor (*GTran*)	−		−0.153		−0.095
			(−2.22)		(−1.45)
Anti Self-Dealing Index (*AntSel*)	−		0.198		0.229
			(1.17)		(1.34)
Disclosure Score Index (*Disc*)	−		0.148		0.080
			(1.20)		(0.41)
Accounting Standard Index (*AcStd*)	−		−0.004		0.001
			(−0.74)		(0.11)
Financial Transparency Index (*FTran*)	−		0.056		0.049
			(0.67)		(0.50)
Behavioral Variables					
Hofstede's Individualism Index (*IDV*)	−			0.001	0.006
				(0.39)	(1.67)
Hofstede's Masculinity Index (*MAS*)	−			−0.002	0.000
				(−1.11)	(−0.08)
Hofstede's Power Distance Index (*PDI*)	+			−0.004	0.004
				(−1.02)	(1.47)
Hofstede's Uncertainty Avoidance Index (*UAI*)	+			0.004	0.004
				(1.83)	(1.69)
Control Variables					
Ln (Geographical Size) (*GeoSize*)	NA	−0.015	−0.007	−0.031	−0.042
		(−0.85)	(−0.46)	(−1.15)	(−2.14)
Ln (Number of Stocks) (*NoStock*)	NA	−0.023	−0.073	−0.003	−0.049
		(−0.88)	(−2.06)	(−0.07)	(−1.46)
Industry Herfindahl Index	NA	0.045	0.144	0.161	0.294

Table 4 (*continued*)

Market Variables	P. Sign	Model 1	Model 2	Model 3	Model 4
(*IndHerf*)					
		(0.17)	(0.50)	(0.60)	(1.07)
Firm Herfindahl Index (*FirmHerf*)	NA	0.170	0.022	−0.015	0.089
		(0.78)	(0.10)	(−0.07)	(0.40)
GDP per Capita (*GDPC*)	NA	−0.067	−0.118	−0.197	−0.160
		(−2.36)	(−2.35)	(−3.30)	(−1.70)
GDP Growth (g_{GDP})	NA	−0.154	−0.804	1.204	−1.740
		(−0.15)	(−1.01)	(1.00)	(−2.13)
N		517	397	527	387
Adj. R^2 (%)		12.1%	16.8%	11.4%	25.4%
Year		Yes	Yes	Yes	Yes

Table 5

Firm-level determinants of liquidity commonality.

This table presents cross-country coefficient estimates of various categories of firm-level determinants on liquidity commonality. 'P. Sign' indicates hypothesized relationships between liquidity commonality (proxied by gamma (γ_j)) and each of the market-level (and control) variables under different categories that measure various dimensions of market-level determinants. Liquidity commonality is measured by Gamma (γ_j), where $\gamma_j = \ln(R_j^2/(1-R_j^2))$. R_j^2 refers to Eq. (1) R^2 values, and higher R^2 indicates stronger market liquidity. R_j^2 values are logistically transformed, as R_j^2 values are constrained to lie between zero and one and cannot be used as dependent variables. Year and market effects are untabulated. The coefficient t-statistics adjusted for heteroscedasticity are reported in parentheses. Standard errors are clustered at firm-level. The descriptive statistics for firm-level (and control) variables are reported in Appendix B (Panel B). The dependent variable, gamma (γ_j), is derived from the regression R^2 value from regressions of relative spread following Chordia et al. (2000).

Firm Variables	**P. Sign**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Economic and Financial Environment & Returns									
Concurrent Year Returns (*Ret*) [*100]	+	0.022		0.011		0.108	−0.328	−0.770	−0.811
		(2.27)		(0.40)		(0.33)	(−0.95)	(−1.71)	(−1.81)
Debt-to-Equity Ratio (*DE*) [*100]	+	−0.006		−0.005		−0.005	0.003	0.013	0.013
		(−2.28)		(−1.55)		(−1.44)	(0.76)	(1.14)	(1.15)
Return Volatility (σ_{Ret})	+	0.557		0.543		0.448	0.500	0.499	0.500
		(31.79)		(29.26)		(17.97)	(17.87)	(16.16)	(16.18)
MSCI Index Membership (*MSCI*)	+/−	−0.120		−0.070		−0.030	−0.064	−0.001	−0.001
		(−13.46)		(−6.52)		(−2.94)	(−5.46)	(−0.05)	(−0.10)
Information Environment									
Analyst Forecast error (*FErr*) [*100]	+		0.000		0.000	0.000	0.000	−0.017	−0.017
			(5.78)		(5.28)	(2.07)	(1.00)	(−1.19)	(−1.22)
Analyst Coverage (*Alyst*)	−		−0.010		−0.007	−0.004	−0.008	−0.008	−0.008
			(−16.32)		(−9.06)	(−7.28)	(−10.42)	(−9.31)	(−9.38)
Correlated Trading									
Domestic Institutional Ownership (*IO_D*)								0.061	
								(3.26)	
Foreign Institutional Ownership (*IO_F*)									−0.010
									(−1.16)
Control Variables									
Firm Size (*Size*)	NA			−0.022	−0.009		0.021	0.030	0.031
				(−7.33)	(−2.88)		(5.48)	(8.10)	(8.46)
Firm Age (*Age*)	NA			0.001	−0.002		0.000	0.000	0.000
				(1.04)	(−4.12)		(0.80)	(−0.20)	(−0.25)
Dividend Yield (*DY*)	NA			0.003	0.001		0.001	0.002	0.002
				(0.66)	(0.43)		(0.46)	(0.72)	(0.67)
Book-to-Market Ratio (*BM*)	NA			−0.002	−0.007		−0.010	−0.006	−0.007
				(−2.19)	(−1.48)		(−2.16)	(−1.37)	(−1.49)
Return-on-Equity Ratio (*ROE*)	NA			0.001	0.000		0.000	0.004	0.004
				(2.11)	(−0.86)		(0.30)	(1.59)	(1.60)
N		213,641	114,007	196,687	104,999	106,347	102,487	100,791	100,791
Adj. R^2 (%)		6.5%	2.3%	6.3%	2.5%	4.0%	4.2%	4.8%	4.7%
Year		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

4.1.2. *Firm-level determinants of liquidity commonality*

Using the same approach as our market-level variables, we regress liquidity commonality on different subgroups of firm variables to study the marginal contributory effects of each firm factor after controlling for other potentially influential firm

Table 6
Asset pricing tests of liquidity commonality.

This table presents the pricing of liquidity commonality in all 39 markets in the datasets from 1996 of 2010. Gamma (γ) is the proxy for liquidity commonality, which is the logistic transformation of regression R^2 as derived from the equation $\Delta RS_{j,t} = \alpha + \beta_1 \Delta RS_{M,t} + \beta_2 \Delta RS_{M,t-1} + \beta_3 \Delta RS_{M,t+1} + \varepsilon_{j,t}$. Coefficients of gamma (γ) are multiplied by 100. The controlled variables include Market Beta (β), log of Market Value (*Size*), log of firms' Book-to-Market ratio (*BM*), and Relative Spread (*RS*). Regressions R^2 are presented for each model. Newey-West adjusted t-statistics are in parentheses. Two capital asset pricing methods are presented—the Implied Cost of Capital (*ICOC*) pricing method (Models (1)–(5)) and the Realized Returns (*RRet*) pricing method (Models (6)–(10)). The *ICOC* used is derived from the average of four different *ICOCs*, namely, CT (2001), GLS (2001), MPEG (2004), and OJ (2005) *ICOC* estimates, as detailed in Appendix C. The dependent variable is the value-weighted average implied cost of capital (R_{ICOC}) for the *ICOC* models (Models (1)–(5)) and the firms' returns (*RE*) for the *RRet* models (Models (6)–(10)). In all regressions, country effects and Newey-West adjustments are performed.

	ICOC					*RRet*				
Var.	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
γ		−0.017	−0.039		−0.019		0.063	0.064		0.064
		(−0.28)	(−0.62)		(−0.32)		(2.46)	(2.06)		(2.48)
β	0.013	0.013		0.013	0.013	0.001	0.000		0.000	0.000
	(6.39)	(6.34)		(6.37)	(6.33)	(0.58)	(0.18)		(0.11)	(0.19)
MV	−0.016	−0.016	−0.016	−0.016	−0.016	−0.002	−0.001	−0.001	−0.001	−0.001
	(−13.73)	(−13.97)	(−12.75)	(−13.77)	(−14.01)	(−2.98)	(−2.23)	(−2.22)	(−2.46)	(−2.24)
BM	0.007	0.007	0.007	0.007	0.007	0.005	0.005	0.006	0.005	0.005
	(4.24)	(4.25)	(3.73)	(4.26)	(4.27)	(4.62)	(5.38)	(5.02)	(5.30)	(5.38)
RS				0.000	0.000				0.000	0.000
				(2.09)	(2.08)				(0.39)	(0.28)
R^2	36.1%	36.1%	35.3%	36.1%	36.1%	10.8%	16.3%	15.7%	15.9%	16.3%

characteristics. The firm-level regression results are reported in Table 5. The findings support our hypothesis that firm-level factors affect liquidity commonality. We show that a firm's financial risk (σ_{Ret}) is positively related to liquidity commonality. Correlated trading, which is measured by domestic institutional ownership (*IO_D*), is positively associated with liquidity commonality. In contrast, foreign institutional ownership (*IO_F*) is negatively related to liquidity commonality. Gul et al. (2010) show the foreign ownership is inversely associated with price synchronicity. Our results show that foreign ownership is also inversely associated with liquidity synchronicity. Furthermore, a better firm informational environment helps reduce liquidity commonality. As expected, stocks have higher liquidity commonality if they have greater analyst forecasting errors (*FErr*) and less analyst coverage (*Alyst*). We find that MSCI index membership is negatively associated with liquidity commonality. MSCI index membership reflects both the concomitant demand of shares and the information quality of the stock. Because MSCI index member stocks usually have more firm-specific information, it is not surprising that these stocks have lower liquidity commonality.

Therefore, greater liquidity commonality is found in firms with high financial risk, low-quality information environments, and a high probability of correlated trading. To date, no other studies have examined the effects of firm-level determinants on liquidity commonality. Thus, we contribute to the literature by extending the current research and showing that firm-level factors also play important roles in determining liquidity commonality.

4.2. The pricing of liquidity commonality

Our results provide comprehensive evidence that both market-level and firm-level factors are important determinants of liquidity commonality around the world. We next examine whether liquidity commonality is priced in the global market and whether the pricing effects differ around the world.

4.2.1. The overall pricing of liquidity commonality

In this subsection, we examine the pricing of liquidity commonality in all 39 markets in our datasets as a whole. The panel regression results are presented in Table 6. Models (2), (3), and (5) measure the pricing of liquidity commonality using the *ICOC* method, and Models (7), (8), and (10) measure the pricing of liquidity commonality using the *RRet* method. Models (1), (4), (6), and (9) test the effects of control variables on the cost of capital under the two methods, excluding liquidity commonality (γ).

In general, the results indicate that liquidity commonality is priced in the world market. Using the *RRet* pricing method, we find that the coefficients on liquidity commonality (γ) in all models are positive and significant, regardless of whether we control for spread. Positive and significant liquidity commonality (γ) coefficients in *RRet* models confirm that liquidity commonality is priced in the overall global market. However, the results are insignificant using the *ICOC* pricing method. Overall, we find that liquidity commonality is priced in the global market using the *RRet* pricing method.

4.2.2. The interaction effects of the overall pricing of liquidity commonality

In this subsection, we examine the interactions between liquidity commonality and market liquidity, market returns, and market volatility. We assess whether the pricing of liquidity commonality is affected by these three market conditions. Table 7 presents panel regression estimates for the overall pricing of liquidity commonality and its interactions with other

Table 7
The interaction effects of the pricing of liquidity commonality.

This table presents the pricing of liquidity commonality in all 39 markets in the datasets from 1996 to 2010. Gamma (γ) is the proxy for liquidity commonality, which is the logistic transformation of regression R^2 as derived in Eq. (1) in Table 3.2. Coefficients of gamma (γ) are multiplied by 100. The controlled variables include Market Beta (β), log of Market Value (Size), log of firms' Book-to-Market ratio (BM), Relative Spread (RS), Market Returns Dummy (RM Dummy), and Volatility Dummy (Vol Dummy). RM Dummy is the dummy variable of market returns (RM), which equals one if the market return is above its time-series average. Vol Dummy is the dummy variable of market volatility, which equals one if the market volatility is above its time-series average. Market volatility is measured by the standard deviations of market returns. Interaction variables are included to test the interacting effects between different explanatory variables. Regressions R^2 are presented for each model. Newey-West adjusted t-statistics are in parentheses. Two capital asset pricing methods are presented—the Implied Cost of Capital (ICOC) pricing method (Models (1)–(3)) and the Realized Returns (RRet) pricing method (Models (4)–(6)). The ICOC used is derived from the average of four different ICOCs, namely, CT (2001), GLS (2001), MPEG (2004), and OJ (2005) ICOC estimates, as detailed in Appendix C. The dependent variable is the value-weighted average implied cost of capital (R_{ICOC}) for the ICOC models (Models (1)–(3)) and the firms' returns (RE) in the RRet models (Models (4)–(6)). Country effects and Newey-West adjustments are performed in all regressions.

	ICOC			*RRet*		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
*γ * RS*	−0.037 (−2.91)			0.000 (0.07)		
*γ * RM Dummy*		0.116 (1.26)			−1.553 (−1.76)	
*γ * Vol Dummy*			−0.018 (−0.23)			0.000 (0.23)
γ	−0.015 (−0.25)	−0.015 (−0.25)	−0.015 (−0.25)	0.001 (2.54)	0.407 (0.71)	0.001 (2.40)
β	0.012 (5.96)	0.012 (5.96)	0.012 (5.96)	0.000 (0.19)	0.153 (1.08)	0.000 (0.20)
MV	−0.016 (−14.12)	−0.016 (−14.12)	−0.016 (−14.12)	−0.001 (−2.24)	−0.115 (−2.25)	−0.001 (−2.23)
BM	0.007 (4.42)	0.007 (4.42)	0.007 (4.42)	0.005 (5.39)	−0.350 (−1.90)	0.005 (5.37)
RS	0.000 (2.06)	0.000 (2.06)	0.000 (2.06)	0.000 (−1.08)	−6.559 (−1.70)	0.000 (0.26)
RM Dummy		0.428 (1.25)			−3.969 (−1.74)	
Vol Dummy			0.004 (0.02)			−0.008 (−1.01)
R^2	36.1%	36.1%	36.1%	16.3%	16.3%	16.3%

related variables in 39 markets. Interaction terms are included to test whether the interactions of liquidity commonality with other variables affect pricing in the overall global market. Three variables are tested for their interactions with liquidity commonality (γ): the market-level relative spread (*RS*), which is the average RS of individual stocks; a market return dummy (*RM Dummy*); and a market volatility dummy (*Vol Dummy*).

In Table 7, regression results based on the *ICOC* pricing method are presented in Models (1)–(3), and regression results obtained using the *RRet* pricing method are presented in Models (4)–(6). Models (1) and (4) include the interaction between liquidity commonality (γ) and market liquidity (*RS*) to examine whether the pricing of liquidity commonality is affected by the market liquidity level. Lower *RS* values signify more-liquid markets, and higher values signify less-liquid markets. The coefficients for the γ**RS* interaction are negative in Model (1), indicating that liquidity commonality is more influential in asset returns when the market is more liquid. Models (2) and (5) include the interaction between liquidity commonality (γ) and market returns (*RM Dummy*) to examine whether the pricing of liquidity commonality is affected by market returns. The *RM Dummy* equals one if the market return is above the time series median. The coefficient for the γ**RM Dummy* interaction is negative and marginally significant using *RRet*, indicating that the pricing of liquidity commonality is stronger in downward markets. The effect of market volatility (*Vol Dummy*) in Models (3) and (6) is insignificant.

Overall, these results indicate that the pricing of liquidity commonality is affected by both market liquidity and market return—being priced higher when the market is more liquid and when the market is going down.

4.2.3. Pricing of liquidity commonality in developed markets, emerging markets, and the U.S. market

To study the pricing of liquidity commonality among different markets, we run separate Fama-Macbeth regressions for developed markets, emerging markets, and the U.S. market. These results are presented in Table 8. We use two proxies to test for pricing: the *ICOC* method (presented in Models (1)–(3)) and the *RRet* method (presented in Models (4)–(6)). We exclude liquidity commonality in Models (1) and (4) to exclusively test the effects of control variables on the cost of capital.

The results in Table 8 provide evidence that liquidity commonality is priced in developed markets based on the consistently positive and predominantly significant liquidity commonality (γ) coefficients under *RRet* pricing methods. In Panel A, under the *RRet* pricing method, the pricing of liquidity commonality is prominent in developed markets, with Models

Table 8
The pricing of liquidity commonality by market development.

This table presents the pricing of liquidity commonality in developed markets (Panel A), emerging markets (Panel B), and the US market (Panel C) from 1996 to 2010. Gamma (γ) is the proxy for liquidity commonality, which is the logistic transformation of the regression R^2, as derived in Eq. (1). Coefficients of Gamma (γ) are multiplied by 100. The control variables include Market Beta (β), the log of Market Value (Size), the log of firms' Book-to-Market ratio (BM), and Relative Spread (RS). Regressions R^2 are presented for each model. Newey-West adjusted t-statistics are in parentheses. In each panel, two capital asset pricing methods are presented—the Implied Cost of Capital (ICOC) pricing method (Models (1)–(3)) and the Realized Returns (RRet) pricing method (Models (4)–(6)). The ICOC used is derived from the average of four different ICOCs, namely, CT (2001), GLS (2001), MPEG (2004), and OJ (2005) ICOC estimates, as detailed in Appendix C. The dependent variable is the value-weighted average implied cost of capital (R_{ICOC}) for the ICOC models (Models (1)–(3)) and the firms' returns (RE) for the RRet models (Models (4)–(6)). In all regressions, country effects and Newey-West adjustments are performed.

	ICOC			*RRet*		
Var.	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
PANEL A - Developed Markets						
γ		0.016	−0.008		0.088	0.092
		(0.23)	(−0.11)		(3.02)	(2.58)
β	0.013	0.013		0.000	0.000	
	(5.73)	(5.71)		(0.01)	(0.13)	
MV	−0.016	−0.016	−0.016	−0.001	−0.001	−0.001
	(−13.44)	(−13.65)	(−12.34)	(−2.11)	(−1.80)	(−1.81)
BM	0.005	0.005	0.004	0.005	0.005	0.005
	(3.09)	(3.10)	(2.47)	(4.53)	(4.68)	(4.25)
RS	0.000	0.000		0.000	0.000	
	(1.53)	(1.56)		(1.21)	(1.16)	
R^2	30.1%	30.2%	29.1%	10.1%	10.4%	9.7%
PANEL B - Emerging Markets						
γ		−0.062	−0.063		0.067	0.051
		(−0.80)	(−0.83)		(1.29)	(0.87)
β	0.011	0.011		0.001	0.001	
	(11.35)	(10.64)		(0.40)	(0.44)	
MV	−0.015	−0.015	−0.015	−0.002	−0.002	−0.002
	(−14.64)	(−15.09)	(−14.20)	(−2.66)	(−2.68)	(−2.39)
BM	0.015	0.015	0.015	0.006	0.006	0.006
	(7.72)	(7.80)	(8.39)	(4.73)	(4.66)	(4.47)
RS	0.000	0.000		0.000	0.000	
	(1.69)	(1.69)		(0.30)	(0.07)	
R^2	38.5%	38.5%	38.1%	22.5%	23.0%	22.6%
PANEL C - US Market						
γ		0.023	0.094		0.076	0.088
		(0.22)	(0.90)		(1.77)	(2.06)
β	0.011	0.011		0.003	0.003	
	(5.35)	(5.28)		(1.12)	(1.10)	
MV	−0.010	−0.010	−0.010	−0.001	−0.001	−0.001
	(−17.23)	(−17.00)	(−15.67)	(−1.38)	(−1.38)	(−1.32)
BM	0.003	0.003	0.003	0.002	0.003	0.003
	(1.53)	(1.58)	(1.51)	(2.28)	(2.30)	(2.29)
RS	−0.021	−0.021		−0.002	−0.002	
	(−3.01)	(−3.05)		(−1.15)	(−1.17)	
R^2	19.4%	19.7%	16.9%	3.3%	3.4%	1.9%

(5) and (6) having positive coefficients that are significant at the 1% level. In addition, the coefficients on commonality in liquidity are all positive in Panel C for U.S. markets but are significant only under the *RRet* pricing method. Therefore, we find that liquidity commonality is priced both in developed markets and in the U.S. market in particular. However, the results in Panel B show an insignificant pricing impact of liquidity commonality in emerging markets. Thus, liquidity commonality is priced in developed markets and the U.S. market but is insignificantly priced in the emerging markets.

5. Conclusion

In this study, we examine the determinants and pricing of liquidity commonality in 39 markets around the world. We not only examine the effects of market-level economic conditions and informational transparency on liquidity commonality, but also show the effects of investors' behavior and firm-level factors on liquidity commonality. We show a significant effect of both market- and firm-level determinants on liquidity commonality. Specifically, we find that liquidity commonality is higher in environments with weaker and more volatile economic and financial conditions, minimal investor protection, and information opacity. At the firm level, we show that correlated trading, firm transparency, and stock performance all have a significant association with liquidity commonality.

Employing four of Hofstede's (2001) cultural dimensions, we are the first to incorporate cultural and behavioral analysis into the study of liquidity commonality. These four cultural dimensions are individualism, masculinity, power distance, and uncertainty avoidance. The empirical results show that liquidity commonality generally increases in markets with greater collectivistic tendencies, low levels of masculinity orientation, and high levels of power distance and uncertainty avoidance.

The results show that liquidity commonality is priced in the world's stock markets. Thus, our findings emphasize the role of liquidity commonality as a source of liquidity risk in asset pricing, which complements related lines of research on asset pricing, particularly research on liquidity premiums. However, the pricing of liquidity commonality is found to differ across markets. Liquidity commonality is significantly priced in developed markets and in the U.S. market, but the asset pricing tests show less-consistent results for emerging markets.

Appendix A. List of stock exchanges by market

This table lists all the stock exchanges used in this research, years covered in the datasets, and the number of firms in each stock exchange. Only the major stock exchange(s) in each market is/are included. The sample uses global TRTH datasets containing intraday financial information on 29,694 firms from 39 markets around the world over a period of 15 years from January 1996 to December 2010. All markets have only one major stock exchange listed, with the exception of China, Japan and the U.S. For the majority of the stock exchanges in the datasets, the period covered is 1996–2010, with the exceptions of Argentina (1998–2010), Brazil (1998–2010), Chile (2002–2010), Ireland (2000–2010), Korea (2003–2010), Mexico (1998–2010), and Poland (2001–2010).

Market	Stock Exchange	Years	No. of Firm
Developed Markets			
Australia	Australian Stock Exchange	1996 – 2010	2076
Austria	Vienna Stock Exchange	1996 – 2010	111
Belgium	Euronext Brussels	1996 – 2010	222
Canada	Toronto Stock Exchange	1996 – 2010	1211
Denmark	Copenhagen Stock Exchange	1996 – 2010	225
Finland	Helsinki Stock Exchange	1996 – 2010	157
France	Euronext Paris	1996 – 2010	1130
Germany	Frankfurt Stock Exchange	1996 – 2010	1154
Hong Kong	Hong Kong Stock Exchange	1996 – 2010	1100
Ireland	Irish Stock Exchange	2000 – 2010	60
Italy	Milano Stock Exchange	1996 – 2010	353
Japan	Osaka Stock Exchange	1996 – 2010	2924
	Tokyo Stock Exchange		
Netherlands	Euronext Amsterdam	1996 – 2010	161
New Zealand	New Zealand Stock Exchange	1996 – 2010	151
Norway	Oslo Stock Exchange	1996 – 2010	301
Singapore	Singapore Stock Exchange	1996 – 2010	831
Spain	SIBE-Mercado Continuo Espanol	1996 – 2010	490
Sweden	Stockholm Stock Exchange	1996 – 2010	525
Switzerland	Swiss Exchange	1996 – 2010	292
United Kingdom	London Stock Exchange	1996 – 2010	2412
United States	American Stock Exchange	1996 – 2010	2365
	New York Stock Exchange		
Emerging Markets			
Argentina	Buenos Aires Stock Exchange	1998 – 2010	83
Brazil	Sao Paolo Stock Exchange	1998 – 2010	169
Chile	Santiago Stock Exchange	2002 – 2010	163
China	Shanghai Stock Exchange	1996 – 2010	1857
	Shenzhen Stock Exchange		
Greece	Athens Stock Exchange	1996 – 2010	341
India	Mumbai Stock Exchange	1996 – 2010	2180
Indonesia	Jakarta Stock Exchange	1996 – 2010	426
Israel	Tel Aviv Stock Exchange	1996 – 2010	705
Korea	Korea Stock Exchange	2003 – 2010	825
Malaysia	Kuala Lumpur Stock Exchange	1996 – 2010	1157
Mexico	Bolsa Mexicana Stock Exchange	1998 – 2010	144
Philippines	Philippines Stock Exchange	1996 – 2010	238
Poland	Warsaw Stock Exchange	2001 – 2010	385
Portugal	Euronext Lisbon	1996 – 2010	82
South Africa	Johannesburg Stock Exchange	1996 – 2010	483

Taiwan	Taiwan Stock Exchange	1996 – 2010	1293
Thailand	Thailand Stock Exchange	1996 – 2010	582
Turkey	Istanbul Stock Exchange	1996 – 2010	330

Appendix B. Market and firm variable definitions and sources

Panels A and B present market- and firm-level variables used in this research and their abbreviations, descriptions and sources. Both market- and firm-level variables are categorized under different headings that represent different dimensions of the markets and firms, according to the hypotheses of this research.

Panel A: Market Variable Definitions and Sources

Variable	Abbrev.	Description	Source
Economic and Financial Environment			
GDP Growth Volatility	σ_{GDP}	Standard deviation of annual GDP growth for the past five years	World Development Indicators, WDI,
Private Credit to GDP	*Credit*	Ratio of private credit to GDP in year t-1	World Development Indicators, WDI,
Stock Market Return	*MktRE*	Equal-weighted market average of firms' monthly stock returns over the current year	TRTH
Investor Protection & Information Environment			
Rule of Law	*Law*	Annual law and order index of year *t*-1.	International Country Risk Guide
Governance Transparency Factor	*GTran*	Based on the extent of governance disclosure on shareholdings and remuneration of firms' insiders and major shareholders.	Bushman, Piotroski and Smith (2004)
Anti Self-Dealing Index	*AntSel*	Based on a country's disclosure quality, approval, and litigation governing self-dealing transactions.	Djankov et al. (2008)
Disclosure Score Index	*Disc*	Calculated based on survey results about the level and availability of financial disclosure in the annual Global Competitiveness Report issued by the World Economic Forum average scores for 1999 and 2000 divided by 10 so that the score falls within the zero to one range.	Gelos and Wei (2005)
Accounting Standard Index	*AcStd*	"Index created by examining and rating companies' 1990 annual reports on their inclusion or omission of 90 items. These items fall into seven categories (general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items). A minimum of three companies in each country were studied. The companies represent a cross section of various industry groups; industrial companies represent 70 percent, and financial companies represented the remaining 30 percent" (La Porta et al., 1998, p. 1125).	La Porta el at. (1998)
Financial Transparency Index	*FTran*	Measures the intensity and timeliness of financial disclosures by firms and interpretation and dissemination of a firm's news by financial analysts and the media.	Bushman, Piotroski and Smith (2004)
Behavioral Variables			
Hofstede's Individualism Index	*IDV*	The degree to which individuals are integrated into groups. Derived from a cross-country psychological survey conducted on IBM employees in 74 countries using 88,000 respondents between 1967 and 1973 and the survey's subsequent extensions.	Hofstede (2001)
Hofstede's Masculinity Index	*MAS*	The distribution of roles between the genders. A 'masculine' country refers to a country in which men are significantly more assertive and competitive than the women in the same country, while a 'feminine' country refers to a country in which both men and women share the same modest and caring values. Derived from a cross-country psychological survey conducted on IBM employees in 74 countries using 88,000 respondents between 1967 and 1973 and the survey's subsequent extensions.	Hofstede (2001)
Hofstede's Power Distance Index	*PDI*	The extent to which the less powerful members of organizations and institutions accept and expect that power is distributed equally. Derived from a cross-country psychological survey conducted on IBM employees in 74 countries using 88,000 respondents between 1967 and 1973 and the survey's subsequent extensions.	Hofstede (2001)
Hofstede's Uncertainty Avoidance Index	*UAI*	The extent to which a society tolerates uncertainty and ambiguity in unstructured situations. Derived from a cross-country psychological survey conducted on IBM employees in 74 countries using 88,000 respondents between 1967 and 1973 and the survey's subsequent extensions.	Hofstede (2001)
Control Variables			
Geographical Size	*GeoSize*	Log of market's geographical size in square kilometers.	CIA World Factbook
Number of Stock	*NoStock*	Log of number of stocks (i.e., firms) in each market in the sample.	Datastream
Industry Herfindahl Index	*IndHerf*	Following Morck et al. (2000), Industry Herfindahl Index of country *j* is defined as $H_j = \Sigma_k h_{k,j}^2$ where $h_{k,j}$ is the combined market value of all country j firms in industry *k* as a percentage of the market value of all country *j* firms. Yearly averages are then taken for each market. Industry classification follows Datastream Industry Classification Benchmark (ICBIN).	Datastream, and own computation
Firm Herfindahl Index	*FirmHerf*	Following Morck et al. (2000), Firm Herfindahl Index of country *j* is defined as $F_j = \Sigma_i h_{i,j}^2$ where $h_{i,j}$ is the market value of firm *i* as a percentage of the total market value of all	Datastream, and own computation

		country j firms. Yearly averages are then taken for each market. Industry classification follows Datastream Industry Classification Benchmark (ICBIN).	
GDP Per Capita	*GDPC*	Log of per capita GDP measured in USD in year t-1	World Development Indicators, WDI
GDP Growth	g_{GDP}	Annual GDP growth in year t-1.	World Development Indicators, WDI
Panel B: Firm Variable Definitions and Sources			
Variable	Abbrev.	Description	Source
Economic and Financial Environment			
Concurrent Year Returns	*Ret*	Average monthly stock returns of year t.	Worldscope
Debt-to-Equity Ratio	*DE*	Ratio of long-term debt to common equity of year t-1.	Worldscope
Return Volatility	σRet	Standard deviation of monthly stock returns of year t-1.	Datastream
MSCI Index Membership	*MSCI*	Dummy variable - equal to one if firm is included in MSCI index.	Datastream
Information Environment			
Earnings Smoothing	*Smth*	The ratio of the standard deviation of operating income to standard deviation of cash flow over the past three years.	Worldscope
Earnings Correlation	*Corr*	Correlation coefficient between changes in the accruals ($\Delta Accr$) and changes in cash flow (ΔCF) over the past five years, with three years required minimum period.	Worldscope
Analyst Forecast error	*FErr*	Absolute value of the difference between announced earnings and mean of estimated earnings, scaled by mean of analyst forecasts in year t-1.	I/B/E/S
Analyst Coverage	*Alyst*	Number of analysts covering a firm in year t-1.	I/B/E/S
Correlated Trading			
Domestic Institutional Ownership	*IO_D*	Aggregate equity holdings by domestic institutional investors as a percentage of total number of outstanding shares at previous year end.	Factset
Foreign Institutional Ownership	*IO_F*	Aggregate equity holdings by foreign institutional investors as a percentage of total number of outstanding shares at previous year end.	Factset
Control Variables			
Firm Size	*Size*	Log of market capitalization in USD at t-1 year-end.	Datastream
Firm Age	*Age*	Number of years from listed date until current date.	Datastream
Dividend Yield	*DY*	Average dividend yield of year t-1.	Worldscope
Book-to-Market Ratio	*BM*	Log of book-to-market equity ratio at year t-1 June.	Datastream, Worldscope
Return-on-Equity Ratio	*ROE*	Returns on equity of year t-1.	Worldscope

Appendix C. Implied cost of capital models

The residual income valuation model from Claus and Thomas (2001) is as follows:

$$p_t = bv_t + \sum_{\tau=1}^{T} \frac{\left(\hat{eps}_{t+\tau} - r_{CT} \cdot bv_{t+\tau-1}\right)}{\left(1 + r_{CT}\right)^{\tau}} + \frac{\left(\hat{eps}_{t+T} - r_{CT} \cdot bv_{t+T-1}\right)(1+g)}{(r_{CT} - g)\left(1 + r_{CT}\right)^{T}}.$$

This model uses actual book values per share and forecasted earnings per share to calculate the series of expected future residual income for up to five years. After five years, the nominal residual income is assumed to grow at rate g, which is equal to the expected inflation.

The residual income valuation model of Gebhardt et al. (2001) is as follows:

$$p_t = bv_t + \sum_{\tau=1}^{T} \frac{\left(\hat{eps}_{t+\tau} - r_{GLS} \cdot bv_{t+\tau-1}\right)}{\left(1 + r_{GLS}\right)^{\tau}} + \frac{\left(\hat{eps}_{t+T+1} - r_{GLS} \cdot bv_{t+T}\right)}{r_{GLS}\left(1 + r_{GLS}\right)^{T}}$$

Future expected residual income for the first three years is calculated using the actual book values per share and forecasted earnings per share. Clean surplus is assumed, with future book values imputed from current book values, forecasted earnings, and dividends. A constant fraction of forecasted earnings is set equal to dividends. After the initial three years, the residual income stream is obtained by linearly reducing the forecasted accounting return on equity to the sector-specific median return. Following Hail and Leuz (2006) and Lau et al. (2010), firms are classified into industrial, service, and financial sectors.

The abnormal earnings growth valuation model of Ohlson and Juettner-Nauroth (2005) is as follows:

$$p_t = \frac{\hat{eps}_{t+1}}{r_{OJ}} \cdot \frac{\left(g_{st} + r_{OJ} \cdot \frac{\hat{d}_{t+1}}{\hat{eps}_{t+1}} - g_{lt}\right)}{(r_{OJ} - g_{lt})}$$

One-year-ahead forecasted earnings, dividends per share, and forecasts of short-term and long-term abnormal earnings growth are used to estimate this model. The growth rate, g_{st}, is derived as the average of the forecasted percentage change in the initial two years of earnings. The I/B/E/S financial analysts' forecasts are used as the five-year growth forecasts.

The MPEG ratio (price-to-earnings ratios divided by the growth rate) model of Easton (2004) is as follows:

$$p_t = \frac{\left(e\hat{p}s_{t+2} - r_{MPEG}\ .\ a\hat{d}_{t+1} - e\hat{p}s_{t+1}\right)}{r^2{}_{MPEG}}$$

One-year-ahead and two-year-ahead earnings per share forecasts and expected dividends per share in period t+1 are used to obtain abnormal earnings growth. After the initial period, perpetual growth in abnormal earnings is assumed.

p_t = Market price of a firm's stock j at time t;.

bv_t = Book value per share at time t;.

$bv_{t+\tau}$= Expected book value per share at time $t+\tau$, where $bv_{t+\tau} = bv_{t+\tau-1} + e\hat{p}s_{t+\tau} - \hat{d}_{t+\tau}$, and $\hat{d}_{t+\tau}$ is the expected future net dividends per share for period $(t+\tau-1,\ t+\tau)$;.

$e\hat{p}s_{t+\tau}$ =Expected future earnings per share at time $(t+\tau-1,\ t+\tau)$;.

g_{st} =Short-term growth rate;.

g_{lt} =Long-term growth rate;.

$\hat{d}_{t+1}$ =Forecasted dividend per share;.

r_{GLS} =*ICOC* for Gebhart, Lee, and Swaminathan's (2001) model;.

r_{CT} =*ICOC* for Claus and Thomas (2001) model;.

r_{MPEG} =*ICOC* for Easton's (2004) MPEG model; and.

r_{OJ} =*ICOC* for Ohlson and Juettner-Nauroth (2005) model.

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