International stock market liquidity: a review

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Abstract

Purpose – The purpose of this paper is to review the literature on liquidity in international stock markets, highlights differences and similarities in empirical results across existing studies, and identifies areas requiring further research.

Design/methodology/approach – International cross-country studies on stock market liquidity are categorized and reviewed. Important relevant single-country studies are also discussed.

Findings – Market liquidity is influenced by exchange characteristics (e.g. the presence of market makers) and regulations (e.g. short-sales constraints). The literature has identified the most appropriate liquidity measures for global research, and for emerging and frontier markets, respectively. Major empirical facts are as follows. Liquidity co-varies within and across countries. Both the liquidity level and liquidity uncertainty are priced internationally. Liquidity is positively associated with firm transparency and share issuance, and negatively related to dividends paid out. The impact of internationalization on liquidity is not universal across firms and countries. Some suggested areas for future studies include: dark pools, high-frequency trading, commonality in liquidity premium, funding liquidity, liquidity and capital structure, and liquidity and transparency.

Research limitations/implications – The paper focusses on international stock markets and does not consider liquidity in international bond or foreign exchange markets.

Originality/value – This paper provides a comprehensive survey of empirical studies on liquidity in international developed and emerging stock markets.

Keywords Corporate finance, Liquidity, Market microstructure, Asset pricing, International markets, Liquidity commonality

Paper type Literature review

1. Introduction

Liquidity, or the ease with which an asset can be traded in a timely manner at low cost, plays an important role in financial markets. A severe liquidity decline is widely cited as an important catalyst of the financial contagion that prevailed during the 2007-2009 financial crisis (e.g. Rosch and Kaserer, 2013). According to Geithner (2007), one aspect of maintaining market stability is ensuring the adequacy of liquidity in normal times. While many early liquidity studies focus on the US markets, research on liquidity in global markets is attracting increased attention. The growing body of international liquidity research is important for a number of reasons. First, international markets are predominantly order-driven markets (e.g. Jain, 2005), which differ from the US quote-driven markets where market makers stand ready to provide liquidity. Second, an international setting provides a rich environment in which to consider the impact of different legal, economic, and political environments on liquidity.

In this paper, we review recent research on international stock market liquidity. Our review relates to a comprehensive US-focussed literature survey on market liquidity by Holden *et al.* (2014). In contrast, we focus on liquidity in international developed and emerging stock markets.

We begin in Section 2 by exploring how market features and regulations affect liquidity. Academic research in this area could be particularly important for

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policymakers. In Section 3, we discuss various liquidity measures for global research, and for emerging and frontier markets, respectively. The best liquidity proxy for developed markets is not necessarily appropriate for emerging markets or frontier markets. For instance, as Kang and Zhang (2014) note, the Amihud (2002) measure, which assumes that the proportion of zero-volume days is negligible, is not necessarily accurate for thinly traded securities in emerging markets. In Section 4, we review evidence on commonality, or co-movement, in liquidity and in liquidity premium. While there has been a large body of research on liquidity commonality, commonality in the illiquidity premium is a new type of commonality documented by Amihud *et al.* (2015). In Sections 5 and 6, we review the connection between liquidity and asset pricing, and liquidity in corporate finance. The final section concludes and discusses areas for future research.

2. How market mechanisms and regulations affect liquidity

Market mechanisms and regulations differ greatly across countries. This section reviews the impact of market design on liquidity, and considers how market regulators and operators can play an active role in improving market efficiency by increasing market liquidity[1]. In addition to Jain (2003, 2005), which are included in Holden *et al.*'s (2014) article, we review eight other papers that provide international evidence, and relevant single-country studies.

2.1 Market features

Jain (2003) investigates how various institutional features of 51 exchanges impact on exchange performance measured by spreads, volatility, and turnover. He shows that quoted, effective and realized spreads are lower in exchanges with designated market makers, a consolidated limit order book, a centralized order flow, a fully automated trading system, a demutualized ownership structure, smaller tick sizes[2], or more exchange transparency. Jain (2005) investigates, based on a sample of 120 countries, the impact of the introduction of electronic trading systems on equity premium and liquidity. He reports that automation of trading leads to lower cost of capital due to improved market liquidity, as measured by turnover and a modified Amihud (2002) measure. Henkel *et al.* (2008) estimate liquidity using the Amihud (2002) measure, zero returns, and the LOT measure from Lesmond *et al.* (1999). They examine the effects of stock market automation on both liquidity level and liquidity risk. Consistent with Jain (2005), the results show a significant improvement in liquidity level. They then use persistence and volatility of liquidity level, and Acharya and Pedersen's (2005) model to measure liquidity risk, and find that liquidity risk falls.

Recently, there has been increasing discussion on high-frequency trading (HFT) and whether high-frequency traders are a reliable source of liquidity provision (e.g. Chung and Chuwonganant, 2014). Using data from 42 markets, Boehmer *et al.* (2014) exploit the co-location events to shed light on how algorithmic trading, the precondition for HFT, impacts on market quality, including liquidity measured by spreads, the Amihud (2002) ratio, and execution shortfalls. They argue that co-location events facilitate algorithmic trading and thus use the first implementation dates as exogenous shocks to algorithmic trading activities. The results suggest that algorithmic trading positively affects stock liquidity and information efficiency for large firms, but leads to higher volatility.

2.2 Policies and trading rules

The idea that regulators can help improve market liquidity has also been discussed (e.g. Handa *et al.*, 1998). Academic research in this area is important for policymakers, as only when regulators and market operators understand how policies and trading rules impact on market quality can they determine the best combination of market features and regulations to improve market liquidity and efficiency (Berkman and Comerton-Forde, 2011).

2.2.1 Tick size changes. Tick size changes have been described as "one of the most important regulatory policies" (Holden *et al.*, 2014, p. 300) that affect market liquidity. Given that the minimum tick size is the lower bound of bid-ask spread yet smaller tick sizes make liquidity provision less profitable, it is not unexpected that tick size reductions can lead to conflicting effects on liquidity.

Lau and McInish (1995) is one of the first to investigate the effects of tick size reductions. They find significant declines in bid-ask spreads and quoted depths following the tick size reduction on the Stock Exchange of Singapore. Bacidore (1997) investigates the effects of the switch to decimal trading on the Toronto Stock Exchange (TSX) in 1996. For stocks with a pre-event price above $5, he finds a statistically and economically significant decline in both spreads and depths, but insignificant change in trading volume. He also analyses the depth-to-spread ratio and the change in effective spreads in different trade sizes. The results suggest a general improvement in liquidity. Smith *et al.* (2006) investigate the effects of the switch to a penny tick on the TSX in 2001. Using five market quality proxies (quoted spread, quoted depth, cumulative depth, price continuity, and order execution speed), they find an overall liquidity improvement. Aitken and Comerton-Forde (2005) investigate the impact of tick size reductions in Australia. They measure liquidity by spread, depth, and the Aitken and Comerton-Forde (2003) method, which weights order values by order execution probability. While the evidence suggests that the reductions in tick sizes lead to an overall liquidity improvement, liquidity in stocks with narrower relative tick size and lower trading volume actually deteriorates. Ahn *et al.* (2007) find significant declines in spreads following tick size reductions on the Tokyo Stock Exchange. They also show an insignificant change in trading volume and more quote revisions following the tick size change.

While many studies document an overall liquidity improvement following tick size reductions, Bourghelle and Declerck (2004), Hsieh *et al.* (2008), Pan *et al.* (2012), and Anderson and Peng (2014) provide evidence that a decrease in tick sizes does not necessarily enhance market liquidity. Bourghelle and Declerck (2004) investigate the market behavior following the tick size change on Euronext Paris. The new pricing grid implemented in 1999 provides a unique opportunity to examine the effects of both tick size reductions and increases. They find significant declines (increases) in order exposure and market depths following a tick size decrease (increase). However, the results present no significant change in spreads. Hsieh *et al.* (2008) find significant declines in spread, depth, and the depth-to-spread ratio (an overall market liquidity proxy), following tick size reductions on the Taiwan Stock Exchange (TWSE). Pan *et al.* (2012) investigate the liquidity impact of tick size reductions on the Hong Kong Stock Exchange (HKEx). They use a modified cumulative depth measure, and find significant liquidity deterioration, especially for high-volume stocks. Anderson and Peng (2014) find the tick size reduction from a cent to half-a-cent in New Zealand decreases both spread and depth significantly. Using a combined liquidity measure from Bollen and Whaley (1998) and the Amihud (2002) measure, they find some evidence that the market liquidity declines.

2.2.2 Short-sales constraints. Regulators around the world impose short-sales restrictions to prevent panic selling which may lead to market crashes (e.g. Beber and Pagano, 2013). However, academics have not reached a consensus on whether such regulations are beneficial. We begin by reviewing literature that finds allowing short selling improves liquidity, and then move to studies that find the reverse.

Charoenrook and Daouk (2005) is one of the first to investigate the effects of short selling in a global context. They document that market liquidity (turnover) is significantly higher in countries where short selling and/or put option trading are permitted and practiced. Beber and Pagano (2013) examine the effects of short-selling bans imposed and lifted around the 2007-2009 financial crisis in 30 countries. The evidence shows that short selling bans are associated with lower liquidity, as measured by bid-ask spreads and the Amihud (2002) ratio, and slower price discovery.

Biais *et al.* (1999) study the impact of short-selling constraints by exploiting the natural market setting of the Paris Bourse, in which "some stocks are traded on a spot basis, while others are traded on a monthly settlement basis" (p. 395). They argue that investors can avoid short-selling constraints when trading on a monthly settlement basis, and provide evidence that short-selling constraints reduce immediate sell orders, measured by the proportion of sell orders to all market orders, and liquidity accordingly. Marsh and Payne (2012) investigate the effects of the introduction and subsequent removal of the short-sales ban on UK market financial firms. They find significant deterioration in liquidity (measured by bid-ask spreads and buy/sell slippages) during the ban period, and strong reversals once the ban is lifted. The list of shortable stocks on the HKEx is revised over time. Bai and Qin (2014) investigate how imposing and removing short-sales constraints affect stock liquidity by taking advantage of this unique setting. They find neither addition to nor deletion from the list affects stock liquidity, as measured by the Amihud (2002) ratio, on average. Nevertheless, relatively illiquid stocks during the pre-event period experience a significantly greater increase in liquidity after short-sales restrictions are imposed or lifted.

Lin (2008) and Chuang and Lee (2010) investigate the effects of removing the short-sales price restriction on the TWSE. While Lin (2008) provides evidence of an insignificant change in trading activity (trading values of individual stocks), Chuang and Lee (2010) use turnover and the Amihud (2002) ratio as liquidity proxies and report that the repeal of short-sales constraints significantly decreases liquidity, liquidity-return relations, and liquidity commonality across stocks. In Lecce *et al.* (2012), lifting naked short-selling bans in Australia leads to significant increases in quoted spreads, effective spreads, and order depths. They consider the effective spread as a more robust measure since it "takes into account both order depth and bid-ask spreads" (p. 98), and conclude that allowing naked short selling results in slightly lower liquidity. According to Sharif *et al.* (2014), the relaxation of short selling and margin trading bans in China is associated with lower trading activity and wider spreads, which indicates a liquidity decline. They argue that heightened asymmetric information in eligible stocks following the regulatory change results in wider spreads, and if outsiders expect higher risk of trading against informed traders, they would reduce their investments.

2.2.3 Other regulatory issues. Levine and Zervos (1998) examine the effects of changes in capital control policies on stock market performance. They find market liquidity (value traded and turnover ratios) improved following key dates when restrictions on international capital flows were liberalized for 16 emerging countries. Frost *et al.* (2006) investigate the impact of stock exchange disclosure policies on

market development. They measure market development as the mean of five market development proxies, including two liquidity measures based on "number of transactions in equity shares" and "adjusted domestic trading volume" (p. 452). They find a positive association between stock exchange disclosure requirements and market development (which encompasses liquidity).

Cumming *et al.* (2011) examine how broadly framed and specific rules affect stock market liquidity differently. They suggest there are significant differences in trading rules designed to limit insider trading, market manipulation, and broker-agent conflicts across exchanges. For instance, Nasdaq sets specific rules to prevent "wash trades, pre-arranged trading, fictitious orders, giving-up priority […]" (p. 652), while other exchanges may only broadly frame what would constitute market manipulation. They report that specific rules enhance investor confidence and hence provide more liquidity (estimated by velocity, volatility, and bid-ask spreads) than broadly framed rules. In Huang *et al.* (2014), there is a positive link between liquidity, as measured by effective spreads and the Amihud (2002) ratio, and firm value. This positive link is stronger in countries with greater investor protection. The authors suggest that investor protection enhances the impact of liquidity on firm value by reducing managerial entrenchment, improving stock price informativeness, and increasing pay-for-performance sensitivity.

3. Liquidity measures for international studies

Existing literature has established standard liquidity measures for the US equity markets (e.g. Goyenko *et al.*, 2009). While it is convenient to use low-frequency liquidity proxies (e.g. daily or monthly) for international studies to reduce computational time, and/or to have a larger sample size over a longer time span, it is important to ensure accurate liquidity measures are used.

Lesmond (2005) tests the efficacy of five liquidity measures in 31 emerging countries. He suggests that the LOT measure from Lesmond *et al.* (1999) and the Roll (1984) measure are better for presenting cross-country variations in liquidity, while the LOT measure and the Amihud (2002) measure perform better for within-country liquidity studies. Marshall *et al.* (2013) assess which liquidity proxies are the best for frontier markets by calculating correlations and root-mean squared errors between a liquidity benchmark and a liquidity proxy. The Gibbs estimate based on Hasbrouck (2004, 2009) and the Amihud (2002) measure have the highest correlations with the liquidity benchmarks. The FHT proxy from Fong *et al.* (2014) has the lowest root-mean squared error and hence is better than the other proxies to estimate the level of transaction costs. Kang and Zhang (2014) construct AdjILLQ, a modified Amihud measure, for relatively illiquid emerging markets. AdjILLIQ combines the original Amihud (2002) ratio with the incidence of zero-volume days to measure liquidity better in emerging markets, as zero-volume measure performs more accurately when the proportion of zero-volume days is relatively high.

Considering the potential difficulty in computing liquidity measures based on intraday data, Fong *et al.* (2014) examine which low-frequency liquidity proxies are the best for global research. They use three performance metrics (the average cross-sectional correlation, the time-series correlation, and the average root-mean squared error[3]), and run horseraces of monthly and daily liquidity proxies against their five liquidity benchmarks (percent effective spread, percent quoted spread, percent realized spread, percent price impact, and the slope coefficient lambda).

They find that the closing percent quoted spread from Chung and Zhang (2014) is the best percent-cost liquidity proxy at both daily and monthly frequencies for global research, although the high-low measure from Corwin and Schultz (2012) performs the best in capturing the level of percent realized spread and percent price impact. The daily Amihud (2002) measure is the best for daily cost-per-volume. Among monthly cost-per-volume proxies, five measures perform similarly well. These five measures are the Amihud (2002) measure, closing percent quoted spread impact, LOT mixed impact, high-low impact, and FHT impact[4].

In summary, for global research, the closing percent quoted spread from Chung and Zhang (2014) is the best spread proxy, while the high-low measure from Corwin and Schultz (2012) performs the best to capture the level of percent realized spread and percent price impact. The Amihud (2002) measure is the best price impact proxy. For emerging markets studies, the LOT measure from Lesmond *et al.* (1999) and the Roll (1984) measure perform better than the Amihud (2002) measure and turnover in presenting cross-country variations, while the LOT and Amihud (2002) measures outperform the Roll (1984) measure and turnover in measuring within-country liquidity. AdjILLIQ from Kang and Zhang (2014) does particularly well for relatively illiquid markets. For frontier markets, the Gibbs measure from Hasbrouck (2004, 2009) and the Amihud (2002) measure are the best spread and price impact proxies for studies where the magnitude of the correlation between a liquidity proxy and benchmark matters most, while the FHT proxy from Fong *et al.* (2014) performs best in capturing the level of spread benchmarks.

4. Liquidity commonality

Liquidity commonality refers to the co-movement in liquidity among individual firms within a market and alternatively across markets. We first present evidence on international liquidity commonality with an emphasis on developed markets. We then focus on evidence for emerging markets.

4.1 Developed markets evidence

One of the first studies investigating international liquidity commonality is a paper by Stahel (2005). Using data from Japan, the UK, and the USA, he measures liquidity by turnover and two other Amihud-type proxies, and shows the existence of a global liquidity factor independent of country and industry liquidity factors. Brockman *et al.* (2009) document commonality in liquidity (measured by spreads and depths) within and across 27 developed markets and 20 emerging markets. The sensitivity of exchange-level liquidity to global liquidity tends to be higher in developed markets. In addition, domestic macroeconomic announcements significantly increase exchange-level liquidity commonality, while US macroeconomic announcements positively affect liquidity commonality globally. Zhang *et al.* (2009) measure liquidity with percentage spreads and examine the impact of a set of firm-level factors (e.g. analyst coverage) on within-country and cross-border liquidity commonality for developed markets. They find that within-country commonality is lower for firms with cross listing in New York or London, and that cross-country commonality is higher for firms with greater foreign ownership.

Karolyi *et al.* (2012) use a modified Amihud (2002) liquidity measure, and investigate the cross-section and time-series patterns in liquidity commonality for 40 countries. Despite of the important role of supply side theories around funding liquidity, their findings are more consistent with demand-side explanations, suggesting that

liquidity commonality is driven by correlated trading activities. According to Amihud *et al.* (2015), commonality also exists in liquidity premium around the world. Amihud *et al.* (2015) define commonality in illiquidity premium as "the extent to which each country's illiquidity return premium co-varies with the global and regional average illiquidity return premiums" (p. 360). They find no evidence of the effects of market conditions (market returns and volatility) on commonality in the liquidity premium.

4.2 Emerging markets evidence

In Brockman *et al.* (2009), emerging Asian markets exhibit much stronger within-exchange liquidity commonality. Tests on the relative importance of local and global liquidity commonality factors show that local conditions play a more important role in emerging market than in developed markets. Moreover, macroeconomic announcements contribute to greater commonality in emerging markets. Consistent with Brockman *et al.* (2009), Karolyi *et al.* (2012) suggest that both level and time-series volatility of liquidity commonality tend to be a greater issue in less developed markets. Karolyi *et al.* (2012) also find the increase in liquidity commonality is greater in less developed markets when market volatility is high. The significant negative relation between liquidity commonality and market return in less developed markets is supportive of the supply side explanations associated with funding liquidity, given that funding constraints are more likely to be an issue during market declines in less developed countries.

Asian countries with their diverse developmental stages allow comparison between liquidity dynamics in emerging and developed markets. Wang (2013) focusses on 12 Asian equity markets, among which eight are emerging markets. Based on an Amihud-type liquidity measure, Wang (2013) proposes a multi-factor model to measure liquidity commonality, and relative contribution of global, regional, and local factors. The set of global factors is constructed using data on the USA and the UK. Two sets of regional factors are constructed based on Asian emerging and Asian developed markets, respectively. In particular, they show increasing commonality in liquidity across Asian countries over the period 2000-2010.

5. Liquidity and asset pricing

The link between liquidity and asset pricing has been examined internationally. The evidence suggests that higher returns are required by holders of assets with lower liquidity or with higher liquidity risk in a global context.

5.1 Developed markets evidence

While some papers extend the investigation for the US markets (e.g. Acharya and Pedersen, 2005) to both developed and emerging markets, a number of studies focus solely on developed markets, suggesting that inferences based on developed markets data are more reliable (e.g. Liang and Wei, 2012).

Dey (2005) investigates the determinants of turnover and the impact of turnover on returns using 48 stock market indices. He reports a positive turnover-return relation, which is contrary to the evidence of a negative turnover-return relation from individual securities in prior studies (e.g. Easley *et al.*, 2002). His reasoning is as follows. Actively managed portfolios, a high proportion of which could be riskier growth stocks, tend to have higher turnover, and the expected returns of these portfolios is higher due to the

higher risk of the stocks. However, when the author repeats the analysis for developed and developing markets separately, this positive turnover-return relation becomes insignificant for developed markets. An explanation given is that liquidity is not a major concern of investors in developed markets where liquidity tends to be adequate.

Given the evidence on within-country and cross-border liquidity co-movements[5], Stahel (2005) documents that this systematic liquidity risk is priced in a global context based on turnover and his two Amihud-type measures. Lee (2011) estimates liquidity by the incidence of zero returns, and finds that liquidity risks (measured by the covariance of individual stocks' liquidity with the local market liquidity, and the covariance of individual stocks' liquidity with local and world market returns) are priced factors. Further, the covariance of a stock's liquidity and the US market return has a significant positive impact on expected returns, especially in developed markets. In addition, in developed markets, which are generally more open and transparent, global liquidity risk is more important than local liquidity risk.

Liang and Wei (2012) investigate the relation between liquidity risk and stock returns for 21 developed markets. They argue that focussing on developed markets allows the empirical evidence not to be affected by currency constraints. Based on the Pastor and Stambaugh (2003) and Amihud (2002) measures, they find that liquidity risk is systematically priced locally in 11 developed markets and globally after Fama and French's (1993) three factors are controlled. They also provide evidence of lower local liquidity risk premium in markets with more effective corporate governance. Using the Amihud (2002) ratio as their liquidity proxy, Amihud *et al.* (2015) find significant illiquidity premium and risk-adjusted illiquidity premium worldwide. Liquidity premium is higher during market declines and lower in developed markets. They suggest that the lower illiquidity premium in developed markets is driven by better information provision and governance in these markets.

Using 39 stock markets indices, Lasfer *et al.* (2003) examine the impact of market liquidity on a momentum phenomenon. They find positive (negative) abnormal returns following positive (negative) prices shocks, and show that this post-shock momentum is greater in more illiquid markets (proxied by market capitalization, market capitalization/GDP, turnover, and sovereign debt quality) and decreasing over time. Asness *et al.* (2013) and Cakici and Tan (2014) study value and momentum returns at the global level. Asness *et al.* (2013) document value and momentum return premiums, and highly correlated value and momentum returns across markets and asset classes. They suggest that global funding liquidity risk could partially explain the correlated patterns. Cakici and Tan (2014) use the Pastor and Stambaugh (2003) and Sadka (2006) liquidity factors to investigate value and momentum effects with a particular focus on the size effect, based on a sample of 23 developed stock markets. They find value returns are more likely to be affected by changes in liquidity conditions, with momentum returns relatively unaffected.

5.2 Emerging markets evidence

Liquidity effects could be stronger in emerging markets where liquidity is relatively scarce, compared with more advanced economies. Therefore, tests in emerging markets could be more powerful and provide additional evidence.

Dey (2005) finds the positive relation between portfolio turnover and expected returns to be exclusively significant for emerging markets. In Lee (2011), local liquidity risk is more important than global liquidity risk in emerging countries, which indicates lower market integration of emerging countries with the world. Lee (2011) argues that high information

asymmetry and political risk in emerging markets could be of greater concerns for global investors. Amihud *et al.* (2015) document that illiquidity premiums are higher in emerging markets. While showing the evidence of significantly positive (negative) price reactions following positive (negative) price shocks, Lasfer *et al.* (2003) find that this momentum phenomenon is of greater economic significance in emerging markets.

A number of studies focus exclusively on emerging markets. Consistent with Dey (2005), Jun *et al.* (2003) report a robust positive relation between aggregate market liquidity and stock returns across 27 emerging markets. However, their causality analysis indicates that there is no significant causal relationship between market liquidity (trading value, turnover ratio, turnover-volatility ratio) and returns. They also highlight the importance of understanding the difference between aggregate market liquidity and liquidity of individual stocks. Their findings are consistent with the idea that emerging markets have a lower degree of market integration with the world; hence, higher market liquidity does not necessarily lead to lower expected returns.

Given the variation in liquidity conditions in emerging markets, Bekaert *et al.* (2007) investigate the predictive power of liquidity (mainly measured by zero returns) and liquidity shocks on expected returns in 18 emerging countries. The findings are consistent with those in Amihud (2002): while excess returns are negatively associated with past liquidity, unexpected positive liquidity shocks lead to higher contemporaneous excess returns. These effects are stronger in segmented markets. Hearn (2010) investigates size and liquidity effects for emerging South Asian stock markets, using quoted spreads and the Liu (2006) measure to proxy for liquidity. Both size and liquidity are priced factors in India, Pakistan, and Bangladesh, with size factor alone priced in Sri Lanka. Donadelli and Prosperi (2012) document significant risk-adjusted returns ("alpha puzzle") and time-varying systematic risk ("beta puzzle") in emerging countries. Their two-country model shows that "alpha puzzle" is solved by additional costs other than illiquidity in emerging markets, while their conditional two-factor model suggests that "beta puzzle" is justified by time-varying global liquidity factors[6].

6. Liquidity in corporate finance

While international research on liquidity in corporate finance investigates similar questions as single-country liquidity research, one main reason for using a global sample is to allow for more cross-sectional variation.

6.1 International markets evidence

Existing literature analyses: liquidity and firm transparency; liquidity and dividend policy; and liquidity and share issuance. Lang and Maffett (2011) investigate the effects of firm transparency on firm liquidity variability and co-variability in 37 countries. They measure liquidity by the Amihud (2002) ratio, and provide evidence that more transparent firms are less sensitive to liquidity shocks, and are less likely to co-move with market liquidity and market returns. Moreover, liquidity uncertainty significantly and negatively affects firm value measured by Tobin's *Q*. Based on a sample of 46 countries, Lang *et al.* (2012) use zero-return days and bid-ask spreads as liquidity measures and find a significant positive relation between firm transparency and stock liquidity. This relation is stronger in countries with weak institutions, during periods of great uncertainty, or for firms with high ownership concentration. They also provide evidence that an increase in liquidity is associated with significantly lower cost of capital and higher firm value.

While Lang and Maffett (2011) and Lang *et al.* (2012) use the magnitude of earnings management as one of the transparency proxies, LaFond *et al.* (2007) directly investigate the relation between earnings smoothing, governance attributes, and firm liquidity. They differentiate between discretionary smoothing and non-discretionary smoothing. The findings report that discretionary earnings smoothing is positively associated with weak governance, and that discretionary smoothing reduces firm transparency and accordingly, leads to lower liquidity (based on zero-return days, bid-ask spreads, and volume). Using data from 47 countries, Charoenwong *et al.* (2014) document a significant positive relation between asset liquidity and stock liquidity measured by the incidence of zero returns. This supports their valuation uncertainty hypothesis, suggesting that firms with more liquid assets are associated with less valuation uncertainty and more stock liquidity accordingly. Moreover, the positive asset and stock liquidity relation is stronger in countries with weak accounting standards and legal environment, which is consistent with the finding in Lang *et al.* (2012) that firm-level factors are of greater importance when country-level institutions are relatively weak.

Prior studies show that, in a global context, dividend distribution is more valuable for illiquid firms. Griffin (2010) presents evidence that more illiquid firms (measured by turnover) distribute more dividends to shareholders, suggesting that offering dividends compensates for firm illiquidity. Jain and Chu (2014) examine, based on a global sample, the effects of a number of country-level factors (including market liquidity proxied by the incidence of zero-return days) on dividend payout policies. The results provide strong evidence that firms pay more dividends in more illiquidity markets.

The papers of Bortolotti *et al.* (2007) and Stulz *et al.* (2014) examine the relation between market liquidity and share issuance. Bortolotti *et al.* (2007) investigate how share-issue privatization (SIP), defined as a common stock issue from a state-owned enterprise in a public exchange, affects market liquidity, as measured by the Amihud (2002) value, in 19 developed countries. The results show that SIPs significantly improve market liquidity through both domestic issues and cross-listings. Moreover, SIPs have a significantly positive impact, or a spillover effect, on liquidity of non-privatized firms. These findings can be explained from the aspects of improvements in risk diversification, risk sharing, and foreign investors' participation. Stulz *et al.* (2014) use the Amihud (2002) ratio as their market liquidity proxy, and provide evidence that firms are more likely to issue shares when markets are more liquid to avoid large price impact.

6.2 Emerging markets evidence

Corporate finance research suggests that additional reasons for emerging markets evidence to be important include: extensive government intervention, different ownership structures, and a relative dearth of academic research in these markets. These factors are likely to make the results different from those in developed markets.

A number of papers study the impact of internationalization (e.g. cross-listings) on liquidity in emerging markets. A theoretical paper by Hargis (2000) suggests that international cross-listings increase market capitalization and liquidity, and that integration benefits emerging local markets. His arguments are consistent with the evidence from developed markets provided by Bortolotti *et al.* (2007). However, Levine and Schmukler (2006) show that internationalization (through cross-listings, depository receipts, or private or public placements in international equity markets) negatively impacts on liquidity in local markets, as measured by turnover, the Amihud (2002) ratio, and the incidence of zero-return days. The authors find that

internationalization results in a migration in trading from domestic markets to international markets for international firms.

Silva and Chavez (2008) use the LOT measure from Lesmond *et al.* (1999), and find the effects of cross-listings on local market liquidity depend on both country origin and firm size, based on data from four main Latin American markets. They show that cross-listings have significantly positive impact on liquidity for larger firms in Argentina, Brazil, and Mexico. One explanation is that, for larger firms, there are adequate information linkages between local and international markets, and liquidity of cross-listed firms improves in local markets due to increased competition. Moreover, they find that liquidity is higher in local markets than in international markets for larger cross-listed firms, but lower for smaller cross-listed firms. Their reasoning is that better investor protection in international markets can mitigate information asymmetry and improve liquidity in smaller firms, while for larger firms, information asymmetry (liquidity) is lower (higher) in local markets due to better access to firm-specific information.

7. Conclusions and areas for future research

This paper reviews the literature on international stock market liquidity, and suggests possible areas for future research.

Prior studies show that market liquidity is influenced by exchange characteristics and regulations. As trading environments continue to evolve, how market mechanisms and policies impact on liquidity is still an important area for future research. Since the 1990s, a large body of research has documented the huge success of the introduction of the fully automated trading systems around the world (e.g. Jain, 2005). In a similar vein, there have been growing interests in dark pools and HFT recently. Although the effects of dark pools and HFT on liquidity have been investigated in a few countries (e.g. He and Lepone, 2014), much less is known at the global level.

While earlier studies describe liquidity as an elusive concept and often use turnover to proxy for liquidity, more recent studies seek to identify the most appropriate liquidity measures for different types of markets. This obviously facilitates future international liquidity research. Evidence on liquidity commonality presents liquidity co-movements within and across countries. A recent paper by Amihud *et al.* (2015) finds that commonality also exists in (il)liquidity premium around the world. Future research may examine cross-sectional and time-series determinants of commonality in (il)liquidity premium, and compare and contrast the results with those in Karolyi *et al.* (2012).

In the asset pricing area, extensive evidence based on assets' market liquidity suggests that both liquidity level and liquidity uncertainty are priced factors. However, much less is known about how funding liquidity is priced especially in non-US markets, despite the important role of funding liquidity in the US literature (e.g. Brunnermeier and Pedersen, 2009). As such, the investigation of funding liquidity in international markets is an important area for future study. There is still much to be investigated regarding the link between liquidity and corporate finance in a global context. For instance, a possible avenue is to investigate the impact of market liquidity on firms' capital structure across countries and over time, provided the international evidence in Stulz *et al.* (2014). In addition, according to Lang and Maffett (2011) and Lang *et al.* (2012), more transparency is always better, which is inconsistent with the arguments in Berkman and Comerton-Forde (2011). Therefore, understanding the role of transparency on liquidity has to be left to future research.

Notes

1. Existing literature presents a strong positive link between market liquidity and efficiency (e.g. Chordia *et al.*, 2008).
2. We discuss how tick size changes impact on liquidity in more details in Section 2.2.
3. See Goyenko *et al.* (2009) for discussion on the three performance metrics.
4. See Fong *et al.* (2014) for discussion on these Amihud-type proxies.
5. See discussion in the liquidity commonality section.
6. Substantial growth in the total value of stocks traded in African markets in recent years (Assefa and Mollick, 2014) indicates an area with much potential for academics. Studies focussing on African markets include Hearn (2009, 2012), Hearn *et al.* (2010), and Assefa and Mollick (2014).

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(The Appendix follows overleaf.)

Appendix

Liquidity measure	Computation	Studies using the measure	Sections referencing the measure
Percent quoted spread	(Ask price−bid price)/quote midpoint	Bourghelle and Declerck (2004), Lecce *et al.* (2012), Cumming *et al.* (2011), Beber and Pagano (2013), Marshall *et al.* (2013)	Market features, tick size changes, short-sales constraints, other regulatory issues, liquidity measures, liquidity commonality, asset pricing, corporate finance
Percent effective spread	2 × |ln(trade price)−ln(quote midpoint)|	Bourghelle and Declerck (2004), Brockman *et al.* (2009), Lecce *et al.* (2012), Marshall *et al.* (2013), Kang and Zhang (2014)	Market features, tick size changes, short-sales constraints, other regulatory issues, liquidity measures, liquidity commonality
Percent price impact	See equation (2.4) in Holden *et al.* (2014)	Marshall *et al.* (2013), Fong *et al.* (2014), Boehmer *et al.* (2014)	Market features, liquidity measures
Percent realized spread	See equation (2.5) in Holden *et al.* (2014)	Jain (2003), Boehmer *et al.* (2014), Fong *et al.* (2014)	Market features, liquidity measures
Dollar quoted spread	Ask price−bid price	Bacidore (1997), Aitken and Comerton-Forde (2005), Smith *et al.* (2006), Ahn *et al.* (2007), Marsh and Payne (2012)	Tick size changes, short-sales constraints
Dollar effective spread	2 × |trade price−quote midpoint|	Bacidore (1997), Ahn *et al.* (2007)	Tick size changes
Volume depth	Number of shares quoted at the best bid and ask prices	Lau and McInish (1995), Bacidore (1997), Smith *et al.* (2006), Hsieh *et al.* (2008), Anderson and Peng (2014)	Tick size changes
Dollar depth	Dollar value of the shares quoted at the best bid and ask prices	Bourghelle and Declerck (2004), Hsieh *et al.* (2008), Anderson and Peng (2014), Lecce *et al.* (2012), Brockman *et al.* (2009)	Tick size changes, short-sales constraints, liquidity commonality
Relative quoted depth	Number of shares quoted at the best bid and ask prices/ number of shares outstanding	Aitken and Comerton-Forde (2005)	Tick size changes
Cumulative depth	See equation (2.7) in Holden *et al.* (2014)	Smith *et al.* (2006), Pan *et al.* (2012)	Tick size changes
Slope coefficient λ	See equation (2.8) in Holden *et al.* (2014)	Kang and Zhang (2014), Fong *et al.* (2014)	Liquidity measures
Roll	See Roll (1984)	Lesmond (2005), Marshall *et al.* (2013), Kang and Zhang (2014), Fong *et al.* (2014)	Liquidity measures
Aminvest	See Amihud *et al.* (1997)	Marshall *et al.* (2013), Kang and Zhang (2014), Fong *et al.* (2014)	Liquidity measures
LOT	See Lesmond *et al.* (1999)	Henkel *et al.* (2008), Lesmond (2005), Fong *et al.* (2014), Silva and Chavez (2008)	Market features, liquidity measures

Table AI.
Liquidity measures

(*continued*)

Liquidity measure	Computation	Studies using the measure	Sections referencing the measure
Zero returns	See Lesmond *et al.* (1999)	Marshall *et al.* (2013), Kang and Zhang (2014), Lee (2011), Bekaert *et al.* (2007), Levine and Schmukler (2006)	Market features, liquidity measures, asset pricing, corporate finance
Amihud	See Amihud (2002)	Bortolotti *et al.* (2007), Lang and Maffett (2011), Beber and Pagano (2013), Marshall *et al.* (2013), Amihud *et al.* (2015)	Market features, tick size changes, short-sales constraints, other regulatory issues, liquidity measures, liquidity commonality, asset pricing, corporate finance
Pastor and Stambaugh	See Pastor and Stambaugh (2003)	Marshall *et al.* (2013), Kang and Zhang (2014), Fong *et al.* (2014), Liang and Wei (2012), Cakici and Tan (2014)	Liquidity measures, asset pricing
Gibbs	See Hasbrouck (2004, 2009)	Marshall *et al.* (2013), Kang and Zhang (2014)	Liquidity measures
Sadka	See Sadka (2006)	Cakici and Tan (2014)	Asset pricing
Liu	See Liu (2006)	Kang and Zhang (2014), Hearn (2009, 2010, 2012)	Liquidity measures, asset pricing
LOT Y-split	See Goyenko *et al.* (2009)	Fong *et al.* (2014)	Liquidity measures
Effective tick	See Goyenko *et al.* (2009)	Fong *et al.* (2014)	Liquidity measures
High-low	See Corwin and Schultz (2012)	Fong *et al.* (2014)	Liquidity measures
Zero volume	See Kang and Zhang (2014)	Kang and Zhang (2014)	Liquidity measures
FHT	See Fong *et al.* (2014)	Marshall *et al.* (2013), Fong *et al.* (2014)	Liquidity measures
Closing percent quoted spread	See Chung and Zhang (2014)	Fong *et al.* (2014)	Liquidity measures
Turnover	Value of shares traded/ market cap; number of shares traded/number of shares outstanding	Jain (2005), Lecce *et al.* (2012), Cumming *et al.* (2011), Lesmond (2005), Dey (2005), Levine and Schmukler (2006)	Market features, short-sales constraints, other regulatory issues, liquidity measures, liquidity commonality, asset pricing, corporate finance
Value traded ratio	Value of shares traded/GDP	Levine and Zervos (1998), Assefa and Mollick (2014)	Other regulatory issues, asset pricing
Trading value	Value of shares traded	Lin (2008), Lecce *et al.* (2012), Sharif *et al.* (2014), Jun *et al.* (2003)	Short-sales constraints, asset pricing

Note: This table outlines key liquidity measures referenced in our paper

Table AI.

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