Essays on International Market Liquidity

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ABSTRACT

Liquidity, or the ease to trade an asset in a timely, low-cost manner, is an important dimension of financial markets for investors, regulators, and academics. This thesis contributes to the literature on liquidity issues in international stock markets. The first essay surveys prior research on international stock market liquidity. The essay concludes by pointing out that while trading environments and techniques continue to evolve, the manner in which market-specific characteristics affect empirical findings on liquidity issues remains an important area for future research.

The next two essays examine market- and stock-level liquidity from a global perspective. Essay Two finds that investors' risk perceptions are an important determinant of stock market liquidity internationally, and the impact of risk perceptions is stronger in more developed markets with better country governance, greater trade openness, and no short-selling constraints. It is also stronger in countries with a more individualistic culture. Based on an international setting, Essay Three finds that stock liquidity is an important channel through which market volatility affects stock returns, and shows this is distinct from the direct volatility-return relation. The influence of the liquidity channel in determining stocks returns is more pronounced in markets with higher levels of market volatility, lower trading volume, better governance, and no short-selling constraints. It is also stronger when high-frequency trading is more active and during financial crisis periods. Both essays are consistent with prior literature suggesting that more developed markets with less market friction are able to impound information in stock markets more efficiently. The final essay in the thesis examines the trading activity and market liquidity in China. Given China's unique institutional and regulatory features, liquidity and trading

activity evidence may deviate from that of other markets, such as the United States. The essay documents anomalous trading behaviour in China, and shows the findings can be partially explained by the overrepresentation of retail investors' trading.

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CHAPTER 1

INTRODUCTION

This chapter provides an overview of this thesis. In particular, it discusses the motivation for investigating liquidity issues in international markets, and the contribution of each of the four essays contained in the thesis. The chapter concludes by outlining a structure for the remainder of the thesis.

1.1 Introduction

Liquidity is an important dimension of financial markets. The inability to buy or sell an asset in a timely, low-cost manner impacts the pricing of assets and market stability. The recent 2007–2009 global crisis also highlighted the importance of liquidity in financial markets. As Rosch and Kaserer (2013) note, "the drying-up of market liquidity during the financial crisis is a well-documented phenomenon held, at least partially, responsible for the financial contagion experienced during that crisis" (p. 2284). Liquidity research is therefore important to academics, practitioners, and regulators.

The majority of early research focuses on the US markets, in which designated market makers supply some or all the liquidity to the market. In more recent times, researchers, such as Brockman, Chung, and Perignon (2009), have directed their attention to liquidity issues in international markets. The market structure of the majority of international markets differs from those in the United States. An international setting allows the investigation of the impact of different regulatory, economic, and political environments on liquidity.

This thesis consists of four essays and contributes to the literature on liquidity in international stock markets. The first essay reviews the literature on international stock market liquidity, and highlights areas requiring future research. The second and third essays examine market- and stock-level liquidity from a global perspective. Essay Two studies the influence of risk perceptions on international stock market liquidity, and Essay Three investigates the interaction between market volatility, stock liquidity, and returns. The final essay of the thesis considers market-wide liquidity and trading activity in China, the largest emerging market, in particular. The Chinese market is an interesting setting

for liquidity studies, since a number of its features (e.g. dominance of retail investors' trading) differentiate it from other markets, such as the United States.

The remainder of this chapter proceeds as follows. The next four sections (Sections 1.2, 1.3, 1.4, and 1.5) provide an overview, including the important contribution to the existing literature, of each of the four essays. Section 1.6 presents the research output from this thesis, and the structure of the remainder of the thesis is contained in Section 1.7.

1.2 Essay One

The first essay presents a review of empirical studies on international stock market liquidity, and identifies areas requiring future research. The essay focuses on liquidity in international developed and emerging markets, which complements a comprehensive US-focused literature survey on market liquidity by Holden, Jacobsen, and Subrahmanyam (2014).

The scope of the survey is limited to stock markets.[1] Key empirical facts are as follows. Market liquidity is affected by various exchange characteristics and regulations. Prior research has identified the most appropriate liquidity measures for international liquidity research, and shows liquidity co-varies within and across exchanges. Consistent with asset pricing models, both liquidity level and liquidity risks are important in determining asset returns in international markets. In the corporate finance field, liquidity is closely related to firm transparency, share issuance, and dividends paid out. The essay concludes by outlining directions for future international liquidity research.

[1] It does not consider other asset classes, such as bonds and derivatives.

1.3 Essay Two

Chung and Chuwonganat (2014) document that uncertainty is an important determinant of liquidity in the United States. The second essay in the thesis, using a sample of 57 countries over the 1990–2015 period, considers 1) whether risk perception is an important determinant of liquidity in global markets, where liquidity is influenced by various country-level factors, and 2) how country-level factors affect the liquidity-risk perception relation.

The essay finds the influence of investors' risk perception on market liquidity is statistically significant and economically meaningful in a global context. The risk perception-liquidity relation is more pronounced in markets with higher GDP per capita, more openness, stronger governance, and no short-selling constraints. The findings are consistent with prior studies showing that development (e.g. Claessens, Klingebiel, and Schmukler, 2006), trade (e.g. Rizova, 2013), governance (e.g. Marshall, Nguyen, Nguyen, and Visaltanachoti, 2016), and market frictions such as short-selling constraints (e.g. Bris, Goetzmann, and Zhu, 2007) impact investors' trading and the speed at which information in incorporated in international markets. Consistent with Hsee and Weber (1999) and Statman (2008) suggesting people in countries with a more individualistic culture have a lower propensity to afford risk, this essay finds that risk perception exerts a stronger negative impact on liquidity in more individualistic countries.

The essay contributes to the existing literature in several ways. First, extending the insights of Chung and Chuwonganat (2014), it is the first to document the significant impact of risk perceptions on market-wide liquidity across various institutional environments over a long time span. It adds to the literature on the determinants of market-wide liquidity. As noted in Chordia, Roll, and Subrahmanyam (2001), aggregate

market liquidity differs from liquidity of individual stocks. While most liquidity research focuses on stock-level liquidity, relatively little is known about aggregate market liquidity. Second and more importantly, the essay uses a global sample and shows country-level factors, such as economic development and the presence of short-selling constraints, are important in determining the risk perception-liquidity relation.

1.4 Essay Three

The third essay of this thesis examines how market volatility, stock liquidity, and returns interact in 41 international markets. Chung and Chuwonganant (2017) find that market volatility affects stock returns directly, and indirectly through the stock liquidity channel. While an out-of-sample test in global markets is important (e.g. Amihud, Hameed, Kang, and Zhang, 2015), the essay also provides insights on which market attributes are associated with the role of the liquidity channel linking market volatility and stock returns.

This essay is the first to examine the effects of liquidity on the market volatility-return relation in international markets, which differs from the effects of liquidity level and liquidity beta (risk) on asset returns (e.g. Lee, 2011; Amihud, Hameed, Kang, and Zhang, 2015). The essay reveals that, across six geographical regions around the world, returns are significantly lower for stocks with greater sensitivity of liquidity to market volatility, indicating an important role of the liquidity channel on stock returns. The results are consistent across portfolio- and stock-level analysis.

Moreover, the essay shows the influence of the liquidity channel is greater in markets with a higher level of market volatility and lower trading volume, and in countries with stronger country governance and no short-selling constraints. Exploiting the changes

in institutional environments over time, the essay shows market volatility exerts a stronger impact on returns through liquidity during financial crisis periods and when high-frequency trading is more active. These results echo with the existing literature, such as Bris, Goetzmann, and Zhu (2007), and previous findings in Essay Two, suggesting that governance environment and frictions, such as short-sales constraints, influence market and price efficiency.

1.5 Essay Four

Emerging markets, typically exhibiting lower liquidity than developed markets (e.g. Fong, Holden, and Trzcinka, 2017), have become more integrated in more recent times. The fourth essay of the thesis examines various aspects of market liquidity and trading activity in China, the largest emerging market, over the last 20 years.

There are a number of reasons why China is an interesting setting in which to examine liquidity and trading activity. First, Chinese listed firms, especially large firms, tend to have a high level of non-tradable state ownership; state owners have relatively low incentive to trade unrestricted shares and provide liquidity. Second, short selling was initially prohibited, and has been allowed only for selected stocks since March 2010. Prior research (e.g. Charoenrook and Daouk, 2005; Beber and Pagano, 2013) shows short selling bans distort trading volume and liquidity. Third, retail investors, whose trading behaviour historically differs from institutional investors (e.g. Kelly and Tetlock, 2017), contribute to more than 80% of the trading volume in the Chinese market (e.g. Hilliard and Zhang, 2015).

This essay finds that trading activity in China increases in up markets more than in down markets. The evidence contrasts with the US evidence that trading activity reacts

symmetrically in up and down markets (e.g. Chordia, Roll, Subrahmanyam, 2001); however, it is consistent with the literature on investor sophistication and the disposition effect. The disposition effect refers to the tendency for investors to hold loser stocks longer than winner stocks, and prior studies also find less sophisticated investors show a greater disposition effect (e.g. Dhar and Zhu, 2006). While, on average, liquidity and trading activity are lower around holidays, the results show that during the more recent period, trading activity is significantly lower prior to holidays, which supports Meneu and Pardo (2004) arguing that retail investors are reluctant to buy before holidays. Aggregate short selling and margin trading increase trading activity, but short selling also leads to greater bid-ask spreads indicating deteriorated liquidity. In addition, the essay provides evidence of an increased influence of global factors on the Chinese market.

1.6 Research outputs from the thesis

Essay One, "International stock market liquidity: a review", was published in the following journal:

Ma, R., Anderson, H. D., and Marshall, B. R. (2016). International stock market liquidity: a review. *Managerial Finance*, *42*(2), 118–135. https://doi.org/10.1108/MF-04-2015-0096

Essay Two, "Risk perceptions and international stock market liquidity", has been presented at:

- Australasian Finance and Banking Conference in Sydney (2016)
- SIRCA Young Researcher Workshop in Sydney (2016)
- School of Economics and Finance Seminar at Massey University (2016)

Essay Three, “Market volatility, liquidity shocks, and stock returns: worldwide evidence”, has been accepted for publication in the following journal:

Ma, R., Anderson, H.D., and Marshall, B.R. (2018). Market volatility, liquidity shocks, and stock returns: worldwide evidence. *Pacific-Basin Finance Journal*, forthcoming. https://doi.org/10.1016/j.pacfin.2018.04.008

Moreover, this essay has been presented at:

- Accounting and Finance Association of Australia and New Zealand (AFAANZ) Conference in Auckland (2018, scheduled)
- New Zealand Finance Colloquium in Palmerston North (2018, INFINZ Best Paper Award for Investments)
- Financial Markets and Corporate Governance Conference in Melbourne (2018)
- School of Economics and Finance Seminar at Massey University (2017)

Essay Four, “Stock market liquidity and trading activity: is China different?”, was published in the following journal:

Ma, R., Anderson, H. D., and Marshall, B. R. (2018). Stock market liquidity and trading activity: Is China different? *International Review of Financial Analysis*, *56*, 32–51. https://doi.org/10.1016/j.irfa.2017.12.010

Moreover, this essay has been presented at:

- Behavioural Finance and Capital Markets Conference in Melbourne (2017, Best PhD Paper Award)
- Auckland Finance Meeting Doctoral Symposium in Queenstown (2017)

- China Accounting and Finance Conference in Beijing (2017)
- School of Economics and Finance Seminar at Massey University (2017)

1.7 Structure of the thesis

The remainder of this thesis is organised as follows. Chapter 2 surveys prior literature on liquidity in international developed and emerging stock markets. The second essay, which examines the impact of investor risk perceptions on global liquidity, is contained in Chapter 3. Chapter 4 presents the third essay on the interaction between market volatility, stock liquidity, and returns. Chapter 5 presents the fourth essay, which focuses on market liquidity and trading activity in China. Chapter 6 concludes by outlining the major findings and implications of each of the three essays.

CHAPTER 2

ESSAY ONE

This chapter surveys empirical studies on liquidity in international markets, and identifies fields for further research. The chapter is structured as follows. Section 2.1 identifies the scope and provides an overview of the literature survey. Section 2.2 describes how market mechanisms and regulations affect liquidity in international markets. Section 2.3 discusses various liquidity measures for international liquidity research. Evidence on liquidity commonality, or liquidity co-movement, within and across stock exchanges is presented in Section 2.4. Sections 2.5 and 2.6 review the link between liquidity and asset pricing, and liquidity in corporate finance, respectively. Section 2.7 concludes and discusses areas requiring future research. An appendix to this chapter and the essay's reference list are provided at the end of the thesis.

International Stock Market Liquidity: A Review

Abstract

Purpose – This paper reviews 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 categorised 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, tick size) and regulations (e.g. short-sales constraints, exchange disclosure policies). 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. Emerging markets' evidence indicates that the impact of internationalisation 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 – As early liquidity research focuses on the US markets, this paper has important implications for academics, regulators, and practitioners in international markets. However, the paper focuses 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: liquidity, international markets, market microstructure, liquidity commonality, asset pricing, corporate finance
Paper type: literature review

2.1 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 2007–09 financial crisis (e.g. Rosch and Kaserer, 2013). According to Geithner (2007), one approach to keep market stability is to ensure 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, the majority of international markets are order-driven markets (Jain, 2005), which differ from the US markets where designated market makers stand ready to provide liquidity to investors. 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 provide a review of recent research on international stock market liquidity. Our review relates to a comprehensive US-focused literature survey on market liquidity by Holden, Jacobsen, and Subrahmanyam (2014). In contrast, we focus on liquidity in international developed and emerging stock markets.

We begin in Section 2.2 by exploring how market features and regulations affect liquidity. Academic research in this area could be particularly important for policymakers. In Section 2.3, we discuss various liquidity measures for global research, and for emerging and frontier markets, respectively. A liquidity proxy that is the best for developed markets is not necessarily appropriate for emerging markets or frontier markets. For instance, as Kang and Zhang (2014) note, one important assumption behind the

Amihud (2002) measure is that the proportion of zero volume days is negligible. Therefore, for thinly traded securities which have zero volume days most of the time, the Amihud (2002) measure is not necessarily valid.

In Section 2.4, 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, defined as "the extent to which each country's illiquidity return premium co-varies with global and regional average illiquidity return premiums" (p. 360), is a new type of commonality documented by Amihud, Hameed, Kang, and Zhang (2015). In Section 2.5 and Section 2.6, we review the connection between liquidity and asset pricing, and liquidity in corporate finance. The final section concludes and discusses research issues that need further investigation.

2.2 How market mechanisms and regulations affect liquidity

Market mechanisms and regulations differ greatly across countries. This section reviews the impact of market designs on liquidity, and how market regulators and operators can play an active role to improve market efficiency by increasing market liquidity.[2] In additional to Jain (2003) and Jain (2005), which are included in Holden, Jacobsen, and Subrahmanyam (2014) article, we review eight other papers that provide international evidence, along with relevant single-country studies.

[2] Existing literature presents a strong positive link between market liquidity and efficiency (e.g. Chordia, Roll, and Subrahmanyam, 2008; Chung and Hrazdil, 2010).

2.2.1 Market features

Using data from 51 stock exchanges, Jain (2003) investigates how various institutional features of exchanges impact on exchange performance measured by spreads, volatility and turnover. He shows that quoted, effective and realised spreads are lower in exchanges with designated market makers, a consolidated limit order book,[3] a centralised order flow, a fully automated trading system, a demutualised ownership structure, smaller tick sizes,[4] or more transparency. Exchange transparency is measured based on the extent to which the details of the order flow (e.g. bid-ask prices, and depths) are displayed to the public.

While previous studies examine the impacts of automatic execution in several different markets (e.g. Blennerhassett and Bowman, 1998; Venkataraman, 2001), the papers of Jain (2005) and Henkel, Jain, and Lundblad (2008) compare the effects of the introduction of electronic trading systems in an international setting. Specifically, Jain (2005) investigates, based on a sample of 120 countries, the impact of automation on equity premium and liquidity. He reports that automation of trading leads to lower cost of capital due to improved market liquidity. Henkel, Jain, and Lundblad (2008) examine the effects of stock market automation on both liquidity level and liquidity risk (i.e. first and second moments of liquidity). Consistent with Jain (2005), the results show a significant improvement in liquidity level. They then use persistence and volatility of

[3] As noted in Jain (2003), orders in a consolidated limit order book (LOB) are matched under price and time priority rules, and unmatched orders remain in the LOB for subsequent matching. Blennerhassett and Bowman (1998) suggest that consolidation provides "more effective matching between liquidity providers" (p. 263).

[4] We discuss how tick size changes impact on liquidity in more details in Section 2.2.2.

liquidity level, and Acharya and Pedersen's (2005) model to measure liquidity risk, and find evidence that liquidity risk falls.

In recent years, high-frequency trading (HFT) has drawn increasing attention and there has been considerable debate around whether high-frequency traders are a reliable source of liquidity provision (e.g. Chung and Chuwonganant, 2014). On the basis that algorithmic trading is the precondition for HFT, Boehmer, Fong, and Wu (2014) exploit the co-location events to shed light on how algorithmic trading impacts on market quality, including liquidity, in 42 stock markets. Boehmer, Fong, and Wu (2014) argue that co-location events facilitate algorithmic trading and thus use the first implementation dates as exogenous shocks to algorithmic trading activities. Overall, the results suggest that algorithmic trading positively affects stock liquidity and information efficiency, but also leads to higher volatility. There is also evidence that algorithmic trading is in fact associated with deteriorated liquidity for small and low-priced firms, or when market making is difficult.

2.2.2 Policies and trading rules

The idea that regulators can help improve market liquidity has also been discussed (e.g. Handa, Schwartz, and Tiwari, 1998). Academic research in this area is particularly 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 the market features and regulations to improve market liquidity and efficiency (Berkman and Comerton-Forde, 2011).

2.2.2.1 Tick size changes

Tick size changes have been described as "one of the most important regulatory policies" (p. 300) that affect market liquidity in Holden, Jacobsen, and Subrahmanyam (2014). In addition to the US studies on tick sizes (e.g. Goldstein and Kavajecz, 2000; Jones and Lipson, 2001; Bessembinder, 2003), the effects of tick size reductions in numerous other countries, such as Canada and Japan, have also been examined. Given 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. Existing studies also typically find the liquidity impact of tick size changes is not uniform across stocks.

Lau and McInish (1995) is one of the first studies 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. They also show the decline in spreads is greater for stocks that are more constrained by the pre-reduction tick size. Bacidore (1997), and Smith, Turnbull, and White (2006) examine the effects of tick size changes on the Toronto Stock Exchange (TSX). Specifically, Bacidore (1997) investigates the effects of the switch to decimal trading on TSX in 1996. For stocks with a pre-event price above $5, he finds a statistically and economically significant decline in both spread and depth, but no significant 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. In addition, using data on the non-cross-listed stocks with a price greater than $5, he documents that stocks with lower prices, more trading activities and higher market capitalisation experience greater declines in spreads. Smith, Turnbull, and White (2006) investigate the effects of the switch to a penny

tick on TSX in 2001. Using five proxies for market quality (spread, depth, price continuity, order execution speed and institutional trading costs), they find an overall liquidity improvement. The tick size reduction benefits the most liquid stocks more. Further, they calculate the hypothetical cost of executing median and large orders, and conclude that liquidity (trading cost) increases (decreases) not only for small traders, but also for large traders.

Aitken and Comerton-Forde (2005) investigate the impact of tick size reductions on the Australian Stock Exchange. 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, Cai, and Hamao (2007) find significant declines in spreads following tick size reductions on the Tokyo Stock Exchange, and the declines are greater in stocks with a greater magnitude of tick size reduction, more trading activities, or higher transitory spread component. 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, Chuang, and Lin (2008), Pan, Song, and Tao (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 behaviour 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, suggesting "an increasing but convex relationship between the relative tick size and the relative bid-ask spread" (p. 386).

Based on Taiwan Stock Exchange data, Hsieh, Chuang, and Lin (2008) find significant declines in spread, depth, and an overall market liquidity proxy, measured as the ratio of depth to spread, following tick size reductions. Pan, Song, and Tao (2012) investigate the liquidity impact of tick size reductions on Hong Kong Stock Exchange. They use a liquidity measure from Goldstein and Kavajecz (2000), and find significant liquidity deterioration, especially for high-volume stocks. Anderson and Peng (2014) investigate the effects of a tick size reduction from a cent to half-a-cent on New Zealand Exchange. They find the tick size reduction decreases both spread and depth significantly. Using a combined liquidity measure from Bollen and Whaley (1998) and the Amihud (2002) measure, they find the market liquidity actually declines, although the decline is not significant. In addition, they provide evidence that trading volumes and turnover in smaller firms are more negatively impacted by narrower tick sizes.

2.2.2.2 Short-sales constraints

While regulators around the world impose short-sales restrictions to prevent panic selling which may lead to market crashes,[5] academics have not reached a consensus on whether such regulations are beneficial. A number of academic papers tend to suggest that short sellers enhance market efficiency and liquidity (e.g. Bris, Goetzmann, and Zhu, 2007; Beber and Pagano, 2013). We begin by reviewing literature that finds allowing

[5] See Beber and Pagano (2013).

short selling (removing short selling constraints) 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, measured by 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 2007-09 financial crisis in 30 countries. The evidence shows that short selling bans are associated with lower liquidity (especially for small firms and firms without listed options) and slower price discovery.

Biais, Bisière, and Décamps (1999) study the impacts 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 supporting that short-selling constraints reduce immediate sell orders and liquidity accordingly. Using London Stock Exchange data, Marsh and Payne (2012) investigate the effects of the introduction and the subsequent removal of the short-sales ban on financial firms. They find significant deterioration in liquidity and other market quality indicators during the ban period, and strong reversals following the lift of the ban.

Bai and Qin (2014) investigate how short-sales constraints affect stock liquidity by taking advantage of the unique market setting of the Hong Kong Stock Exchange, which only allows a subset of stocks to be sold short. The list of shortable stocks is revised over time, and the changes in the list provide an opportunity to examine the effects of both imposing and removing short-sales restrictions. Interestingly, they find neither

addition to nor deletion from the list affects stock liquidity on average. Nevertheless, stocks that are more thinly traded or relatively illiquid 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[6] on the Taiwan Stock Exchange. While Lin (2008) provides evidence of an insignificant change in trading activity measured by daily trading values of individual stocks, Chuang and Lee (2010) report that the repeal of short-sales constraints significantly decreases liquidity, liquidity-return relations, and liquidity commonality across stocks. Findings from Chuang and Lee (2010) are consistent with Baker and Stein's (2004) model predictions. Lecce, Lepone, McKenzie, and Segara, (2012) study the impact of lifting naked short-selling bans on the Australian Securities Exchange. The results show significant increases in relative bid-ask spread, effective spread, and order depth. They consider the effective spread as a more robust liquidity measure since it "takes into account both order depth and bid-ask spreads" (p. 98), and conclude by arguing that allowing naked short selling results in increased execution costs and accordingly slightly lower liquidity. Sharif, Anderson, and Marshall (2014) investigate the effects of the relaxation of short selling and margin trading bans in Mainland China. They find the regulatory change is associated with lower trading activity and wider spreads, which indicates a liquidity decline. Their reasoning is as follows. Heightened asymmetric information in eligible stocks following the regulatory change

[6] According to the short-sale price restriction, "short-sale prices must not be lower than the closing price of the previous trading day" (Lin, 2008, p. 1657).

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, as measured by value traded and turnover ratios, improved following key dates when restrictions on international capital flows were liberalized for 16 emerging countries. Frost, Gordon, and Hayes (2006) investigate the impact of stock exchange disclosure policies on market development. The authors measure market development as the mean of five market development proxies, two of which are market liquidity measures. Their "overall disclosure" measure consists of five "disclosure other than monitoring and enforcement" components and seven "monitoring and enforcement" components (p. 440). They provide strong evidence of the positive association between stock exchange disclosure requirements and market development (which encompasses liquidity), while also emphasizing that the evidence shows association rather than causation.

Cumming, Johan, and Li (2011) examine how broadly framed and specific rules affect stock market liquidity differently. They suggest that 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 than broadly framed rules. A recent study by Huang, Wu, Yu, and

Zhang (2014) investigates the impact of investor protection on the relation between firm value and liquidity in 41 countries. They measure investor protection based on legal protection, information transparency, and political stability in a given country. They present evidence that liquidity is positively associated with firm value measured by Tobin's Q, and that this association 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.

2.3 Liquidity measures for international studies

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. In this section, we review which low-frequency liquidity measures should be used for global research, and discuss a number of studies that investigate the best liquidity proxies for emerging and frontier markets, given the distinct features of these markets (e.g. relatively low market efficiency, and substantial cross-country difference).[7]

Lesmond (2005) tests the efficacy of five liquidity measures in 31 emerging countries. He suggests that the LOT measure from Lesmond, Ogden, and Trzcinka (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. There is also evidence that political risk is a more dominant

[7] Existing literature has established standard liquidity measures for the US equity markets. See Goyenko, Holden, and Trzcinka (2009), Corwin and Schultz (2012), and Holden and Jacobsen (2014) for discussion.

determinant of emerging market liquidity, compared with other factors that capture the effects of code law/civil law classification, the enforcement of insider trading laws, and judicial efficiency. Marshall, Nguyen, and Visaltanachoti (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. Among the liquidity measures examined, 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, Holden, and Trzcinka (2017) has the lowest root-mean squared error and hence is better than the other proxies to estimate the level of transaction costs, although the root-mean squared error of FHT is also statistically different from zero.

Kang and Zhang (2014) construct a modified Amihud measure (*AdjILLIQ*) for emerging markets where liquidity is relatively limited. *AdjILLIQ* combines the original Amihud (2002) ratio with the incidence of zero-volume days in a given month. Kang and Zhang (2014) argue that the original Amihud (2002) measure is a less valid liquidity proxy when stocks are thinly traded. They include the zero-volume measure in *AdjILLIQ* to measure liquidity better in emerging markets, as zero-volume measure performs more accurately when market liquidity is low and the proportion of zero-volume days is relatively high.[8] Using data from European emerging markets, Vidovic, Poklepovic, and Aljinovic (2014) argue that the Amihud (2002) proxy and turnover are poor liquidity measures when securities are thinly traded, and propose a new liquidity measure. This proposed measure is based on the ratio of absolute daily change in trading volume to average volume for a stock in a given period. Vidovic, Poklepovic, and Aljinovic (2014)

[8] See also Bekaert, Harvey, and Lundblad (2007) for discussion.

conclude by claiming that their illiquidity measure captures the pressure of volume on stock returns, and is particularly applicable for illiquid markets.

Considering the potential difficulty in computing liquidity measures based on intraday data, Fong, Holden, and Trzcinka (2017) 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),[9] 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, overall, 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 to capture 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 closing percent quoted spread impact, LOT mixed impact, high-low impact, FHT impact, and the Amihud (2002) measure.[10]

In summary, prior studies generally use correlations and prediction error as performance metrics to assess the efficacy of low-frequency liquidity proxies. For global

[9] As Goyenko, Holden, and Trzcinka (2009) note, the first two metrics are important for asset pricing studies where how well a low-frequency liquidity proxy and a high-frequency liquidity benchmark correlate matters most, and the third metric is particularly important for market efficiency or corporate finance studies where the level of a liquidity proxy matters.

[10] Closing percent quoted spread impact, LOT mixed impact, high-low impact, and FHT impact are extended Amihud proxies, computed as closing percent quoted spread, LOT mixed, high-low, and FHT divided by average daily dollar volume. LOT mixed is from Lesmond, Ogden, and Trzcinka (1999). High-low is from Corwin and Schultz (2012). FHT is a new liquidity proxy Fong, Holden, and Trzcinka (2017) create in their paper.

research, the closing percent quoted spread from Chung and Zhang (2014) is the best spread proxy, whilst 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, Ogden, and Trzcinka (1999) and the Roll (1984) measure perform better than the Amihud (2002) measure and turnover in presenting cross-country variations, while the LOT measure and the Amihud (2002) measure outperform the Roll (1984) measure and turnover in measuring within-country liquidity. *AdjILLIQ*, a liquidity proxy recently developed for emerging markets by 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 asset pricing studies where the magnitude of the correlation between a liquidity proxy and benchmark matters most, while the FHT proxy from Fong, Holden, and Trzcinka (2017) does the best to capture the level of spread benchmarks.

2.4 Liquidity commonality

Liquidity commonality refers to the co-movement in liquidity among individual firms within a market and alternatively across markets. While earlier papers investigate commonality in liquidity for the US (e.g. Chordia, Roll, and Subrahmanyam, 2000; Hasbrouck and Seppi, 2001), more recent studies extend the US evidence to global markets. In this section, we first present evidence on international liquidity commonality with an emphasis on developed markets. We then focus on evidence for emerging markets.

2.4.1 Developed markets evidence

Prior studies have established that liquidity co-moves within and across countries. One of the first studies investigating international liquidity commonality is a paper by Stahel (2005). Using data from Japan, the UK and the US, he shows the existence of a global liquidity factor independent of country and industry liquidity factors. Brockman, Chung, and Perignon (2009) document commonality in liquidity within and across 27 developed markets and 20 emerging markets. The sensitivity of exchange-level liquidity to global liquidity (i.e. the coefficients on the global liquidity factor) tends to be higher in developed markets. In addition, they suggest that domestic macroeconomic announcements significantly increase liquidity commonality at exchange level, whilst U.S. macroeconomic announcements positively affect liquidity commonality globally. Based on intraday data from 25 developed markets, Zhang, Cai, and Cheung (2009) add to the literature by examining the impact of a set of firm-level factors, such as analyst coverage, cross listing and foreign investors, on within-country and cross-border commonality in liquidity. The findings show 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.

De Nicolo and Ivaschenko (2009) present evidence of increased co-movement in liquidity among 12 developed countries and 18 emerging countries, and conclude that equity markets around the world have been more vulnerable to systemic liquidity shock. Using a sample of 40 countries, Karolyi, Lee, and van Dijk (2012) investigate the cross-section and time-series patterns in liquidity commonality. Despite of the important role of supply-side theories around funding liquidity in the literature, their findings are more consistent with demand-side explanations, suggesting that liquidity commonality is

driven by correlated trading activities. According to Amihud, Hameed, Kang, and Zhang (2015), commonality exists not only in liquidity, but also in liquidity premium around the world. Amihud, Hameed, Kang, and Zhang (2015) define commonality in illiquidity premium as "the extent to which each country's illiquidity return premium co-varies with global and regional average illiquidity return premiums" (p. 360). They find no evidence of the effects of market conditions (measured by market returns and volatility) on commonality in liquidity premium.

2.4.2 Emerging markets evidence

Many global liquidity studies investigate the difference between developed and emerging markets. Brockman, Chung, and Perignon (2009) include 20 emerging markets in the 47 exchanges they investigate. They find that, compared with other regions, 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. Evidence also shows that macroeconomic announcements contribute to greater commonality in emerging markets. Consistent with Brockman, Chung, and Perignon (2009), Karolyi, Lee, and van Dijk (2012) suggest that both level and time-series volatility of liquidity commonality tend to be a greater issue in less developed markets. Karolyi, Lee, and van Dijk (2012) also assess how liquidity commonality in developed and less developed countries is differently affected by supply- and demand-side factors. In particular, 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 (the relation is insignificant in 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) focuses on 12 Asian equity markets, among which eight are emerging markets. 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 US 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 to 2010.

2.5 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, while the diversity among countries is not negligible.

2.5.1 Developed markets evidence

Relevant US studies include Amihud and Mendelson (1986), Amihud (2002), Brennan and Subrahmanyam (1996), and Acharya and Pedersen (2005). With some papers extending the investigation 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 data on 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, Hvidkjaer, and O'Hara, 2002). Dey's (2005) 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 separates countries into two groups (developed countries and emerging countries), this positive turnover-return relation becomes insignificant for developed markets (instead volatility becomes highly and consistently significant). 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,[11] Stahel (2005) conjectures that this systematic liquidity risk is priced in a global context. Consistent with the conjecture, the estimates on liquidity risk premium are statistically significant for all his liquidity measures. Lee (2011) 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, after market risk, size, book-to-market ratio, and liquidity level are controlled. 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.

[11] See discussion in the liquidity commonality section.

Liang and Wei (2012) use 21 developed markets data to investigate the relation between liquidity risk and stock returns. They argue that focusing on developed markets allows the empirical evidence not to be affected by currency constraints. The results indicate that liquidity risk is systematically priced locally in 11 developed markets (among 21 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. Amihud, Hameed, Kang, and Zhang (2015) find significant illiquidity premium, measured by returns on illiquid-minus-liquid portfolios, and risk-adjusted illiquidity premium worldwide. Liquidity premium is higher during market declines and lower in developed markets. Amihud, Hameed, Kang, and Zhang (2015) suggest that the lower illiquidity premium in developed markets is driven by better information provision and governance in these markets. As discussed in Section 2.4.1, they also assess the existence of commonality in liquidity premiums, and find greater commonality in liquidity premiums in markets which are more open to global investors and in developed markets.

Based on a sample of 39 stock markets indices, Lasfer, Melnik, and Thomas (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 and decreasing over time. Asness, Moskowitz, and Pedersen (2013), and Cakici and Tan (2014) study value and momentum returns at the global level. Using individual stocks, equity indices, currencies, government bonds, and commodity futures data, Asness, Moskowitz, and Pedersen (2013) document value and momentum return premiums, and highly correlated value and momentum returns across markets and asset classes. Their analysis shows that global

funding liquidity risk could at least partially explain the correlated patterns they find. Cakici and Tan (2014) investigate value and momentum effects with a particular focus on the size effect, based on a sample of 23 developed stock markets. When examining how funding liquidity and market liquidity impact on value and momentum effects, they find value returns are more likely to be affected by changes in liquidity conditions, with momentum returns relatively unaffected.

2.5.2 Emerging markets evidence

According to prior research, liquidity effects could be stronger in emerging markets where liquidity is relatively scarce, compared with more advanced economies. As a result, tests in emerging markets could be more powerful and provide additional evidence.

When partitioning countries into two subsamples of developed and emerging markets, Dey (2005) finds the positive relation between portfolio turnover and expected returns to be exclusively significant for emerging markets. Dey (2005) suggests this is due to different asset pricing mechanisms in developed and emerging markets. According to 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 the concerns for global investors. Amihud, Hameed, Kang, and Zhang (2015) document that illiquidity premiums are higher in emerging markets, in which liquidity is relatively scarce. While showing the evidence of significantly positive (negative) price reactions following positive (negative) price shocks, Lasfer, Melnik, and Thomas (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) discussed in Section 2.5.1, Jun, Marathe, and Shawky (2003) report a robust positive relation between aggregate market liquidity and stock returns across 27 emerging markets. However, their causality analysis indicates that, despite of the strong positive link they report, there is no significant causal relationship between market liquidity (measured by 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, Harvey, and Lundblad (2007) use a panel VAR model and investigate the predictive power of liquidity and liquidity shocks, mainly measured based on the incidence of zero-return days, 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 (India, Pakistan, Bangladesh, and Sri Lanka), using a size and liquidity augmented CAPM and time varying techniques. The findings show that both size and liquidity are priced factors in India, Pakistan, and Bangladesh, with size factor alone priced in Sri Lanka. Results from time varying techniques indicate considerable segmentation among South Asian stock markets.

Using data from 19 emerging countries, Donadelli and Prosperi (2012) document significant risk-adjusted returns ("alpha puzzle") and time-varying systematic risk ("beta puzzle") in emerging countries. They find the significant excess returns cannot be justified by local liquidity measured by volume. Their two-country model shows that "alpha puzzle" in emerging markets is solved by additional costs other than illiquidity in emerging markets, whilst their conditional two-factor model suggests that "beta puzzle" is justified by time-varying global liquidity factors. They claim that the two puzzles documented present a challenge to existing asset pricing models, which fail to explain these puzzles simultaneously.

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. Empirical studies focusing on African markets include Hearn (2009), Hearn, Piesse, and Strange (2010), Hearn (2012), and Assefa and Mollock (2014).

Hearn, Piesse, and Strange (2010) find both firm size and illiquidity factors affect stock returns significantly in South Africa, Kenya, Egypt and Morocco. They include the London Stock Exchange in their sample as a representative of developed markets. The findings imply that African companies have to afford much higher cost of capital to raise funds, which puts the firms at a competitive disadvantage. Therefore, international investors interested in African emerging markets need to be aware of the potential high transactions costs, and the importance of including size and illiquidity premiums into their asset pricing measures.

Hearn (2009) and Hearn (2012) investigate size and liquidity effects for three largest emerging markets in East Africa (Uganda, Tanzania and Kenya) and Sub Saharan African markets (excluding South Africa), respectively. Both studies present evidence

that size and liquidity are priced factors. In addition, Hearn (2012) suggests that for Sub Saharan African stocks, the size-liquidity model based on Martinez, Nieto, Rubio, and Tapia (2005) is most efficient among four asset pricing models they examine.

Assefa and Mollick (2014) examine the relation between stocks returns and aggregate market liquidity, measured by stocks traded/market capitalisation or stocks traded/GDP, for 16 African countries. In line with Jun et al. (2003), they report a significant positive liquidity-return relation when South Africa is excluded from the sample (i.e. when the sample includes 15 countries). According to Assefa and Mollick (2014), that more liquid stocks in African markets have a higher premium indicates the liquidity problems in Africa equity markets.

2.6 Liquidity in corporate finance

While international research on liquidity in corporate finance investigates some similar questions as single-country liquidity research (e.g. liquidity and dividend policy), one main reason for using a global sample is to allow for more cross-sectional variation. As discussed in Holden, Jacobsen, and Subrahmanyam (2014), in corporate finance studies, it is essential to deal with endogeneity issues (including reverse causality). For instance, as privatisation and market liquidity might be simultaneously determined by a hot market condition, Bortolotti, de Jong, Nicodano, and Schindele (2007) adopt a two-stage least squares procedure to address the potential endogeneity issue. To avoid reverse causality, Stulz, Vagias, and van Dijk (2014) examine the relation between equity issuance and aggregate market liquidity (rather than individual firm liquidity) to determine whether firms are more likely to issue shares in good liquidity conditions. They

argue that aggregate market liquidity is unlikely to be affected by new issues, as newly issued shares only account for a very tiny proportion of the whole market.

2.6.1 International markets evidence

Existing literature analyses: (1) liquidity and transparency, (2) liquidity and dividend policy, and (3) liquidity and share issuance. According to Madhayan (2000), transparency refers to "the ability of market participants to observe information about the trading process" (p. 205). Transparency issues have been critical for regulators especially in recent years.[12] Studies examining the relation between liquidity and transparency include Lang and Maffett (2011), and Lang, Lins, and Maffett (2012). Lang and Maffett (2011) investigate the effects of firm transparency on firm liquidity variability and co-variability in 37 countries. They provide robust 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. Using a sample of 46 countries, Lang, Lins, and Maffett (2012) find a significant positive relation between firm transparency and stock liquidity, and 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, Lins, and Maffett (2012) use the magnitude of earnings management as one of the transparency proxies, LaFond, Lang,

[12] For example, see http://asic.gov.au/regulatory-resources/markets/market-structure/dark-liquidity-and-high-frequency-trading/

and Skaife (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. Using data from 47 countries, Charoenwong, Chong, and Yang (2014) document a significant positive relation between asset liquidity and stock liquidity. This supports their valuation uncertainty hypothesis, suggesting that firms with more liquid assets are associated with less valuation uncertainty (i.e. it is easier to value liquid assets than illiquid assets), 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, Lins, and Maffett (2012) that firm-level factors are of greater importance when country-level institutions are relatively weak. Charoenwong, Chong, and Yang (2014) also show that the positive asset and stock liquidity relation is partially driven by transparency effects, based on the evidence that stock liquidity is significantly positively associated with a firm's holding of cash, cash equivalents, and intangible assets.

Prior studies show that, in a global context, dividend distribution is more valuable for illiquid firms, which are typically associated with large transaction costs. Griffin (2010) investigates the relation between firm liquidity and dividends paid out in seven economies: Canada, Australia, Mexico, Brazil, Argentina, Hong Kong, and the UK. The results present some evidence that more illiquid firms 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 measured by the incidence of zero-return days) on dividend payout policies. Consistent with Griffin (2010), the results provide strong evidence that firms pay more dividends in more illiquidity markets.

The papers of Bortolotti, de Jong, Nicodano, and Schindele (2007), and Stulz, Vagias, and van Dijk (2014) examine the relation between market liquidity and share issuance. Bortolotti, de Jong, Nicodano, and Schindele (2007) investigate how share-issue privatisation (SIP), defined as a common stock issue from a state-owned enterprise in a public exchange, affects market liquidity in 19 developed countries. They focus on developed markets data to isolate the SIP effects in well-established markets. 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, Vagias, and van Dijk (2014) provide evidence that firms are more likely to issue shares when markets are more liquid to avoid large price impact. Further, firms prefer issuing private equity to public equity in poor market liquidity conditions.

2.6.2 Emerging markets evidence

In this section, we review empirical studies focusing on issues in emerging countries. Corporate finance research suggests that additional reasons for emerging markets evidence to be important include the 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 internationalisation (e.g. cross-listings) on liquidity in emerging markets. A theoretical paper by Hargis (2000) suggests that international cross-listings increase market capitalisation and liquidity, and that integration benefits emerging local markets and provides empirical evidence in Latin American stock markets supporting the theories. His arguments are consistent with the evidence from developed markets provided by Bortolotti, de Jong, Nicodano, and Schindele (2007). However, contrary to Hargis's (2000) prediction, empirical results in Levine and Schmukler (2006) show that internationalisation (through cross-listings, depository receipts, or private or public placements in international equity markets) negatively impacts on liquidity in local markets. In particular, Levine and Schmukler (2006) find that internationalisation results in a migration in trading from domestic markets to international markets for international firms. Further, they provide evidence that this migration effect leads to spillover effects on other non-internationalized firms in local markets. As a result, liquidity deteriorates in local markets for both international firms and non-internationalized firms. Silva and Chavez (2008) 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.

In addition, a recent study by Hearn (2014) investigates how firm governance affects firm liquidity (computed as the sum of bid-ask spread and commission fees) during pre- and post-Arab Spring periods in Egypt, Morocco, Tunisia and Algeria. The Arab Spring began in December 2010, as "an unprecedented wave of political upheaval across the Middle East and North Africa region" (p.128). He finds that the Arab Spring significantly increases firm illiquidity level, and that this impact is greater in markets which are less regulated.

2.7 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. Nonetheless, how market mechanisms and policies impact on liquidity patterns in international markets with diverse institutional environments is still an important area of future research, as trading environments continue to evolve. 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; Berkman and Comerton-Forde, 2011). In a similar vein, there have been growing research interests in dark pools and high-frequency trading recently. Although the effects of dark pools and high-frequency trading on liquidity have been investigated in a few countries (e.g. He and Lepone, 2014; Hagströmer, Nordén, and Zhang, 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 (e.g. Domowitz, Glen, and Madhavan, 2001), more recent studies seek to identify the most appropriate liquidity measures, among various liquidity measures in the literature, for different types of markets. This obviously facilitates future international liquidity research. Evidence on liquidity commonality presents liquidity co-movements within and across countries, and shows that the commonality is more consistent with demand-side explanations associated with correlated trading activities. A recent paper by Amihud, Hameed, Kang, and Zhang (2015) finds that commonality does not only exist in liquidity level, but also in (il)liquidity premium around the world.[13] Future research may examine cross-sectional and time-series determinants of commonality in liquidity premium, and compare and contrast the results with those in Karolyi, Lee, and van Dijk (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. Moreover, given the evidence in Amihud, Hameed, Kang, and Zhang (2015), it is possible to further explore country-level determinants of illiquidity premium.

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

[13] According to Amihud, Hameed, Kang, and Zhang (2015), commonality in the liquidity premium differs from commonality in liquidity per se, and liquidity shocks do not necessarily mean liquidity premium shocks.

impact of market liquidity on firms' capital structure across countries and over time, provided the international evidence in Stulz, Vagias, and van Dijk (2014) that firms are more likely to issue shares when aggregate market liquidity is high. In addition, according to Lang and Maffett (2011) and Lang, Lins, and Maffett (2012), more transparency is always better, which is inconsistent with the predictions in Stenzel and Wagner (2014) and arguments in Berkman and Comerton-Forde (2011). Therefore, understanding the role of transparency on liquidity has to be left to future research.

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STATEMENT OF CONTRIBUTION TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Rui Ma

Name/Title of Principal Supervisor: Professor Hamish Anderson

Name of Published Research Output and full reference:

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In which Chapter is the Published Work: Chapter 2

Please indicate either:

- The percentage of the Published Work that was contributed by the candidate:

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  Rui Ma sourced all literature, completed all analysis and wrote the draft working paper along with subsequent revisions.

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Date

CHAPTER 3

ESSAY TWO

This chapter presents the second essay which investigates the impact of investors' risk perceptions on international stock market liquidity, using data for 57 countries over the period 1990–2015. A brief overview of the key findings and related literature are presented in Section 3.1. Section 3.2 describes the sample, and the liquidity and risk perception measures used in this study. Sections 3.3 and 3.4 present the core results and robustness checks, respectively. Section 3.5 concludes this chapter. An appendix to this chapter and the essay's reference list are provided at the end of the thesis.

Risk Perceptions and International Stock Market Liquidity

Abstract

We show, using data for 57 countries over the 1990–2015 period, that investors' risk perceptions are an important determinant of international stock market liquidity. Increased risk perception reduces liquidity around the world, and its impact is not subsumed by other well-documented market-level determinants of liquidity. The effect is pervasive, but is stronger in countries with higher GDP per capita, more trade openness, stronger governance, a more individualistic culture, and no short-selling constraints. It is not driven by periods of extreme changes in risk perception, expansionary or recessionary phases of the business cycle, or the way liquidity is measured.

JEL Classification Codes: G15, G18

Keywords: liquidity, international stock markets, risk perception, VIX

3.1 Introduction

We investigate the impact of investor risk perception on international equity market liquidity. Chung and Chuwonganant (2014) show uncertainty is an important determinant of stock liquidity in the US. However, little is known about a) its impact in international markets where liquidity is affected by many country-level factors,[14] or b) how country-level factors influence the liquidity–uncertainty relation. We consider both these issues.

Our results indicate the influence of investor risk perception on liquidity is both statistically significant and economically meaningful in global markets after controlling for other well-documented market-level determinants of liquidity. The risk perception–liquidity relation is more pronounced in countries with higher GDP per capita, more trade openness, stronger governance, and no short-selling constraints. This is consistent with papers that show that development (e.g. Claessens, Klingebiel, and Schmukler, 2006), trade (e.g. Rizova, 2013), governance (e.g. Marshall, Nguyen, Nguyen, and Visaltanachoti, 2016), and frictions such as short-selling constraints (e.g. Bris, Goetzmann, and Zhu, 2007) impact investor trading activity and the speed at which information is impounded in international markets. Consistent with Hsee and Weber (1999) and Statman (2008), who suggest people in countries with a more individualistic culture have a lower propensity to take risk than people in more collectivistic countries,

[14] These include level of market development (e.g. Claessens, Klingebiel, and Schmukler, 2006), degree of market integration with world markets (e.g. Bekaert, Harvey, and Lumsdaine, 2002), existence of market makers (e.g. Anand, Tanggaard, and Weaver, 2009) and short-selling constraints (e.g. Beber and Pagano, 2013), legal and governance environment (e.g. Lesmond, 2005), market size (e.g. Cumming, Johan, and Li, 2011), foreign investor ownership (e.g. Ng, Wu, Yu, and Zhang, 2016), and macroeconomic variables (e.g. Bernile, Korniotis, and Wang, 2015).

we show heightened risk perception exerts a stronger impact on liquidity in more individualistic countries.

We use the Chicago Board Options Exchange Market Volatility Index (VIX), which measures the implied volatility of S&P 500 Index options and is often referred to as the "fear gauge." Nagel (2012) shows expected returns from providing liquidity increase with VIX, and Graham and Harvey (2010) find that the equity risk premium is correlated with VIX. There is also widespread evidence that VIX is a good measure of risk perception in global markets. The International Monetary Fund (2004), Ciarlone, Piselli, and Trebeschi (2009), and Longstaff, Pan, Pedersen, and Singleton (2010) find a strong relation between VIX and sovereign bond credit spreads in developed and emerging economies, while Sari, Soytas, and Hacihasanoglu (2011), for example, use VIX to measure global risk perception. VIX-like measures have been developed for international markets in recent times. We determine that these are highly correlated with VIX, but we use VIX due to its longer time series and ability to include a greater sample of countries.[15]

Our results are consistent and robust. We find that a 1% increase in investor risk perception in a given month leads to, on average, a 0.68% (0.80%) increase in the value-weighted (equal-weighted) Amihud (2002) ratio and a 0.40% (0.30%) increase in the value-weighted (equal-weighted) closing percent quoted spread of Chung and Zhang (2014) for global stock markets. Moreover, there is no evidence of reverse causality. While stronger in the more recent period, these effects persist throughout the sample period, and are evident in both expansionary and recessionary phases of the business cycle.

[15] We also find US VIX is highly correlated with credit spreads in a range of international markets for the period of our study. Our results also continue to hold when we replace the US VIX with international VIX indices.

They are robust to alternative ways of measuring market liquidity, alternative data frequencies (monthly and daily liquidity), the choice of univariate or multivariate model specification, and are not driven by extreme changes in risk perception.

These results contribute to several strands of the literature. Prior studies on VIX and liquidity are largely US-centric (e.g. Bao, Pan, and Wang, 2011; Nagel, 2012). We contribute to this literature by investigating the relation between VIX and market liquidity on a global level using 45,564 stocks in 57 countries over the 1990–2015 period. Our work relates to the recent evidence of Chung and Chuwonganant (2014), who find the impact of VIX on stock liquidity is stronger than all other well-known determinants of stock liquidity using US data. Our study differs from their work in a number of important ways. First, while Chung and Chuwonganant (2014) focus on the liquidity of individual stocks, we examine the link between VIX and aggregate market liquidity. As Chordia, Roll, and Subrahmanyam (2001) note, aggregate market liquidity differs from individual stock liquidity, with Jun, Marathe, and Shawky (2003) pointing out market liquidity depends largely on factors that are systemic to a given economy, while stock liquidity is affected by many individual security characteristics. Second, we use an international setting and generate evidence on how the impact of VIX varies across various legal, economic, and political environments, which has implications for regulators and policy makers focusing on stabilizing market liquidity. Third, Chung and Chuwonganant (2014) use a 2007–2009 sample period for their core results. Given the nature of their sample period, it is interesting to explore whether and to what extent the impact of VIX exists during non-crisis periods. Using the longer sample period enables us to assess the impact of VIX through time and in different business cycle phases.

We add to the research on the factors affecting market liquidity level in international markets. For example, Jain (2003) investigates the impact of institutional features on stock liquidity in 51 stock exchanges. Jain (2005) shows, based on a sample of 120 countries, that automation of trading systems reduces cost of capital due to improved market liquidity. Using data on emerging markets, Lesmond (2005) finds higher liquidity in countries with better legal and political environments. Cumming and Li (2011) show specific exchange trading rules provide more market liquidity than broadly framed rules. Beber and Pagano (2013) find short-selling bans around the 2007–09 crisis period are associated with lower liquidity in 30 countries. We examine the effects on market liquidity of various country-level factors, such as market development, market integration, foreign institutional ownership, governance environments, short-selling constraints, the existence of market makers, macroeconomic instability, and foreign exchange rates. To our knowledge, we are the first to include all these well-known determinants of market liquidity.

As well as investigating the impact of country-level factors on liquidity, we document how these factors influence the link between risk perception and liquidity. Chung and Chuwonganant (2014) exploit time-series regulatory changes in the US and show market structure is an important determinant of how VIX affects liquidity. We explore the cross-sectional determinants of the VIX–liquidity relation in a rich international setting, and show economic development, trade openness, the presence of short-selling constraints, and governance environments constitute key equity market and country variables affecting the VIX's influence on liquidity. Rieger, Wang, and Hens (2015) find cultural factors such as individualism and uncertainty avoidance play an important role in shaping risk preferences. We therefore investigate whether cultural factors influence the risk perception–liquidity relation. We find market liquidity in

countries high in the Hofstede (2001) individualism dimension is more sensitive to changes in VIX, which is consistent with the Hsee and Weber (1999) and Statman (2008), who find that people in more individualistic countries tolerate less risk.

The remainder of this paper proceeds as follows. Section 3.2 describes the data, sample selection procedures, and the liquidity and risk perception metrics. The core results are set forth in Section 3.3, and robustness checks are presented in Section 3.4. Finally, Section 3.5 describes our conclusions.

3.2 Data and measures of liquidity and risk perceptions

3.2.1 Sample construction

Our sample consists of 57 countries over the January 1990–April 2015 period. We include all countries from Griffin, Hirschey, and Kelly (2011) for which we can source data. We also include Luxembourg, South Korea, and Sri Lanka, because papers such as Griffin, Kelly, and Nardari (2010) and Lee (2011) include these countries.[16] Our sample includes 28 developed markets and 29 emerging markets, according to the classification by Griffin, Kelly, and Nardari (2010), and Griffin, Hirschey, and Kelly (2011). The start year is determined by the availability of VIX. While the VIX Index was introduced by the Chicago Board Options Exchange (CBOE) in 1993, it has been calculated back to January 1990. Daily VIX Index data are obtained from Thomson Reuters Datastream along with total return index (RI), stock prices (P and UP), shares outstanding (NOSH), trading volume (VO), closing bid price (PB) and ask price (PA) for all countries except for US stock bid and ask prices. US closing bid and ask prices are collected from the

[16] Latvia and Slovakia are dropped from the initial 59 countries because they do not have valid monthly Amihud (2002) values to satisfy all the filters described in Section 3.2.2.

Centre for Research in Security Prices (CRSP) for the 1993–2014 period, as CRSP bid and ask prices are available only when a stock's closing price is missing for the 1990–1992 period.

Following Amihud, Hameed, Kang, and Zhang (2015), we obtain the above described data in US dollars and apply the following screens. We include only securities traded in local currency and identified as equity and primary quotes on the main exchange(s) in each country. We apply the Griffin, Kelly, and Nardari (2010) generic and country-specific name filters to eliminate non-common equity securities, such as preferred stocks, warrants, and real estate investment trusts (REITs), as their trading characteristics can differ from common shares. We use one major stock exchange in each country, except for China (Shanghai Stock Exchange and Shenzhen Stock Exchange), Japan (Osaka Securities Exchange and Tokyo Stock Exchange), and South Korea (Korea Stock Exchange and KOSDAQ).[17] For these three countries, we exclude stocks that are listed on both exchanges. We retain all dead stocks in the sample to avoid survivorship bias.

To handle data errors in Datastream, we follow Ince and Porter (2006), and set daily returns as missing if they are greater than 200%, or if $(1+r_{i,d})\times(1+r_{i,d-1})-1 \leq 50\%$, where $r_{i,d}$ is the return of stock i on day d and at least either $r_{i,d}$ or $r_{i,d-1}$ is greater than 100%. Monthly returns are also set as missing if they are above 500%, or they are above 300% and are reversed within the following month (i.e. if $(1+r_{i,t})\times(1+r_{i,t-1})-1 \leq 50\%$, where $r_{i,t}$ is the return of stock i in month t and at least either $r_{i,t}$ or $r_{i,t-1}$ is greater than 300%). Daily returns are calculated from the total RI of each stock, which controls for stock splits and dividends and is reported to the nearest hundredth. To avoid rounding

[17] For the US, we follow Karolyi, Lee, and van Dijk (2012) and include stocks on NYSE only, since NASDAQ interdealer trading volume is double-counted and hence overstated (Atkins and Dyl, 1997).

errors, we set daily returns as missing if the total RI for either the previous day or the current day is less than 0.01. In addition, we set daily share trading volume as missing if it is larger than total shares outstanding. Daily dollar volume is set to missing if it is below 100 US dollars. Finally, we exclude non-trading days, defined as days on which more than 90% of stocks in a country have zero returns.

3.2.2 Measuring liquidity

We follow Karolyi, Lee, and van Dijk (2012) and Amihud, Hameed, Kang, and Zhang (2015) in using the Amihud (2002) ratio as our first liquidity measure. Fong, Holden, and Trzcinka (2014) examine which low-frequency liquidity proxies are best for global research, and show that the Amihud (2002) measure is the best price impact proxy. The Amihud (2002) ratio for stock *i* in month *t* is estimated as follows:

$$Amihud_{i,t} = \frac{1}{N_{i,t}} \sum_{d=1}^{N_{i,t}} \frac{|r_{i,d,t}|}{vol_{i,d,t}} \tag{1}$$

where $N_{i,t}$ is the number of trading days with non-zero volume for stock *i* in month *t*, $|r_{i,d,t}|$ is the absolute value of return in US dollars for stock *i* on day *d* in month *t*, and $vol_{i,d,t}$ is trading volume in US dollars of stock *i* on day *d* in month *t*.

We require a minimum of 10 daily observations[18] to estimate the Amihud (2002) ratio of a stock in a given month. Similar to Amihud, Hameed, Kang, and Zhang (2015), we remove stock-month observations with a stock price at the end of the previous month

[18] This filter ensures that our monthly liquidity proxies are reliable and our results are not driven by extreme illiquid stocks and/or extreme illiquid periods. However, when we remove the filter requiring a minimum of 10 daily observations in a given month, our finding on the impact of VIX on liquidity becomes slightly stronger.

in the top or bottom 1%, or a monthly Amihud (2002) ratio in the top 1% of the cross section within a country. A stock should also have data on the number of shares outstanding at the end of the previous month used for value weighting. Finally, we drop any country-month with fewer than 10 stocks.[19] The final sample covers 45,564 unique stocks in 57 countries.

The closing percent quoted spread from Chung and Zhang (2014) is our second liquidity measure. According to Fong, Holden, and Trzcinka (2014), the closing percent quoted spread from Chung and Zhang (2014) is the best low-frequency spread proxy for global research that captures the percent-cost dimension of liquidity. The closing percent quoted spread (Spread) of stock *i* on day *d* is defined as per Equation (2):

$$Spread_{i,d} = \frac{Ask_{i,d} - Bid_{i,d}}{M_{i,d}} \tag{2}$$

where $Ask_{i,d}$ is the closing ask price of stock *i* on day *d*, $Bid_{i,d}$ is the closing bid price of stock *i* on day *d*, and $M_{i,d}$ is the mean of $Ask_{i,d}$ and $Bid_{i,d}$. We exclude negative spreads, and following Chung and Zhang (2014), we drop all closing percent quoted spreads that are greater than 50% of the quote midpoint. We construct monthly spreads by calculating monthly mean values for each stock for 56 countries, as we do not have valid spread data for Czech Republic.[20] We value weight and equal weight each stock's monthly liquidity on its market capitalisation at the end of the previous month, and construct monthly aggregate market liquidity measures.

[19] For consistency, we apply the following filters to the spread measure: (1) we remove stock-month observations with a stock price at the end of the previous month in the top or bottom 1% of the cross section within a country; (2) a stock should have data on the number of shares outstanding at the end of the previous month, for value weighting; and (3) we exclude any country-month with fewer than 10 stocks.

[20] Recent studies using the same liquidity measures as ours include Chung and Chuwonganant (2017).

3.2.3 Measuring global risk perception

VIX measures implied volatility of S&P 500 Index options, and is known as the "fear index." We use VIX to proxy for international risk perceptions, for the following reasons.

First, VIX is a leading risk aversion indicator for international markets commonly used by financial institutions and academics (Coudert and Gex, 2008). Prior studies such as Bekaert, Hoerova, and Scheicher (2009) suggest that credit spreads "can serve as indicators of investors' risk attitude" (p. 21). The International Monetary Fund (2004), Ciarlone, Piselli, and Trebeschi (2009), and Longstaff, Pan, Pedersen, and Singleton (2010) find a strong relation between VIX and sovereign bond credit spreads in developed and emerging economies. Sari, Soytas, and Hacihasanoglu (2011) use VIX as a measure of global risk perception to assess its effect on oil prices. In Marshall, Nguyen, and Visaltannachoti (2015), the benefits of frontier market diversification are lower when VIX used as an international risk perception proxy is higher. Moreover, the European Central Bank (2007) includes VIX in their list of market-based risk appetite indicators. Pan and Singleton (2008) also suggest that "VIX is a key factor in investors' appetite for global 'event risk' in credit markets" (p. 2375).

Second, as shown in Panel A of Appendix B.1, the VIX Index highly co-varies with international VIX indices. We calculate the monthly correlations between the US VIX and 17 international VIX indices; the average value of the correlations is as high as 0.91. While VIX measures have been developed for international markets in recent times, using the US VIX enables us to include more sample countries over a longer sample period.

Third, VIX is highly correlated with international credit spreads. While the US corporate bond spread is often used to proxy for international risk perceptions (e.g. Schuknecht, Hagen, and Wolswijk, 2009), Coudert and Gex (2008) find that eight credit spreads for international markets perform similarly well to their risk aversion indicator using principal components analysis. In Panel B of Appendix B.1, we show the correlations between US VIX and four series of corporate bond spreads (Asia emerging markets corporate bond spread; Latin America emerging markets corporate bond spread; Europe, Middle East, and Africa emerging markets corporate bond spread; and US Baa-Aaa corporate bond spread) are 0.72, 0.75, 0.69, and 0.72, respectively.

Before 2003, US VIX was measured based on S&P 100 Index option prices. We calculate the correlation between VIX and US credit spread (computed as the difference between the yields on Baa bonds and 10-year US treasuries) over two subperiods: 1990–2002 and 2003–2015. VIX co-varies with US credit spread in both periods, with correlations of 0.59 and 0.85, respectively. We conclude that VIX is an appropriate risk perception indicator before and after the change in the method for measuring VIX.

3.3 Main results

3.3.1 Summary statistics and liquidity measure comparison

Table 3.1 presents summary statistics for 45,564 unique stocks, with 31,976 in 28 developed markets and 13,588 in 29 emerging markets over the period January 1990 to April 2015. Data start from 1990 for most developed countries, with the latest starting year of 2005 for Croatia.[21] The number of unique stocks for each market is between 17

[21] The first month from which the data reported in Table 3.1 are available is based on the Amihud (2002) measure. Spread data typically start later than the starting month indicated in Table 3.1.

for Luxembourg and 4,067 for the US. Compared to emerging markets, developed markets on average have more stocks, higher GDP per capita, greater market capitalisation, and lower market volatility and returns. The final two columns present the value-weighted Amihud (2002) and spread time-series means, and indicate that developed markets are generally more liquid. We further conduct a t-test and find that the volatility and liquidity differences between developed and emerging market are statistically significant at the 0.01 level, while the return difference is statistically insignificant.

3.3.2 VIX and international market liquidity

This section applies the methodology of Chung and Chuwonganant (2014) to capture the influence of risk perception, reflected in VIX, on international market-level liquidity. We use an unbalanced data set of monthly data and cluster standard errors by country for our core results. We also run regressions with standard errors clustered both by country and month to check the presence of time effects, as suggested in Petersen (2009). The regression model is:

$$ILLIQUIDITY_{ct}=\alpha+\beta VIX_t+\gamma Controls+\varepsilon_{ct} \quad (3)$$

where *ILLIQUIDITY* is the log of one of four liquidity measures (the value- and equal-weighted Amihud (2002) and Spread) for country *c* in month *t*. VIX_t is the log of average VIX Index value in month *t*. We use monthly data for the most part, for two reasons. First, this represents the norm in recent international liquidity studies (e.g. Cumming, Johan, and Li, 2011; Karolyi, Lee, and van Dijk, 2012; Amihud, Hameed, Kang, and Zhang,

Table 3.1: Summary statistics

This table presents summary statistics for 57 markets for the January 1990 to April 2015 period. The markets are divided into 28 developed markets and 29 emerging markets, following the classification of Griffin, Kelly, and Nardari (2010) and Griffin, Hirschey, and Kelly (2011). The first four columns present the first month from which the data are available, the number of months with valid observations, the number of unique stocks, and average GDP per capita for each market. The next three columns present average monthly market capitalisation, market return, and market volatility (monthly standard deviation of market returns). The final two columns present the time-series means of monthly market liquidity measures. The market liquidity in a given month, measured by the Amihud (2002) ratio and the closing percent quoted spread from Chung and Zhang (2014), is value-weighted on market capitalisation across individual stocks within a market.

Market	Starting month	No. of months	No. of unique stocks	GDP per capita (US$)	Market cap (000 US$)	Market return (%)	Market volatility (%)	Amihud VW	Spread VW
Panel A: Developed markets									
Australia	1990:01	304	2,799	32,548	549,119,145	0.9817	6.2380	0.0351	0.0079
Austria	1990:01	304	197	34,348	69,365,505	0.6046	6.6357	0.0143	0.0095
Belgium	1990:01	304	256	32,434	170,221,589	0.8020	5.4952	0.0052	0.0044
Canada	1990:01	304	2,435	31,704	742,453,062	0.9212	5.3221	0.0330	0.0048
Cyprus	1994:05	212	146	19,972	7,975,248	0.4500	13.4072	0.4688	0.0193
Denmark	1990:01	302	385	42,057	131,261,069	0.9863	5.3738	0.0199	0.0086
Finland	1990:05	293	223	34,062	148,505,717	1.1394	8.3087	0.0562	0.0119
France	1990:01	298	1,621	30,896	1,248,160,619	0.7481	5.6084	0.0093	0.0057
Germany	1990:01	304	1,306	32,611	1,001,833,904	0.7353	5.8520	0.0137	0.0063
Greece	1990:01	304	412	17,726	71,164,359	0.4953	10.7732	0.0885	0.0093
Hong Kong	1990:01	304	1,664	26,294	880,394,587	1.2482	7.4007	0.0139	0.0053
Ireland	2000:06	179	67	34,747	70,572,443	0.9910	11.1368	0.0317	0.0111
Israel	1993:02	267	786	21,446	65,247,686	0.6113	7.8138	0.2907	0.0083
Italy	1990:01	304	584	27,359	471,192,307	0.5776	6.9012	0.0035	0.0065
Japan	1990:01	304	3,584	35,644	3,414,457,606	0.2011	6.0181	0.0060	0.0042
Luxembourg	1999:03	15	17	67,389	13,364,021	0.0269	5.4732	0.0304	0.0383
Netherlands	1990:01	304	281	35,570	446,958,809	0.8840	5.5157	0.0055	0.0046
New Zealand	1990:01	304	263	22,161	27,604,062	0.9927	5.9212	0.0694	0.0100
Norway	1990:01	304	583	56,509	139,552,813	0.9567	7.2374	0.0296	0.0093
Portugal	1990:01	303	177	15,483	50,388,992	0.5014	6.1570	0.0758	0.0080
Singapore	1990:01	304	735	30,042	180,735,680	0.8681	6.9156	0.0458	0.0092
South Korea	1990:01	304	2,594	15,240	478,504,928	0.8706	10.5742	0.0189	0.0036
Spain	1990:02	303	273	21,587	439,953,511	0.8145	6.6199	0.0047	0.0046
Sweden	1990:01	304	1,087	39,232	325,527,385	1.0730	7.1960	0.0187	0.0047
Switzerland	1990:05	300	480	52,406	812,029,319	1.0266	4.9539	0.0018	0.0035
Taiwan	1991:05	288	1,030	14,991	428,958,167	0.6390	8.3684	0.0030	0.0028
United Kingdom	1990:01	304	3,924	31,034	1,976,968,462	0.7929	4.9299	0.0033	0.0064
United States	1990:01	304	4,067	38,228	7,841,682,544	0.9114	3.9927	0.0009	0.0050
Average		283	1,142	31,919	793,005,484	0.7804	7.0050	0.0499	0.0083

Table 3.1 (continued)

Panel B: Emerging markets									
Argentina	1993:08	261	121	7,872	34,760,483	0.9858	9.2765	0.0966	0.0173
Brazil	1994:08	249	311	5,834	417,460,986	1.0846	10.5591	0.1529	0.0567
Bulgaria	2004:11	125	108	3,584	6,052,386	0.1335	10.5100	1.0995	0.1149
Chile	1990:01	304	222	7,370	128,646,625	1.1663	8.1733	0.0835	0.0170
China	1992:04	276	2,704	2,175	1,470,222,227	1.5296	12.8964	0.0026	0.0020
Colombia	1992:02	185	65	3,577	88,240,356	2.5614	8.3937	0.0304	0.0113
Croatia	2005:11	114	122	9,650	23,247,737	0.5619	8.4872	0.1354	0.0558
Czech Republic	1994:03	80	175	11,250	14,473,071	-0.8985	7.8911	0.1037	-
Egypt	1996:11	219	169	1,547	42,468,707	0.6535	8.3700	0.1265	0.0292
Estonia	1997:08	142	27	10,396	2,798,781	0.2439	11.1485	0.1719	0.0117
Hungary	1994:01	252	87	8,542	18,679,290	1.4019	10.7735	0.0332	0.0183
India	1995:01	244	2,955	723	19,011,378	0.3437	8.9245	1.4991	0.0301
Indonesia	1997:08	46	485	1,543	335,274,295	-2.3846	10.4797	0.0408	0.0097
Kenya	1993:11	251	61	612	7,405,950	1.7841	8.3566	0.7129	0.0436
Lithuania	2002:04	146	31	12,337	2,744,609	1.2963	7.8846	0.3690	0.0140
Malaysia	1990:01	304	1,087	5,572	203,798,670	0.8908	8.5130	0.0770	0.0105
Mexico	1990:01	304	242	6,703	119,613,614	0.6643	9.3149	0.0472	0.0148
Morocco	1994:09	248	101	1,854	33,959,718	0.8346	4.9785	0.0405	0.0078
Pakistan	1991:04	271	374	708	25,397,290	1.1457	9.0305	0.3869	0.0051
Peru	1992:03	278	178	3,008	28,751,487	0.1228	9.1448	0.1322	0.0382
Philippines	1990:01	304	321	1,385	68,710,043	0.8007	8.2773	0.2173	0.0151
Poland	1994:02	254	951	7,213	82,909,293	0.6559	10.1227	0.0620	0.0129
Romania	1997:03	217	176	4,234	10,895,687	1.3317	13.1135	0.8575	0.0067
Slovenia	1998:02	205	96	17,561	8,012,637	0.6678	6.2719	0.0805	0.0227
South Africa	1990:01	304	878	4,663	226,680,548	1.0059	7.2210	0.0623	0.0100
Sri Lanka	1990:02	297	313	1,355	6,223,781	1.0919	7.8351	1.0659	0.0352
Thailand	1990:01	304	785	2,996	135,121,517	0.8394	9.7657	0.0923	0.0076
Turkey	1990:02	303	422	5,794	110,082,222	1.7445	14.8801	0.0758	0.0066
Venezuela	2000:06	32	21	6,285	5,010,771	3.2344	14.1827	0.4992	0.1378
Average		225	469	5,391	126,781,178	0.8791	9.4751	0.2881	0.0272

2015). Second, we use monthly data to avoid problems with time zone and day-of-the-week effects. However, we also estimate Equation (3) using daily data as a check for robustness, as discussed in Section 3.4.4.[22]

Controls represents various explanatory variables, controlling for country and equity market characteristics. These include the level of country development, trade openness, degree of equity market segmentation, foreign institutional investor ownership, presence of short-selling constraints and market makers, country governance environment, macroeconomic instability, exchange rate changes, equity market size, trading volume, and price level.

We expect more developed countries to have lower information asymmetry and greater liquidity (e.g. Claessens, Klingebiel, and Schmukler, 2006). The first development proxy is *DEV_MKT*, a dummy variable set to 1 for developed markets as outlined in Section 3.2.1. Following Karolyi, Lee, and van Dijk (2012), the second proxy for country development is GDP per capita (*GDP_PER_CAP*). Since the Amihud (2002) and Spread are measures of illiquidity (not liquidity), we expect negative coefficients on *DEV_MKT* and *GDP_PER_CAP*.

When a country becomes more integrated with, or less segmented from, world markets, there is often an increase in the local market's trading activity and liquidity accordingly (Bekaert, Harvey, and Lumsdaine, 2002; de la Torre, Gozzi, and Schmukler, 2007). To control for market integration, we calculate *TRADE_OPENNESS* and *SEGMENTATION*. The former is a traditional country openness measure, computed as

[22] Our results hold when we include lag and lead VIX in Equation (3). However, leads and lags are more common to see in the liquidity commonality literature, in which daily data are used, to control for non-synchronous trading and to "capture any lagged adjustment in commonality" (Chordia, Roll, and Subrahmanyam, 2000, p. 10). Our results remain intact if we add a time fixed effect or a time trend to control the influence of the aggregate time trend.

the sum of exports and imports relative to GDP in a given year. The latter is a monthly valuation-based proxy for equity market segmentation, originally developed by Bekaert, Harvey, Lundblad, and Siegel (2011). We expect a negative sign on *TRADE_OPENNESS* and a positive sign on *SEGMENTATION*.

Larger investor bases could lead to greater liquidity (e.g. Amihud and Mendelson, 2012). We therefore posit a negative relation between foreign institutional ownership (*INSTIT_OWNER*) and market illiquidity. Countries that provide better investor protection have higher liquidity (Bhattacharya and Daouk, 2002; Brockman and Chung, 2003; Lesmond, 2005; Eleswarapu and Venkataraman, 2006). We use *GOVERNANCE* as a proxy for investor protection and expect a negative coefficient on the governance proxy. *GOVERNANCE* is the average of the components of the Worldwide Governance Indicators (WGI) from Kaufmann, Kraay, and Mastruzzi (2010). WGI consists of six composite indicators measuring six dimensions of governance: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.[23]

Beber and Pagano (2013) show short-selling bans lower market liquidity, using data on 30 international markets. We therefore include *SHORT_SELLING*, a time-varying proxy set to 1 for the existence of short-selling constraints, based on the data on short-selling regulations in Charoenrook and Daouk (2005), and Jain, Jain, McInish, and McKenzie (2013). We expect a positive coefficient on short-selling constraints. Since the

[23] Following Lesmond (2005), we also try *LEGAL_ORIGIN*, a dummy variable set to 1 for English common law countries. However, our results show the legal origin dummy has an opposite sign from what the legal origin theory predicts, which is consistent with the Roe (2006) argument that "although stock holder protection, property rights, and their supporting legal institutions are quite important, legal origin is not their foundation" (p. 462). We find the average Amihud (2002) value is the second highest for English common law countries, which is consistent with Table 3.1 in Amihud, Hameed, Kang, and Zhang (2015). The high average Amihud (2002) ratio for English legal origin countries is partly driven by illiquidity in a few relatively small economies, such as Sri Lanka, Cyprus, and Israel.

presence of market makers can lead to significant improvements in market liquidity (e.g. Nimalendran and Petrella, 2003; Anand, Tanggaard, and Weaver, 2009), we include *MKT_MAKER*, a time-varying dummy variable set to 1 for markets with the presence of market makers and zero otherwise, and expect a negative sign on *MKT_MAKER*. We allow the market maker variable to vary over time, because a number of countries introduced market makers for stocks during the sample period.

We use GDP growth volatility (*GROWTH_VOLA*) to control for macroeconomic instability. As noted by Claessens, Klingebiel, and Sergio (2006), macroeconomic instability can have a negative impact on financial markets. We therefore expect *GROWTH_VOLA* to be positively related to market illiquidity. In addition, we follow Karolyi, Lee, and van Dijk (2012) by including a proxy for foreign exchange rate changes (*EXCHANGE_RATE*), computed as monthly percentage changes in the value of a country's local currency relative to special drawing rights (SDR). A positive change in *EXCHANGE_RATE* suggests depreciation of a given currency relative to SDR. We expect depreciation of a country's currency to be associated with lower market liquidity, and therefore with a positive coefficient on *EXCHANGE_RATE*.

Larger markets are likely to be more liquid. We use *MKT_CAP* to control for size effects, following Cumming, Johan, and Li (2011), and Kang and Zhang (2014). Stoll (2000) shows volume and price are important cross-sectional determinants of stock liquidity. We therefore calculate market volume (*MKT_VOL*) and price level (*MKT_PRICE*) by value weighting volumes and prices of individual stocks within a given market. We expect the coefficients on market capitalisation, market volume, and price level to be negative. The description and data sources of the variables used in the analysis

are provided in Table 3.2. The correlation matrix of the variables is presented in Panel A of Appendix B.2.

Table 3.2: Variable definitions
This table defines the explanatory variables.

Variable	Description
VIX	Log of average VIX value in a given month. Source: Datastream.
DEV_MKT	A dummy variable set to 1 if a country is classified as a developed economy by the World Bank, and zero otherwise. Sources: Griffin, Kelly, and Nardari (2010), and Griffin, Hirschey, and Kelly (2011).
GDP_PER_CAP	Log of gross domestic product (GDP) per capita (in US$) in the previous year. Sources: World Bank, and IMF World Economic Outlook.
TRADE_OPENNESS	Proxy for market openness, computed as (Export + Import)/GDP in the same year. Source: World Bank.
SEGMENTATION	Monthly proxy for equity market segmentation based on valuation, developed by Bekaert, Harvey, Lundblad, and Siegel (2011), constructed for each market. Source: Datastream.
INSTIT_OWNER	Foreign institutional ownership measured as a percentage of a country's stock market capitalisation. Source: Ferreira and Matos (2008).
GOVERNANCE	Average of the six components of the Worldwide Governance Indicators in a given year. Source: World Bank.
SHORT_SELLING	A time-varying dummy variable set to 1 if short selling is prohibited, and zero otherwise. Source: Jain, Jain, McInish, and McKenzie (2013), and Charoenrook and Daouk (2005).
MKT_MAKER	Time-varying dummy variable set to 1 for markets with presence of market makers, and zero otherwise. To ensure our market maker dummy reflects the presence of market makers in a given market and over time, we survey the main stock exchange(s) when we are unsure of the trading mechanism in that exchange. Sources: Survey answers from main exchanges, and exchange webpages.
INDIVIDUALISM	Individualism versus collectivism (IDV) index of the Hofstede (2001) dimensions. Source: Hofstede (2001) dimensions.
UNCERT_AVOID	Uncertainty avoidance index of the Hofstede (2001) dimensions. Source: Hofstede (2001) dimensions.
GROWTH_VOLA	Standard deviation of the growth in each country's GDP. Sources: World Bank and IMF World Economic Outlook.
EXCHANGE_RATE	Monthly percentage changes in the value of a country's local currency relative to special drawing rights (SDR). Source: IMF International Financial Statistics.
MKT_CAP	Log of market capitalisation of listed firms in a country at the end of each month. Source: Datastream.
MKT_VOL	Log of value-weighted average of stock dollar volume within a market in a given month.
MKT_PRICE	Log of value-weighted average of stock prices within a market in a given month.

Table 3.3 shows the estimation results of Equation (3). In each regression model, we include our key variable VIX and one control variable (as indicated in Column 1 of each row), given the relatively high correlations between some controls. However, we also run regressions on VIX and the combinations of the controls, which have pair-wise correlations lower than 0.50, as a check on robustness.[24] We find a strong link between

[24] The results are consistent with our main results. In addition, the impact of VIX is not subsumed when we include all control variables.

Table 3.3: Risk perceptions and global liquidity

This table presents the results of panel regressions. In each regression model, we include our key variable VIX and one control variable. The first column indicates which control (with its expected sign in brackets) is included. However, we also run regressions on VIX and the combinations of the controls as a check on robustness. The dependent variable is the monthly aggregate market liquidity measured by the Amihud (2002) value and closing percent quoted spread from Chung and Zhang (2014). Independent variables are as defined in Table 3.2. The monthly Amihud (2002) and spread measures are value- and equal-weighted on market capitalisation across individual stocks within a market. The liquidity measures, VIX, GDP per capita (GDP_PER_CAP), market capitalisation (MKT_CAP), market volume (MKT_VOL), and market price level (MKT_PRICE) are natural log scaled. We have more than or equal to 54 markets with valid data in 11 out of the 13 regression models. The two regressions with MKT_MAKER and INSTIT_OWNER are based on data available for 43 and 26 markets, respectively. Standard errors are clustered by country. VW (EW) refers to the monthly market liquidity being value- (equal-) weighted. Numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

	Amihud				Spread			
	VW		EW		VW		EW	
	VIX	Control	VIX	Control	VIX	Control	VIX	Control
DEV_MKT (-)	0.6835***	-1.9780***	0.8031***	-0.8226**	0.3996***	-0.7785***	0.2950***	-0.0365
	(8.64)	(-4.93)	(10.29)	(-2.06)	(7.39)	(-3.80)	(5.29)	(-0.13)
GDP_PER_CAP (-)	0.7324***	-0.8350***	0.8268***	-0.3526**	0.3910***	-0.2312**	0.3201***	0.1278
	(9.50)	(-5.58)	(10.46)	(-2.13)	(7.39)	(-2.38)	(6.19)	(1.11)
TRADE_OPENNESS (-)	0.6958***	0.0266	0.8035***	0.2122	0.4222***	-0.0295	0.2974***	0.1273
	(7.39)	(0.12)	(9.13)	(1.16)	(7.98)	(-0.28)	(5.60)	(0.84)
SEGMENTATION (+)	0.4162***	15.3420**	0.6351***	8.7327*	0.2727***	11.0361***	0.1796***	8.9113**
	(4.01)	(2.47)	(6.19)	(1.82)	(4.16)	(3.43)	(3.08)	(2.28)
INSTIT_OWNER (-)	0.7104***	-1.0000	0.9206***	-0.2623	0.4412***	-1.3386	0.4129***	1.5529
	(5.98)	(-0.24)	(7.64)	(-0.08)	(6.26)	(-0.94)	(6.31)	(0.72)
GOVERNANCE (-)	0.8732***	-1.0977***	0.7421***	-0.2887	0.4472***	-0.3863***	0.3163***	0.1916
	(13.83)	(-3.83)	(12.25)	(-0.96)	(8.43)	(-2.78)	(5.45)	(1.21)
SHORT_SELLING (+)	0.7450***	1.8131***	0.8247***	0.5211	0.4241***	0.6806*	0.2956***	0.0088
	(8.57)	(3.85)	(9.76)	(1.06)	(7.76)	(1.93)	(5.14)	(0.02)
MKT_MAKER (-)	0.6446***	-1.1140**	0.8272***	-0.2283	0.4001***	-0.4488*	0.3370***	0.1838
	(6.50)	(-2.32)	(8.77)	(-0.49)	(7.09)	(-1.95)	(5.37)	(0.58)
GROWTH_VOLA (+)	0.6928***	0.5674***	0.8075***	0.2211	0.4236***	0.1766**	0.2948***	-0.0070
	(8.26)	(3.76)	(10.13)	(1.64)	(7.88)	(2.32)	(5.11)	(-0.07)
EXCHANGE_RATE (+)	0.6883***	4.6002***	0.8155***	2.8958***	0.3833***	0.7741**	0.2732***	0.0598
	(6.28)	(5.08)	(7.95)	(3.84)	(5.94)	(2.09)	(4.06)	(0.13)
MKT_CAP (-)	0.5506***	-0.7790***	0.7214***	-0.4495***	0.3802***	-0.2550***	0.2841***	-0.2082**
	(9.32)	(-11.70)	(9.49)	(-5.57)	(6.91)	(-4.06)	(5.03)	(-2.45)
MKT_VOL (-)	0.8605***	-0.6403***	0.8903***	-0.3261***	0.4492***	-0.2384***	0.3151***	-0.1157**
	(13.13)	(-13.21)	(11.65)	(-5.62)	(9.01)	(-6.33)	(5.19)	(-2.08)
MKT_PRICE (-)	0.5623***	-0.4960***	0.7403***	-0.2465*	0.3753***	-0.1171*	0.3218***	0.1090
	(6.99)	(-3.52)	(9.15)	(-1.79)	(7.07)	(-1.67)	(6.19)	(1.24)

VIX and all four measures of market liquidity, which is consistent with Brunnermeier and Pedersen (2009) and Nagel (2012), suggesting that liquidity decreases at times of high VIX when traders' funding liquidity is low and liquidity providers require higher returns. In Chung and Chuwonganant (2014), the impact of VIX is greater than the combined effects of a number of common determinants of individual stock liquidity, such as price and trading volume in the US markets. Using data on international markets, we find the impact of VIX is highly significant after controlling for all other well-documented determinants of market-level liquidity.[25] The average coefficient on VIX in Column 2 (Column 4) is 0.68 (0.80), suggesting that a 1% increase in international risk perception, as reflected in VIX, in month t on average leads to a 0.68% (0.80%) increase in the value- (equal-) weighted Amihud (2002) illiquidity ratio of a market during the same month. The average coefficient on VIX in Column 6 (Column 8) is 0.40 (0.30), showing a 1% increase in VIX is associated with a 0.40% (0.30%) increase in the value- (equal-) weighted spread of a given market in the same month.

To ensure the relation between global liquidity and risk perception is not driven by US market liquidity and VIX, we add two additional tests. First, we exclude the US market from our panel regressions, and regress non-US monthly market liquidity on US VIX. Second, we calculate a value-weighted average of 15 non-US implied volatility indices over the 2000–2015 period and regress the non-US monthly market liquidity on the value-weighted non-US global implied volatility. Our results, shown in Panel A of Appendix B.3, indicate that the non-US results are slightly stronger than our main results (including the US market). In addition, the Panel A, Appendix B.3 results suggest the R^2

[25] While the VIX index was introduced by CBOE in 1993, it was back-calculated to January 1990. We re-estimate the regression models using the subperiod 1993-2015; our results continue to hold.

based on VIX alone is approximately 2%. Thus, we conclude that the relation between global volatility and global liquidity we document is not driven by the US market.

Moreover, it is reasonable to expect the influence of VIX to vary with the liquidity level of a market. We perform quantile regressions (with standard errors clustered by country) of the market Amihud (2002) and spread values on VIX. Appendix B.4 plots the quantile against the coefficient estimates of VIX and shows a consistent impact of VIX across quantiles of both liquidity measures except that the coefficient is relatively lower when the spread value is around its 0.9 quantile.

The coefficients on the controls in Columns 3, 5, 7, and 9 of Table 3.3 confirm the effects of various country-level factors on market (il)liquidity level, indicating that liquidity is, on average, higher in more developed and integrated markets, in markets that allow short selling and have market makers, and in markets with better investor protection, more favourable macroeconomic conditions, greater market capitalisation, trading volume, and price level.

3.3.3 Causal relations between VIX and global liquidity

It is possible that heightened world illiquidity leads to higher investor risk aversion. To investigate the causal relation between VIX and world illiquidity, we measure world illiquidity as the global average of monthly value- and equal-weighted Amihud (2002) and spread values.

In Figure 3.1, we depict the generalised impulse response functions for shocks in VIX and world illiquidity. The solid line represents the generalised responses, and the dashed lines are the 95% confidence bands. A shock in VIX has a significantly positive

and long lived impact on world illiquidity, while there is no VIX response to world illiquidity. Therefore, our results in Table 3.3 are not driven by reverse causality.

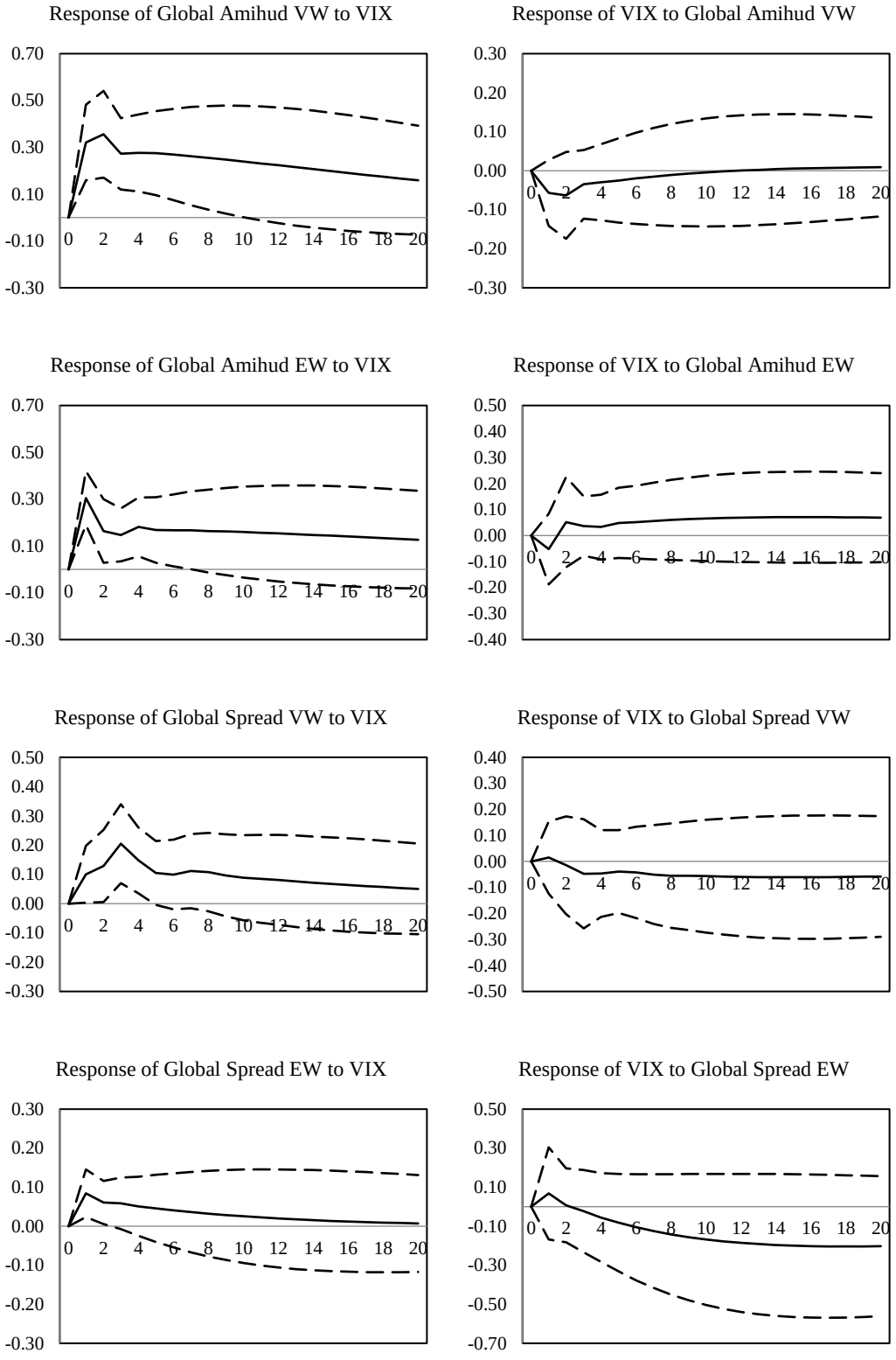


Figure 3.1: Generalised impulse responses
The solid line represents the generalised responses, and the dashed lines are the 95% confidence bands.

3.3.4 Impact of VIX on market liquidity by country

We document a strong link between VIX and global liquidity in Table 3.3. In this subsection, we assess whether and to what extent the impact of VIX on market liquidity varies across countries. We run the following time-series regression for each country:

$$ILLIQUIDITY_{c,t} = \alpha_c + \beta_{VIX,c} VIX_t + \varepsilon_{c,t} \quad (4)$$

where $ILLIQUIDITY_{c,t}$ is the log of one of four liquidity measures (the value- and equal-weighted Amihud (2002) and spread) for country *c* in month *t*. VIX_t is the log of average VIX Index value in month *t*. The estimated coefficient on VIX, $\beta_{VIX,c}$, from Equation (4) measures the percentage change in market liquidity in response to a 1% change in VIX (i.e. elasticity). Therefore, $\beta_{VIX,c}$ denotes the elasticity of market liquidity (with respect to VIX).

Panel A of Table 3.4 reports elasticity of market liquidity ($\beta_{VIX,c}$) for developed markets. Of the 28 developed markets, 23 (82.14%) and 24 (85.71%) country $\beta_{VIX,c}$ are positive when the value- and equal-weighted Amihud (2002) are used, respectively, while 24 (85.71%) and 26 (92.86%) are positive for the value- and equal-weighted spread. Columns 2 and 4 show 21 (75.00%) developed markets have a significantly positive $\beta_{VIX,c}$ on the value-weighted Amihud (2002), and this number increases to 22 (78.57%) for the value-weighted spread. While a 1% increase in VIX in month t on average leads to a 0.58% (0.41%) increase in the value-weighted Amihud (2002) measure (Spread) in the same month, the percentage change in the value-weighted Amihud (2002) measure (Spread) in response to a 1% change in VIX ranges from -0.64% (-0.16%) to 1.73% (1.15%).

Turning to the equal-weighted results, we find VIX exerts a greater negative impact on the equal-weighted than on the value-weighted Amihud (2002), but a weaker impact on the equal-weighted spread measure compared to the value-weighted spread measure. This shows changes in risk perception have a greater effect on the price impact dimension of liquidity for small-cap firms. One potential explanation for the weaker influence on the equal-weighted spread is that small-cap firms have relatively low stock prices, and tick sizes are more likely to be binding constraints on spreads for small firms.

Table 3.4: Risk perceptions and liquidity by country

This table presents the results of time-series regressions of monthly market liquidity, measured by the Amihud (2002) and spread values, on VIX for each country. Liquidity measures are value- or equal-weighted on market capitalisation across individual stocks within each market. We report the coefficients on VIX (β_{VIX}) for developed markets in Panel A, and emerging markets in Panel B. VW (EW) refers to the monthly market liquidity being value-(equal-) weighted. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

Panel A: Developed markets

	Amihud		Spread	
	VW	EW	VW	EW
Australia	0.2792***	0.7693***	0.4239***	0.4696***
Austria	0.6521***	0.5054***	0.6994***	0.1001
Belgium	1.2140***	1.6306***	0.9150***	0.3377***
Canada	0.5156***	0.8090***	0.4943***	0.5455***
Cyprus	-0.3017	-0.1975	-0.0401	0.1794***
Denmark	0.7824***	0.8873***	0.3910***	0.4408***
Finland	-0.0020	0.7061***	-0.0286	0.3409***
France	0.5244***	0.7534***	0.3504***	0.4034***
Germany	0.9149***	1.1951***	0.5535***	0.2565***
Greece	-0.4365**	-0.6919***	0.0447	-0.2363**
Hong Kong	0.7567***	1.0743***	0.1954***	0.2680***
Ireland	1.1849***	1.4399***	0.4921***	0.4522***
Israel	-0.3532*	-0.0043	0.6748***	0.5341***
Italy	0.6478***	1.0559***	0.9173***	0.7648***
Japan	1.3669***	1.8531***	0.4716***	0.8742***
Luxembourg	1.7269**	2.4340***	0.2539*	0.1736**
Netherlands	0.5499***	0.6646***	1.1471***	0.6754***
New Zealand	0.7369***	0.5503***	0.3188***	0.0960**
Norway	0.8816***	1.0938***	0.9774***	0.8604***
Portugal	-0.6383***	-0.0749	-0.1640*	-0.1894**
Singapore	1.2182***	1.2736***	0.2665***	0.3490***
South Korea	0.7811***	0.9667***	0.2980***	0.4377***
Spain	0.2142	0.2313*	-0.1074	0.1788**
Sweden	1.0284***	1.2696***	0.6695***	0.7235***
Switzerland	0.6137***	0.9472***	0.4241***	0.5117***
Taiwan	0.7496***	0.9544***	0.1134***	0.3204***
United Kingdom	0.6939***	1.1131***	0.0846	0.2582***
United States	0.0488	0.0580	0.6664***	0.7238***
Average	0.5839	0.8310	0.4108	0.3875
% Positive	82.14%	85.71%	85.71%	92.86%
% Positive significant	75.00%	82.14%	78.57%	89.29%

Table 3.4 (continued)

Panel B: Emerging markets

	Amihud		Spread	
	VW	EW	VW	EW
Argentina	0.4539***	0.0899	0.5853***	0.2302***
Brazil	1.0341***	0.7257***	0.6257***	-0.1740
Bulgaria	0.6789***	0.9956***	1.1944***	0.8831***
Chile	0.7581***	0.5445***	0.5074***	0.3834***
China	-0.7803***	-0.7099***	-0.1830***	-0.1022
Colombia	-0.8841***	-0.7870***	0.2307	0.2054
Croatia	0.0451	0.6132***	0.0483	-0.7475***
Czech Republic	0.2313	2.7856***	-	-
Egypt	0.8872***	0.3743**	0.2208*	0.2283**
Estonia	1.0556***	1.2916***	0.6550***	0.6114***
Hungary	-0.0547	0.3080**	0.6394***	0.3516***
India	0.8210***	0.7771***	0.0742	0.0014
Indonesia	1.0219***	1.0106***	0.4936***	0.2599***
Kenya	0.8640***	0.5654***	0.0594	0.1236
Lithuania	0.7280***	1.0128***	0.4253***	0.2888***
Malaysia	1.6503***	1.6390***	0.5337***	0.3990***
Mexico	0.7893***	0.8939***	0.6109***	0.4739***
Morocco	0.2159*	0.1732*	0.7627*	0.7694*
Pakistan	0.9576***	0.7429***	-0.2749***	-0.2307***
Peru	0.1889**	-0.0374	0.3001***	-0.0456
Philippines	0.9759***	0.7943***	0.4319***	0.1161*
Poland	1.2444***	1.6830***	0.7410***	0.5533***
Romania	1.8382***	1.1288***	0.8494***	0.3214***
Slovenia	0.8061***	0.7390***	0.2042***	-0.5774***
South Africa	1.1704***	1.1442***	0.6144***	0.2806***
Sri Lanka	1.5048***	1.5567***	-0.1802*	-0.3752***
Thailand	1.1596***	1.1543***	0.2070***	0.2652***
Turkey	0.0861	0.1621	0.3510***	0.2994***
Venezuela	-2.2882***	-1.9474***	0.6439	0.6195
Average	0.5917	0.6698	0.4061	0.1933
% Positive	86.21%	86.21%	89.29%	75.00%
% Positive significant	75.86%	79.31%	71.43%	60.71%

Accordingly, spreads of small firms are less affected by changes in VIX than those of large firms. Another possible reason is that some exchanges have market makers / liquidity providers under obligation to maintain a pre-defined maximum price spread with a minimum order size, especially for smaller firms.[26] The emerging markets results in Panel B are similar to the evidence for developed markets. We also replace US VIX with 16 international VIX indices and re-estimate the time-series regressions. The results are shown in Panel B of Appendix B.3.

[26] For example, we are informed by the Istanbul Stock Exchange that their liquidity-providing program was developed with an aim to improve the liquidity of stocks with low traded values. See also http://www.nasdaqbaltic.com/en/products-services/trading-2/market-making-program/.

3.3.5 Market attributes and the impact of VIX

Using time-series regulatory changes in the US, Chung and Chuwonganant (2014) find market structure plays an important role in explaining how VIX affects stock liquidity. We now investigate which cross-sectional country and equity market attributes influence the impact of VIX on market liquidity. It is possible that some attributes influence liquidity differently through the risk aversion channel than they do directly. For instance, countries that allow short selling might be more liquid on average. However, these countries may have a higher sensitivity of market liquidity to VIX due to short selling, resulting in concerns about risk being reflected in the market more readily. We use elasticity of market liquidity, $\beta_{VIX,c}$, from Equation (4) to measure the magnitude of the impact of VIX on liquidity and run cross-sectional regressions of $\beta_{VIX,c}$ on a number of market attributes, as per Equation (5):

$$\beta_{VIX,c}=\lambda_0+\lambda_1 Attributes_c+\varepsilon_c \quad (5)$$

where $Attributes_c$ represents the set of market attributes we examine, including all equity market and country variables examined in Equation (3) and two Hofstede (2001) cultural dimensions. For each country, we use the mean values of *GDP_PER_CAP*, *TRADE_OPENNESS*, *SEGMENTATION*, *GOVERNANCE*, *EXCHANGE_RATE*, *MKT_CAP*, *MKT_VOL*, and *MKT_PRICE* during the entire sample period in the regressions. In addition, we set the short-selling dummy to 1 if a market has short-selling constraints for one month or more. We set the market maker dummy to 1 if a market has

market makers for one month or more.[27] Panel B of Appendix B.2 presents the correlation matrix of the country-level attribute variables.

In choosing the appropriate explanatory variables, we are motivated by prior literature and by intuitive reasoning.[28] We hypothesize that developed countries more integrated with or less segmented from world markets attract more international investors and are likely to be more affected by international risk perceptions as measured by VIX. The intuition here is that more integrated markets are subject to greater exposure to global shocks (e.g. Amihud, Hameed, Kang, and Zhang, 2015). This hypothesis also implies that markets with a higher proportion of foreign institutional ownership are more sensitive to changes in VIX, and hence have a stronger risk perception–liquidity relation. We therefore expect positive coefficients on *DEV_MKT*, *GDP_PER_CAP*, *TRADE_OPENNESS*, and *INSTIT_OWNER*, and a negative coefficient on *SEGMENTATION*.

More developed and integrated countries typically have better governance, macroeconomic environments, larger market capitalisation, and greater trading volume. Marshall, Nguyen, Nguyen, and Visaltanachoti (2016) find countries with stronger governance respond more quickly to global innovations. In Manconi, Massa, and Yasuda (2012), institutional investors prefer to liquidate their holdings of more liquid assets during crisis periods, rather than sell illiquid assets at fire-sale prices. The finding of Manconi, Massa, and Yasuda (2012) is consistent with Scholes (2000), arguing that in

[27] We also compute the short selling variable as (Number of months with short-selling constraints)/(Total number of months) and the market maker variable as (Number of months with market makers)/(Total number of months). We then re-estimate our cross-sectional regressions using these alternative measures, and find similar results. While we follow the methodology of Chung and Chuwonganant (2014) and use the mean values of independent variables over the sample period, we acknowledge that an alternative approach is to follow Fama and MacBeth (1973), and run the regression in each month and obtain the time series of estimated coefficients.

[28] Chordia, Roll, and Subrahmanyam (2001) use a similar approach.

response to an unfolding crisis, market participants liquidate the most liquid investments in their portfolios first, as transaction costs in these markets tend to be lower and trading volumes are larger. Thus we posit that countries with stronger governance, more favourable macroeconomic environments, larger markets, and higher trading volume are more affected. The competing hypothesis is more advanced markets exhibit less information-based trading, and therefore investors in more advanced markets are less sensitive to changes in risk perception. Thus, a priori, we expect the former effect to outweigh the latter (positive coefficients on *GOVERNANCE*, *MKT_CAP*, and *MKT_VOL*, and negative coefficients on *GROWTH_VOLA* and *EXCHANGE_RATE*).

There is substantial evidence of short-selling constraints impeding the efficient processing of negative information (e.g. Bris, Goetzmann, and Zhu, 2007; Beber and Pagano, 2013). As noted in Chung and Chuwonganant (2014, p. 478), "a direct reflection of expected volatility in prices and quotes, without the filtering by market intermediaries, could increase the volatility of market liquidity." Thus, we expect investor risk perception to exert a greater negative impact on liquidity in markets without short-selling constraint and on market makers, and therefore negative signs on *SHORT_SELLING* and *MKT_MAKER*. Chung and Chuwonganant (2014) also suggest that the spreads of high-priced stocks are more affected by market uncertainty because tick sizes are less binding for these stocks, which implies a positive coefficient on *MKT_PRICE* when the spread measure is used, but offer no clear prediction for the Amihud (2002) measure.

The literature also show cultural factors are important in explaining differences in risk preferences or propensities for risk (e.g. Weber and Hsee, 1998; Statman, 2008). Using survey results from 53 countries, Rieger, Wang, and Hens (2015) find risk preferences depend not only on economic conditions, but also on cultural factors

measured by two Hofstede (2001) dimensions, individualism and uncertainty avoidance. We study whether cultural factors exert a significant influence on the risk perception–liquidity relation. Following Rieger, Wang, and Hens (2015), the two cultural factors we examine are the Hofstede (2001) individualism and uncertainty avoidance dimensions. In Hsee and Weber (1999) and Statman (2008), people in more collectivistic countries can afford more risk, as a collectivistic society provides more downside protection than an individualistic society. The uncertainty avoidance dimension captures the degree to which a society can tolerate uncertainty and ambiguity. Thus, we expect the risk perception–liquidity relation to be stronger in countries with higher scores on individualism (*INDIVIDUALISM*) and uncertainty avoidance (*UNCERT_AVOID*).

Table 3.5 presents the estimation results for Equation (5). In each regression model, we include one of our market attribute variables or cultural factors as the explanatory variable. We show significantly positive coefficients on *GDP_PER_CAP* and *GOVERNANCE*, and significantly negative coefficients on *SHORT_SELLING* across the Amihud (2002) and spread measures, indicating the risk perception–liquidity relation is stronger in more economically developed countries with better governance and in countries with no short-selling constraints. Columns 3 and 4 show the effect of *TRADE_OPENNESS* is highly significant at the 1% level, supporting the notion that the impact of VIX on the value- and equal-weighted Amihud (2002) illiquidity ratio, which reflects "the price concession… that a buyer or seller must make to effect a trade" (Amihud and Mendelson, 2012, p. 17), is significantly stronger in countries with greater trade openness. This finding is consistent with the significant negative coefficient on *SEGMENTATION*, which proxies for equity market segmentation, when the equal-weighted Amihud (2002) is used. Our results support Claessens, Klingebiel, and Schmukler (2006), Bris, Goetzmann, and Zhu (2013), Rizova (2013), and Marshall,

Nguyen, Nguyen, and Visaltanachoti (2016), which show country development, governance, trade openness, and short-selling constraints influence trading activity and the rate at which information is incorporated in international equity markets.

Table 3.5: Market attributes and the risk perception–liquidity relation
This table shows results for the effects of market attributes on the risk perception–liquidity relation. In each regression model, we include one equity market / country attribute as the explanatory variable given the relatively high correlations between the equity market / country attribute variables as reported in Panel B of Appendix B.2. The dependent variable is $\beta_{VIX,c}$ obtained from Equation (4) based on the value- and equal-weighted Amihud (2002) and spread measures. Explanatory variables are as defined in Table 3.2. VW (EW) refers to the monthly market liquidity being value- (equal-) weighted. Numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

		Amihud		Spread	
	Exp sign	VW	EW	VW	EW
DEV_MKT	+	-0.0078	0.1612	0.0047	0.1942**
		(-0.04)	(0.79)	(0.05)	(2.20)
GDP_PER_CAP	+	0.0027	0.1307*	0.0638*	0.0903***
		(0.04)	(1.93)	(1.80)	(3.09)
TRADE_OPENNESS	+	0.3199***	0.4453***	0.0049	0.0201
		(2.79)	(2.89)	(0.10)	(0.52)
SEGMENTATION	-	-8.7755	-10.0089**	1.5742	0.2865
		(-1.65)	(-2.30)	(1.10)	(0.18)
INSTIT_OWNER	+	0.6749	1.4695	0.5451	0.6151
		(0.39)	(0.85)	(0.43)	(0.96)
GOVERNANCE	+	0.1670	0.3430**	0.0708	0.1186**
		(1.14)	(2.66)	(1.31)	(2.56)
SHORT_SELLING	-	-0.1552	-0.4094**	-0.1663*	-0.0962
		(-0.87)	(-2.07)	(-1.92)	(-1.03)
MKT_MAKER	-	0.0059	-0.0459	0.1574	0.0948
		(0.03)	(-0.19)	(1.48)	(0.83)
INDIVIDUALISM	+	0.0044	0.0094*	0.0054***	0.0058***
		(0.88)	(1.92)	(3.16)	(3.58)
UNCERT_AVOID	+	-0.0067	-0.0063	0.0004	-0.0029
		(-1.59)	(-1.40)	(0.22)	(-1.45)
GROWTH_VOLA	-	-0.0933	-0.0949	0.0306	0.0097
		(-0.86)	(-0.93)	(1.00)	(0.33)
EXCHANGE_RATE	-	-3.3748	-13.7228	6.5113	-4.5836
		(-0.38)	(-1.51)	(1.67)	(-0.83)
MKT_CAP	+	0.0218	0.0278	0.0095	0.0545*
		(0.36)	(0.42)	(0.37)	(1.99)
MKT_VOL	+	-0.0035	0.0416	0.0085	0.0526**
		(-0.07)	(0.83)	(0.35)	(2.15)
MKT_PRICE	+	-0.1286**	-0.0470	0.0592**	0.0353
		(-2.03)	(-0.71)	(2.47)	(1.27)

Columns 5 and 6 set forth results based on the spread measure, which captures trading costs as a percentage of stock price; these results show a significantly positive coefficient on *MKT_PRICE*, which is supportive of our expectation and the view in Chung and Chuwonganant (2014) that high-priced stocks are more sensitive to changes in VIX, since tick sizes are less likely to be binding constraints for these stocks. However,

we find a negative sign on *MKT_PRICE* when the Amihud (2002) measure is used. Consistent with our hypotheses, we find that factors shown to improve market liquidity (e.g. GDP per capita and the practice of short selling) in Table 3.3 are associated with higher sensitivity of market liquidity to VIX, which implies greater liquidity volatility.

Turning to cultural factors, we find strong evidence across the Amihud (2002) and spread measures that the risk perception–liquidity relation is more pronounced in more individualistic countries, consistent with the notion that a collectivistic society provides more downside protection than an individualistic society, and therefore can tolerate more risk.

3.4 Robustness checks

3.4.1 Impact of extreme VIX

In Cespa and Foucault (2014), illiquidity spillovers can be particularly strong when liquidity providers' risk tolerance approaches some critical value. We now investigate whether the impact of VIX we document is driven by extreme VIX values. We add interaction terms of VIX and extreme VIX dummies, and re-estimate the regression models contained in Table 3.3 as follows:

$$ILLIQUIDITY_{ct}=\alpha+\beta VIX_t+\beta_{HIGH}VIX_tD_{HIGH,t}+\beta_{LOW}VIX_tD_{LOW,t}+Controls+\varepsilon_{ct} \quad (6)$$

where $D_{HIGH,t}$ is a dummy variable set to 1 if VIX_t is more than 1.5 standard deviations above its mean, and $D_{LOW,t}$ is a dummy variable set to 1 if VIX_t is more than 1.5 standard deviations below its mean.[29] Other variables are as defined in Equation (3). Because our

[29] We follow Hameed, Kang, and Viswanathan (2010), and use 1.5 standard deviations to define extreme high and low VIX. If we use 2.0 standard deviations to define extreme VIX, we end with only 9 extreme

focus is to assess the effects of extreme VIX, we present only the coefficients on VIX and the interaction terms that show us the incremental effects of extreme high and low VIX on market liquidity. From this point on, for brevity, we report the results based on value-weighted liquidity measures in the tables. Our results hold when equal-weighted measures are used.

Table 3.6: Extreme risk perception and liquidity

This table presents the panel regression results of Equation (6). DHIGH is a dummy variable set to 1 if VIX_t is more than 1.5 standard deviations above its mean, and DLOW is a dummy variable set to 1 if VIX_t is more than 1.5 standard deviations below its mean. Other variables are as defined in Equation (3). Because our focus is on the effects of extreme VIX, we report only the coefficients on VIX and the interaction terms. VW refers to monthly market liquidity being value-weighted. Numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

	Amihud VW			Spread VW		
	VIX	VIX×D_{HIGH}	VIX×D_{LOW}	VIX	VIX×D_{HIGH}	VIX×D_{LOW}
DEV_MKT	0.5606***	0.0472**	-0.1109***	0.3883***	0.0045	-0.0059
	(5.07)	(2.29)	(-3.51)	(5.05)	(0.31)	(-0.23)
GDP_PER_CAP	0.5205***	0.0954***	-0.1040***	0.3403***	0.0222	-0.0111
	(4.96)	(4.32)	(-3.40)	(4.48)	(1.56)	(-0.40)
TRADE_OPENNESS	0.5516***	0.0603**	-0.0966***	0.4037***	0.0092	0.0034
	(4.28)	(2.67)	(-2.68)	(5.22)	(0.61)	(0.13)
SEGMENTATION	0.2775**	0.0562**	-0.1085***	0.3058***	-0.0161	-0.0013
	(2.37)	(2.02)	(-3.55)	(3.69)	(-1.31)	(-0.05)
INSTIT_OWNER	0.5276***	0.0660**	-0.2085***	0.4578***	-0.0107	-0.0173
	(3.44)	(2.66)	(-5.59)	(4.74)	(-0.73)	(-0.63)
GOVERNANCE	0.7943***	0.0278	-0.0474*	0.4422***	0.0039	0.0120
	(8.47)	(1.67)	(-1.88)	(5.45)	(0.27)	(0.49)
SHORT_SELLING	0.6154***	0.0547**	-0.0863***	0.4187***	0.0038	0.0085
	(5.24)	(2.47)	(-2.84)	(5.23)	(0.24)	(0.39)
MKT_MAKER	0.4267***	0.0900***	-0.1571***	0.3616***	0.0173	-0.0060
	(3.28)	(3.54)	(-4.56)	(4.57)	(1.04)	(-0.22)
GROWTH_VOLA	0.5623***	0.0507**	-0.1141***	0.4168***	0.0023	-0.0059
	(4.91)	(2.51)	(-3.62)	(5.37)	(0.16)	(-0.23)
EXCHANGE_RATE	0.6024***	0.0428*	-0.0243	0.3864***	0.0027	0.0275
	(4.21)	(1.78)	(-0.66)	(4.02)	(0.14)	(0.89)
MKT_CAP	0.4099***	0.0647***	-0.0607***	0.4030***	-0.0083	0.0167
	(5.43)	(4.36)	(-2.81)	(5.87)	(-0.71)	(0.74)
MKT_VOL	0.7807***	0.0527***	0.0646**	0.4923***	-0.0117	0.0592***
	(9.49)	(3.22)	(2.44)	(8.08)	(-1.04)	(3.16)
MKT_PRICE	0.4552***	0.0447**	-0.0747**	0.3608***	0.0065	-0.0019
	(4.23)	(2.03)	(-2.38)	(4.60)	(0.39)	(-0.07)

Table 3.6 presents a consistent and highly significant link between VIX and both liquidity measures. The significant coefficients on high and low VIX dummies in Columns 3 and 4 suggest the effect of a 1% increase in VIX on market liquidity rises

high and 0 extreme low VIX values. We therefore use 1.5 standard deviations to define extreme VIX values, and the numbers of extreme high and low VIX are 24 and 8, respectively.

significantly at times of high VIX and decreases significantly at times of low VIX, when the Amihud (2002) measure is used. We conclude the influence of VIX on the price impact dimension of liquidity is stronger when VIX is extremely high, and weaker when VIX is extremely low. However, Columns 6 and 7 show extreme VIX has insignificant incremental effects on the spread measure.

3.4.2 Subperiod analysis on the impact of VIX

We initially split the sample into two subperiods (1990–2002 and 2003–2015), and investigate whether the link between VIX and international liquidity is unique to the second subperiod, which covers the Global Financial Crisis. Splitting on 2003 not only produces relatively similar subperiods of time, but it also reflects the period in which the VIX methodology was changed as discussed in Section 3.2.3. Figure 3.2 plots the VIX Index and the global average of the value-weighted Amihud (2002) values, and shows a strong co-movement between VIX and global liquidity measured by the Amihud (2002) values over the entire sample period. We re-estimate the regressions in Table 3.3 and report coefficients on VIX values for the two subperiods in Panel A of Table 3.7. The impact of VIX on the Amihud (2002) measure is present in both subperiods, with the impact being stronger in the more recent period, when the VIX Index is more volatile. However, while the effect of VIX on closing percent quoted spread is highly significant during the 2003–2015 subperiod, the effect during the 1990–2002 subperiod is significant in only three models. This is likely due, at least in part, to the fewer country-month spread observations during the earlier subperiod. For example, spread data exist for only 37 countries in the earlier period.

We then conduct additional tests for the periods prior to the Global Financial Crisis (1990–2006), during the crisis (2007–2009), and after the crisis (2010–2015),

separately. The results in Panel B of Table 3.7 show that the impact of VIX is highly statistically significant in all three subperiods, and is more economically significant during the crisis (2007–2009). This finding is consistent with Baele, Bekaert, Inghelbrecht and Wei (2015), which suggests that flight-to-safety episodes coincide with increases in VIX and decreases in liquidity.[30]

[30] We re-estimate our subperiod analysis using dummy variables, and the results remain intact.

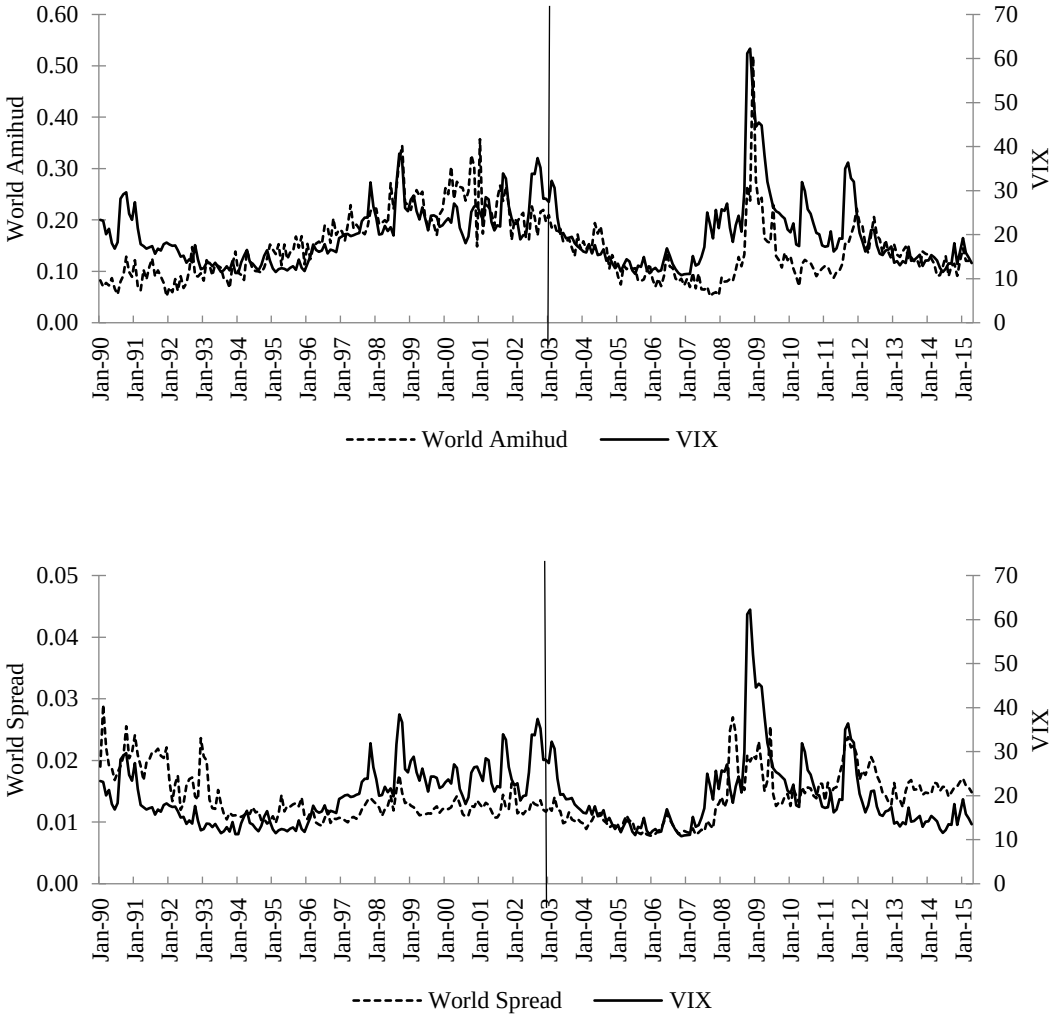


Figure 3.2: Risk perceptions and world liquidity
This figure presents the time series of monthly VIX, defined as average VIX value within a month, and the global average of the value-weighted Amihud (2002) and spread values across all sample countries.

3.4.3 Business cycle and the impact of VIX

We also investigate whether the impact of VIX on market liquidity is robust over different states of the business cycle. We add recession and expansion dummies to Equation (3) and estimate the following regression:

$$ILLIQUIDITY_{ct}=\alpha+\beta_{REC}VIX_tD_{REC,ct}+\beta_{EXP}VIX_tD_{EXP,ct}+Controls+\varepsilon_{ct} \quad (7)$$

where $D_{REC,ct}$ is a dummy variable set to 1 if the economy of country *c* is contracting in month *t*, and zero otherwise, and $D_{EXP,ct}$ is a dummy variable set to 1 if the economy is

Table 3.7: Subperiod results
This table reports the impact of VIX by subperiod. In Panel A, we split the sample into two subperiods and investigate whether the link between VIX and international liquidity is unique to the more recent subperiod. Splitting on 2003 not only produces relatively similar subperiods, but also reflects the period when the VIX methodology was changed as discussed in Section 3.2.3. In Panel B, we test the influence of VIX for the periods prior to the Global Financial Crisis (1990-2006), during the crisis (2007-2009), and after the crisis (2010-2015). We investigate whether the impact of VIX on market liquidity is robust over expansionary and recessionary phases of the business cycle in Panel C. VW refers to monthly market liquidity being value-weighted. Numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

Panel A: The pre- and post-2003 subperiods

	Amihud VW		Spread VW	
	VIX 1990-2002	VIX 2003-2015	VIX 1990-2002	VIX 2003-2015
DEV_MKT	0.3732*	0.7702***	0.1899	0.4030***
	(1.78)	(12.02)	(0.77)	(7.99)
GDP_PER_CAP	0.5470**	0.8754***	0.2460	0.4396***
	(2.53)	(11.98)	(1.10)	(8.16)
TRADE_OPENNESS	0.5053**	0.7553***	0.3136	0.4302***
	(2.12)	(11.24)	(1.61)	(8.30)
SEGMENTATION	0.2207	0.4964***	0.2322	0.3036***
	(1.01)	(4.72)	(1.42)	(4.14)
INSTIT_OWNER	0.1133	1.0279***	-0.0258	0.4440***
	(0.39)	(14.64)	(-0.17)	(7.10)
GOVERNANCE	0.8323***	0.7579***	0.6451**	0.3979***
	(4.89)	(12.23)	(2.39)	(7.69)
SHORT_SELLING	0.6803***	0.7410***	0.2645	0.4065***
	(2.88)	(11.30)	(1.43)	(7.40)
MKT_MAKER	0.2862	0.8101***	0.1539	0.4173***
	(1.10)	(10.18)	(0.75)	(7.79)
GROWTH_VOLA	0.4376*	0.7626***	0.2973	0.4081***
	(1.90)	(12.07)	(1.34)	(7.95)
EXCHANGE_RATE	0.7624***	0.6102***	0.3705*	0.3758***
	(2.95)	(6.78)	(1.82)	(5.98)
MKT_CAP	0.5599***	0.5920***	0.2802	0.3514***
	(3.31)	(11.43)	(1.44)	(6.62)
MKT_VOL	1.1154***	0.7773***	0.3766**	0.4030***
	(7.25)	(12.07)	(2.12)	(7.71)
MKT_PRICE	0.3162	0.6702***	0.2197	0.3796***
	(1.52)	(11.08)	(1.20)	(6.73)

Table 3.7 (continued)

Panel B: The 2007-09 crisis and non-crisis periods

	Amihud VW			Spread VW		
	Crisis period	Non-crisis period		Crisis period	Non-crisis period	
	VIX 2007-2009	VIX 1990-2006	VIX 2010-2015	VIX 2007-2009	VIX 1990-2006	VIX 2010-2015
DEV_MKT	1.2351***	0.7199***	0.6841***	0.4955***	0.4705***	0.3264***
	(16.91)	(5.82)	(6.54)	(10.31)	(5.38)	(3.15)
GDP_PER_CAP	1.3527***	0.6300***	0.5507***	0.5415***	0.4338***	0.2824***
	(15.65)	(5.12)	(4.60)	(9.99)	(4.17)	(3.04)
TRADE_OPENNESS	1.2195***	0.7368***	0.6204***	0.5179***	0.4652***	0.3079***
	(15.41)	(5.19)	(5.18)	(9.97)	(5.16)	(2.97)
SEGMENTATION	0.7681***	0.4323***	0.4594**	0.4040***	0.3652***	0.2171
	(4.88)	(3.23)	(2.25)	(6.99)	(4.45)	(1.49)
INSTIT_OWNER	1.5041***	0.6535***	0.8656***	0.5537***	0.5142***	0.4078***
	(21.36)	(3.73)	(7.77)	(8.72)	(5.39)	(3.00)
GOVERNANCE	1.2338***	1.1288***	0.6655***	0.4984***	0.6019***	0.3124***
	(17.80)	(8.55)	(6.98)	(10.16)	(5.94)	(3.12)
SHORT_SELLING	1.1657***	0.8183***	0.6526***	0.4690***	0.4776***	0.3522***
	(16.68)	(6.09)	(7.17)	(9.32)	(5.44)	(3.51)
MKT_MAKER	1.3317***	0.6044***	0.5930***	0.5356***	0.4359***	0.3100***
	(17.22)	(3.94)	(4.54)	(9.18)	(4.30)	(3.65)
GROWTH_VOLA	1.2403***	0.7371***	0.6619***	0.5159***	0.4674***	0.3075***
	(18.84)	(5.63)	(6.97)	(10.08)	(5.60)	(3.03)
EXCHANGE_RATE	1.0499***	0.7533***	0.5145***	0.4478***	0.3988***	0.2912**
	(9.95)	(4.73)	(4.54)	(7.92)	(3.71)	(2.33)
MKT_CAP	0.8158***	0.4961***	0.3627***	0.3360***	0.4510***	0.2653**
	(11.49)	(5.26)	(4.35)	(6.75)	(5.46)	(2.64)
MKT_VOL	1.0114***	0.7866***	0.7390***	0.3903***	0.4807***	0.3766***
	(13.56)	(8.39)	(7.44)	(8.08)	(6.29)	(3.78)
MKT_PRICE	1.0077***	0.5216***	0.5394***	0.4879***	0.4246***	0.2572**
	(10.27)	(4.06)	(5.45)	(8.46)	(5.26)	(2.29)

Panel C: Expansionary and recessionary phases of the business cycle

	Amihud VW		Spread VW	
	$VIX \times D_{REC,C}$	$VIX \times D_{EXP,C}$	$VIX \times D_{REC,C}$	$VIX \times D_{EXP,C}$
DEV_MKT	0.7082***	0.6104***	0.4340***	0.4110***
	(7.72)	(3.82)	(6.90)	(5.02)
GDP_PER_CAP	0.7451***	0.5839***	0.4314***	0.3907***
	(9.28)	(4.77)	(6.53)	(5.01)
TRADE_OPENNESS	0.7125***	0.6891**	0.4512***	0.4621***
	(4.55)	(2.61)	(5.95)	(4.22)
SEGMENTATION	0.4839***	0.5202**	0.3844***	0.4131***
	(3.11)	(2.73)	(4.53)	(4.37)
INSTIT_OWNER	0.7694***	0.8378***	0.4957***	0.5369***
	(5.86)	(3.65)	(6.28)	(5.09)
GOVERNANCE	0.9968***	1.0364***	0.5236***	0.5670***
	(8.55)	(4.55)	(5.71)	(4.16)
SHORT_SELLING	0.7395***	0.6646***	0.4872***	0.4972***
	(6.39)	(4.01)	(6.43)	(6.02)
MKT_MAKER	0.7840***	0.7011**	0.4484***	0.4504***
	(5.35)	(2.84)	(5.90)	(4.33)
GROWTH_VOLA	0.7415***	0.6810***	0.4905***	0.4965***
	(6.18)	(3.29)	(6.95)	(5.26)
EXCHANGE_RATE	0.6828***	0.6116**	0.4435***	0.4169***
	(4.04)	(2.19)	(5.12)	(3.41)
MKT_CAP	0.6882***	0.6465***	0.3932***	0.3921***
	(9.66)	(6.75)	(4.46)	(3.51)
MKT_VOL	1.0335***	0.9961***	0.4815***	0.4727***
	(8.06)	(5.14)	(6.33)	(4.41)
MKT_PRICE	0.6878***	0.5953***	0.4407***	0.4307***
	(6.54)	(3.52)	(6.41)	(5.20)

expanding, and zero otherwise. We obtain the business cycle peak and trough dates for 20 countries from the Economic Cycle Research Institute (ECRI).[31] The other variables are identical to those defined in Equation (3).

We re-estimate the regressions in Table 3.3. As shown in Panel C of Table 3.7, both β_{REC} and β_{EXP} are statistically significant in all models, and the magnitude of these estimated coefficients is comparable to the estimated coefficient on *VIX* in Table 3.3. Moreover, our results show a slightly higher influence of VIX on market liquidity in recessionary periods compared to expansionary periods.

3.4.4 Other robustness checks

Since both monthly and daily frequencies are of interest in the liquidity literature (e.g. Fong, Holden, and Trzcinka, 2014), we estimate Equation (3) using daily liquidity measures. Following Chung and Chuwonganant (2014), we regress daily liquidity measures on VIX values on days *t*, *t*-1, and *t*+1, and include the day-of-the-week dummies. We follow Lehkonen (2015) and address the issue of time zones by using one-day lagged data for Western Hemisphere countries. Our daily data results in Appendix B.5 are consistent with the results based on monthly frequency. We also run our panel regressions with two-way clustered standard errors. Regression results with standard errors clustered by both country and time are consistent with the main results in Table 3.3. Comparing the standard errors in Table 3.3 and in the regression results with standard errors clustered by both country and time, we observe no time effect in the data.

Our results continue to hold when we replace US VIX with 16 international VIX indices. The economic significance of the coefficients on VIX is higher when US VIX is

[31] See https://www.businesscycle.com/. ECRI uses the same approach used to determine the NBER business cycle dates to determine international business cycles.

replaced with the international VIX. This is likely driven by the fact that the 16 countries that have their local VIX are relatively more developed and open to world markets, given the evidence in Sections 3.3.4 and 3.3.5. Note also that there is a difference in the time periods of the US and local VIX results.

3.5 Conclusions

It is well established that uncertainty is an important determinant of liquidity in the US. However, the importance of uncertainty in international markets remains uninvestigated. We use VIX to proxy for risk perception internationally and examine its influence on market liquidity using 45,564 stocks in 57 countries.

We show the impact of VIX on international market liquidity is highly statistically significant and is not subsumed by other well-documented determinants of market liquidity. Further, it is economically meaningful. A 1% increase in VIX in a given month leads to a 0.68% (0.80%) increase in the value- (equal-) weighted Amihud (2002) illiquidity ratio and a 0.40% (0.30%) increase in the value- (equal-) weighted closing percent quoted spread of Chung and Zhang (2014) for a market in the same month. We find no evidence of reverse causality.

We solve the question of which country-level factors exert a significant influence on the risk perception–liquidity relation. Our results indicate investor risk perception, as reflected in VIX, exerts a greater influence on market liquidity in more economically developed countries, and in countries with more trade openness, better governance environments, and no short-selling constraints. This is consistent with the view that more developed countries attract more international investors, incorporate information faster, and are, accordingly, likely to be more affected by changes in international risk

perceptions. Moreover, we document a stronger risk perception–liquidity relation in more individualistic countries. Our findings are important in explaining why market liquidity in certain countries is more volatile than in others, and they have implications for policy makers focusing on stabilizing market liquidity.

We further show our core results are not driven by extreme VIX values, remain intact during the subperiods of our study, and in both expansionary and recessionary phases of the business cycle. Our results continue to hold when we replace monthly liquidity measures with daily liquidity measures.

CHAPTER 4

ESSAY THREE

Volatility, liquidity, and returns are of great importance to market participants and policymakers. This chapter presents the third essay which investigates how market volatility, stock liquidity, and returns interact in a sample of 41 countries. It also explores which market attributes influence the interaction between these variables. An overview of the study, including its key contributions to the literature, is presented in Section 4.1. Section 4.2 describes the data sources and sample selection procedures. Section 4.3 discusses liquidity and shocks measures. The empirical results are provided in Section 4.4, and Section 4.5 concludes this chapter. An appendix to this chapter and the essay's reference list are provided at the end of the thesis.

Market Volatility, Liquidity Shocks, and Stock Returns: Worldwide Evidence

Abstract

We examine the interaction between market volatility, liquidity shocks, and stock returns in 41 countries over the period 1990–2015 period. We find liquidity is an important channel through which market volatility affects stock returns in international markets and we show this is distinct from the direct volatility–return relation. The influence of the liquidity channel on the link between market volatility and returns is stronger in markets exhibiting higher levels of market volatility and lower trading volume. It is also stronger in countries with better governance, no short-selling constraints, and more high-frequency trading and during financial crisis periods.

JEL Classification Codes: G12, G15, G18

Keywords: market volatility, liquidity, returns, international stock markets

4.1 Introduction

We investigate how volatility, liquidity, and stock returns interact in international markets with diverse institutional environments. Chung and Chuwonganant (2017) find that market volatility affects returns directly, as well as indirectly through stock liquidity, suggesting that liquidity providers play an important role on the market volatility–return relation in the United States. While an out of sample test in international markets is important (e.g. Brockman, Chung, and Perignon, 2009; Amihud, Hameed, Kang, and Zhang, 2015), our main motivation is to provide insights on which market attributes are associated with the impact of the liquidity channel linking volatility and returns by exploiting the rich variation in institutional environments around the world. This issue is important, since many institutional factors, such as a country's governance (e.g. Chung, Kim, Park, and Sung, 2012), the degree of market segmentation (e.g. Bekaert, Harey, and Lumsdaine, 2002), and the existence of market makers (e.g. Clark-Joseph, Ye, and Zi, 2017) and short selling constraints (e.g. Beber and Pagano, 2013), influence the role of liquidity providers in global markets.

We contribute to several strands of literature. Earlier research on the role of liquidity in determining asset returns is typically focused on the United States (e.g. Amihud and Mendelson, 1986; Acharya and Pedersen, 2005); more recently, researchers have turned their attention to international markets. For example, Lee (2011) shows liquidity risks, as measured by the covariances of individual stock liquidity with market liquidity and returns, are priced factors around the world. Amihud, Hameed, Kang, and Zhang (2015) provide evidence of the pricing of stock liquidity level (as opposed to liquidity risks) in an international setting. We contribute to this literature on liquidity and asset pricing by documenting that liquidity is an important channel through which market

volatility influences returns in a sample of 41 countries. Using the methodology of Chung and Chuwonganant (2017) to measure market volatility and stock liquidity shocks, we begin our empirical tests with a portfolio-level analysis. Our double-sorted portfolio results verify that returns are more negative for stocks with greater liquidity sensitivity to market volatility when market volatility shocks are controlled. We group countries based on geographical regions[32] and show the average return differential between quintile portfolios of stocks with the highest (positive) liquidity shocks and stocks with the lowest (negative) liquidity shocks within a given region ranges from 0.80% to 6.02% per month, depending on the proxy to measure liquidity.

Using stock-level regressions for each market, we find the effects of market volatility shocks and stock liquidity shocks on stock returns remain intact after controlling for various stock and market characteristics, such as stock idiosyncratic volatility, size and market returns. We show the effects of liquidity shocks on returns are stronger than market volatility shocks. Moreover, our five-year subperiod regression results indicate the influence of the liquidity channel that links market volatility and stock returns is time-varying.

We also add to the literature on how market-specific characteristics influence the role of liquidity on the volatility-return relation. As noted in Nagel (2012) and Cespa and Foucault (2014), liquidity is more likely to evaporate in times of market turmoil. Beber and Pagano (2013) show the impact of short-selling bans on liquidity is more pronounced in markets that are overrepresented by small stocks. In Ma, Anderson, and Marshall (2016), liquidity reacts more to market uncertainty in more developed markets with more trade openness, better governance and no short selling constraints. This strand of literature

[32] Brockman, Chung, and Perignon (2009) use a similar approach.

suggests that the sensitivity of liquidity, and accordingly, the influence of the liquidity channel on returns could vary depending on various market characteristics across countries and over time. Following Chung and Chuwonganant (2017), we measure the indirect effect of volatility on returns through liquidity by computing the difference in monthly stock returns between stocks with liquidity shock values in the 75th and 25th percentiles, respectively, associated with a median market volatility shock. Overall, our results show country governance, as a proxy for investor protection, is a key factor that determines the impact of the liquidity channel through which volatility affects returns. A one standard deviation increase in our country governance measure, on average, increases the impact of volatility on monthly stock returns though the liquidity channel by 0.66% when we measure liquidity based on the Amihud (2002) ratio and by 1.03% for the closing percent quoted spread of Chung and Zhang (2014). Given the evidence that better country governance leads to higher liquidity (e.g. Chung Kim, Park, and Sung, 2012) and a positive relation between governance and institutional ownership (e.g. Chung and Zhang, 2011), our finding is consistent with previous research (e.g. Manconi, Massa, and Yasuda, 2012) showing institutional investors liquidate liquid securities first when it is too costly to sell illiquid assets. We also provide evidence that the influence of the liquidity channel is greater in markets with a higher level of market volatility, lower trading volume, and no short selling constraints. Moreover, we exploit changes in the institutional environment over time in subsets of countries, and show that market volatility exerts a stronger impact on stock returns through liquidity during financial crisis periods, when high frequency trading (HFT) is more active, and in the absence of market maker services. Our results are consistent with papers examining liquidity dry-ups during market turmoil, and studies suggesting that governance environment (e.g. Marshall,

Nguyen, Nguyen, and Visaltanacoti, 2016) and market fictions, such as short-sales constraints, influence price and market efficiency (e.g. Bris, Goetzmann, and Zhu, 2007).

The remainder of the paper is organised as follows. Section 4.2 describes the data and our sample selection criteria. In Section 4.3, we discuss the liquidity and shocks measures and provide summary statistics. Section 4.4 presents our empirical results. We conclude the paper in Section 4.5.

4.2 Data

Our sample consists of all common stocks listed in 41 markets over the period from January 1990 to April 2015.[33] The markets are divided into 25 developed markets and 16 emerging markets following the classification of Griffin, Kelly, and Nardari (2010). We further classify the developed and emerging markets based on their geographical regions. The developed markets group contains two American markets (N-America), seven Asia-Pacific markets (Asia-Pacific), and 16 European and Middle Eastern markets (European-ME). The emerging markets contain four Latin American markets (L-America), seven Asia-Pacific markets (Asia-Pacific), and five European, Middle Eastern and African markets (Europe-MEA).

We obtain the daily total return index (RI), stock prices (P and UP), shares outstanding (NOSH), trading volume (VO), closing bid price (PB) and ask price (PA), historic stock beta (897E), and price-to-book values (PTBV) for all countries, except for the United States, from Thomson Reuters Datastream, with US data sourced from the Centre for Research in Security Prices (CRSP). We collect stock data in US dollars to

[33] The initial sample includes all countries from Griffin, Kelly, and Nardari (2010) for which we can source data. In addition, we require the stock data of a country to satisfy the data screens discussed in Sections 4.2 and 4.3.

make our proxies and results comparable across countries (e.g. Fong, Holden, and Trzcinka, 2017). Following Amihud, Hameed, Kang, and Zhang (2015), we include only stocks traded in local currency and identified as equity and primary quotes on the main exchange(s) in each country. We use the generic and country-specific security name filters in Appendix B of Griffin, Kelly, and Nardari (2010) to eliminate non-common equity securities, such as preferred stocks and real estate investment trusts, for non-US markets. We use the leading stock exchange in each country, except for Japan, South Korea, and China, for which we use the Osaka Securities Exchange and Tokyo Stock Exchange, the Korea Stock Exchange and KOSDAQ, and the Shanghai Stock Exchange and Shenzhen Stock Exchange. For the United States, we follow Karolyi, Lee, and van Dijk (2012) and include common stocks on the New York Stock Exchange only, because trading volume reported on NASDAQ is double-counted and therefore overstated (Atkins and Dyl, 1997). We retain data on dead stocks to avoid survivorship bias.

We follow Ince and Porter (2006) to handle data errors in Datastream. In addition, we set the number of shares traded to missing if it is greater than total shares outstanding, and set daily dollar volume to missing if it is below US$100. We further exclude non-trading days, defined as days on which more than 90% of stocks in a market have zero returns.

4.3 Measures and summary statistics

4.3.1 Measuring liquidity

We use the Amihud (2002) ratio as our main liquidity measure, which captures price changes per dollar volume, as in the following equation. Following Karolyi, Lee,

and van Dijk (2012), we use logarithms to make the distribution of *ILLIQ* close to normal and reduce the influence of outliers for international markets:

$$ILLIQ_{i,t} = \frac{1}{N_{i,t}} \sum_{d=1}^{N_{i,t}} \log(1 + \frac{|r_{i,d,t}|}{vol_{i,d,t}}) \quad (1)$$

where $N_{i,t}$ is the number of trading days with a non-zero volume for stock *i* in month *t*; $|r_{i,d,t}|$ is the absolute value of the return in US dollars for stock *i* on day *d* in month *t*; and $vol_{i,d,t}$ is the trading volume in US dollars of stock *i* on day *d* in month *t*. We require each month to have at least 25 stocks with valid Amihud values for a given market.[34]

Fong, Holden, and Trzcinka (2017) show that the closing percent quoted spread of Chung and Zhang (2014) is the best low frequency liquidity proxy to capture changes in effective and quoted spread. Our second liquidity measure is therefore the closing percent quoted spread, calculated as follows:

$$SPREAD_{i,t} = \frac{1}{N_{i,t}} \sum_{d=1}^{N_{i,t}} \frac{Ask_{i,d,t} - Bid_{i,d,t}}{M_{i,d,t}} \quad (2)$$

where for stock *i*, $N_{i,t}$ is the number of trading days with valid closing spreads in month *t*; $Ask_{i,d}$ is the closing ask price on day *d*; $Bid_{i,d}$ is the closing bid price on day *d*; and $M_{i,d}$ is the mean of $Ask_{i,d}$ and $Bid_{i,d}$. When constructing monthly spread values, we exclude negative daily closing spreads, and closing spreads that are greater than 50% of the quote midpoint.

[34] We need sufficient numbers of stocks to construct portfolios, as described in Section 4.4.1. Similarly, we require a minimum of 25 stocks in a given month when computing the spread measure.

4.3.2 Measuring shocks

We follow Chung and Chuwonganant (2017) and measure market volatility and individual stock liquidity shocks as unexpected changes in market volatility and stock liquidity, respectively, as follows:

$$VOLASHOCK_t = (MKTVOLA_t - AVGVOLA_{t\text{-}12,\ t\text{-}1})/\ AVGVOLA_{t\text{-}12,\ t\text{-}1} \quad (3)$$

$$AMISHOCK_{i,t} = -(ILLIQ_{i,t} - AVGILLIQ_{i|t\text{-}12,t\text{-}1})/AVGILLIQ_{\ i|t\text{-}12,t\text{-}1} \quad (4)$$

$$SPRSHOCK_{i,t} = -(SPREAD_{i,t} - AVGSPR_{i|t\text{-}12,t\text{-}1})/AVGSPR_{i|t\text{-}12,t\text{-}1} \quad (5)$$

where $MKTVOLA_t$ is the standard deviation of daily value-weighted market returns in month t;[35] $AVGVOLA_{t\text{-}12,\ t\text{-}1}$ is the average of $MKTVOLA_t$ from months t -12 *to* t -1; $ILLIQ_{i,t}$ is the log-transformed Amihud ratio, *ILLIQ*, for stock i in month t; $AVGILLIQ_{i|t\text{-}12,t\text{-}1}$ is the average of *ILLIQ* for stock i from months t -12 to t - 1; $SPREAD_{i,t}$ is the closing percent quoted spread for stock i in month t; $AVGSPR_{i|t\text{-}12,t\text{-}1}$ is the average monthly spread value for stock i from months t - 12 to t - 1.

We require at least six months' data over the past 12 months to measure shocks in market volatility and stock liquidity (*VOLASHOCK*, *AMISHOCK*, and *SPRSHOCK*), and we drop the stock-month observations with the top and bottom 1% of *AMISHOCK* and *SPRSHOCK* values for each market. A positive *VOLASHOCK* value indicates an increase in market volatility (*MKTVOLA*) relative to its mean in the past 12 months. Positive *AMISHOCK* and *SPRSHOCK* values indicate an increase in stock liquidity (a

[35] Our monthly market volatility measure is realised market volatility, while Chung and Chuwonganant (2017) use the Chicago Board Options Exchange Volatility Index (VIX) for the US market. While VIX-like measures have been recently calculated for international markets, using realised market volatility allows us to capture more sample countries over a longer time span. The correlation between VIX and the US realised market volatility is as high as 0.8855 for our full sample period. We plot the monthly VIX and the US realised market volatility in Figure 4.1.

decrease in *ILLIQ* and *SPREAD*), since multiplication by -1 in *AMISHOCK* and *SPRSHOCK* converts the interpretation of illiquidity to liquidity.

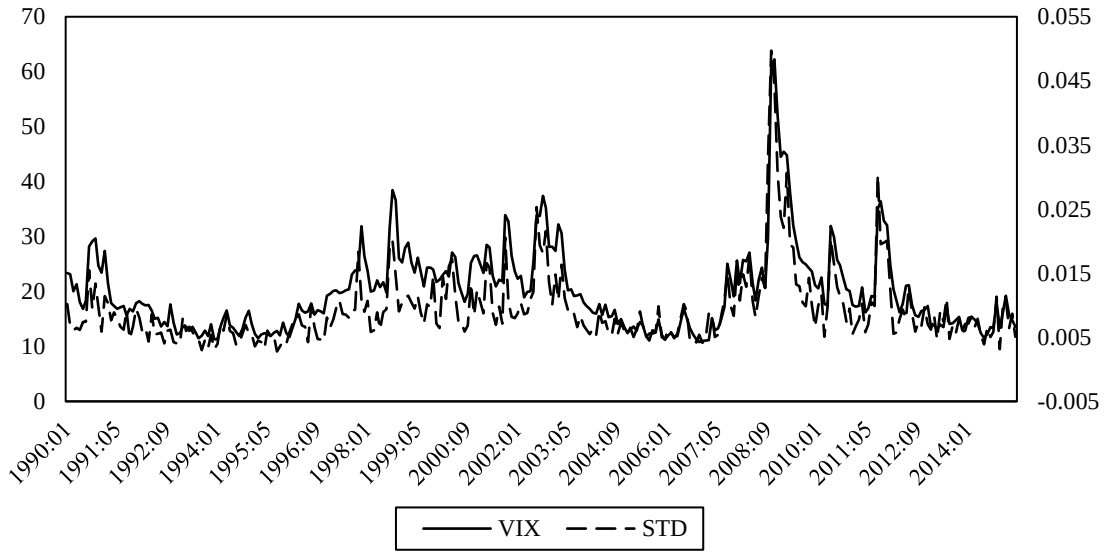


Figure 4.1: Monthly VIX and realised volatility levels
This figure presents the time series of monthly VIX levels, calculated as the average daily VIX level in a month, and the monthly realised market volatility, defined as the standard deviation of daily value-weighted market returns in a month.

Table 4.1 presents summary statistics for 37,677 unique stocks, 27,601 in developed markets and 10,076 in emerging markets, over the period 1990–2015. The number of stocks for each market is between 94 for Peru and 5,055 for the United States.[36] The mean (median) *VOLASHOCK*, *AMISHOCK*, and *SPRSHOCK* values for developed markets are 0.0184 (0.0208), -0.0018 (0.0021), and 0.0041 (0.0041), respectively, while the corresponding values for emerging markets are 0.0109 (0.0091), -0.0083 (-0.0126), and -0.0028 (-0.0044), suggesting stocks in developed markets on average experience

[36] We initially follow Lee (2011) in excluding any country with fewer than 100 stocks. To ensure that our core results can represent the full sample period, we also require each country to have at least 100 months with valid data. We include Peru to include as many countries as possible, whereas, for other countries dropped from our sample, the number of stocks is well under 100. The inclusion or exclusion of Peru however does not change the overall results.

Table 4.1: Summary statistics

This table presents summary statistics for 37,677 stocks listed in 41 markets over the period January 1990 to April 2015. The markets are divided into 25 developed markets and 16 emerging markets following the classification of Griffin, Kelly, and Nardari (2010). The first four columns present the geographic region, the starting month, the number of months with valid observations, and the number of unique stocks for each market. The next three columns present the average monthly market volatility shock and stock liquidity shock. Stock liquidity in a given month is measured by the Amihud (2002) ratio and the closing percent quoted spread from Chung and Zhang (2014). The final columns present the average monthly stock returns, prices in US dollars, trading values, and idiosyncratic volatility.

	Region	Starting month	No. of months	No. of unique stocks	VOLASHOCK	AMISHOCK	SPRSHOCK	Return	Price (US$)	Volume (US$ million)	Volatility
Panel A: Developed markets											
Australia	Asia-Pacific	1990:07	297	2331	0.0284	0.0078	-0.0184	0.0135	2.46	19.5839	0.0424
Hong Kong	Asia-Pacific	1990:07	298	1583	0.0085	-0.0060	0.0012	0.0199	1.55	33.3786	0.0321
Japan	Asia-Pacific	1990:07	298	3475	0.0079	0.0084	0.0490	0.0066	12.04	56.1454	0.0242
New Zealand	Asia-Pacific	2001:02	171	157	0.0006	0.0094	0.0059	0.0124	1.53	6.6681	0.0211
Singapore	Asia-Pacific	1999:10	187	696	-0.0054	-0.0425	-0.0073	0.0121	0.63	15.2142	0.0305
South Korea	Asia-Pacific	1990:07	298	2132	0.0009	0.0187	0.0190	0.0213	28.04	46.2710	0.0464
Taiwan	Asia-Pacific	1991:11	282	972	-0.0100	-0.0225	0.0074	0.0125	0.87	70.2952	0.0206
Austria	Europe-ME	1990:08	297	153	0.0068	-0.0248	0.0233	0.0063	39.69	31.4346	0.0179
Belgium	Europe-ME	1995:06	239	171	0.0322	0.0040	-0.0162	0.0082	60.25	41.4975	0.0196
Denmark	Europe-ME	1992:04	236	283	0.0408	0.0033	0.0222	0.0084	32.83	27.8286	0.0224
Finland	Europe-ME	1995:02	243	189	0.0104	0.0087	0.0287	0.0120	10.41	55.6415	0.0225
France	Europe-ME	1992:01	280	1227	0.0260	0.0050	0.0041	0.0099	38.60	83.4317	0.0241
Germany	Europe-ME	1990:08	269	989	0.0271	-0.0390	-0.0186	0.0048	24.12	3.5191	0.0329
Greece	Europe-ME	1990:07	297	375	0.0285	-0.0435	-0.0734	0.0068	6.27	9.7029	0.0277
Israel	Europe-ME	1993:08	261	460	0.0100	0.0008	0.0007	0.0147	14.65	6.4566	0.0229
Italy	Europe-ME	1994:06	149	395	0.0204	-0.0004	-0.0223	0.0062	8.65	132.8661	0.0198
Netherlands	Europe-ME	1990:07	298	241	0.0292	-0.0004	0.0055	0.0089	23.95	220.6272	0.0210
Norway	Europe-ME	1990:07	298	433	0.0342	-0.0063	-0.0014	0.0106	11.62	44.8422	0.0282
Portugal	Europe-ME	1994:04	253	106	0.0399	-0.0250	-0.0066	0.0077	5.36	33.6334	0.0197
Spain	Europe-ME	1990:08	297	237	0.0218	-0.0027	0.0005	0.0087	12.87	188.3816	0.0188
Sweden	Europe-ME	1990:07	298	755	0.0202	0.0196	0.0520	0.0122	7.75	51.5587	0.0287
Switzerland	Europe-ME	1990:11	294	363	0.0077	0.0229	0.0272	0.0121	199.71	157.7676	0.0184
United Kingdom	Europe-ME	1990:07	298	3162	0.0208	0.0021	0.0184	0.0094	4.15	77.3885	0.0238
Canada	N-America	1990:07	298	1661	0.0297	0.0227	-0.0335	0.0169	7.99	35.1410	0.0341
United States	N-America	1990:07	298	5055	0.0226	0.0360	0.0342	0.0121	20.61	395.9326	0.0242
Mean			269	1104	0.0184	-0.0018	0.0041	0.0110	23.07	73.8083	0.0257
Median			297	460	0.0208	0.0021	0.0041	0.0106	11.62	44.8422	0.0238

Table 4.1 (continued)

	Region	Starting month	No. of months	No. of unique stocks	VOLASHOCK	AMISHOCK	SPRSHOCK	Return	Price (US$)	Volume (US$ million)	Volatility
Panel B: Emerging markets											
China	Asia-Pacific	1993:06	262	2497	0.0068	0.0366	-0.0112	0.0197	1.12	179.9139	0.0211
India	Asia-Pacific	1995:12	233	2283	0.0112	-0.0115	-0.0189	0.0214	1.06	0.3009	0.0397
Malaysia	Asia-Pacific	1990:07	298	1072	0.0238	-0.0213	0.0066	0.0109	0.59	6.1278	0.0260
Pakistan	Asia-Pacific	1993:02	264	211	0.0024	0.0070	0.0141	0.0242	0.86	9.5540	0.0247
Philippines	Asia-Pacific	1990:08	297	272	0.0106	-0.0118	0.0267	0.0162	0.47	7.7260	0.0293
Sri Lanka	Asia-Pacific	1993:01	250	225	0.0180	-0.0066	-0.0363	0.0209	0.53	0.7638	0.0290
Thailand	Asia-Pacific	1990:07	298	697	0.0077	-0.0173	-0.0513	0.0152	0.72	18.1416	0.0246
Egypt	Europe-MEA	1997:06	213	142	0.0040	-0.0195	-0.0481	0.0138	3.78	10.6923	0.0218
Poland	Europe-MEA	1995:06	239	814	-0.0108	-0.0186	-0.0036	0.0091	6.71	5.2330	0.0313
Romania	Europe-MEA	1997:11	203	152	-0.0086	-0.0202	-0.0185	0.0151	0.66	1.0191	0.0331
South Africa	Europe-MEA	1995:08	237	651	0.0397	0.0004	0.0443	0.0082	2.95	26.3682	0.0289
Turkey	Europe-MEA	1992:02	277	377	0.0027	-0.0163	0.0149	0.0181	3.09	41.2122	0.0243
Brazil	L-America	1996:12	214	257	0.0313	-0.0101	0.0502	0.0139	8.26	91.8939	0.0265
Chile	L-America	1990:07	297	150	-0.0193	0.0079	-0.0052	0.0153	2.95	14.5197	0.0191
Mexico	L-America	1990:07	295	182	0.0419	-0.0176	0.0072	0.0169	1.98	35.0549	0.0215
Peru	L-America	1993:10	211	94	0.0135	-0.0134	-0.0163	0.0238	4.29	2.8379	0.0230
Mean			256	630	0.0109	-0.0083	-0.0028	0.0164	2.50	28.2099	0.0265
Median			256	265	0.0091	-0.0126	-0.0044	0.0157	1.55	10.1231	0.0254

increasing liquidity over our sample period. Developed market stocks also exhibit lower returns and idiosyncratic volatility, and higher prices and trading value.

4.4 Results

4.4.1 Univariate and bivariate portfolio analysis

We first show the effects of market volatility shocks on individual stock returns and liquidity using univariate portfolio sorts. For each market, we sort stocks on market volatility shocks (VOLASHOCK) in each month into five portfolios. We then calculate the average return (*RETURN*) and liquidity shocks (*AMISHOCK* and *SPRSHOCK*) for each portfolio. In Table 4.2, we present the cross-market means of portfolio returns and liquidity shocks within each region. We show, across the six geographical regions, the average monthly portfolio returns decrease with the increase in market volatility. For example, in the Europe-ME region, the average monthly return declines from 2.60% for the lowest volatility shock portfolio to -2.29% for the highest volatility shock portfolio, the difference of 4.88% indicating an economically meaningful return difference. The return differences between the highest and lowest volatility shock portfolios are statistically significant in all 25 (25) developed markets, and 11 (10) out of 16 emerging markets in our sample at the 0.10 (0.05) level. Both measures of liquidity shock show that the liquidity of higher volatility shock portfolios is significantly lower. Overall, developed market returns and liquidity react more to market volatility shocks.

In Figure 4.2, we depict the average monthly portfolio returns, *AMISHOCK*, and *SPRSHOCK* across *VOLASHOCK* quintiles for all sample countries, and for developed

Table 4.2: Monthly portfolio returns and liquidity for volatility shock quintiles

For each market, we sort stocks into five portfolios based on market volatility shocks (*VOLASHOCK*) in each month. We then calculate the average stock returns and liquidity shocks (*AMISHOCK* and *SPRSHOCK*) for each portfolio. This table presents the cross-market means (within each region) of the portfolio returns and liquidity shocks. In the final two columns, we report the percentage of markets for which High-Low is negative and significant at the 0.10 and 0.05 levels, respectively.

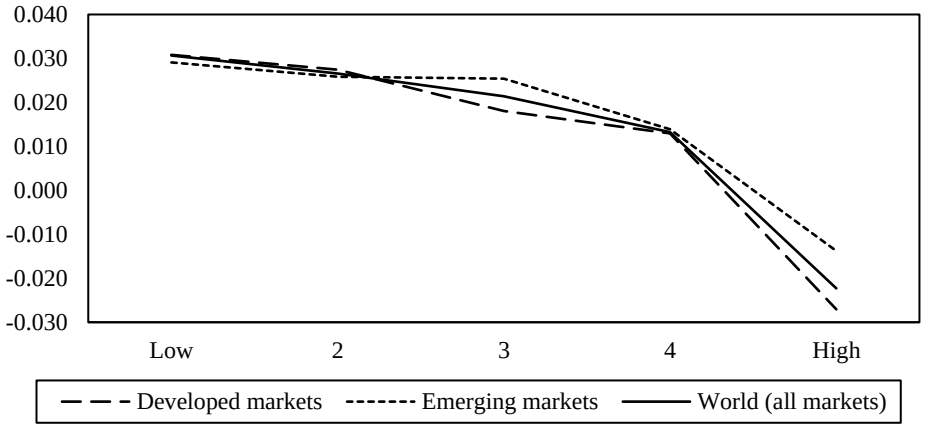
Panel A: Developed markets

	VOLASHOCK							
	Low	2	3	4	High	High-Low	% Negative significant at 0.10 level	% Negative significant at 0.05 level
Panel A1: Asia-Pacific								
RETURN	0.0288	0.0312	0.0183	0.0163	-0.0273	-0.0562	100.00%	100.00%
AMISHOCK	0.0959	0.0567	0.0179	-0.0345	-0.1649	-0.2608	100.00%	100.00%
SPRSHOCK	0.0986	0.0627	0.0168	-0.0263	-0.1442	-0.2429	100.00%	100.00%
Panel A2: Europe-ME								
RETURN	0.0260	0.0179	0.0162	0.0070	-0.0229	-0.0488	100.00%	100.00%
AMISHOCK	0.0817	0.0355	0.0154	-0.0232	-0.1365	-0.2182	100.00%	100.00%
SPRSHOCK	0.0967	0.0507	0.0136	-0.0502	-0.2118	-0.3085	100.00%	100.00%
Panel A3: N-America								
RETURN	0.0377	0.0331	0.0197	0.0157	-0.0309	-0.0686	100.00%	100.00%
AMISHOCK	0.1254	0.0631	0.0403	0.0009	-0.1069	-0.2323	100.00%	100.00%
SPRSHOCK	0.1928	0.0546	0.0314	-0.0466	-0.2332	-0.4260	100.00%	100.00%

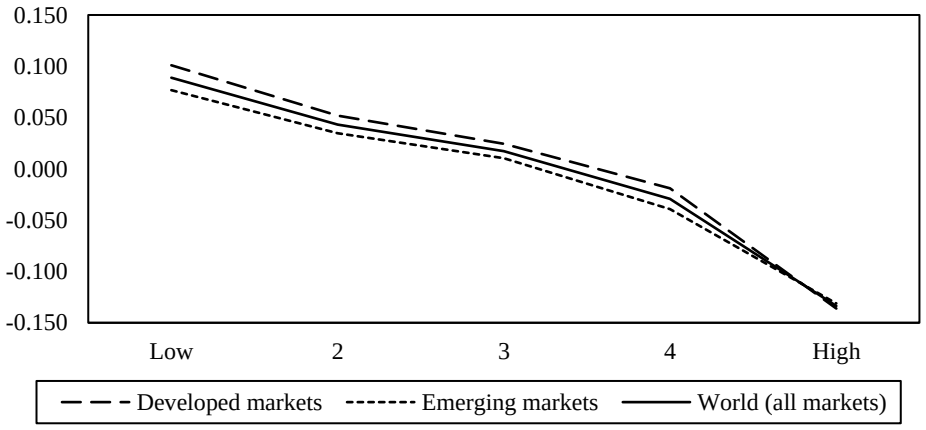
Table 4.2 (continued)

Panel B: Emerging markets

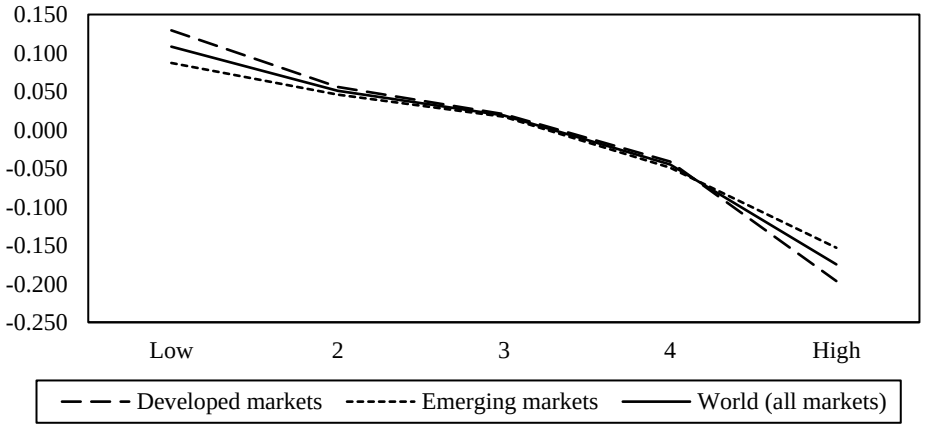
	VOLASHOCK							
	Low	2	3	4	High	High-Low	% Negative significant at 0.10 level	% Negative significant at 0.05 level
Panel B1: Asia-Pacific								
RETURN	0.0276	0.0255	0.0211	0.0160	-0.0015	-0.0291	57.14%	42.86%
AMISHOCK	0.0583	0.0190	0.0089	-0.0355	-0.1136	-0.1718	100.00%	85.71%
SPRSHOCK	0.0836	0.0226	0.0165	-0.0476	-0.1223	-0.2059	100.00%	100.00%
Panel B2: Europe-MEA								
RETURN	0.0333	0.0252	0.0318	0.0111	-0.0288	-0.0621	100.00%	100.00%
AMISHOCK	0.0664	0.0265	0.0162	-0.0313	-0.1245	-0.1909	100.00%	100.00%
SPRSHOCK	0.0834	0.0524	-0.0022	-0.0136	-0.1411	-0.2244	100.00%	100.00%
Panel B3: L-America								
RETURN	0.0264	0.0268	0.0234	0.0146	-0.0110	-0.0374	50.00%	50.00%
AMISHOCK	0.1055	0.0585	0.0057	-0.0513	-0.1553	-0.2608	100.00%	100.00%
SPRSHOCK	0.0942	0.0620	0.0366	-0.0856	-0.1959	-0.2901	100.00%	75.00%



(a) *RETURN*



(b) *AMISHOCK*



(c) *SPRSHOCK*

Figure 4.2: Monthly returns and liquidity shocks across *VOLASHOCK* quintiles
For each market, we sort stocks on market volatility shocks in each month into five portfolios and then calculate the average return (*RETURN*) and liquidity shocks (*AMISHOCK* and *SPRSHOCK*) for each portfolio. This figure presents the average monthly portfolio returns, *AMISHOCK*, and *SPRSHOCK* across *VOLASHOCK* quintiles for all sample countries, and for developed and emerging markets.

and emerging markets. Both stock returns and liquidity decrease more in the highest *VOLASHOCK* quintile compared to the other four quintiles, suggesting the effects of volatility on returns is likely to be stronger during periods of extreme uncertainty.

We next examine whether the impact of market volatility on stock returns is stronger for stocks with greater liquidity sensitivity to market volatility shocks. We perform conditional bivariate sorts on market volatility shock and stock liquidity shock by sorting the stocks in each *VOLASHOCK* quintile into five portfolios, based on the liquidity shocks of individual stocks in each month. We then calculate the mean returns of the 25 portfolios double-sorted on volatility and liquidity shocks. Table 4.3 reports the cross-market means within each region for the 25 portfolio returns, with liquidity shock measured by *AMISHOCK*. Consistent with the US evidence in Chung and Chuwonganant (2017), our international results indicate that returns are lower for stocks with more negative liquidity shocks, when controlling for market volatility shocks. We also report the percentage of markets within a region for which the return differential between portfolios of stocks with the highest liquidity shocks (Quintile 5) and stocks with the lowest liquidity shocks (Quintile 1) is positive and significant at the 0.10 and 0.05 levels, respectively. For instance, according to the Europe-ME results in Panel A2, within each VOLASHOCK quintile, the raw return difference between the highest and lowest AMISHOCK quintiles, ranging from 5.23% to 6.01%, is consistently significant at the 0.05 level for all European and Middle Eastern markets. Table 4.4 presents similar results when we measure liquidity by the closing spread. Consistent with our univariate portfolio analysis in Table 4.2, we find more significant results for developed markets.

Table 4.3: Monthly returns for liquidity shock portfolios within each volatility shock quintile: *AMISHOCK*

For each market, we first sort stocks on monthly market volatility shocks (*VOLASHOCK*) into five portfolios. We then sort the stocks in each market volatility quintile into five portfolios based on their liquidity shocks (*AMISHOCK*), and calculate the mean returns for the 25 portfolios. This table presents the cross-market means (within each region) for the 25 portfolio returns. The High-Low section shows, the percentages of markets for which High-Low is positive and significant at the 0.10 and 0.05 levels, respectively.

Panel A: Developed markets

	VOLASHOCK					
	Low	2	3	4	High	Average
Panel A1: Asia-Pacific						
Low	0.0097	0.0100	-0.0050	-0.0056	-0.0549	-0.0091
2	0.0174	0.0167	0.0047	0.0038	-0.0442	-0.0003
3	0.0265	0.0261	0.0149	0.0139	-0.0347	0.0094
4	0.0387	0.0396	0.0260	0.0262	-0.0207	0.0220
High	0.0548	0.0571	0.0451	0.0469	0.0051	0.0418
Average	0.0295	0.0299	0.0172	0.0170	-0.0299	
High-Low	0.0451	0.0471	0.0501	0.0525	0.0600	
% Positive Significant at 0.10	85.71%	85.71%	85.71%	85.71%	85.71%	
% Positive Significant at 0.05	85.71%	85.71%	85.71%	85.71%	71.43%	
Panel A2: Europe-ME						
Low	0.0021	-0.0094	-0.0078	-0.0189	-0.0520	-0.0172
2	0.0136	0.0061	0.0036	-0.0060	-0.0418	-0.0049
3	0.0275	0.0174	0.0154	0.0036	-0.0302	0.0067
4	0.0380	0.0315	0.0274	0.0150	-0.0168	0.0190
High	0.0544	0.0481	0.0463	0.0349	0.0081	0.0384
Average	0.0271	0.0187	0.0170	0.0057	-0.0265	
High-Low	0.0523	0.0575	0.0541	0.0538	0.0601	
% Positive Significant at 0.10	100.00%	100.00%	100.00%	100.00%	100.00%	
% Positive Significant at 0.05	100.00%	100.00%	100.00%	100.00%	100.00%	
Panel A3: N-America						
Low	0.0113	0.0027	-0.0103	-0.0135	-0.0480	-0.0116
2	0.0217	0.0161	0.0009	-0.0005	-0.0409	-0.0005
3	0.0330	0.0225	0.0134	0.0097	-0.0331	0.0091
4	0.0405	0.0383	0.0251	0.0264	-0.0199	0.0221
High	0.0562	0.0592	0.0476	0.0464	-0.0012	0.0416
Average	0.0325	0.0277	0.0153	0.0137	-0.0286	
High-Low	0.0450	0.0565	0.0579	0.0599	0.0468	
% Positive Significant at 0.10	100.00%	100.00%	100.00%	100.00%	100.00%	
% Positive Significant at 0.05	100.00%	100.00%	100.00%	100.00%	100.00%	

Table 4.3 (continued)

Panel B: Emerging markets

	VOLASHOCK					
	Low	2	3	4	High	Average
Panel B1: Asia-Pacific						
Low	0.0026	0.0003	-0.0025	-0.0085	-0.0292	-0.0075
2	0.0114	0.0125	0.0077	-0.0007	-0.0219	0.0018
3	0.0255	0.0229	0.0191	0.0133	-0.0079	0.0146
4	0.0377	0.0371	0.0355	0.0260	0.0013	0.0275
High	0.0578	0.0569	0.0521	0.0528	0.0248	0.0489
Average	0.0270	0.0259	0.0224	0.0166	-0.0066	
High-Low	0.0552	0.0567	0.0546	0.0612	0.0540	
% Positive Significant at 0.10	100.00%	100.00%	85.71%	85.71%	85.71%	
% Positive Significant at 0.05	100.00%	100.00%	71.43%	71.43%	42.86%	
Panel B2: Europe-MEA						
Low	0.0027	-0.0032	0.0084	-0.0201	-0.0598	-0.0144
2	0.0206	0.0134	0.0227	-0.0082	-0.0456	0.0006
3	0.0337	0.0307	0.0319	0.0087	-0.0312	0.0148
4	0.0458	0.0408	0.0455	0.0241	-0.0173	0.0278
High	0.0621	0.0539	0.0651	0.0454	0.0026	0.0458
Average	0.0330	0.0271	0.0347	0.0100	-0.0303	
High-Low	0.0594	0.0571	0.0567	0.0656	0.0625	
% Positive Significant at 0.10	100.00%	100.00%	100.00%	100.00%	40.00%	
% Positive Significant at 0.05	100.00%	100.00%	100.00%	100.00%	40.00%	
Panel B3: L-America						
Low	0.0161	0.0152	0.0142	0.0086	-0.0383	0.0032
2	0.0304	0.0303	0.0219	0.0113	-0.0324	0.0123
3	0.0369	0.0336	0.0282	0.0194	-0.0245	0.0187
4	0.0442	0.0423	0.0354	0.0308	-0.0118	0.0282
High	0.0534	0.0486	0.0425	0.0438	-0.0042	0.0368
Average	0.0362	0.0340	0.0284	0.0228	-0.0222	
High-Low	0.0373	0.0334	0.0283	0.0353	0.0341	
% Positive Significant at 0.10	75.00%	75.00%	50.00%	75.00%	25.00%	
% Positive Significant at 0.05	75.00%	50.00%	50.00%	25.00%	25.00%	

Table 4.4: Monthly returns for liquidity shock portfolios within each volatility shock quintile: *SPRSHOCK*

For each market, we first sort stocks on monthly market volatility shocks (*VOLASHOCK*) into five portfolios. We then sort the stocks in each market volatility quintile into five portfolios based on their liquidity shocks (*SPRSHOCK*), and calculate the mean returns for the 25 portfolios. This table presents the cross-market means (within each region) for the 25 portfolio returns. In the High-Low section, we report the percentages of markets for which High-Low is positive and significant at the 0.10 and 0.05 levels, respectively.

Panel A: Developed markets

	VOLASHOCK					
	Low	2	3	4	High	Average
Panel A1: Asia-Pacific						
Low	0.0209	0.0140	0.0065	0.0054	-0.0478	-0.0002
2	0.0286	0.0210	0.0156	0.0135	-0.0413	0.0075
3	0.0354	0.0290	0.0210	0.0182	-0.0361	0.0135
4	0.0417	0.0342	0.0265	0.0263	-0.0300	0.0197
High	0.0502	0.0404	0.0388	0.0336	-0.0177	0.0291
Average	0.0354	0.0277	0.0217	0.0194	-0.0346	
High-Low	0.0292	0.0264	0.0323	0.0282	0.0302	
% Positive Significant at 0.10	42.86%	42.86%	42.86%	42.86%	28.57%	
% Positive Significant at 0.05	42.86%	42.86%	42.86%	28.57%	14.29%	
Panel A2: Europe-ME						
Low	0.0191	0.0052	0.0037	-0.0070	-0.0413	-0.0041
2	0.0241	0.0148	0.0119	-0.0003	-0.0329	0.0035
3	0.0291	0.0201	0.0161	0.0040	-0.0279	0.0083
4	0.0349	0.0256	0.0237	0.0110	-0.0208	0.0149
High	0.0414	0.0332	0.0299	0.0192	-0.0105	0.0226
Average	0.0297	0.0198	0.0171	0.0054	-0.0267	
High-Low	0.0223	0.0280	0.0262	0.0261	0.0309	
% Positive Significant at 0.10	50.00%	68.75%	62.50%	56.25%	56.25%	
% Positive Significant at 0.05	50.00%	62.50%	43.75%	50.00%	37.50%	
Panel A3: N-America						
Low	0.0229	0.0105	0.0082	-0.0105	-0.0703	-0.0079
2	0.0305	0.0178	0.0141	-0.0027	-0.0528	0.0014
3	0.0352	0.0233	0.0227	0.0050	-0.0408	0.0091
4	0.0404	0.0292	0.0251	0.0118	-0.0361	0.0141
High	0.0505	0.0426	0.0366	0.0265	-0.0218	0.0269
Average	0.0359	0.0247	0.0213	0.0060	-0.0444	
High-Low	0.0276	0.0322	0.0284	0.0370	0.0485	
% Positive Significant at 0.10	100%	100%	50%	100%	100%	
% Positive Significant at 0.05	100%	100%	50%	100%	100%	

Table 4.4 (continued)

Panel B: Emerging markets

	VOLASHOCK					
	Low	2	3	4	High	Average
Panel B1: Asia-Pacific						
Low	0.0205	0.0224	0.0147	0.0054	-0.0163	0.0093
2	0.0255	0.0224	0.0143	0.0051	-0.0142	0.0106
3	0.0252	0.0296	0.0221	0.0088	-0.0098	0.0152
4	0.0339	0.0323	0.0284	0.0171	-0.0037	0.0216
High	0.0304	0.0341	0.0275	0.0143	-0.0069	0.0199
Average	0.0271	0.0282	0.0214	0.0101	-0.0102	
High-Low	0.0099	0.0117	0.0128	0.0089	0.0094	
% Positive Significant at 0.10	14.29%	28.57%	28.57%	14.29%	0.00%	
% Positive Significant at 0.05	0.00%	28.57%	28.57%	14.29%	0.00%	
Panel B2: Europe-MEA						
Low	0.0374	0.0287	0.0242	0.0122	-0.0477	0.0110
2	0.0333	0.0330	0.0312	0.0054	-0.0470	0.0112
3	0.0373	0.0362	0.0312	0.0083	-0.0458	0.0134
4	0.0373	0.0373	0.0310	0.0133	-0.0404	0.0157
High	0.0403	0.0335	0.0368	0.0177	-0.0336	0.0190
Average	0.0371	0.0338	0.0309	0.0114	-0.0429	
High-Low	0.0029	0.0048	0.0126	0.0055	0.0141	
% Positive Significant at 0.10	20.00%	0.00%	0.00%	40.00%	0.00%	
% Positive Significant at 0.05	0.00%	0.00%	0.00%	20.00%	0.00%	
Panel B3: L-America						
Low	0.0265	0.0226	0.0131	0.0021	-0.0422	0.0044
2	0.0294	0.0202	0.0203	-0.0021	-0.0321	0.0071
3	0.0378	0.0207	0.0218	0.0076	-0.0326	0.0110
4	0.0394	0.0284	0.0247	0.0099	-0.0299	0.0145
High	0.0394	0.0372	0.0269	0.0128	-0.0250	0.0183
Average	0.0345	0.0258	0.0214	0.0061	-0.0324	
High-Low	0.0129	0.0146	0.0138	0.0107	0.0172	
% Positive Significant at 0.10	0.00%	0.00%	0.00%	0.00%	0.00%	
% Positive Significant at 0.05	0.00%	0.00%	0.00%	0.00%	0.00%	

4.4.2 Multivariate regression models and results

In addition to the portfolio-level analysis, we examine the effects of volatility and liquidity shocks on stock-level returns, to determine whether the impact of market volatility and liquidity shocks on stock returns remains intact after controlling for other stock and market characteristics. Following the model specification of Chung and Chuwonganant (2017), we run the following regression to examine the effects of volatility and liquidity shocks on stock returns for each market:

$$\begin{aligned} RETURN_{i,t} &= \beta_0 + \beta_1 VOLASHOCK_t + \beta_2 (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \\ &+ \beta_3 VOLASHOCK_t \times (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \\ &+ \beta_4 IVOSHOCK_{i,t} + \beta_5 DVOLSHOCK_{i,t} + \beta_6 MKTRET_t \\ &+ \beta_7 (MKTAMISHOCK_t \text{ or } MKTSPRSHOCK_t) + \beta_8 BETA_{i,t} \\ &+ \beta_9 \log(SMKTCAP_{i,t}) + \beta_{10} MAXRET_{i,t} + \beta_{11} REVISE_{i,t} \\ &+ \beta_{12} MOMENT_{i,t} + \beta_{13} STDTO_{i,t} + \beta_{14} BVTOPRI_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (6)$$

where $RETURN_{i,t}$ is the raw monthly return of stock i in month t; $IVOSHOCK_{i,t}$ and $DVOLSHOCK_{i,t}$ are, respectively, shocks in idiosyncratic volatility, estimated from the market model as in Bali and Cakici (2008), and the dollar trading volume of stock i in month t; $MKTRET_t$ is the value-weighted market return in month t; $MKTAMISHOCK_t$ and $MKTSPRSHOCK_t$ are market liquidity shocks in month t; $BETA_{i,t}$ is the stock beta of stock i in month t; $SMKTCAP_{i,t}$ is the market capitalisation in million dollars of stock i in month t; $MAXRET_{i,t}$ is the maximum daily return for stock i in month t - 1; $REVISE_{i,t}$ is the return for stock i in month t - 1; $MOMENT_{i,t}$ is the cumulative return of stock i over months t - 12 to t - 2; $STDTO_{i,t}$ is the standard deviation of the monthly turnover over the past 12 months for stock i in month t; and $BVTOPRI_{i,t}$ is the ratio of the book value to

price for stock *i* in month *t*.[37] Standard errors are clustered by both stock and month as suggested in Petersen (2009). More detailed description of the variables and data sources are given in Panel A of Appendix C.1.

Tables 4.5 and 4.6 report regression results based on *AMISHOCK* and *SPRSHOCK*, respectively. We show that when other stock and market characteristics are controlled for, stock liquidity shocks exert a stronger impact on stock returns than market volatility shocks do across international markets. We find positively significant coefficients for the interaction term between volatility and liquidity shocks for a number of countries, such as South Korea, Denmark, and France, suggesting the effects of market volatility are greater for stocks with a larger negative contemporaneous liquidity shock in these countries. However, the interaction term is not consistently significant across markets. Overall, we find market volatility exerts a stronger impact on stocks with larger liquidity shocks in the great majority of global markets. Our results are unlikely to be driven by reverse causality from returns to volatility, because our volatility measure measures shocks in aggregate market volatility. The causal direction is more likely from aggregate market volatility to stock returns rather than from stock returns to aggregate volatility (e.g. Ang, Hodrick, Xing, and Zhang, 2006).

[37] Five emerging countries (India, Egypt, Poland, Romania, and Mexico) have insufficient data for the variable *BVTOPRI*, so we exclude it from the regressions for these countries. The book-to-market ratios are not available from the CRSP; we therefore exclude this variable from the regression for the United States.

Table 4.5: Regression Results: *AMISHOCK*

This table presents the panel regression results according to Equation (6) based on *AMISHOCK* over the full sample period for each country. Standard errors are clustered by country and month. We report the coefficients for only the key variables for brevity. The controls represent other stock-level return determinants in the regression. *t*-Statistics are in parentheses. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

Panel A: Developed markets

	VOLASHOCK	*AMISHOCK*	*VOLASHOCK* × *AMISHOCK*	*IVOSHOCK*	*DVOLSHOCK*	*MKTRET*	*MKTAMISHOCK*	Controls	Obs	R^2
Panel A1: Asia-Pacific										
Australia	-0.0287***	0.1307***	0.0028	0.0727***	0.0149***	1.1086***	-0.0420	YES	184190	0.2776
	(-3.03)	(18.49)	(0.18)	(12.64)	(12.11)	(23.40)	(-1.51)	YES		
Hong Kong	-0.0139	0.0670***	0.0140	0.0897***	0.0092***	0.9187***	0.0462**	YES	163460	0.3206
	(-1.51)	(15.41)	(0.94)	(14.67)	(10.00)	(13.28)	(2.37)	YES		
Japan	-0.0221***	0.0385***	-0.0053	0.0495***	0.0077***	0.9643***	-0.0137	YES	601293	0.3030
	(-4.16)	(16.39)	(-0.87)	(10.86)	(12.69)	(22.99)	(-1.03)	YES		
New Zealand	-0.007	0.0596***	-0.0134	0.0161*	0.0026*	1.0014***	-0.0247	YES	11766	0.2473
	(-1.20)	(6.80)	(-1.08)	(1.83)	(1.84)	(18.86)	(-1.54)	YES		
Singapore	-0.0078	0.0612***	0.0123	0.0437***	0.0069***	1.1070***	0.0074	YES	61425	0.3771
	(-1.19)	(14.46)	(1.30)	(7.59)	(9.09)	(21.82)	(0.48)	YES		
South Korea	-0.0120	0.0213***	0.0174***	0.0647***	0.0154***	0.8441***	0.0329	YES	233459	0.2826
	(-1.48)	(6.49)	(4.77)	(10.47)	(12.77)	(19.16)	(1.54)	YES		
Taiwan	-0.0193***	0.0407***	-0.0071	0.0480***	0.0190***	0.9413***	-0.0215**	YES	137000	0.4368
	(-3.24)	(9.90)	(-1.07)	(8.31)	(7.58)	(23.82)	(-2.27)	YES		
Panel A2: Europe-ME										
Austria	-0.0026	0.0308***	0.0067	0.0062	0.0221***	0.8388***	-0.0200**	YES	14229	0.2985
	(-0.56)	(4.85)	(0.58)	(0.97)	(8.27)	(19.61)	(-2.02)	YES		
Belgium	-0.0126**	0.0590***	0.0146	0.0259***	0.0145***	0.8024***	-0.0203**	YES	18127	0.3061
	(-2.52)	(5.98)	(1.59)	(4.35)	(3.24)	(18.84)	(-2.53)	YES		
Denmark	-0.0207***	0.0733***	0.0207*	0.0352***	0.0102***	0.7643***	-0.0340**	YES	27133	0.2317
	(-4.21)	(10.36)	(1.95)	(6.60)	(4.89)	(16.53)	(-2.39)	YES		
Finland	-0.0340***	0.0661***	-0.0078	0.0449***	0.0028***	0.5176***	-0.0101	YES	22141	0.2340
	(-4.86)	(9.26)	(-0.50)	(5.76)	(3.91)	(11.03)	(-1.07)	YES		
France	-0.0249***	0.1049***	0.0254*	0.0587***	0.0012	0.8191***	-0.0148	YES	117942	0.2256
	(-4.99)	(17.34)	(1.73)	(10.48)	(1.54)	(20.90)	(-1.34)	YES		
Germany	-0.0198***	0.1032***	0.0036	0.0453***	0.0158***	0.8942***	-0.0308**	YES	86435	0.2020
	(-3.01)	(7.20)	(0.16)	(6.14)	(3.95)	(17.65)	(-1.96)	YES		

Greece	-0.0222***	0.1332***	-0.0052	0.0667***	0.0045**	0.9534***	-0.0522***	YES	49937	0.3755
	(-2.62)	(13.81)	(-0.24)	(8.38)	(2.10)	(18.95)	(-3.44)	YES		
Israel	-0.0063	0.0740***	0.0174	0.0492***	0.0111***	0.9261***	-0.0239	YES	35432	0.2828
	(-0.79)	(7.41)	(1.08)	(4.81)	(7.94)	(23.24)	(-0.60)	YES		
Italy	-0.0209***	0.0361***	-0.0004	0.0441***	0.0120***	0.8709***	-0.0190*	YES	34086	0.3996
	(-3.02)	(7.36)	(-0.05)	(6.29)	(6.50)	(22.26)	(-1.67)	YES		
Netherlands	-0.0043	0.0396***	-0.0033	0.0049	0.0183***	0.8452***	-0.0071	YES	31638	0.2348
	(-0.89)	(9.18)	(-0.41)	(0.88)	(9.58)	(19.01)	(-0.89)	YES		
Norway	-0.0099*	0.0741***	0.0154	0.0400***	0.0099***	0.8725***	-0.0006	YES	33307	0.2717
	(-1.85)	(8.13)	(1.33)	(5.84)	(2.94)	(27.47)	(-0.04)	YES		
Portugal	-0.0253***	0.0760***	0.0026	0.0612***	0.0026*	0.8067***	-0.0394***	YES	9826	0.2958
	(-4.21)	(10.04)	(0.26)	(5.53)	(1.70)	(15.73)	(-3.70)	YES		
Spain	-0.0092*	0.0457***	0.0046	0.0381***	0.0138***	0.8216***	-0.0172	YES	31197	0.3371
	(-1.75)	(7.45)	(0.77)	(6.78)	(4.25)	(21.08)	(-1.36)	YES		
Sweden	-0.0221***	0.0894***	-0.0053	0.0637***	0.0075***	0.8402***	-0.0245*	YES	74119	0.2528
	(-3.97)	(13.41)	(-0.47)	(10.49)	(5.15)	(22.39)	(-1.65)	YES		
Switzerland	-0.0196***	0.0432***	0.0151	0.0188**	0.0155**	0.8175***	-0.0114	YES	45717	0.2512
	(-4.10)	(3.03)	(1.25)	(2.32)	(2.08)	(18.81)	(-0.96)	YES		
United Kingdom	-0.0156***	0.0834***	0.0163*	0.0292***	0.0133***	0.9066***	-0.0039	YES	246986	0.1892
	(-2.94)	(16.39)	(1.68)	(8.29)	(6.15)	(14.67)	(-0.27)	YES		
Panel A3: N-America										
Canada	-0.0259***	0.0898***	0.0107	0.0460***	0.0197***	1.0517***	-0.0572*	YES	164684	0.2512
	(-3.97)	(13.72)	(0.79)	(9.34)	(10.61)	(24.28)	(-1.94)	YES		
United States	-0.0108***	0.0179***	-0.0001	0.0085***	0.0113***	0.9730***	0.0317**	YES	421552	0.1046
	(-3.03)	(5.67)	(-0.02)	(3.52)	(5.69)	(19.45)	(2.37)	YES		

Panel B: Emerging markets										
	VOLASHOCK	*AMISHOCK*	*VOLASHOCK × AMISHOCK*	*IVOSHOCK*	*DVOLSHOCK*	*MKTRET*	*MKTAMISHOCK*	Controls	Obs	R^2
Panel B1: Asia-Pacific										
China	-0.0251	0.0211***	-0.0051	0.0239***	0.0314***	0.8582***	0.0004	YES	261730	0.4574
	(-1.47)	(3.81)	(-0.34)	(3.79)	(10.93)	(13.59)	(0.03)	YES		
India	0.0081	0.1519***	0.0023	0.0933***	0.0064	1.3011***	-0.0831***	YES	129218	0.3141
	(0.68)	(6.32)	(0.09)	(10.37)	(1.55)	(18.57)	(-2.74)	YES		

Malaysia	-0.0067	0.0686***	0.0023	0.0478***	0.0052***	1.1693***	-0.0515***	YES	143940	0.4556
	(-1.46)	(17.05)	(0.28)	(11.18)	(9.11)	(19.03)	(-3.45)	YES		
Pakistan	-0.0245***	0.0428***	-0.0004	0.0758***	0.0088**	0.9476***	-0.0083	YES	21425	0.3553
	(-4.57)	(4.19)	(-0.05)	(8.51)	(2.55)	(18.97)	(-0.57)	YES		
Philippines	-0.0070	0.0896***	0.0022	0.0877***	0.0041*	1.2188***	-0.0528***	YES	23916	0.3749
	(-1.06)	(9.61)	(0.25)	(7.96)	(1.78)	(14.89)	(-3.02)	YES		
Sri Lanka	-0.0300***	0.1002***	-0.0111	0.0977***	0.0060***	1.1332***	-0.0968***	YES	17895	0.4645
	(-6.31)	(9.48)	(-0.88)	(9.25)	(3.28)	(16.52)	(-4.97)	YES		
Thailand	-0.0055	0.0526***	0.0231**	0.0621***	0.0040***	0.9123***	-0.0085	YES	72655	0.3466
	(-0.87)	(12.17)	(2.39)	(12.10)	(4.85)	(15.33)	(-0.56)	YES		
Panel B2: Europe-MEA										
Egypt	-0.0185**	0.0567***	0.0054	0.0590***	0.0091***	0.9559***	-0.0352*	YES	15914	0.3275
	(-2.18)	(7.85)	(0.36)	(6.24)	(4.15)	(15.83)	(-1.94)	YES		
Poland	-0.0158	0.1266***	-0.0042	0.0520***	0.0117***	0.8465***	-0.0483*	YES	48785	0.2781
	(-1.47)	(10.05)	(-0.27)	(6.25)	(3.65)	(19.10)	(-1.68)	YES		
Romania	-0.0378***	0.2133***	-0.0027	0.0647***	0.0002	0.6789***	-0.0221	YES	6501	0.2936
	(-3.37)	(8.78)	(-0.08)	(5.05)	(0.49)	(15.31)	(-0.94)	YES		
South Africa	-0.0034	0.0750***	0.0152*	0.0278***	0.0091***	0.8661***	-0.0064	YES	46012	0.2514
	(-0.98)	(11.72)	(1.66)	(6.64)	(7.15)	(38.37)	(-0.44)	YES		
Turkey	-0.0305***	0.0254***	0.0008	0.0815***	0.0206***	0.8358***	-0.0003	YES	49251	0.5025
	(-3.64)	(3.21)	(0.07)	(12.42)	(4.79)	(32.31)	(-0.02)	YES		
Panel B3: L-America										
Brazil	-0.0276***	0.0784***	-0.0013	0.0710***	0.0006	0.8136***	0.0167	YES	19544	0.323
	(-3.10)	(10.27)	(-0.10)	(5.97)	(0.81)	(12.58)	(0.86)	YES		
Chile	-0.0233***	0.0312***	0.0026	0.0475***	0.0007	0.8963***	-0.0138	YES	15214	0.3197
	(-3.17)	(6.98)	(0.47)	(5.41)	(1.43)	(14.78)	(-1.01)	YES		
Mexico	-0.0115*	0.0779***	0.0044	0.0541***	0.0031**	0.6346***	0.0056	YES	12773	0.2841
	(-1.78)	(9.68)	(0.35)	(5.53)	(2.46)	(5.23)	(0.28)	YES		
Peru	0.0074	0.0904***	0.0166	0.0503***	0.0065**	1.4625***	-0.0622***	YES	5815	0.3298
	(0.49)	(6.25)	(0.54)	(5.38)	(2.49)	(14.61)	(-2.64)	YES		

Table 4.6: Regression Results: *SPRSHOCK*

This table presents the panel regression results according to Equation (6) based on *SPRSHOCK* over the full sample period for each country. Standard errors are clustered by country and month. We report the coefficients for only the key variables for brevity. The controls represent other stock-level return determinants in the regression. *t*-Statistics are in parentheses. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

Panel A: Developed markets

	VOLASHOCK	*SPRSHOCK*	*VOLASHOCK* × *SPRSHOCK*	*IVOSHOCK*	*DVOLSHOCK*	*MKTRET*	*MKTSPRSHOCK*	Controls	Obs	R^2
Panel A1: Asia-Pacific										
Australia	-0.0181***	0.0463***	0.0101*	0.0477***	0.0223***	1.0811***	-0.0072	YES	110954	0.2984
	(-2.58)	(13.90)	(1.92)	(7.90)	(15.40)	(26.85)	(-1.19)	YES		
Hong Kong	-0.0138*	0.0334***	-0.0002	0.0675***	0.0111***	1.0034***	0.0414*	YES	114379	0.2984
	(-1.65)	(8.50)	(-0.03)	(9.42)	(4.76)	(15.64)	(1.69)	YES		
Japan	-0.0192***	0.0203***	-0.0209***	0.0492***	0.0069***	0.9393***	0.0267	YES	365012	0.2469
	(-3.18)	(7.10)	(-3.77)	(11.64)	(11.02)	(19.72)	(1.34)	YES		
New Zealand	-0.0046	0.0183***	0.0087*	0.0194**	0.0012	1.0048***	0.0002	YES	11140	0.2776
	(-0.95)	(4.55)	(1.86)	(2.16)	(1.51)	(17.44)	(0.03)	YES		
Singapore	-0.0111*	0.0287***	-0.004	0.0344***	0.0072***	1.1140***	0.0128	YES	44887	0.3671
	(-1.79)	(7.50)	(-1.03)	(3.49)	(5.55)	(24.09)	(0.68)	YES		
South Korea	-0.0137*	0.0121***	0.0143*	0.0340***	0.0174***	0.8656***	0.0559*	YES	208369	0.2584
	(-1.73)	(2.99)	(1.93)	(9.77)	(13.00)	(17.62)	(1.67)	YES		
Taiwan	-0.0162**	0.0038***	-0.0013	0.0449***	0.0179***	1.0338***	0.0253	YES	73359	0.4828
	(-2.13)	(3.50)	(-0.32)	(7.80)	(10.70)	(22.34)	(0.86)	YES		
Panel A2: Europe-ME										
Austria	-0.0039	0.0077*	-0.0172**	0.0098	0.0126**	0.9005***	-0.0003	YES	6143	0.2930
	(-0.60)	(1.87)	(-2.06)	(0.95)	(2.39)	(17.98)	(-0.05)	YES		
Belgium	-0.0106*	0.0282***	0.0059	0.0195***	0.0196***	0.8056***	-0.0091	YES	16655	0.3282
	(-1.91)	(6.62)	(1.08)	(3.20)	(6.46)	(18.73)	(-1.14)	YES		
Denmark	-0.0184***	0.0320***	0.0064	0.0427***	0.0113***	0.8341***	-0.005	YES	22488	0.2496
	(-3.75)	(7.08)	(1.08)	(7.58)	(4.48)	(17.54)	(-0.86)	YES		
Finland	-0.0367***	0.0355***	-0.0010	0.0493***	0.0031***	0.5340***	-0.0028	YES	22063	0.2398
	(-5.16)	(6.76)	(-0.08)	(5.84)	(4.47)	(11.68)	(-0.31)	YES		
France	-0.0207***	0.0545***	0.0135***	0.0718***	0.0017	0.8361***	0.0162*	YES	116613	0.2313
	(-4.24)	(16.65)	(2.79)	(12.05)	(1.61)	(22.61)	(1.87)	YES		
Germany	-0.0215***	0.0542***	0.0030	0.0427***	0.0212***	0.9090***	-0.0473***	YES	82897	0.2196
	(-3.12)	(7.72)	(0.27)	(5.41)	(5.16)	(18.59)	(-2.91)	YES		

Greece	-0.0187	0.0364***	-0.0192	0.0593***	0.0114***	0.9685***	-0.0124	YES	25173	0.4027
	(-1.50)	(7.07)	(-1.28)	(6.12)	(5.30)	(18.39)	(-0.71)	YES		
Israel	-0.0071	0.0131***	0.0032	0.0471***	0.0109***	0.8750***	0.0239	YES	22837	0.2496
	(-0.72)	(2.79)	(0.27)	(3.85)	(6.45)	(14.73)	(1.17)	YES		
Italy	-0.0273***	0.0049	0.0009	0.0494***	0.0095***	0.8888***	-0.0082***	YES	33973	0.3964
	(-4.57)	(1.39)	(0.24)	(5.85)	(2.81)	(22.82)	(-2.74)	YES		
Netherlands	-0.0059	0.0211***	0.0008	0.0000	0.0230***	0.9221***	-0.0096***	YES	18419	0.2519
	(-1.11)	(4.85)	(0.15)	(-0.01)	(10.03)	(19.40)	(-3.56)	YES		
Norway	-0.0130**	0.0416***	0.0018	0.0472***	0.0099***	0.8885***	0.0095	YES	28409	0.2740
	(-2.17)	(6.80)	(0.23)	(6.18)	(2.77)	(25.06)	(0.66)	YES		
Portugal	-0.0254***	0.0482***	-0.0093	0.0614***	0.0028*	0.8197***	-0.0126**	YES	9712	0.3166
	(-4.58)	(9.04)	(-1.26)	(7.38)	(1.83)	(17.65)	(-2.20)	YES		
Spain	-0.0176***	0.0343***	0.0011	0.0552***	0.0047	0.8168***	-0.0014	YES	29016	0.2947
	(-3.73)	(6.65)	(0.26)	(7.55)	(1.11)	(20.14)	(-0.49)	YES		
Sweden	-0.0204***	0.0380***	-0.0075	0.0579***	0.0080***	0.8952***	-0.0076	YES	48326	0.2581
	(-3.94)	(9.49)	(-1.10)	(8.71)	(4.83)	(21.31)	(-0.82)	YES		
Switzerland	-0.0190***	0.0097**	0.0146**	0.0095**	0.0291***	0.8292***	-0.0071	YES	45278	0.2899
	(-4.56)	(2.32)	(2.02)	(2.06)	(8.06)	(19.04)	(-1.46)	YES		
United Kingdom	-0.0258***	0.0585***	0.0124**	0.0256***	0.0144***	0.9062***	-0.0274*	YES	223248	0.1918
	(-6.39)	(20.90)	(2.12)	(8.78)	(8.71)	(17.91)	(-1.92)	YES		
Panel A3: N-America										
Canada	-0.0108	0.0608***	0.0142**	0.0550***	0.0195***	1.0652***	-0.0005	YES	67145	0.2766
	(-1.10)	(11.17)	(2.43)	(6.49)	(7.00)	(20.45)	(-0.02)	YES		
United States	-0.0149***	0.0251***	0.0034	0.0115***	0.0083***	1.0179***	-0.0004	YES	337069	0.1091
	(-3.79)	(11.16)	(0.96)	(5.16)	(4.93)	(21.10)	(-0.07)	YES		

Panel B: Emerging markets										
	VOLASHOCK	*SPRSHOCK*	*VOLASHOCK* × *SPRSHOCK*	*IVOSHOCK*	*DVOLSHOCK*	*MKTRET*	*MKTSPRSHOCK*	Controls	Obs	R^2
Panel B1: Asia-Pacific										
China	-0.0300*	0.0014	0.0009	0.0267***	0.0311***	0.8794***	0.013	YES	260910	0.4522
	(-1.81)	(1.54)	(0.15)	(4.07)	(11.70)	(14.65)	(0.49)	YES		
India	-0.0033	0.0214***	-0.0025	0.0979***	0.0157***	1.1654***	-0.0095	YES	68314	0.4087
	(-0.34)	(7.74)	(-0.33)	(16.01)	(11.10)	(23.82)	(-0.97)	YES		

Malaysia	-0.0027	0.0245***	-0.0069	0.0466***	0.0050***	1.1582***	0.0070	YES	107804	0.4515
	(-0.46)	(9.44)	(-1.01)	(8.10)	(6.19)	(18.83)	(0.49)	YES		
Pakistan	-0.0163**	-0.0001	-0.0024	0.0548***	0.0145***	0.9627***	-0.0135	YES	8894	0.3191
	(-1.98)	(-0.05)	(-0.50)	(6.15)	(5.32)	(18.59)	(-0.70)	YES		
Philippines	-0.0088	0.0150***	0.0102	0.0804***	0.001	1.2729***	-0.0212**	YES	11425	0.3812
	(-1.39)	(3.42)	(1.19)	(8.49)	(0.88)	(13.13)	(-2.14)	YES		
Sri Lanka	-0.0234***	-0.0003	0.0071	0.0943***	0.0050**	1.0884***	0.014	YES	8519	0.4414
	(-2.86)	(-0.10)	(0.90)	(7.21)	(2.48)	(12.77)	(1.20)	YES		
Thailand	-0.0175***	-0.0022**	-0.0003	0.0506***	0.0027***	0.8186***	0.0604***	YES	29442	0.3477
	(-2.71)	(-2.01)	(-0.08)	(9.43)	(5.70)	(13.84)	(2.59)	YES		
Panel B2: Europe-MEA										
Egypt	-0.0222***	0.0088	0.0126**	0.0618***	0.0080***	0.9847***	-0.0158*	YES	13747	0.3710
	(-2.73)	(1.49)	(1.97)	(6.11)	(3.71)	(17.48)	(-1.68)	YES		
Poland	0.0071	0.0286***	0.0123	0.0670***	0.0129***	0.9651***	0.0162	YES	36221	0.3181
	(1.01)	(5.70)	(1.53)	(6.64)	(3.65)	(23.72)	(1.22)	YES		
Romania	-0.0285**	0.0348***	0.0154**	0.0948***	0.0042	0.8132***	0.0282	YES	852	0.3538
	(-2.01)	(2.66)	(1.89)	(3.46)	(1.60)	(10.87)	(0.64)	YES		
South Africa	-0.0082*	0.0111***	0.0093**	0.0190***	0.0094***	0.8914***	0.0003	YES	38961	0.2815
	(-1.91)	(4.14)	(2.43)	(4.13)	(6.54)	(38.79)	(0.05)	YES		
Turkey	-0.0262***	0.0078*	0.0050	0.0777***	0.0183***	0.8704***	0.0227	YES	38813	0.4698
	(-3.14)	(1.87)	(0.43)	(10.35)	(4.10)	(20.99)	(0.98)	YES		
Panel B3: L-America										
Brazil	-0.0398***	0.0337***	-0.0044	0.0711***	0.001	0.8525***	0.0002	YES	18805	0.3185
	(-4.80)	(5.04)	(-0.39)	(5.51)	(0.93)	(11.95)	(0.10)	YES		
Chile	-0.0223***	0.0128***	-0.0038	0.0580***	0.0038***	1.0417***	-0.0014	YES	4844	0.4201
	(-4.69)	(3.42)	(-0.89)	(4.35)	(2.98)	(18.90)	(-0.31)	YES		
Mexico	-0.0157***	0.0088*	-0.0030	0.0338**	0.0063***	1.0496***	0.0096*	YES	8294	0.3646
	(-2.58)	(1.75)	(-0.92)	(1.96)	(2.61)	(24.85)	(1.67)	YES		
Peru	-0.0224	0.0166***	0.0063	0.0260**	0.0057*	1.3047***	-0.0157	YES	1333	0.4049
	(-1.54)	(3.27)	(0.55)	(2.10)	(1.90)	(17.66)	(-1.03)	YES		

Table 4.7: Mean regression coefficients

This table presents the cross-market means of our regression coefficients within each region. The mean *t*-statistics within a region are in parentheses. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

	VOLASHOCK	*AMISHOCK* (or *SPRSHOCK*)	*VOLASHOCK* ×*AMISHOCK* (or *SPRSHOCK*)	*IVOSHOCK*	*DVOLSHOCK*	*MKTRET*	*MTKAMISHOCK* (or *MKTSPRSHOCK*)
Panel A: Developed markets							
Panel A1: *AMISHOCK*							
Asia-Pacific Mean	-0.0158**	0.0599***	0.0030	0.0549***	0.0108***	0.9836***	-0.0022
	(-2.26)	(12.56)	(0.60)	(9.48)	(9.44)	(20.48)	(-0.28)
% Positive (Negative) Significant at 0.10	(42.86%)	100.00%	14.29%	100.00%	100.00%	100.00%	14.29%
% Positive (Negative) Significant at 0.05	(42.86%)	100.00%	14.29%	85.71%	85.71%	100.00%	14.29%
Europe-ME Mean	-0.0169***	0.0707***	0.0075	0.0395***	0.0109***	0.8311***	-0.0206
	(-2.89)	(9.45)	(0.67)	(5.87)	(4.64)	(19.26)	(-1.62)
% Positive (Negative) Significant at 0.10	(81.25%)	100.00%	18.75%	87.50%	93.75%	100.00%	0.00%
% Positive (Negative) Significant at 0.05	(68.75%)	100.00%	0.00%	87.50%	87.50%	100.00%	0.00%
N-America Mean	-0.0183***	0.0539***	0.0053	0.0272***	0.0155***	1.0124***	-0.0128
	(-3.50)	(9.70)	(0.38)	(6.43)	(8.15)	(21.86)	(0.21)
% Positive (Negative) Significant at 0.10	(100.00%)	100.00%	0.00%	100.00%	100.00%	100.00%	50.00%
% Positive (Negative) Significant at 0.05	(100.00%)	100.00%	0.00%	100.00%	100.00%	100.00%	50.00%
Panel A2: SPRSHOCK							
Asia-Pacific Mean	-0.0138**	0.0233***	0.0010	0.0424***	0.0120***	1.0060***	0.0222
	(-2.00)	(6.86)	(0.08)	(7.45)	(8.85)	(20.53)	(0.72)
% Positive (Negative) Significant at 0.10	(85.71%)	100.00%	42.86%	100.00%	85.71%	100.00%	28.57%
% Positive (Negative) Significant at 0.05	(42.86%)	100.00%	0.00%	100.00%	85.71%	100.00%	0.00%
Europe-ME Mean	-0.0183***	0.0324***	0.0006	0.0405***	0.0121***	0.8518***	-0.0063
	(-3.25)	(7.38)	(0.30)	(5.72)	(4.78)	(18.97)	(-0.97)
% Positive (Negative) Significant at 0.10	(75.00%)	93.75%	18.75%	87.50%	87.50%	100.00%	6.25%
% Positive (Negative) Significant at 0.05	(68.75%)	87.50%	18.75%	87.50%	81.25%	100.00%	0.00%
N-America Mean	-0.0128**	0.0430***	0.0088*	0.0333***	0.0139***	1.0416***	-0.0005
	(-2.45)	(11.17)	(1.70)	(5.83)	(5.96)	(20.78)	(-0.04)
% Positive (Negative) Significant at 0.10	(50.00%)	100.00%	50.00%	100.00%	100.00%	100.00%	0.00%
% Positive (Negative) Significant at 0.05	(50.00%)	100.00%	50.00%	100.00%	100.00%	100.00%	0.00%

Table 4.7 (continued)

Panel B: Emerging markets

	VOLASHOCK	*AMISHOCK* (or *SPRSHOCK*)	*VOLASHOCK*× *AMISHOCK* (or *SPRSHOCK*)	*IVOSHOCK*	*DVOLSHOCK*	*MKTRET*	*MTKAMISHOCK* (or *MKTSPRSHOCK*)
Panel B1: *AMISHOCK*							
Asia-Pacific Mean	-0.0130**	0.0753***	0.0019	0.0697***	0.0094***	1.0772***	-0.0429**
	(-2.15)	(8.95)	(0.25)	(9.02)	(4.86)	(16.70)	(-2.18)
% Positive (Negative) Significant at 0.10	(28.57%)	100.00%	14.29%	100.00%	85.71%	100.00%	0.00%
% Positive (Negative) Significant at 0.05	(28.57%)	100.00%	14.29%	100.00%	71.43%	100.00%	0.00%
Europe-MEA Mean	-0.0212**	0.0994***	0.0029	0.0570***	0.0101***	0.8366***	-0.0225
	(-2.33)	(8.32)	(0.35)	(7.32)	(4.05)	(24.18)	(-1.00)
% Positive (Negative) Significant at 0.10	(60.00%)	100.00%	20.00%	100.00%	80.00%	100.00%	0.00%
% Positive (Negative) Significant at 0.05	(60.00%)	100.00%	0.00%	100.00%	80.00%	100.00%	0.00%
L-America Mean	-0.0137*	0.0695***	0.0056	0.0557***	0.0027*	0.9517***	-0.0134
	(-1.89)	(8.30)	(0.32)	(5.57)	(1.79)	(11.80)	(-0.63)
% Positive (Negative) Significant at 0.10	(75.00%)	100.00%	0.00%	100.00%	50.00%	100.00%	0.00%
% Positive (Negative) Significant at 0.05	(50.00%)	100.00%	0.00%	100.00%	50.00%	100.00%	0.00%
Panel B2: *SPRSHOCK*							
Asia-Pacific Mean	-0.0146*	0.0085***	0.0009	0.0645***	0.0107***	1.0494***	0.0072
	(-1.65)	(2.86)	(0.05)	(8.49)	(6.19)	(16.52)	(0.14)
% Positive (Negative) Significant at 0.10	(66.67%)	50.00%	0.00%	100.00%	85.71%	100.00%	14.29%
% Positive (Negative) Significant at 0.05	(50.00%)	50.00%	0.00%	100.00%	85.71%	100.00%	0.00%
Europe-MEA Mean	-0.0156*	0.0182***	0.0109*	0.0641***	0.0105***	0.9050***	0.0103
	(-1.76)	(3.17)	(1.65)	(6.14)	(3.92)	(22.37)	(0.24)
% Positive (Negative) Significant at 0.10	(80.00%)	80.00%	60.00%	100.00%	80.00%	100.00%	0.00%
% Positive (Negative) Significant at 0.05	(60.00%)	60.00%	60.00%	100.00%	80.00%	100.00%	0.00%
L-America Mean	-0.0251***	0.0180***	-0.0012	0.0472***	0.0042**	1.0621***	-0.0018
	(-3.40)	(3.37)	(-0.41)	(3.48)	(2.11)	(18.34)	(0.11)
% Positive (Negative) Significant at 0.10	(75.00%)	100.00%	0.00%	100.00%	75.00%	100.00%	25.00%
% Positive (Negative) Significant at 0.05	(75.00%)	75.00%	0.00%	100.00%	50.00%	100.00%	0.00%

We then aggregate individual country regression results into regions in Table 4.7. Below the mean coefficients for each region, we also report the mean t-values, along with the percentage of markets for which the corresponding variable is statistically significant at the 0.10 and 0.05 levels with the expected sign. The aggregate developed and emerging market results are similar, when we measure liquidity using the Amihud ratio, while the emerging markets results are less significant when liquidity is measured using the spread.

We re-estimate our regression results by five-year subperiods to explore whether regression estimates of interest change over time. In Chung and Chuwonganant (2017, p. 5), β_2 and β_3 from Equation (6) are the two coefficients associated with "the additional effect of volatility shock on stock returns that operates through its effect on liquidity". We present the global mean and median regression estimates β_2 and β_3 by period in Panel A of Table 4.8, and plot the estimated coefficients β_2 and β_3 in Figure 4.3. We find the global average of β_3, ranging from -0.0062 (-0.0234) to 0.0185 (0.0071) when we use the Amihud (Spread) liquidity measure, peaks in subperiod 4, while β_2 remains relatively stable over time. According to our calculation, the average absolute percentage changes in β_2 and β_3 are 0.1382 (0.3285) and 2.6920 (2.7065), respectively, based on the Amihud (spread) value, indicating that β_3 exhibits much higher volatility over time.

In Panel B of Table 4.8, we find that the differences in the mean and median β_3 values between subperiod 4 and the other four subperiods are significantly positive. In addition, we show β_3 per se is significantly different from zero in row 5. The evidence of a significantly higher β_3 in subperiod 4, which covers the 2007–2009 global financial crisis, suggests the effects of market volatility on stock returns through liquidity providers is likely to be positively related to the level of market volatility. Consistent with Nagel

(2012), our finding highlights the heightened importance of liquidity providers on stock returns during periods of high uncertainty.

Table 4.8: Estimated coefficients over subperiods

Panel A presents the estimated β_2 and β_3 coefficients over five-year subperiods based on *AMISHOCK* and *SPRSHOCK*. In Panel B, we test the differences in the means and medians of β_2 and β_3, using the t test and Wilcoxon test, respectively. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

Panel A: β_2 and β_3 over five-year subperiods

Panel A1: *AMISHOCK*

Subperiod	mean β_2	median β_2	mean β_3	median β_3
[1] 1990:01-1994:12	0.0644	0.0580	-0.0062	-0.0019
[2] 1995:01-1999:12	0.0675	0.0627	-0.0015	0.0017
[3] 2000:01-2004:12	0.0770	0.0599	-0.0024	-0.0033
[4] 2005:01-2009:12	0.0601	0.0494	0.0185	0.0174
[5] 2010:01-2015:04	0.0514	0.0433	0.0048	0.0043

Panel A2: *SPRSHOCK*

Subperiod	mean β_2	median β_2	mean β_3	median β_3
[1] 1990:01-1994:12	0.0548	0.0427	0.0064	0.0069
[2] 1995:01-1999:12	0.0263	0.0277	-0.0234	-0.0029
[3] 2000:01-2004:12	0.0312	0.0261	-0.0018	-0.0039
[4] 2005:01-2009:12	0.0159	0.0148	0.0071	0.0078
[5] 2010:01-2015:04	0.0178	0.0174	0.0042	0.0005

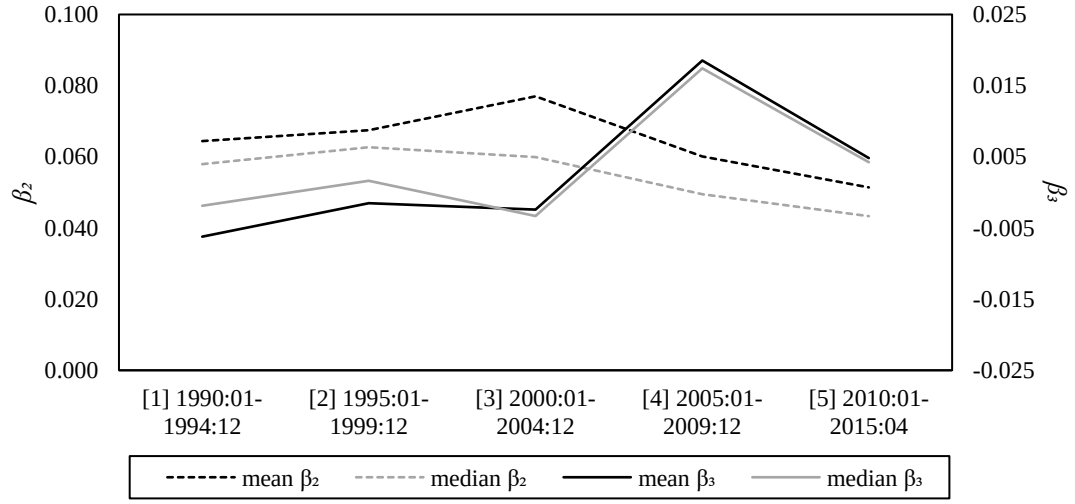
Panel B: Differences in β means and medians

	Amihud		Spread	
	Diff in mean β_3	Diff in median β_3	Diff in mean β_3	Diff in median β_3
H0: [4]-[1] = 0	0.0248***	0.0193***	0.0007	0.0009
H0: [4]-[2] = 0	0.0200***	0.0158***	0.0305	0.0107***
H0: [4]-[3] = 0	0.0210***	0.0208***	0.0089*	0.0117**
H0: [4]-[5] = 0	0.0137***	0.0132***	0.0029	0.0073
H0: [4] = 0	0.0185***	0.0174***	0.0071***	0.0078***

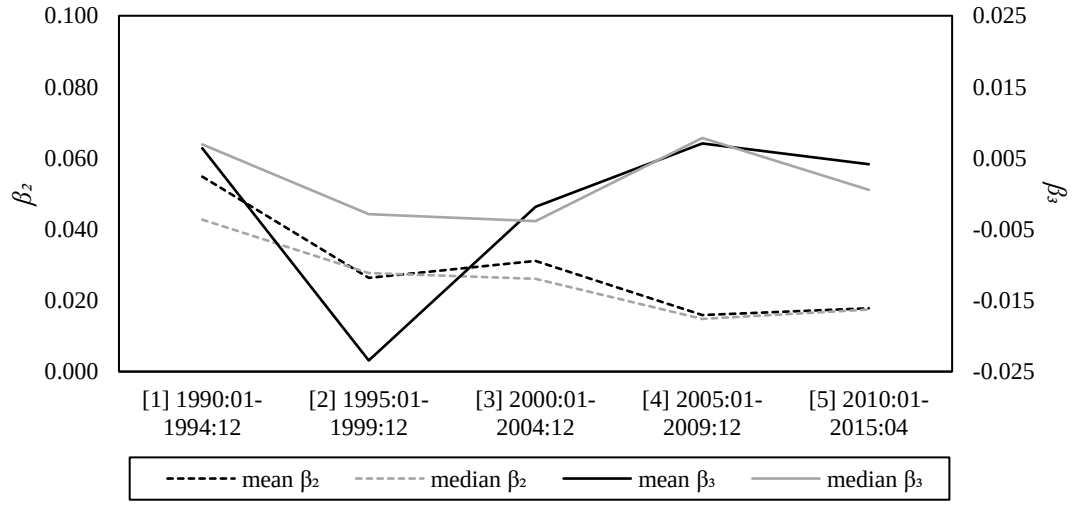
4.4.3 Market attributes and the role of liquidity providers

Our results in Sections 4.4.1 and 4.4.2 indicate that liquidity is an important channel through which market volatility affects returns at both the portfolio- and stock-levels across regions in international markets, and the influence of the liquidity channel is likely to be stronger during financial crisis periods. We now investigate which market attributes affect the influence of the liquidity channel.[38]

[38] We use the term *impact of the liquidity channel* to refer to the impact of market volatility on stock returns through the liquidity channel hereafter.



(a) *AMISHOCK*



(b) *SPRSHOCK*

Figure 4.3: Estimated beta coefficients over five-year subperiods
We re-estimate our regression according to Equation (6) by five-year subperiods to explore whether regression estimates of interest change over time. This figure plots the global mean and median regression estimates β_2 and β_3 by time period.

We begin our analysis with a two-step process. In the first step, we collect five-year subperiods' estimates of β_2 and β_3 for each market from Section 4.4.2. Following Chung and Chuwonganant (2017), we compute the indirect effect of market volatility shock on stock returns through the liquidity channel as the return difference between stocks with the 75th and 25th liquidity shock percentiles, associated with the median market volatility shock for country c in subperiod s: $\lambda_{c,s} = (\beta_{2,c,s} +$

$\beta_{3,c,s}VOLASHOCK_{50,c,s}$)($LIQSHOCK_{75,c,s}$ - $LIQSHOCK_{25,c,s}$), where $\beta_{2,c,s}$ and $\beta_{3,c,s}$ are the β_2 and β_3 estimates, respectively, of country *c* over subperiod *s* according to Equation (6); $VOLASHOCK_{50,c,s}$ is the median *VOLASHOCK* value for country *c* in subperiod *s*; $LIQSHOCK_{75,c,s}$ and $LIQSHOCK_{25,c,s}$ are the 75th and 25th liquidity shock percentile values, measured by either *AMISHOCK* or *SPRSHOCK*, for country *c* in subperiod *s*.

In the second step, we estimate the following regression with standard errors clustered by country and subperiod:

$$\lambda_{c,s} = \pi_0 + \pi_1 Attributes_{c,s} + \varepsilon_{c,s} \quad (7)$$

where $Attributes_{c,s}$ represents a set of market attributes varying across countries and over time.[39] The market attributes we investigate include the level of market volatility (*MKTVOLA*), the market trading volume (*MKTDVOL*), market capitalisation (*MKTCAP*), the country's governance environment (*GOVERNANCE*), the country's economic development (*GDP_PER_CAP*), equity market development (*DEVELOPMENT*), its trade openness (*OPENNESS*), equity market segmentation (*SEGMENTATION*), and the presence of short sellers (*SHORT_SELLING*) and market makers (*MKT_MAKER*). For each country, we calculate the mean values of *MKTVOLA*, *MKTDVOL*, *MKTCAP*, *GDP_PER_CAP*, *GOVERNANCE*, *DEVELOPMENT*, *OPENNESS*, *SEGMENTATION*, *SHORT_SELLING*, and *MKTMAKER* over each five-year subperiod. More detailed descriptions of our market attribute variables are contained in Panel B of Appendix C.1.

Studies suggest that liquidity is most needed, and therefore valued, during market downturns and times of high uncertainty (e.g. Nagel, 2012; Rosch and Kaserer, 2013). In

[39] If we add a time trend to Equation (7), the results are similar.

Section 4.4.2, we show the β_3 estimate is significantly higher in subperiod 4, which coincides with the global financial crisis. We therefore expect the liquidity channel to play a more important role when market volatility is higher. Prior research also provides evidence that more developed markets facilitate trading activity and incorporate market innovations into stock prices more efficiently (e.g. Claessens, Klingebiel, and Schmukler, 2006; Marshall, Nguyen, Nguyen, and Visaltanachoti, 2016). Our second hypothesis, therefore, is that market volatility exerts a greater impact on returns through the liquidity channel in more developed markets characterised by features such as better governance and a higher gross domestic product per capita.

In Bris, Goetzmann, and Zhu (2007), stock prices impound negative information faster when short selling is practiced. We conjecture that short selling constraints create frictions, and impede the liquidity channel to convey the negative effects of market volatility. We therefore expect the impact of the liquidity channel to be stronger when short selling is allowed. As noted in Chung and Chuwonganant (2014), the decreased role of designated market makers leads to increased sensitivity of liquidity to market uncertainty in the United States. Thus, we hypothesise that, in the absence of market makers, the influence of the liquidity channel is stronger.

Table 4.9 presents the estimation results for Equation (7). In Models [1]–[10], we include one of our market attribute variables as the explanatory variable to avoid potential multicollinearity.[40] We find market volatility and the dollar volume have a significant influence on the liquidity channel. In Model [11], we include both market volatility and the market dollar volume, and the variables remain significant, suggesting that the impact

[40] Appendix C.2 shows the correlation matrix of the independent variables for Equation (7). In Appendix C.3, as robustness checks, we also run regressions on combinations of market attributes with pair-wise correlations lower than 0.50.

of the liquidity channel is stronger when markets are more volatile and in markets with lower trading volume. Panel B presents the results based on the spread measure. The results are consistent with our hypothesis that the liquidity channel plays a more significant role in markets with better governance, often used as a proxy for investor protection, since information is impounded in these countries more efficiently. In the final column, we include all market attributes as independent variables. We show country governance is significant across both liquidity measures, and find an increase of 0.66% (1.03%) in the return difference between stocks with the 75th and 25th percentile values of *AMISHOCK* (*SPRSHOCK*) for a one standard deviation increase in our governance measure. We therefore conclude that country governance is a key determinant of the influence of liquidity providers. There is also evidence of a lower impact of the liquidity channel in the presence of the short selling constraints in Panel A.

The measured effects in Table 4.9 stemming from both the time-series and cross-sectional dimensions show no significant influence of market makers. We therefore follow an approach similar to that in Chung and Chuwonganant (2017), and in Appendix C.4 test whether the influence of market makers is more time-series based. Exploiting the introduction of market maker services in seven international markets (Singapore, South Korea, Austria, Israel, Norway, Sweden, and Turkey), a reverse process of US regulatory changes that reduced market makers' obligations, we show reduced effects of the liquidity channel in the presence of market makers.

4.4.4 Impact of the 2007–2009 crisis

Given the large body of research suggesting that liquidity can easily dry up and the impact of liquidity shocks can be magnified during financial turmoil (e.g. Cespa and

Table 4.9: Market attributes and the role of liquidity providers

This table presents our regression results for Equation (5). The variables *MKTDVOL* and *MKTCAP* are logarithmically scaled. Standard errors are clustered by country and time. *t*-Statistics are in parentheses. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

Panel A: Dependent variable - $(\beta_2 + \beta_3 VOLASHOCK_{50})(AMISHOCK_{75} - AMISHOCK_{25})$

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
MKTVOLA	0.5399**										0.5007**	0.2099
	(1.99)										(2.05)	(0.90)
MKTDVOL		-0.0021**									-0.0021**	-0.0003
		(-2.22)									(-2.28)	(-0.31)
MKTCAP			-0.0051									-0.0009
			(-1.39)									(-0.58)
GOVERNANCE				-0.0003								0.0080*
				(-0.12)								(1.67)
GDP_PER_CAP					-0.0059							-0.0052
					(-1.12)							(-1.19)
DEVELOPMENT						-0.0011						0.0010
						(-0.44)						(0.27)
OPENNESS							0.0006					0.0007
							(0.58)					(0.36)
SEGMENTATION								0.0165				0.0012
								(0.36)				(0.02)
SHORT_SELLING									0.0156			-0.0081*
									(1.08)			(-1.77)
MKT_MAKER										-0.0021		0.0001
										(-0.52)		(0.03)
Constant	0.0186***	0.0517***	0.1217*	0.0235***	0.0810	0.0262***	0.0254***	0.0253***	0.0224***	0.0236***	0.0445***	0.0834***
	(4.47)	(4.30)	(1.73)	(14.94)	(1.59)	(7.97)	(6.80)	(5.67)	(8.43)	(15.13)	(4.41)	(6.15)
Obs	193	193	193	162	193	187	188	193	193	140	193	110
R^2	0.0038	0.0126	0.0501	0.0003	0.0399	0.0003	0.0001	0.0002	0.0236	0.0067	0.0158	0.1134

Table 4.9 (continued)

Panel B: Dependent variable - $(\beta_2 + \beta_3 VOLASHOCK_{50})(SPRSHOCK_{75} - SPRSHOCK_{25})$

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
MKTVOLA	-0.2579										-0.0642	0.0412
	(-0.97)										(-0.33)	(0.15)
MKTDVOL		0.0004										-0.0012*
		(0.82)										(-1.75)
MKTCAP			0.0006									0.0000
			(0.70)									(-0.02)
GOVERNANCE				0.0046***							0.0046***	0.0126***
				(2.94)							(3.01)	(4.09)
GDP_PER_CAP					0.0017							-0.0032
					(1.57)							(-1.65)
DEVELOPMENT						0.0016						0.0041
						(1.09)						(1.59)
OPENNESS							-0.0002					-0.0021*
							(-0.21)					(-1.73)
SEGMENTATION								0.0232				0.0872
								(0.18)				(0.96)
SHORT_SELLING									-0.0041			0.0003
									(-1.58)			(0.09)
MKT_MAKER										0.0033		0.0022
										(1.17)		(0.81)
Constant	0.0141***	0.0054	-0.0004	0.0068***	-0.0055	0.0103***	0.0110***	0.0100**	0.0113***	0.0090***	0.0077**	0.0421**
	(2.99)	(0.92)	(-0.03)	(3.54)	(-0.52)	(4.42)	(3.87)	(2.58)	(4.88)	(3.94)	(2.55)	(2.45)
Obs	136	136	136	136	136	130	134	136	136	104	136	98
R^2	0.0094	0.0054	0.0073	0.1311	0.0439	0.0104	0.0003	0.0010	0.0171	0.0229	0.1317	0.3074

Foucault, 2014; Dow and Han, 2017), we conjecture that the sensitivity of stock returns to market volatility increases during financial crisis periods due to the increased sensitivity of stock liquidity to market volatility. We use subperiod 4 from Section 4.4.2, and estimate the following regression to directly examine the impact of financial crisis periods:

$$\begin{aligned} RETURN_{i,t} &= \beta_0 + \beta_1 VOLASHOCK_t + \beta_2 (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \\ &+ \beta_3 VOLASHOCK_t \times (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \\ &+ \beta_4 VOLASHOCK_t \times (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \times CRISIS \\ &+ \text{Controls} + \varepsilon_{i,t} \end{aligned} \tag{8}$$

where *CRISIS* is a dummy variable set to one for the years 2007–2009, and zero for 2005–2006. The control variables are the same as in Equation (6).[41]

We report the regression results based on the Amihud measure in Table 4.10. Our finding is consistent with the subperiod results in Table 4.8 and our results on the link between market attributes and the liquidity channel in Table 4.9. The coefficient of the interaction term $VOLASHOCK_t \times AMISHOCK_{i,t} \times CRISIS$ indicates that, in 16 out of 41 countries, the impact of volatility on returns through stock liquidity significantly increases during the financial crisis period. Table 4.11 reports similar results for the spread measure.

[41] To be consistent with the results in other sections of the essay, we estimate the regression results for each market. However, we acknowledge that an alternative approach is to run a single panel regression using data from all countries.

Table 4.10: Impact of the 2007–2009 crisis period: *AMISHOCK*

This table presents the regression results for our Equation (8) over the 2005–2009 subperiod. Standard errors are clustered by country and time. *t*-Statistics are in parentheses. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

	VOLA SHOCK	*AMI SHOCK*	*VOLASHOCK* × *AMISHOCK*	*VOLASHOCK* × *AMISHOCK* × *CRISIS*	Controls	Obs	R^2
Panel A: Developed markets							
Panel A1: Asia-Pacific							
Australia	-0.0414***	0.1400***	-0.0846***	0.0938**	YES	59017	0.3178
	(-2.65)	(13.38)	(-2.75)	(2.09)	YES		
Hong Kong	-0.0264	0.0594***	0.0130	0.0295	YES	43970	0.3530
	(-1.50)	(5.68)	(0.52)	(0.84)	YES		
Japan	-0.0219**	0.0337***	-0.0041	-0.0136	YES	139181	0.1993
	(-2.16)	(8.04)	(-0.30)	(-0.93)	YES		
New Zealand	-0.0044	0.0499***	-0.0005	-0.0222	YES	4338	0.3119
	(-0.51)	(4.71)	(-0.01)	(-0.37)	YES		
Singapore	-0.0059	0.0649***	-0.0275**	0.0524***	YES	22273	0.4401
	(-0.62)	(6.09)	(-2.70)	(3.40)	YES		
South Korea	-0.0040	0.0116**	0.0414***	-0.0248	YES	72591	0.3277
	(-0.31)	(2.06)	(2.71)	(-1.54)	YES		
Taiwan	-0.0128	0.0422***	-0.0152	0.0198	YES	40517	0.5172
	(-1.46)	(6.16)	(-0.90)	(0.96)	YES		
Panel A2: Europe-ME							
Austria	-0.0154	0.0249	-0.0210	0.0601*	YES	2929	0.3254
	(-1.30)	(1.18)	(-0.84)	(1.91)	YES		
Belgium	-0.0002	0.0406***	-0.0034	0.0388**	YES	5027	0.3943
	(-0.02)	(26.74)	(-0.18)	(2.24)	YES		
Denmark	-0.0038	0.0393***	-0.0162	0.0409***	YES	7418	0.3147
	(-0.41)	(4.09)	(-0.98)	(3.19)	YES		
Finland	-0.0324***	0.0342***	-0.0310*	0.0376	YES	6629	0.3112
	(-2.65)	(3.14)	(-1.69)	(1.23)	YES		
France	-0.0222***	0.0340***	-0.0082	0.0461*	YES	28512	0.3403
	(-3.32)	(3.99)	(-0.33)	(1.90)	YES		
Germany	-0.0189***	0.0854***	-0.0243	0.0468	YES	29884	0.2255
	(-2.59)	(5.59)	(-0.90)	(1.48)	YES		
Greece	-0.0235*	0.1178***	0.0367*	0.0105	YES	14704	0.3825
	(-1.86)	(10.97)	(1.86)	(0.48)	YES		
Israel	0.0020	0.0986***	0.0325	0.0483	YES	14195	0.2685
	(0.10)	(5.92)	(0.92)	(1.02)	YES		
Italy	-0.0109	0.0255***	0.0047	0.0017	YES	14084	0.4254
	(-1.17)	(3.29)	(0.28)	(0.12)	YES		
Netherlands	-0.0085	0.0245***	-0.0200	0.0247*	YES	5877	0.3027
	(-0.98)	(4.61)	(-1.50)	(1.82)	YES		
Norway	-0.0293**	0.0618***	-0.0477***	0.0920***	YES	8061	0.3174
	(-2.24)	(7.90)	(-4.52)	(4.23)	YES		
Portugal	-0.0305*	0.0517***	-0.0096	0.0092	YES	2018	0.2949
	(-1.77)	(3.17)	(-0.28)	(0.27)	YES		
Spain	-0.0045	0.0339***	0.0021	0.0048	YES	6115	0.3384
	(-0.53)	(4.48)	(0.08)	(0.19)	YES		
Sweden	-0.0194**	0.0648***	-0.0283*	0.0465**	YES	18642	0.2679
	(-2.13)	(5.56)	(-1.80)	(2.01)	YES		
Switzerland	-0.0235***	0.0447***	-0.0171	0.0463**	YES	10457	0.3243
	(-3.13)	(4.25)	(-1.08)	(2.46)	YES		
United Kingdom	-0.0165	0.0827***	0.0053	0.0156	YES	65608	0.2035
	(-1.58)	(11.25)	(0.33)	(0.69)	YES		
Panel A2: Europe-ME							
Canada	-0.0455***	0.0830***	-0.0411	0.0706**	YES	45169	0.3105
	(-2.68)	(6.84)	(-1.38)	(2.26)	YES		
United States	-0.0202**	0.0178**	0.0156	-0.0042	YES	68273	0.1323
	(-2.49)	(2.33)	(1.35)	(-0.26)	YES		

Table 4.10 (continued)

Panel B: Emerging markets

	VOLA SHOCK	*AMI SHOCK*	*VOLASHOCK × AMISHOCK*	*VOLASHOCK × AMISHOCK × CRISIS*	Controls	Obs	R^2
Panel B1: Asia-Pacific							
China	-0.0177	0.0044	-0.0391	0.1472	YES	71419	0.4566
	(-0.55)	(0.31)	(-0.41)	(1.48)	YES		
India	0.0234	0.0781***	-0.0016	0.1214	YES	51600	0.4406
	(0.97)	(3.40)	(-0.02)	(1.35)	YES		
Malaysia	-0.0053	0.0703***	-0.0475***	0.0582***	YES	39831	0.2885
	(-0.83)	(9.77)	(-4.37)	(2.79)	YES		
Pakistan	-0.0209**	0.0326***	-0.0098	0.0387*	YES	6654	0.2828
	(-2.56)	(3.18)	(-0.74)	(1.94)	YES		
Philippines	-0.0277	0.0496**	-0.0457	0.0787**	YES	5638	0.4721
	(-1.61)	(2.29)	(-1.49)	(2.29)	YES		
Sri Lanka	-0.0365***	0.1050***	-0.0107	0.0044	YES	5939	0.5027
	(-4.32)	(12.79)	(-0.36)	(0.10)	YES		
Thailand	-0.0094*	0.0352***	0.0095	0.0318**	YES	18216	0.3426
	(-1.69)	(5.94)	(1.56)	(2.32)	YES		
Panel B2: Europe-MEA							
Egypt	-0.0239	0.0569***	-0.1290**	0.1703***	YES	4604	0.3900
	(-1.35)	(4.04)	(-2.47)	(2.83)	YES		
Poland	-0.0054	0.0887***	-0.024	0.0298	YES	12793	0.4031
	(-0.47)	(4.29)	(-0.50)	(0.67)	YES		
Romania	-0.0225	0.2547***	-0.0379	0.0771	YES	2144	0.3995
	(-1.00)	(7.68)	(-0.51)	(0.94)	YES		
South Africa	-0.0146	0.0518***	0.0376**	-0.0429**	YES	11160	0.3368
	(-1.28)	(6.22)	(2.16)	(-2.55)	YES		
Turkey	-0.0563***	0.0159	-0.0059	0.0290	YES	15582	0.5237
	(-3.44)	(0.92)	(-0.36)	(1.22)	YES		
Panel B3: L-America							
Brazil	-0.0335***	0.0697***	-0.0050	0.0411	YES	5890	0.4405
	(-3.50)	(4.89)	(-0.21)	(1.25)	YES		
Chile	-0.0154***	0.0320***	-0.0050	0.0200	YES	3393	0.4439
	(-2.86)	(4.80)	(-0.33)	(1.17)	YES		
Mexico	-0.0114	0.0411***	0.0217	0.0119	YES	2187	0.4165
	(-1.50)	(2.72)	(1.36)	(0.59)	YES		
Peru	0.0005	0.1164***	0.1414***	-0.1494*	YES	2115	0.3753
	(0.02)	(4.93)	(4.98)	(-1.78)	YES		

Table 4.11: Impact of the 2007–2009 crisis period: *SPRSHOCK*

This table presents the regression results for our Equation (8) over the 2005–2009 subperiod. Standard errors are clustered by country and time. *t*-Statistics are in parentheses. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

	VOLA SHOCK	*SPR SHOCK*	*VOLASHOCK* × *SPRSHOCK*	*VOLASHOCK* × *SPRSHOCK* × *CRISIS*	Controls	Obs	R^2
Panel A: Developed markets							
Panel A1: Asia-Pacific							
Australia	-0.0227**	0.0552***	0.0011	0.0082	YES	46771	0.3220
	(-2.32)	(9.03)	(0.06)	(0.37)	YES		
Hong Kong	-0.0331**	0.0275***	-0.008	0.0171	YES	31161	0.3259
	(-2.30)	(4.62)	(-0.50)	(0.84)	YES		
Japan	-0.0194**	0.0180***	-0.0087	-0.0104	YES	137012	0.1955
	(-2.05)	(4.28)	(-0.45)	(-0.49)	YES		
New Zealand	0.0003	0.0069	0.0598	-0.0573	YES	4141	0.3325
	(0.04)	(1.35)	(1.47)	(-1.37)	YES		
Singapore	-0.011	0.0182***	-0.0229***	0.0243***	YES	16705	0.4456
	(-1.24)	(3.40)	(-3.01)	(3.23)	YES		
South Korea	-0.0146	-0.0072	0.0494	-0.0330	YES	70731	0.3253
	(-1.30)	(-1.18)	(1.33)	(-0.87)	YES		
Taiwan							
Panel A2: Europe-ME							
Austria	-0.0105	0.0148*	-0.0153	0.0042	YES	2029	0.2686
	(-1.33)	(1.95)	(-0.61)	(0.15)	YES		
Belgium	-0.0030	0.0215***	0.0113	-0.0009	YES	5085	0.3966
	(-0.35)	(6.19)	(1.36)	(-0.12)	YES		
Denmark	0.0063	0.0092	0.0162	-0.0024	YES	7378	0.3253
	(0.83)	(1.11)	(1.14)	(-0.21)	YES		
Finland	-0.0270***	0.0218**	-0.0107	0.0178	YES	6721	0.3229
	(-2.77)	(1.96)	(-0.58)	(0.60)	YES		
France	-0.0111	0.0213***	0.0124	0.0137	YES	28561	0.3517
	(-1.58)	(4.10)	(1.15)	(1.63)	YES		
Germany	-0.0205***	0.0435***	-0.0153	0.0306**	YES	28695	0.2521
	(-2.94)	(4.64)	(-1.21)	(2.18)	YES		
Greece	0.1336***	0.0006	-0.2836***	0.3062***	YES	552	0.3966
	(10.60)	(0.05)	(-14.40)	(13.90)	YES		
Israel							
Italy	-0.0110**	-0.0034	0.0343***	-0.0260**	YES	14187	0.4396
	(-2.02)	(-0.85)	(3.16)	(-2.46)	YES		
Netherlands	-0.0106	0.0195***	-0.0128	0.0206	YES	6017	0.3158
	(-1.28)	(3.00)	(-0.87)	(1.31)	YES		
Norway	-0.0288**	0.0253***	-0.0333**	0.0496***	YES	8132	0.3191
	(-2.05)	(3.26)	(-2.37)	(2.83)	YES		
Portugal	-0.0152	0.0271**	-0.0119	0.0079	YES	2059	0.3972
	(-1.46)	(2.56)	(-0.61)	(0.39)	YES		
Spain	-0.0051	0.0169***	0.0226	-0.0215	YES	6394	0.3441
	(-0.59)	(2.62)	(1.26)	(-1.25)	YES		
Sweden	-0.0154*	0.0308***	-0.0053	0.0226	YES	18681	0.2774
	(-1.81)	(4.54)	(-0.40)	(1.29)	YES		
Switzerland	-0.0337***	0.0021	0.0051	0.0138	YES	10643	0.3631
	(-4.35)	(0.40)	(0.38)	(0.92)	YES		
United Kingdom	-0.0189***	0.0384***	0.0018	0.0145	YES	57631	0.2057
	(-2.77)	(8.81)	(0.24)	(1.51)	YES		
Panel A2: Europe-ME							
Canada							
United States	-0.0175**	0.0147***	-0.0009	0.0071	YES	69634	0.1400
	(-2.04)	(4.57)	(-0.15)	(0.82)	YES		

Table 4.11 (continued)

Panel B: Emerging markets	*VOLA SHOCK*	*SPRS HOCK*	*VOLASHOCK × SPRSHOCK*	*VOLASHOCK × SPRSHOCK × CRISIS*	Controls	Obs	R^2
Panel B1: Asia-Pacific							
China	-0.0043	-0.0025	0.0033	0.0211	YES	71556	0.4588
	(-0.14)	(-1.56)	(0.77)	(1.16)	YES		
India	-0.0043	0.0139***	-0.0121	0.0336	YES	25259	0.5284
	(-0.23)	(5.46)	(-0.64)	(1.40)	YES		
Malaysia	-0.0081	0.0196***	-0.0246***	0.0196*	YES	32511	0.2835
	(-1.35)	(5.60)	(-3.29)	(1.88)	YES		
Pakistan							
Philippines	-0.0327***	-0.0014	-0.0182	0.0088	YES	2829	0.4085
	(-3.55)	(-0.17)	(-0.89)	(0.35)	YES		
Sri Lanka							
Thailand	-0.0119	-0.0065***	-0.0072***	-0.0008	YES	9494	0.3705
	(-1.53)	(-4.40)	(-2.60)	(-0.17)	YES		
Panel B2: Europe-MEA							
Egypt	-0.0349*	0.0111	0.0409**	-0.0189	YES	4448	0.4158
	(-1.92)	(1.11)	(2.23)	(-1.07)	YES		
Poland	-0.0021	0.0223**	-0.0185	0.0226	YES	12365	0.4111
	(-0.18)	(2.35)	(-0.87)	(1.35)	YES		
Romania							
South Africa	-0.0067	0.0032	0.0242***	-0.0132	YES	9841	0.3952
	(-0.53)	(1.26)	(3.16)	(-1.30)	YES		
Turkey	-0.0544***	0.0034	0.0055	0.0311	YES	15733	0.5411
	(-3.79)	(0.37)	(0.44)	(1.28)	YES		
Panel B3: L-America							
Brazil	-0.0426***	0.0275***	-0.0126	0.0275	YES	5779	0.4282
	(-4.88)	(2.77)	(-0.83)	(1.33)	YES		
Chile							
Mexico	-0.0279*	-0.0023	0.0021	-0.0129	YES	2035	0.4064
	(-1.77)	(-0.21)	(0.30)	(-1.32)	YES		
Peru							

4.4.5 Impact of HFT

The presence of high frequency traders tends to exacerbate the effects of market volatility and increases liquidity sensitivity to market volatility (e.g. Chung and Chuwonganant, 2014). Chung and Chuwonganant (2017) use 2005 and 2009 as pre- and

post-periods to test the effects of increased HFT.[42] We extend their work in an international setting. We use the introduction of the Chi-X trading platforms in 15 countries documented in He, Jarnecic, and Liu (2015) as exogenous shocks to HFT and examine whether the volatility-liquidity effect on return is stronger following the introduction of Chi-X. For each of the 15 markets, we use one-year pre- and post-event windows. The regression model is of the form:

$$\begin{aligned} RETURN_{i,t} &= \beta_0 + \beta_1 VOLASHOCK_t + \beta_2 (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \\ &+ \beta_3 VOLASHOCK_t \times (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \\ &+ \beta_4 VOLASHOCK_t \times (AMISHOCK_{i,t} \text{ or } SPRSHOCK_{i,t}) \times CHIX \\ &+ \text{Controls} + \varepsilon_{i,t} \end{aligned} \quad (9)$$

where *CHIX* is a dummy variable set to one for the one-year period following the launch of Chi-X and the control variables are the same as in Equation (6). If the Chi-X launch date is between 2007 and 2009 (financial crisis period), we use 2006 and 2010 as the pre- and post-periods, respectively.

In Table 4.12, we show the interaction term $VOLASHOCK_t \times (AMISHOCK_{i,t}$ or $SPRSHOCK_{i,t}) \times CHIX$ is statistically significant for six (four) out of 15 countries when we measure liquidity based on the Amihud (spread) value. Consistent with prior literature on high frequency traders exacerbating downward movements in prices as well as evidence that HFT facilitates price discovery (e.g. Easley, Lopez de Prado, and O'Hara, 2011; Brogaard, Hendershott, and Riordan, 2014), our results indicate the negative effects of unexpected market volatility shocks on returns through the liquidity channel are magnified when there is more HFT.

[42] Chung and Chuwonganant (2017) use the 1999–2005 period as the pre-HFT period, and 2006–2012 as the post-HFT period for robustness checks.

Table 4.12: Impact of HFT

This table presents the regression results according to Equation (9) over the pre- and post-periods of the Chi-X introduction. Standard errors are clustered by country and time. *t*-Statistics are in parentheses. * = significance at the 0.10 level; ** = significance at the 0.05 level; *** = significance at the 0.01 level.

Panel A: *AMISHOCK*

	VOLA SHOCK	*AMI SHOCK*	*VOLASHOCK* × *AMISHOCK*	*VOLASHOCK* × *AMISHOCK* × *CHIX*	Controls	Obs	R^2
Australia	0.0234	0.1918***	-0.0554	0.1730*	YES	25062	0.3121
	(0.52)	(10.77)	(-0.94)	(1.76)	YES		
Austria	-0.0115*	-0.0057	0.0201	-0.0306	YES	1154	0.4261
	(-1.74)	(-0.45)	(0.68)	(-0.86)	YES		
Belgium	-0.0168	0.0500***	-0.0146	0.0767**	YES	2069	0.3838
	(-1.49)	(4.63)	(-0.58)	(2.27)	YES		
Denmark	-0.0267**	0.0208**	-0.0098	0.0595***	YES	2992	0.3476
	(-2.43)	(2.05)	(-0.53)	(2.76)	YES		
Finland	-0.0291***	0.0381***	-0.024	0.1240***	YES	2666	0.4543
	(-2.77)	(3.40)	(-1.55)	(3.05)	YES		
France	-0.0297***	0.0379**	0.0064	0.0213	YES	11411	0.3539
	(-3.13)	(2.18)	(0.23)	(1.02)	YES		
Germany	-0.0215*	0.0172	-0.0097	0.1194	YES	11320	0.2866
	(-1.96)	(1.11)	(-0.48)	(1.26)	YES		
Japan	-0.0134**	0.0293***	0.0211*	-0.0171	YES	54985	0.2202
	(-2.54)	(7.56)	(1.75)	(-1.29)	YES		
Netherlands	-0.0113	0.0188*	-0.0320***	0.0528*	YES	2287	0.3929
	(-1.33)	(1.86)	(-3.14)	(1.94)	YES		
Norway	-0.0235**	0.0344***	-0.0412***	0.0711***	YES	3303	0.3563
	(-2.04)	(2.59)	(-3.64)	(5.44)	YES		
Portugal	-0.0312**	0.0076	0.0125	-0.0149	YES	815	0.5531
	(-2.06)	(0.86)	(0.48)	(-0.61)	YES		
Spain	-0.0382***	0.0233***	0.0395	-0.0361	YES	2494	0.5298
	(-2.67)	(3.08)	(1.39)	(-1.25)	YES		
Sweden	-0.0195***	0.0636***	-0.0340**	-0.0138	YES	7595	0.2733
	(-3.45)	(4.55)	(-2.36)	(-0.50)	YES		
Switzerland	-0.0167*	0.0636***	-0.0069	-0.0598	YES	4297	0.3042
	(-1.88)	(8.68)	(-0.44)	(-1.60)	YES		
United Kingdom	-0.0307**	0.0886***	-0.0042	0.0243	YES	25542	0.1991
	(-2.02)	(9.70)	(-0.23)	(1.09)	YES		

Table 4.12 (continued)

Panel B: *SPRSHOCK*

	VOLA SHOCK	*SPR SHOCK*	*VOLASHOCK × SPRSHOCK*	*VOLASHOCK × SPRSHOCK × CHIX*	Controls	Obs	R^2
Australia	0.0119	0.0649***	-0.0031	0.0332	YES	17659	0.3194
	(0.45)	(9.27)	(-0.10)	(0.70)	YES		
Austria	-0.0214**	-0.0031	0.0022	0.0482	YES	1028	0.4410
	(-2.91)	(-0.19)	(0.09)	(1.11)	YES		
Belgium	-0.0195	0.0578***	-0.0251**	0.0486**	YES	2057	0.4008
	(-1.32)	(6.16)	(-2.04)	(2.47)	YES		
Denmark	-0.0160*	0.0122	0.0173	-0.0424	YES	2841	0.3546
	(-1.79)	(1.01)	(0.86)	(-1.07)	YES		
Finland	-0.0314***	0.0247***	-0.0196	0.0390	YES	2633	0.4522
	(-2.84)	(3.08)	(-1.43)	(1.44)	YES		
France	-0.0324***	0.0277***	0.0064	0.0231*	YES	11337	0.3691
	(-3.62)	(3.12)	(0.61)	(1.84)	YES		
Germany	-0.0197**	0.0227***	-0.0115	0.0258	YES	10936	0.2739
	(-2.05)	(2.79)	(-1.41)	(0.45)	YES		
Japan	-0.0241**	0.0180***	0.0115	-0.0165	YES	54736	0.2151
	(-2.47)	(3.36)	(0.60)	(-0.72)	YES		
Netherlands	-0.0175**	0.0163***	-0.0160	0.0280*	YES	2298	0.3932
	(-2.18)	(4.59)	(-1.32)	(1.70)	YES		
Norway	-0.0294*	0.0061	-0.0311***	-0.0195	YES	3311	0.3635
	(-1.77)	(0.58)	(-2.70)	(-0.96)	YES		
Portugal	-0.0170	0.0058	-0.0109	0.0360	YES	815	0.5394
	(-1.16)	(0.59)	(-0.42)	(1.43)	YES		
Spain	-0.0334***	0.0262***	0.0180	-0.0205	YES	2529	0.5309
	(-3.72)	(3.35)	(1.21)	(-1.40)	YES		
Sweden	-0.0206**	0.0270***	-0.0011	-0.0027	YES	7370	0.2734
	(-2.18)	(4.05)	(-0.09)	(-0.16)	YES		
Switzerland	-0.0241**	-0.004	0.0178	-0.0382**	YES	4302	0.3800
	(-2.14)	(-0.45)	(1.30)	(-2.11)	YES		
United Kingdom	-0.0300***	0.0445***	-0.0014	0.0211*	YES	22304	0.1927
	(-2.61)	(11.96)	(-0.22)	(1.67)	YES		

4.5 Conclusions

Volatility, liquidity, and returns are of importance to market participants and regulators. We use 37,677 stocks in 41 markets to document that liquidity is a key channel through which unexpected changes in market volatility affect stock returns, and highlight the importance of liquidity providers in determining security returns. More importantly, we answer the question of whether market-specific characteristics affect the influence of the liquidity channel through which market volatility affects returns.

In Chung and Chuwonganant (2017), market volatility affects stock returns directly, as well as indirectly, through liquidity, in the US markets. Using an approach similar to that in Chung and Chuwonganant (2017), we show across six geographical regions around the globe, that returns are significantly lower for stocks with greater liquidity sensitivity to market volatility, after controlling for other stock- and market-level determinants of stock returns, such as stock idiosyncratic volatility, trading volume, stock past returns, market returns, and market liquidity.

Overall, our results indicate country governance, as a proxy for investor protection, is a key determinant of the role of the liquidity channel. Our results also show market volatility exerts stronger effects on returns via liquidity when the level of market volatility is higher, and in markets with lower trading value and no short selling constraints. In addition, we find that the influence of this liquidity channel that links market volatility and returns is greater during the financial crisis period, and when there are no market makers as intermediaries and more HFT.

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STATEMENT OF CONTRIBUTION TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Rui Ma

Name/Title of Principal Supervisor: Professor Hamish Anderson

Name of Published Research Output and full reference:

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Please indicate either:

- The percentage of the Published Work that was contributed by the candidate:

  and / or

- Describe the contribution that the candidate has made to the Published Work:

  Rui Ma collected, collated and cleaned the datasets before completing all the empirical analysis. Rui Ma then wrote the draft working paper and completed subsequent revisions before publication acceptance at the Pacific-Basin Finance Journal.

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26/04/2018

Date

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23/4/18

Date

CHAPTER 5

ESSAY FOUR

This chapter presents the final essay of the thesis, which investigates various aspects of the market liquidity and trading activity in China over the past 20 years. Section 5.1 provides an overview of the essay and discusses the motivations to examine the Chinese market liquidity and trading activity. Section 5.2 presents the institutional background. Section 5.3 describes the data and the liquidity and trading activities metrics. The empirical findings are shown in Section 5.4. This chapter concludes in Section 5.5. An appendix to this chapter and the essay's reference list are provided at the end of the thesis.

Stock Market Liquidity and Trading Activity: Is China Different?

Abstract

We study market-wide liquidity and trading activity in China. Trading activity increases in up markets more than in down markets, which is consistent with the disposition effect and the large number of unsophisticated retail investors in China. Whereas, on average, liquidity and trading activity are lower around holidays, in more recent times, trading activity has been significantly lower before holidays and higher afterward. Aggregate short selling and margin trading activity boost trading activity, but short selling also increases spreads, indicating lower liquidity. We also document the increased influence of global factors in China.

JEL Classification Codes: G12; G15; G18

Keywords: Liquidity, trading activity, volume, stock market, China

5.1 Introduction

Liquidity is an important aspect of financial markets for investors, researchers, and regulators. Reduced liquidity provision is widely cited as an important catalyst of the 2007–2009 financial crisis (e.g. Nagel, 2012; Rosch and Kaserer, 2013). Emerging markets have historically had lower liquidity than their developed market counterparts (e.g. Fong, Holden, and Trzcinka, 2017), but this may have changed as the markets have become more integrated.

We investigate the level, volatility, autocorrelation, and determinants of time-varying market liquidity in China, the largest emerging market, over the last 20 years. In addition to its importance to the global economy, China is an interesting market in which to consider liquidity and trading activity, since a number of the market's features differentiate it from other markets, such as the United States.[43] First, despite the steadily growing influence of institutional investors in China, the Chinese stock market is still dominated by retail investors exhibiting behavioural biases (e.g. Xu, 2000; Yao, Ma, and He, 2014; Hilliard and Zhang, 2015), while, in mature markets, institutional investors are the key players (e.g. Shih, Chang, and Chen, 2008). Second, short selling was prohibited, and has been allowed only for selected stocks since March 2010. Prior studies, such as Charoenrook and Daouk (2005) and Beber and Pagano (2013), show short selling bans distort trading volume and liquidity. Third, weaker investor protection regulation is likely to result in more information asymmetry, which is an important determinant of liquidity (e.g. Frijns, Gilbert, and Tourani-Rad, 2008). Fourth, Chinese listed firms, especially large firms, tend to have a high level of non-tradable state ownership; state owners tend

[43] The impressive growth in the Chinese equity market with its unique features has recently attracted increased research interest on the comparison between the Chinese and US benchmark results and on the question of whether the classic theories stemming from the US can be applied in the Chinese market (e.g. Titman, Wei, and Zhao, 2016; Cheema and Nartea, 2017).

to have low incentive to actively trade unrestricted stocks and/or provide liquidity.[44] Fifth, China has experienced a number of policy changes and reforms aimed at reducing market fragmentation and improving its market liquidity and efficiency. For instance, China opened the foreign B-share market to domestic investors in February 2001 (e.g. Lee and Wong, 2012) and allowed qualified foreign institutional investors (QFII) to invest in the domestic A-share market in December 2002 (e.g. Ding, Nisson, and Suardi, 2017). China's Split-share Structure Reform was launched in April 2005, converting non-tradable A-shares into tradable shares (e.g. Liao, Liu, and Wang, 2014). In March 2010, China started allowing short selling and margin trading on selected stocks (e.g. Chang, Luo, and Ren, 2014). According to World Bank data,[45] the total value of stocks traded in China increased 506-fold, from US$77.5 billion in 1995 to US$39.3 trillion in 2015, compared to a seven-fold increase, from US$5.1 trillion to US$41.4 trillion, in the US market over the same period.

Our work, which follows an approach similar to that of Chordia, Roll, and Subrahmanyam (2001), makes several contributions. First, a body of literature has emerged documenting the different characteristics and trading behaviour of retail and institutional investors (e.g. Kelly and Tetlock, 2017). We add to this strand of research by investigating market-wide liquidity and trading activity in China's retail investor-dominated stock market. Following the approach of Chordia, Roll, and Subrahmanyam (2001), we find trading activity in China increases more in up markets than in down markets. This finding contrasts with the authors' US evidence, where trading activity reacts symmetrically in up and down markets. However, it is consistent with the literature on investor sophistication and the disposition effect. The disposition effect suggests

[44] See Peng, Wei, and Yang (2011) for discussion on the ownership of Chinese listed firms.
[45] See http://www.worldbank.org.

investors hold loser stocks longer than winner stocks and prior research also shows less sophisticated investors exhibit a greater disposition effect (e.g. Dhar and Zhu, 2006). While, on average, liquidity and trading activity are lower around holidays, we show that, in more recent times, trading activity is significantly lower immediately prior to holidays and higher afterward. The opposite effects between the days prior to and after holidays support the argument of Meneu and Pardo (2004), that retail investors are reluctant to buy before holidays.

We also add to the literature on short selling and margin trading activities in China. Chang, Luo, and Ren (2014) and Zhao, Li, and Xiong (2014) find stock price efficiency increases and return volatility decreases after short selling and margin trading bans are lifted. Chen, Kadapakkam, and Yang (2016) provide evidence that short sellers and margin traders in China anticipate forthcoming news and help incorporate information into stock prices more efficiently. Sharif, Anderson, and Marshall (2014) show stock liquidity declines when short selling bans are lifted. Their reasoning is that uninformed investors avoid trading with informed investors and therefore withdraw liquidity from shortable stocks. In contrast to prior studies, which typically investigate stock prices and/or the liquidity of relatively small samples of stocks over a short time, we use a sample period of 1995–2016 and provide empirical evidence on the effects of aggregate short selling and margin trading activity on aggregate market liquidity and trading activity. While aggregate short selling and margin trading improve market trading activity, aggregate short selling also increases spreads, indicating lower liquidity. The detrimental effect of short selling on spreads in China is inconsistent with the developed market evidence (e.g. Beber and Pagano, 2013), but it is supportive of the idea that short sellers in China are informed investors (e.g. Chang, Luo, and Ren, 2014) and, accordingly, their trading increases the information asymmetry component of the spreads.

Earlier research on time-series changes in the Chinese market liquidity uses monthly turnover and turnover–volatility ratios as liquidity proxies (e.g. Gao and Kling, 2006). Fong, Holden, and Trzcinka (2017) investigate low-frequency liquidity proxies for international equity markets and show that the Amihud (2002) ratio is the best low-frequency price impact proxy and the closing percent quoted spread of Chung and Zhang (2014) is the best low-frequency spread proxy to capture the percent cost dimension of liquidity. We therefore use the Amihud (2002) ratio and the closing percent quoted spread of Chung and Zhang (2014) to measure the price impact and percent cost dimensions of liquidity, respectively; we use share volume and trading value to measure trading activity. In addition, we consider the role of global factors and document their increased influence in China. We conduct our analysis for the entire Chinese market as a whole and for five subgroups of stocks: (1) Shanghai A shares, (2) Shanghai B shares, (3) Shenzhen A shares excluding ChiNext (the Growth Enterprise Board of the Shenzhen Stock Exchange) shares, (4) Shenzhen B shares, and (5) ChiNext shares.

The remainder of this paper proceeds as follows. Section 5.2 describes the data and our liquidity and trading activity measures. The core results are set forth in Section 5.3. Section 5.4 presents our conclusions.

5.2 Institutional background

The Chinese stock market consists of two main exchanges: the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE), both established in early 1990s. Two share classes are traded on the exchanges. The A shares are denominated in Chinese Yuan and predominantly traded by domestic retail investors, while B shares are priced in US and Hong Kong dollars, and traded exclusively by foreign investors until

February 2001 when the Chinese government allowed domestic residents to invest in B shares.

Other regulatory changes launched to remove barriers to capital participation have been enacted. For example, the QFII program, designed to allow qualified foreign institutions' direct access to the capital market in China, came into effect in December 2002. The total QFII quota has been expanded from the program's initial US$4 billion to US$87.3 billion by the end of 2016 (China Daily, 2016). In April 2005, the Split-Share Structure Reform was initiated with an aim to convert all non-tradable shares (including non-tradable state-owned shares) into tradable shares (Liao, Liu, and Wang, 2014). In March 2010, the removal of short selling and margin trading bans on 90 selected stocks marked the first time for short selling and margin trading to take place in China's equity market (Chen, Kadapakkam, and Yang, 2016). The number of stocks eligible for short selling and margin trading reached 700 by March 2014 (Li, Li, Li, and Wu, 2016). In addition, the Shanghai-Hong Kong Stock Connect was launched in November 2014. The program provides an investment channel through which investors in the Chinese and Hong Kong stock markets can trade eligible stocks listed on the other market through their local exchange (Huo and Ahmed, 2017).

5.3 Data and liquidity and trading measures

Our sample consists of all stocks listed on the SSE and SZSE between January 1995 and June 2016. We source stock data on the total return index (RI), stock prices (P and UP), shares outstanding (NOSH), trading volume (VO), closing bid (PB), and ask prices (PA) from Thomson Reuters Datastream. Following Yao, Ma, and He (2014), we obtain all stock data in Chinese yuan (CNY). We follow Amihud, Hameed, Kang, and Zhang (2015) in handling data errors in Datastream. We set daily returns as missing if

they are greater than 200% or if $(1 + r_{i,d})\times(1 + r_{i,d-1}) - 1 \leq 50\%$, where $r_{i,d}$ is the return of stock i on day d and at least either $r_{i,d}$ or $r_{i,d-1}$ is greater than 100%. Daily returns are calculated using the individual stock total return index, which controls for stock splits and dividends and is reported to the nearest hundredth. To avoid rounding errors, we set daily returns as missing if the return index for the previous or the current day is less than 0.01. We exclude non-trading days defined as days on which more than 90% of stocks have zero returns. Data on one-year loan prime rates and term spreads are from the People's Bank of China and the Asian Development Bank.[46] Macroeconomic announcements dates over 2000–2016 are sourced from Bloomberg. In addition, we obtain daily short selling and margin trading data from Chinese Securities Market and Accounting Research (CSMAR).

Whereas earlier studies often describe liquidity as an elusive concept, more recent research has established standard liquidity measures. We follow Amihud, Hameed, Kang, and Zhang (2015) and use Amihud's (2002) ratio as our first liquidity measure. The daily Amihud (2002) measure is defined as:

$$Amihud_t = \frac{|r_t|}{volume_t} \tag{1}$$

where r_t is the return on day t and $volume_t$ is the dollar volume on day t. We remove stocks with Amihud (2002) values in the top 1% each day. We also remove stocks priced in the top or bottom 1% of the cross section.[47]

[46] See www.pbc.gov.cn/zhengcehuobisi/125207/125213/125440/125838/125888/2968985/index.html (in Chinese) and asianbondsonline.adb.org/china/data.php.

[47] For consistency, we exclude stocks priced in the top or bottom 1% of the cross section when calculating other liquidity and trading activity variables.

According to Fong, Holden, and Trzcinka (2017), the closing percent quoted spread from Chung and Zhang (2014) is the best spread proxy for capturing changes in effective and quoted spreads. The closing percent quoted spread (*Spread*) of stock *i* on day *t* is defined as:

$$Spread_{i,t} = \frac{Ask_{i,t} - Bid_{i,t}}{M_{i,t}} \quad (2)$$

where $Ask_{i,t}$ is the closing ask price of stock *i* on day *t*, $Bid_{i,t}$ is the closing bid price of stock *i* on day *t*, and $M_{i,t}$ is the mean of $Ask_{i,t}$ and $Bid_{i,t}$. We exclude negative spreads and, following Chung and Zhang (2014), we drop all closing percent quoted spreads that are greater than 50% of the quote midpoint.

We calculate the market share volume and trading value as proxies for stock trading activity. We assign a value of zero for the share volume and trading value if a stock does not trade on a given day.[48] To construct reliable market-level measures for each of the above liquidity and trading activity variables, we require a minimum number of 10 stocks on a given day; we then equal- and value-weight each stock's daily liquidity and trading activity on its market capitalisation of the previous day. Similar to Chung and Chuwonganant (2014), we take the log of our liquidity and trading activity measures.[49] Following Chordia, Roll, and Subrahmanyam (2001) and Brockman, Chung, and Perignon (2009), we use the equal-weighted measures for our core results.[50]

[48] This method is not applied to the Amihud (2002) and spread measures, since a stock that does not trade on a given day does not have an Amihud ratio (2002) or spread value of zero.
[49] In contrast to the results of Chordia, Roll, and Subrahmanyam (2001), we find positive skewness for all the liquidity and trading activity measures. We therefore use log-scaled measures and include summary statistics for the original values in Appendix D.1.
[50] The value-weighted results are similar to the equal-weighted results we report.

5.4 Results

5.4.1 Summary statistics of market liquidity and trading activity

Table 5.1 presents summary statistics for the log-scaled market liquidity and trading activity measures for the entire market and for each of our five subgroups. A-share markets, on average, are more liquid and have higher price levels and trading activity than B-share markets do. The average liquidity and trading activity of ChiNext are higher than for the other subgroups, at least partly because ChiNext was launched more recently, in October 2009. Figures 5.1 and 5.2 indicate the Amihud (2002) and spread measures have declined over time, while the dollar volume and share volume have gradually increased. There is a significant increase around the 2007–2009 crisis period in both figures, indicating an increase in trading activity and a decrease in market liquidity. The number of listed stocks steadily increases (Figure 5.3) and remains almost constant between 2004 and 2006, 2008 and 2009, and 2012 and 2013, coinciding with periods of moratorium for IPOs in China. Driven largely by the establishment of ChiNext, the period between October 2009 and June 2012 saw a relatively rapid growth in the number of stocks.

We present summary statistics for the absolute log differences for all the variables[51] in Table 5.2. Panel A's results for the entire market suggest that the average absolute daily percentage changes in the Amihud (2002) ratio, spread, share volume, and trading value are 50.77%, 12.02%, 17.70%, and 17.67%, respectively. Consistent with Chordia, Roll, and Subrahmanyam (2001), we find greater volatility in the share volume and trading value than in the spread measure. The average absolute daily percentage

[51] While reducing the influence of outliers, log differences in the variables are approximately equal to the daily percentage changes in these variables.

change in prices is around 1.38%, indicating the volatility of price is markedly lower compared to other liquidity and trading activity proxies but higher than the 0.56% in the United States (Chordia, Roll, and Subrahmanyam, 2001). Consistent with the results in Table 5.1, we find greater volatility in B shares than in A shares.

Table 5.1:Descriptive statistics of market liquidity and trading activity
This table presents summary statistics for the following log-scaled market liquidity and trading activity measures: the Amihud (2002) ratio, spread, price (CNY), share volume (millions), and trading value (millions of CNY). Panel A shows the results for the entire market. Panels B to F show the results for the following five subgroups of stocks: (1) Shanghai A shares, (2) Shanghai B shares, (3) Shenzhen A shares excluding ChiNext shares, (4) Shenzhen B shares, and (5) ChiNext shares.

	No. of stocks	Amihud	Spread	Price	Share volume	Trading value
Panel A: Full sample						
Mean	1572	-7.5524	-5.9383	1.7566	1.7431	3.3283
SD	717	1.9417	0.7135	0.5285	0.9345	1.3533
Median	1459	-7.8949	-6.0518	1.8190	1.8541	3.2889
Minimum	343	-11.0983	-7.2982	0.5800	-4.9015	-3.4429
Maximum	2891	-0.5940	-2.4434	3.2730	3.9810	6.6780
Panel B: Shanghai A shares						
Mean	709	-8.6321	-6.1656	1.7942	1.8959	3.4939
SD	255	1.3048	0.3935	0.4920	1.0084	1.4160
Median	823	-8.5979	-6.1943	1.8692	1.9944	3.3816
Minimum	169	-11.8776	-7.1957	0.7516	-4.3823	-2.8062
Maximum	1072	-2.1200	-4.4763	3.1860	4.4649	7.1164
Panel C: Shanghai B shares						
Mean	50	-6.3155	-5.0573	1.0825	-0.0991	0.9315
SD	5	1.9370	1.0187	0.6395	0.8673	1.2660
Median	52	-6.7178	-5.4075	1.2488	-0.1489	0.9377
Minimum	33	-10.5437	-6.8755	-0.6116	-4.7946	-3.6680
Maximum	52	-0.4415	-2.0462	2.4433	3.4568	5.1011
Panel D: Shenzhen A shares						
Mean	665	-8.5827	-6.2547	1.7760	1.6707	3.2627
SD	339	1.2422	0.5102	0.5367	0.9376	1.3392
Median	530	-8.6207	-6.2507	1.8349	1.8011	3.3168
Minimum	118	-11.6593	-7.5849	0.4231	-5.9956	-5.1758
Maximum	1236	-1.9514	-2.5516	3.2358	4.6942	6.5097
Panel E: Shenzhen B shares						
Mean	51	-5.8196	-4.9488	1.2254	-0.1459	0.8902
SD	7	2.0193	0.9080	0.5794	1.0104	1.3518
Median	53	-6.3559	-5.2078	1.2792	-0.1022	1.1131
Minimum	23	-10.1942	-6.8709	-0.2921	-6.9728	-6.7181
Maximum	58	1.1903	-0.7499	2.4193	5.7340	5.7842
Panel F: ChiNext shares						
Mean	314	-9.3651	-6.8769	2.3435	2.0018	4.2035
SD	132	0.9645	0.4110	0.5041	0.4386	0.8259
Median	355	-9.4660	-6.8494	2.2426	2.0337	4.1315
Minimum	28	-11.6674	-8.8691	1.5403	0.6997	2.4473
Maximum	493	-4.0816	-5.7573	3.6232	3.3267	6.1798

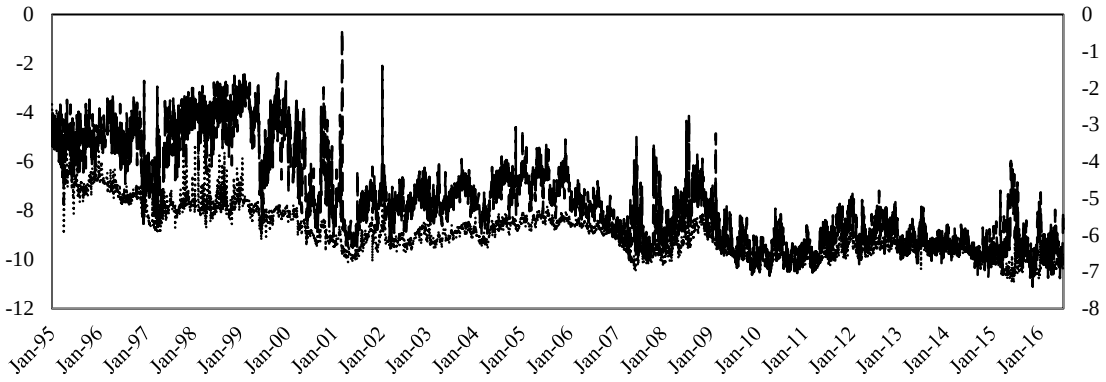

Figure 5.1: Average log Amihud (2002) ratios and closing percent quoted spreads

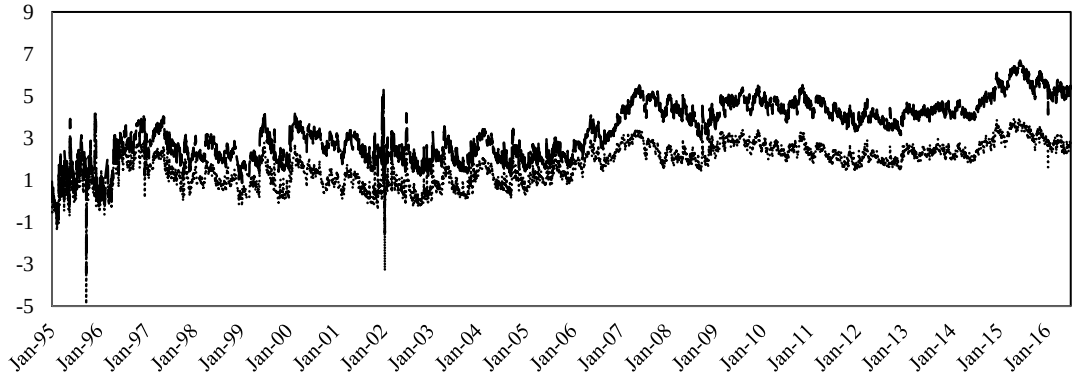

Figure 5.2: Average log dollar volume and share volume

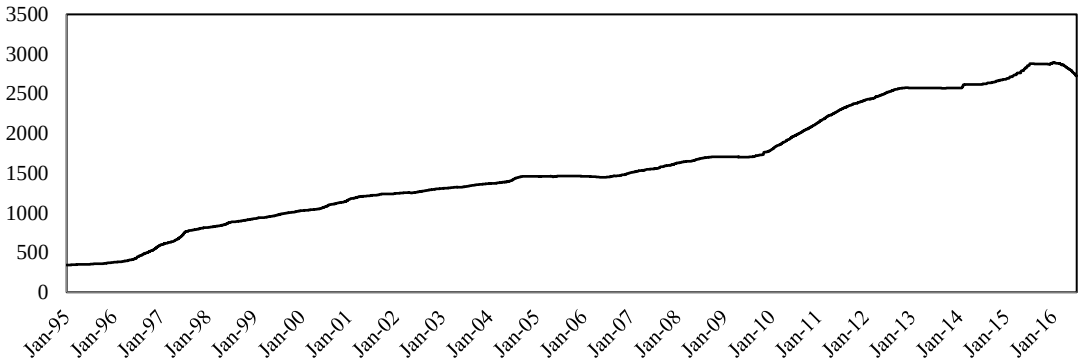

Figure 5.3: Number of stocks for the entire sample

Table 5.2: Absolute log differences in market liquidity and trading activity

This table presents summary statistics for the absolute values of log differences in market liquidity and trading activity. Panel A contains the results for the entire market. Panels B to F contain the results for the following five subgroups of stocks: (1) Shanghai A shares, (2) Shanghai B shares, (3) Shenzhen A shares excluding ChiNext shares, (4) Shenzhen B shares, and (5) ChiNext shares.

	Market liquidity		Trading activity		
	|ΔAmihud|	|ΔSpread|	|ΔPrice|	|ΔShare volume|	|ΔTrading value|
Panel A: Full sample					
Mean	0.5077	0.1202	0.0138	0.1770	0.1767
SD	0.4984	0.1526	0.0141	0.2310	0.2232
Median	0.3767	0.0803	0.0098	0.1278	0.1264
Panel B: Shanghai A shares					
Mean	0.4184	0.1116	0.0138	0.1883	0.1876
SD	0.3915	0.1185	0.0146	0.2342	0.2272
Median	0.3166	0.0793	0.0096	0.1354	0.1361
Panel C: Shanghai B shares					
Mean	0.5869	0.1998	0.0145	0.3219	0.3223
SD	0.5002	0.1666	0.0167	0.2991	0.3004
Median	0.4679	0.1597	0.0089	0.2540	0.2509
Panel D: Shenzhen A shares					
Mean	0.4117	0.1389	0.0142	0.1748	0.1751
SD	0.3907	0.2544	0.0147	0.2459	0.2422
Median	0.3066	0.0812	0.0100	0.1261	0.1263
Panel E: Shenzhen B shares					
Mean	0.5740	0.1925	0.0142	0.3277	0.3287
SD	0.5596	0.1818	0.0167	0.3539	0.3551
Median	0.4258	0.1490	0.0088	0.2419	0.2402
Panel F: ChiNext shares					
Mean	0.5127	0.2092	0.0179	0.1479	0.1495
SD	0.4578	0.1709	0.0157	0.1338	0.1346
Median	0.4101	0.1744	0.0136	0.1164	0.1158

5.4.2 Correlations and autocorrelations of market liquidity and trading activity

In Table 5.3, we report the correlations between simultaneous log differences in market liquidity and trading activity variables. As expected, we find negative correlations between (il)liquidity and trading activity measures. In Panel A, the correlation between the Amihud (2002) and spread measures is positive but low, at 0.1270, ranging from 0.0661 to 0.1856 for five subgroups in Panels B through F. The trading volume and share volume co-vary closely and the correlation is as high as 0.9848 for the entire market and above 0.97 for all five subgroups of stocks.

Table 5.4 presents the first- to fifth-order autocorrelations for each of the five variables in Table 5.3. We show statistically significant negative autocorrelations in the log differences of the Amihud (2002) ratio, spread, share volume, and trading value, suggesting that daily changes in these variables are likely to be stationary. In addition, we find a significant positive first-order autocorrelation in market prices.[52]

5.4.3 Market liquidity and trading activity determinants

To examine the determinants of daily changes in market liquidity and trading activity, we first follow Chordia, Roll, and Subrahmanyam (2001) and estimate our baseline regression as per Equations (3) and (4). We use the Cochrane–Orcutt (1949) procedure to correct for first-order serial dependence in the residuals:

$$\Delta MKTILLQ_t = \alpha_0 + \beta' X_t + \sum_{i=1}^{4} \alpha_{1i} DAY_{it} + \alpha_2 HOLI_t + \alpha_3 GDP_t + \alpha_4 GDP(1\text{-}2)_t + \alpha_5 CPI_t + \alpha_6 CPI(1\text{-}2)_t + \varepsilon_t \quad (3)$$

$$\Delta TRADING_t = \alpha_0 + \beta' X_t + \sum_{i=1}^{4} \alpha_{1i} DAY_{it} + \alpha_2 HOLI_t + \alpha_3 GDP_t + \alpha_4 GDP(1\text{-}2)_t + \alpha_5 CPI_t + \alpha_6 CPI(1\text{-}2)_t + \varepsilon_t \quad (4)$$

where $\Delta MKTILLQ$ is the log difference (denoted by Δ) in market (il)liquidity measured by either the Amihud (2002) or the spread values and $\Delta TRADING$ is the log difference in trading activity measured by either the share volume or trading value. We conduct augmented Dickey–Fuller tests to ensure the log differences in our liquidity and trading activity variables are stationary.

[52] Greater price dependency implies a less efficient price discovery process.

The term X_t represents a set of potential time-varying determinants of daily variations in market liquidity and trading activity, including $MKT\_RET^+_t$, $MKT\_RET^-_t$, $MA\_MKT^+_t$, $MA\_MKT^-_t$, MA_ABMKT_t, $\Delta PRIME\_RATE_t$, and $\Delta TERM\_SPR_t$. The variables MKT_RET^+ and MKT_RET^- are the signed concurrent market returns; MA_MKT^+ and MA_MKT^- are the signed five-day moving averages of past market returns; *MA_ABMKT* is the past five-day average of absolute market returns used as a proxy for market volatility; $\Delta PRIME\_RATE$ and $\Delta TERM\_SPR$ are the daily changes in the one-year loan prime rate and term spread, respectively; DAY_{it} is the day of the week dummies for Monday through Thursday; and $HOLI_t$ is a dummy variable set to one for days immediately preceding and following holiday closures.

According to Chordia, Roll, and Subrahmanyam (2001) and Brockman, Chung, and Perignon (2009), market liquidity and trading activity increase prior to scheduled macroeconomic announcements. We include dummy variables to capture pre-announcement portfolio rebalancing. The variables GDP_t and $GDP(1\text{-}2)_t$ are dummies set to one for the gross domestic product (GDP) announcement dates and for two trading days prior to GDP announcements. The variables CPI_t and $CPI(1\text{-}2)_t$ are defined as for *GDP*, but for Consumer Price Index (CPI) announcements. The description and data sources of the variables used in the analysis are provided in Table 5.5.

We estimate Equations (3) and (4) for the entire sample and for five subsamples of stocks. In Table 5.6, we present only the regression results for the entire market for brevity. Our findings hold for subsamples and the results are contained in Appendixes D.2 and D.3 for the SSE and SZSE, respectively. With all the explanatory variables included in regressions, the adjusted R^2 values range from 0.1675 to 0.6200, suggesting

Table 5.3: Correlations of simultaneous market liquidity and trading activity

This table presents the correlations between simultaneous log differences in market liquidity and trading activity measures. Panel A contains the results for the entire market. Panels B to F contain the results for the following five subgroups of stocks: (1) Shanghai A shares, (2) Shanghai B shares, (3) Shenzhen A shares excluding ChiNext shares, (4) Shenzhen B shares, and (5) ChiNext shares.

	Market liquidity		Trading activity	
	ΔAmihud	ΔSpread	ΔPrice	ΔShare volume
Panel A: Full sample				
ΔSpread	0.1270			
ΔPrice	-0.1900	-0.4226		
ΔShare volume	-0.0761	-0.0398	0.1827	
ΔTrading value	-0.0936	-0.0735	0.2610	0.9848
Panel B: Shanghai A shares				
ΔSpread	0.1856			
ΔPrice	-0.2925	-0.4760		
ΔShare volume	-0.0599	-0.0051	0.1982	
ΔTrading value	-0.0887	-0.0417	0.2741	0.9824
Panel C: Shanghai B shares				
ΔSpread	0.0661			
ΔPrice	-0.1823	-0.3414		
ΔShare volume	-0.1587	-0.1252	0.1099	
ΔTrading value	-0.1607	-0.1369	0.1563	0.9763
Panel D: Shenzhen A shares				
ΔSpread	0.0812			
ΔPrice	-0.3265	-0.2431		
ΔShare volume	-0.1581	-0.0322	0.1897	
ΔTrading value	-0.1825	-0.0519	0.2634	0.9884
Panel E: Shenzhen B shares				
ΔSpread	0.0683			
ΔPrice	-0.2118	-0.3011		
ΔShare volume	-0.1925	-0.1103	0.1141	
ΔTrading value	-0.1874	-0.1128	0.1544	0.9703
Panel F: ChiNext shares				
ΔSpread	0.0665			
ΔPrice	-0.1822	-0.6099		
ΔShare volume	0.0588	-0.0049	0.1725	
ΔTrading value	0.0337	-0.0903	0.2949	0.9827

that these variables explain 16.75% to 62.00% of the variation in market liquidity and trading activity. Consistent with Chordia, Roll, and Subrahmanyam (2001), on average, our liquidity measures respond to negative market returns more than to positive market returns. The trading activity results indicate the share volume and trading value are significantly higher when there are larger positive or negative market returns; however,

Table 5.4: Autocorrelations of market liquidity and trading activity

This table presents the first- to fifth-order autocorrelations for each of the variables contained in Table 5.3. Autocorrelations that are statistically significant at the 0.0001 level are in bold. Panel A contains the results for the entire market. Panels B to F contain the results for the following five subgroups of stocks: (1) Shanghai A shares, (2) Shanghai B shares, (3) Shenzhen A shares excluding ChiNext shares, (4) Shenzhen B shares, and (5) ChiNext shares.

	Order (lag in daily observations)				
	1	2	3	4	5
Panel A: Full sample					
ΔAmihud	**-0.4223**	0.0142	-0.0554	0.0244	-0.0395
ΔSpread	**-0.3636**	**-0.0792**	-0.0106	0.0006	-0.0190
ΔPrice	**0.0724**	-0.0015	0.0316	0.0415	0.0017
ΔShare volume	**-0.2250**	**-0.0604**	**-0.0588**	-0.0157	-0.0009
ΔTrading value	**-0.1785**	**-0.0820**	**-0.0614**	-0.0206	0.0036
Panel B: Shanghai A shares					
ΔAmihud	**-0.4111**	-0.0056	-0.0347	0.0152	0.0073
ΔSpread	**-0.3632**	**-0.0934**	0.0389	-0.0434	-0.0063
ΔPrice	**0.0677**	-0.0042	0.0189	0.034	0.0032
ΔShare volume	**-0.2404**	**-0.0607**	**-0.0601**	-0.0103	0.004
ΔTrading value	**-0.1928**	**-0.0854**	**-0.0586**	-0.0171	0.0047
Panel C: Shanghai B shares					
ΔAmihud	**-0.4519**	0.0037	-0.0029	-0.0516	0.0449
ΔSpread	**-0.4227**	-0.0204	-0.0251	0.0019	0.0040
ΔPrice	**0.1292**	-0.0053	0.0375	0.0340	0.0217
ΔShare volume	**-0.2595**	**-0.1050**	-0.0373	-0.0400	0.0005
ΔTrading value	**-0.2537**	**-0.1001**	-0.0374	-0.0408	-0.0008
Panel D: Shenzhen A shares					
ΔAmihud	**-0.3964**	0.0011	-0.0292	0.0105	-0.0063
ΔSpread	**-0.3720**	**-0.1234**	-0.0112	0.0367	-0.0021
ΔPrice	**0.0746**	0.0026	0.0340	0.0469	-0.0012
ΔShare volume	**-0.2154**	**-0.0707**	-0.0474	-0.0111	-0.0269
ΔTrading value	**-0.1897**	**-0.0758**	-0.0424	-0.0146	-0.0251
Panel E: Shenzhen B shares					
ΔAmihud	**-0.3929**	-0.0311	-0.0102	-0.0108	-0.0035
ΔSpread	**-0.3639**	-0.0622	0.0143	-0.0137	-0.0054
ΔPrice	**0.1137**	0.0246	**0.0744**	**0.0574**	0.0346
ΔShare volume	**-0.2646**	**-0.0900**	-0.0208	-0.0264	-0.0111
ΔTrading value	**-0.2602**	**-0.0821**	-0.0333	-0.0226	-0.0016
Panel F: ChiNext shares					
ΔAmihud	**-0.2850**	-0.1017	-0.0270	0.0081	-0.0140
ΔSpread	**-0.3705**	**-0.1190**	0.0515	-0.0125	-0.0497
ΔPrice	**0.0973**	-0.0244	0.0423	0.0264	-0.0045
ΔShare volume	**-0.2383**	**-0.1392**	0.0013	0.0026	-0.0530
ΔTrading value	**-0.2014**	**-0.1443**	0.0040	0.0024	-0.0606

Table 5.5: Variable definitions
This table defines the explanatory variables in the time-series regressions.

Determinants of liquidity	
MKT_RET+	The concurrent market return if positive and zero otherwise. Source: Datastream.
MKT_RET-	The concurrent market return if negative and zero otherwise. Source: Datastream.
MA_MKT+	The market return of the past five trading days if positive and zero otherwise. Source: Datastream.
MA_MKT-	The market return of the past five trading days if negative and zero otherwise. Source: Datastream.
MA_ABMKT	The average of absolute market returns of the past five trading days. Source: Datastream.
Δ*PRIME_RATE*	China's one-year loan prime rate. Source: People's Bank of China and Datastream.
Δ*TERM_SPR*	The difference between the 10- and 2-year benchmark bond yields. Source: Asian Development Bank.
DAYi	Day of the week dummies for Monday through Thursday.
HOLI	A dummy variable set to 1 for the days immediately preceding and/or following holidays (including New Year, Spring Festival, Qingming Festival, Labor Day, Dragon Boat Festival, Mid-Autumn Festival, and National Day).
GDP	A dummy variable set to 1 for GDP announcement dates. Source: Bloomberg.
GDP(1-2)	A dummy variable set to 1 for two trading days prior to a GDP announcement. Source: Bloomberg.
CPI	A dummy variable set to 1 for CPI announcement dates. Source: Bloomberg.
CPI(1-2)	A dummy variable set to 1 for two trading days prior to a CPI announcement. Source: Bloomberg.
Δ*SHORT_SELL*	Total volume of the underlying securities sold by credit traders through securities lending. Source: CSMAR.
Δ*MARGIN_TRAD*	Total value of the underlying securities bought by credit traders through margin trading. Source: CSMAR.

trading activity reacts to positive returns more than to negative returns. We show a change in the share volume of 8.62% (0.08615) and a change in trading value of 9.58% (0.09584) for a one standard deviation increase in a positive market return, whereas a one standard deviation decrease in a negative market return leads to a 2.98% (0.02979) increase in the share volume and a 1.62% (0.01615) increase in trading value. The finding is inconsistent with the US evidence that shows trading activity responds symmetrically to positive and negative returns (Chordia, Roll, and Subrahmanyam, 2001). However, provided that the Chinese stock market is well known for its dominance of unsophisticated individual investors (e.g. Chen, Cai, and Ho, 2009), our results are supportive of the literature on investor sophistication and the disposition effect. The disposition effect states investors tend to hold loser stocks longer than winner stocks and prior research, such as the study of Dhar and Zhu (2006), shows that less sophisticated investors exhibit a greater disposition effect. Our conjecture is further supported by the subsample results in Appendixes D.2 and D.3 showing that the asymmetric effects of positive and negative

market-wide returns on market liquidity are stronger in the A-share markets which are dominated by relatively unsophisticated individual investors, than in the foreign institutional investors dominated B-share markets. Moreover, we find positive market returns exert a stronger impact in the SSE than the SZSE, which is consistent with Tan, Chiang, Mason, and Nelling (2008) providing evidence that herding behaviour is greater in the Shanghai market and in rising markets.

Our finding also supports the arguments of Wang and Cheng (2004). As those authors note, a large volume of winner stocks would indicate that relatively irrational investors dominate the market, while a large volume of loser stocks is less likely to be caused by irrational investors in the presence of short selling constraints.[53] To assess the extent to which the asymmetric response of trading activity to market returns is due to short selling and margin trading bans, we re-estimate our regressions in Table 5.6 for the post-March 2010 period, when short selling and margin trading bans were lifted for selected stocks, and report the regression results in Appendix D.4. While both positive and negative market returns exert stronger effects on market trading activity, our results indicate the response of trading activity to market returns becomes less asymmetric when short selling and margin trading bans are lifted.

[53] China started allowing short selling and margin trading only after March 2010.

Table 5.6: Time-series regressions

Panel A presents our baseline time-series regression results for the entire market. The results for our subgroups are similar and reported in Appendixes D.2 and D.3 for the Shanghai Stock Exchange and Shenzhen Stock Exchange, respectively. Independent variables are as defined in Table 5.5. In Panel B, we test whether the days preceding holidays and the days following holidays have different effects. We use the Cochrane–Orcutt (1949) procedure to correct for first-order serial dependence in the residuals. The numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

	ΔAmihud		ΔSpread		ΔShare volume		ΔTrading value	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Panel A: Full Sample								
MKT_RET+	-0.8949	2.8981***	-3.2148***	-5.0999***	11.2166***	7.4664***	12.0563***	8.3058***
	(-1.20)	(3.17)	(-15.85)	(-30.39)	(34.70)	(24.92)	(38.32)	(27.96)
MKT_RET-	-13.0653***	-14.0533***	-4.1651***	-4.5309***	-3.2187***	-2.4156***	-2.1748***	-1.3099***
	(-18.48)	(-19.07)	(-21.67)	(-33.98)	(-10.58)	(-10.00)	(-7.35)	(-5.47)
MA_MKT+	1.5482	3.3669**	1.9337***	2.7327***	0.2655	1.5976***	0.1706	1.3886***
	(1.06)	(2.13)	(4.83)	(9.30)	(0.41)	(3.02)	(0.27)	(2.65)
MA_MKT-	6.0733***	4.6082***	3.6944***	4.8533***	-1.8404***	-1.4174***	-2.1069***	-1.7295***
	(3.85)	(2.81)	(8.56)	(15.91)	(-2.62)	(-2.58)	(-3.06)	(-3.18)
MA_ABMKT	-5.5879***	-8.4728***	-0.4190	0.8857***	-7.5639***	-5.3712***	-7.5616***	-5.3311***
	(-5.53)	(-7.48)	(-1.52)	(4.20)	(-16.77)	(-14.16)	(-17.09)	(-14.21)
MONDAY	0.1513***	0.1880***	0.0047	0.0062	-0.0289**	0.0138	-0.0276**	0.0140
	(4.38)	(4.98)	(0.54)	(0.98)	(-2.17)	(1.19)	(-2.18)	(1.22)
TUESDAY	-0.0524*	-0.0552*	0.0041	0.0064	-0.0011	0.0360***	0.0009	0.0339***
	(-1.88)	(-1.79)	(0.56)	(1.19)	(-0.10)	(3.68)	(0.09)	(3.49)
WEDNESDAY	0.0083	0.0199	-0.0007	0.0084	0.0062	0.0223**	0.0079	0.0209**
	(0.30)	(0.65)	(-0.09)	(1.58)	(0.55)	(2.30)	(0.73)	(2.17)
THURSDAY	-0.0476	0.0073	0.0185**	0.0219***	0.0195	0.0305***	0.0171	0.0264**
	(-1.37)	(0.19)	(2.12)	(3.49)	(1.46)	(2.63)	(1.35)	(2.29)
HOLI	0.0868**	0.0595*	0.0051	0.0043	-0.0558***	0.0032	-0.0555***	0.0050
	(2.56)	(1.68)	(0.55)	(0.66)	(-3.71)	(0.27)	(-3.76)	(0.42)
Δ*PRIME_RATE*		34.9812		5.5312		-26.0880***		-24.7181***
		(1.32)		(1.16)		(-3.01)		(-2.87)
Δ*TERM_SPR*		-7.7792		-2.5132		4.5584		5.2417
		(-0.64)		(-1.14)		(1.14)		(1.32)
GDP		-0.1729**		-0.0030		0.0002		-0.0024
		(-2.32)		(-0.23)		(0.01)		(-0.10)
GDP(1-2)		0.1073**		0.0124		-0.0120		-0.0101

		(2.36)		(1.47)		(-0.79)		(-0.67)
CPI		-0.0833*		0.0048		-0.0328**		-0.0311**
		(-1.79)		(0.57)		(-2.16)		(-2.07)
CPI(1-2)		0.0112		-0.0145***		-0.0119		-0.0083
		(0.39)		(-2.72)		(-1.24)		(-0.88)
Constant	-0.0041	-0.0257	-0.0003	-0.0083*	-0.0017	-0.0261***	-0.0017	-0.0243***
	(-0.18)	(-0.98)	(-0.06)	(-1.78)	(-0.18)	(-3.09)	(-0.19)	(-2.90)
Obs	5212	2547	5206	2545	5214	2547	5214	2547
Adj. R^2	0.0903	0.1675	0.1985	0.6200	0.1991	0.2172	0.2375	0.2678
Panel B: Effects of days preceding and following holidays								
PRE_HOLI	-0.0432	-0.0582	0.0253	0.0100	-0.0360	-0.0398**	-0.0296	-0.0353*
	(-0.73)	(-0.96)	(1.62)	(0.93)	(-1.45)	(-2.04)	(-1.23)	(-1.82)
POST_HOLI	0.2164***	0.1771***	-0.0151	-0.0014	-0.0756***	0.0463**	-0.0813***	0.0452**
	(3.66)	(2.92)	(-0.97)	(-0.13)	(-3.05)	(2.37)	(-3.39)	(2.34)
Obs	5212	2547	5206	2545	5214	2547	5214	2547
Adj. R^2	0.0914	0.1691	0.1987	0.6199	0.199	0.2197	0.2375	0.2700

The coefficients of *MA_MKT-* indicate that a recent down market is associated with decreased market liquidity and trading activity. Consistent with Chordia, Roll, and Subrahmanyam (2001), we find higher market-wide volatility (*MA_ABMKT*) is associated with lower trading activity. The impact of *MA_ABMKT* on market liquidity is not consistent across the two liquidity measures. The day-of-the-week dummies show significantly lower market liquidity and trading activity on Monday, but significant improvements in market liquidity and trading activity on Tuesday. The results in Columns (2), (4), (6), and (8) of Table 5.6 show evidence of decreased liquidity and trading activity around holidays, while the results in Columns (7) and (9) suggest an insignificant impact of *HOLI* on trading activity during more recent times.[54] We therefore replace *HOLI* in Equations (3) and (4) with *PRE_HOLI* (a dummy variable set to one for the days preceding holidays) and *POST_HOLI* (a dummy variable set to one for the days following holidays) and then re-estimate the regressions results. We find opposite effects for the days immediately prior to and after holidays for our trading activity measures: The share volume and trading value are lower immediately before holidays and higher after holidays. Our results support the argument of Meneu and Pardo (2004), that retail investors are reluctant to buy before holidays. In Panel B, we present only the coefficients of *PRE_HOLI* and *POST_HOLI* for brevity.

China's one-year loan prime rate change has a significantly negative effect on trading activity,[55] which supports the idea that increases in interest rates decrease trading activity. We present evidence of increased market liquidity around macroeconomic announcements, but the results show trading activity decreases as well.

[54] Note that the results are based on a shorter period when Δ*PRIME_RATE*, Δ*TERM_SPR*, *GDP*, *GDP(1-2)*, *CPI*, and *CPI(1-2)* are included in the regressions.
[55] Our subsample results show that the market liquidity of Shenzhen A shares also significantly decreases when the loan prime rate increases.

5.4.4 Influence of short selling and margin trading

The adjusted R^2 values in Table 5.6 suggest it is possible to find variables that have additional explanatory power for daily changes in market liquidity and trading activity. China started to allow short selling and margin trading for selected stocks in March 2010. It has been established that short selling and margin trading affect stock liquidity (e.g. Beber and Pagano, 2013). In this section, we add two proxies for daily short selling (*SHORT_SELL*) and margin trading (*MARGIN_TRAD*) to our baseline regressions to investigate whether aggregate short selling and margin trading have additional explanatory power.[56] We estimate the following regressions:

$$\begin{aligned}\Delta MKTILLQ_t = {} & \alpha_0 + \beta' X_t + \sum_{i=1}^{4} \alpha_{1i} DAY_{it} + \alpha_2 HOLI_t + \alpha_3 GDP_t + \alpha_4 GDP(1\text{-}2)_t \\ & + \alpha_5 CPI_t + \alpha_6 CPI(1\text{-}2)_t + \alpha_7 \Delta SHORT\_SELL + \alpha_8 \Delta MARGIN\_TRAD \\ & + \varepsilon_t \end{aligned} \quad (5)$$

$$\begin{aligned}\Delta TRADING_t = {} & \alpha_0 + \beta' X_t + \sum_{i=1}^{4} \alpha_{1i} DAY_{it} + \alpha_2 HOLI_t + \alpha_3 GDP_t + \alpha_4 GDP(1\text{-}2)_t \\ & + \alpha_5 CPI_t + \alpha_6 CPI(1\text{-}2)_t + \alpha_7 \Delta SHORT\_SELL + \alpha_8 \Delta MARGIN\_TRAD \\ & + \varepsilon_t \end{aligned} \quad (6)$$

where $\Delta SHORT\_SELL$ is the daily change in the total volume of the underlying securities sold by credit traders through securities lending and $\Delta MARGIN\_TRAD$ is the daily change in the total value of the underlying securities bought by credit traders through margin

[56] China makes daily short selling and margin trading data available to the public, which allows us to study whether aggregate short selling and margin trading affect market liquidity and trading activity on a daily basis. The other policy changes and reforms aforementioned in Section 5.2 are more likely to influence market liquidity and trading activity in a gradual process over time. The data associated with these events are not available at daily frequency (e.g. state-owner shareholding); accordingly, we do not add proxies for these events to our baseline regressions.

trading. Other variables are as defined in Equations (3) and (4). In Table 5.7, we present only the coefficients of *SHORT_SELL* and *MARGIN_TRAD*. Adding *SHORT_SELL* and *MARGIN_TRAD* to the baseline regressions improves the adjusted R^2 values from 0.81% to 8.97%. The full-sample results in Panel A show that margin trading is associated with a greater share volume and trading value and lower spreads. Short selling is also positively related to trading activity measures but larger spreads. Our finding of increased spreads is consistent with the work of Chang, Luo, and Ren (2014), who argue that short sellers in China "are potentially informative investors" (p. 412). We find no significant effects of short selling and trading activity on the Amihud (2002) measure, which could be partially due to China's price limit regulation. Our results hold when we re-estimate the models for the SSE and SZSE, respectively, in Panels B and C.

5.4.5 Influence of global factors

Given the large body of research documenting the success of China's recent policy changes and reforms (including the lift of short selling and margin trading bans), we expect improved Chinese market integration and aggregate market liquidity in more recent years, and therefore posit an increased impact of global factors on the Chinese market's liquidity. We consider two variables as global factors: (1) global liquidity (*GLBILLQ*), calculated as per Brockman, Chung, and Perignon (2009), and (2) the Chicago Board Options Exchange Market Volatility Index (VIX), a proxy for global risk perceptions.

Table 5.7: Short selling and margin trading activity

This table presents the effects of short selling and margin trading activity for the entire sample and for the Shanghai and Shenzhen A-share markets, respectively. The numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

	ΔAmihud	ΔSpread	ΔShare volume	ΔTrading value
Panel A: Full Sample				
Δ*SHORT_SELL*	0.5056	1.6383***	6.5148***	6.2012***
	(0.41)	(7.54)	(17.33)	(16.56)
Δ*MARGIN_TRAD*	-0.0364	-0.0343*	0.0748**	0.0835***
	(-0.36)	(-1.94)	(2.44)	(2.74)
Obs	2547	2545	2547	2547
Adj. R^2	0.1669	0.6281	0.3069	0.3451
Panel B: Shanghai A shares				
Δ*SHORT_SELL*	-0.7435	3.0630***	10.0245***	9.6695***
	(-0.38)	(9.57)	(16.36)	(15.83)
Δ*MARGIN_TRAD*	-0.0824	-0.0507**	0.0602	0.0709*
	(-0.66)	(-2.49)	(1.55)	(1.83)
Obs	2547	2544	2547	2547
Adj. R^2	0.2019	0.5967	0.3053	0.3373
Panel C: Shenzhen A shares				
Δ*SHORT_SELL*	2.4322	4.5789***	17.1935***	16.8103***
	(0.74)	(7.88)	(17.87)	(17.63)
Δ*MARGIN_TRAD*	0.0444	-0.2448***	0.6863***	0.6888***
	(0.10)	(-3.29)	(5.49)	(5.56)
Obs	2547	2532	2547	2547
Adj. R^2	0.2037	0.6048	0.3171	0.3642

We split the sample into two equal subperiods (1995–2005 and 2006–2016) and first conduct the following regression:

$$\Delta MKTILLQ_t = \Delta GLOB\_FACTOR_t + \Delta GLOB\_FACTOR_{t-1} + \Delta GLOB\_FACTOR_{t+1} + \varepsilon_t \quad (7)$$

where $\Delta MKTILLQ_t$ is the log difference in market (il)liquidity measured by either the Amihud (2002) or spread values on day t; $\Delta GLOB\_FACTOR_t$, $\Delta GLOB\_FACTOR_{t-1}$, and $\Delta GLOB\_FACTOR_{t+1}$ are the log differences in global factors measured by either global liquidity (*GLBILLQ*) or the VIX index (*VIX*) on days t, t - 1, and t + 1.

Table 5.8: Global factors

This table presents the effects of global factors (global liquidity and VIX) on market liquidity. The results for our subgroups are similar and reported in Appendixes D.5 and F for the Shanghai Stock Exchange and the Shenzhen Stock Exchange, respectively. The numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

Panel A: Without local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
ΔGLOB_FACTORt	-0.0629	0.0981*	-0.1899	0.3564**	0.0413	0.0829***	0.1570*	0.1135***
	(-0.60)	(1.84)	(-0.62)	(2.41)	(0.81)	(2.81)	(1.78)	(3.30)
ΔGLOB_FACTORt-1	-0.2848***	0.0332	-0.4797	-0.2917**	0.1045*	0.0308	-0.0695	-0.0328
	(-2.62)	(0.61)	(-1.64)	(-2.03)	(1.91)	(1.03)	(-0.81)	(-0.96)
ΔGLOB_FACTORt+1	-0.0115	0.0522	0.6594**	0.4218***	0.0386	0.1089***	-0.0275	0.0950***
	(-0.11)	(0.95)	(2.26)	(2.93)	(0.71)	(3.65)	(-0.32)	(2.79)
Constant	-0.0004	-0.0005	-0.0005	-0.0005	-0.0014	-0.0005	-0.0013	-0.0005
	(-0.04)	(-0.07)	(-0.05)	(-0.07)	(-0.42)	(-0.29)	(-0.41)	(-0.29)
Obs	2420	2503	2420	2503	2416	2501	2416	2501
Adj R2	0.0019	0.0003	0.0031	0.0082	0.0005	0.0058	0.0001	0.0083

Panel B: With local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
ΔGLOB_FACTORt	-0.0936	-0.0018	-0.0907	0.1024	0.0345	-0.0110	0.1560*	-0.0130
	(-0.92)	(-0.04)	(-0.29)	(0.78)	(0.69)	(-0.63)	(1.75)	(-0.62)
ΔGLOB_FACTORt-1	-0.3075***	-0.0407	-0.4340	-0.2494*	0.1003*	-0.0239	-0.0472	-0.0097
	(-2.88)	(-0.84)	(-1.48)	(-1.96)	(1.88)	(-1.34)	(-0.55)	(-0.47)
ΔGLOB_FACTORt+1	0.0224	0.0184	0.5084*	0.1204	0.0540	0.0249	-0.0269	0.0044
	(0.21)	(0.38)	(1.74)	(0.94)	(1.01)	(1.40)	(-0.31)	(0.22)
MKT_RET+	-3.3221***	-0.1719	-3.3049***	-0.1046	-1.8143***	-5.4712***	-1.8075***	-5.4797***
	(-2.71)	(-0.19)	(-2.70)	(-0.12)	(-4.95)	(-36.41)	(-4.92)	(-36.42)
MKT_RET-	-12.1960***	-16.7135***	-12.2880***	-16.5980***	-3.1299***	-4.0395***	-3.1246***	-4.0457***
	(-8.75)	(-22.57)	(-8.81)	(-22.28)	(-7.25)	(-33.00)	(-7.24)	(-32.81)
MA_MKT+	-0.8823	4.7704***	-1.0097	4.5856***	1.3806*	2.9356***	1.4224*	2.9261***

	(-0.32)	(3.06)	(-0.37)	(2.95)	(1.65)	(11.14)	(1.70)	(11.08)
MA_MKT-	7.1149**	6.0496***	7.4436**	5.9775***	2.3611**	3.9417***	2.2482**	3.9576***
	(2.26)	(3.69)	(2.36)	(3.65)	(2.47)	(14.20)	(2.35)	(14.21)
MA_ABMKT	-3.1181*	-7.8148***	-3.0378*	-7.7530***	-1.1842**	0.9124***	-1.2254**	0.9248***
	(-1.70)	(-6.90)	(-1.65)	(-6.86)	(-2.12)	(4.76)	(-2.20)	(4.81)
MONDAY	0.1048*	0.2126***	0.0781	0.2105***	0.0089	0.0059	0.0129	0.0059
	(1.68)	(5.89)	(1.23)	(5.83)	(0.51)	(1.09)	(0.72)	(1.08)
TUESDAY	-0.0648	-0.0537*	-0.0745	-0.0575**	0.0035	0.0102**	-0.0009	0.0104**
	(-1.30)	(-1.85)	(-1.48)	(-1.98)	(0.25)	(2.23)	(-0.06)	(2.27)
WEDNESDAY	-0.0202	0.0306	-0.0017	0.0338	-0.0071	0.0093**	-0.0069	0.0096**
	(-0.41)	(1.07)	(-0.03)	(1.18)	(-0.50)	(2.05)	(-0.47)	(2.11)
THURSDAY	-0.1038*	0.0215	-0.1118*	0.0221	0.0149	0.0181***	0.0158	0.0183***
	(-1.67)	(0.59)	(-1.79)	(0.61)	(0.85)	(3.31)	(0.90)	(3.36)
HOLI	0.1419**	0.1132***	0.1230*	0.1112***	0.0105	0.0068	0.0120	0.0063
	(2.11)	(3.40)	(1.83)	(3.35)	(0.52)	(1.20)	(0.59)	(1.12)
Constant	0.0232	-0.0455*	0.0285	-0.0451*	0.0042	-0.0074*	0.0041	-0.0076*
	(0.58)	(-1.82)	(0.71)	(-1.80)	(0.36)	(-1.86)	(0.35)	(-1.90)
Obs	2420	2503	2420	2503	2416	2501	2416	2501
Adj R^2	0.0542	0.2299	0.053	0.2314	0.0494	0.6483	0.049	0.6476

In Panel A of Table 5.8, our results indicate global factors have exerted a greater impact on the Chinese market in more recent years. However, when local factors are added to the regressions in Panel B, global factors are no longer significant. This result suggests that the impact of global factors on market liquidity is through local factors. Our results for the subsamples of stocks are similar and presented in Appendixes D.5 and D.6.

5.5 Conclusions

Liquidity is an important consideration for market participants, regulators, and academics. We contribute to the literature by investigating various aspects of market-wide liquidity and trading activity in China, the largest emerging economy, over 1995–2016. The Chinese market is an interesting setting for liquidity studies, since a number of its features differentiate it from other markets, such as the United States (e.g. dominance of retail investors with speculative trading motives, recent policy and market reforms that were at least partially designed to improve liquidity).

We show gradually increased market liquidity and trading activity over time. The average absolute daily percentage changes in the Amihud (2002) ratio, spread, share volume, and trading value are 50.77%, 12.02%, 17.70%, and 17.67%, respectively, indicating highly volatile market liquidity and trading activity. While it is well established that market liquidity reacts to negative market returns more than to positive returns (e.g. Hameed, Kang, and Viswanathan, 2010), we find positive market returns exert a greater impact on trading activity than negative returns do in China. This finding is consistent with the Chinese market being dominated by unsophisticated retail investors, who are likely to exhibit a stronger disposition effect (e.g. Dhar and Zhu, 2006). A recent down market is associated with decreased market liquidity and trading activity. Recent market volatility reduces trading activity but has mixed effects on liquidity. While both liquidity

and trading activity decrease around holidays, on average, we find, in more recent times, that trading activity is significantly lower immediately prior to holidays and higher afterward, which is consistent with the study of Meneu and Pardo (2004), who show retail investors are reluctant to buy before holidays. Our results also show that aggregate short selling and margin trading lead to a greater market-wide share volume and trading value, but short selling also increases spreads. Moreover, we find an increased influence of global factors in China.

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STATEMENT OF CONTRIBUTION TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Rui Ma

Name/Title of Principal Supervisor: Professor Hamish Anderson

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Please indicate either:

- The percentage of the Published Work that was contributed by the candidate:

  and / or

- Describe the contribution that the candidate has made to the Published Work:

  Rui Ma collected, collated and cleaned the datasets before completing all the empirical analysis. Rui Ma then wrote the draft working paper and completed subsequent revisions before publication acceptance at the International Review of Financial Analysis.

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CHAPTER 6

CONCLUSION

This chapter concludes the thesis by summarising the major findings for each of the three essays in Section 6.1, and suggesting areas for future research in Section 6.2.

6.1 Major findings and implications

6.1.1 Essay One

Market liquidity is influenced by various country-level factors, such as institutional characteristics and regulations. The first essay surveys the literature on liquidity issues in international stock markets, compares and contrasts empirical results across prior studies, and highlights potential areas for further investigation.

Key empirical findings in former studies are as follows. Individual stock liquidity co-moves within and across exchanges. Both liquidity level and liquidity risks are priced internationally. In the corporate finance field, liquidity is positively related to firm transparency and number of shares issued, and negatively associated with dividends paid to shareholders, while the effects of internationalisation on liquidity are inconsistent across firms and countries. The essay concludes by suggesting that, while trading environments continue to evolve (e.g. the recent development of dark pools and high-frequency trading platforms), how market attributes affect empirical results on liquidity issues are still an important area of future research.

6.1.2 Essay Two

The second essay examines the impact of investors' risk perceptions on market liquidity using a sample of 57 countries between 1990 and 2015. Using VIX, also known as the "fear gauge", to proxy for investor risk perception internationally (e.g. Sari, Soytas, and Hacihasanoglu, 2011), the essay shows a 1% increase in VIX in a given month, on average, leads to a 0.68% (0.80%) increase in the value-weighted (equal-weighted) Amihud (2002) illiquidity ratio, and a 0.40% (0.30%) increase in the value-weighted

(equal-weighted) closing bid-ask spread measure of Chung and Zhang (2014) of a market in the same month. The generalised impulse response functions for shocks in VIX and liquidity measures indicate the influence of VIX on liquidity is long-lived and not driven by reverse causality.

The influence of VIX on liquidity is stronger in more economically developed and integrated markets with better country governance and no short-selling constraints, despite developed markets typically exhibiting greater liquidity level than their emerging market counterparts (e.g. Fong, Holden, and Trzcinka, 2017). The results are consistent with the idea that developed and integrated economies attract more international investors, incorporate information in a more efficient manner, and therefore are more influenced by global risk perceptions reflected in VIX.

Overall, the essay provides evidence that investors' risk perception is an important determinant of liquidity in global markets. The findings also help explain why liquidity is more volatile in certain countries than in others, and provide implications for policymakers and regulators aiming at stabilising market liquidity.

6.1.3 Essay Three

Chung and Chuwonganant (2017) show unexpected changes in market volatility affect stock returns directly, as well as indirectly through stock liquidity in the US markets, suggesting that liquidity is an important channel through which market volatility affects stock returns. The third essay of the thesis explores the role of the stock liquidity in determining the volatility-return relation in 41 countries over the period 1990–2015, and seeks to solve the question of which market-specific characteristics affect the impact of the liquidity channel.

The essay begins with portfolio-level analysis. The double-sorted portfolio results show returns are significantly lower for stocks with greater liquidity sensitivity to market volatility, when market volatility shocks are controlled. The average return differential between quintile portfolios of stocks with the highest liquidity shocks and stocks with the lowest liquidity shocks within a given geographical region ranges from 0.80% to 6.02% per month, depending on the liquidity proxy used. The findings remain intact when the essay further conducts stock-level regression analysis controlling for other market- and stock-level determinants of stock returns, such as market returns and stock idiosyncratic volatility.

Following Chung and Chuwonganant (2017), the essay measures the indirect effect of volatility on returns through liquidity in a given market as the difference in monthly stock returns between stocks with liquidity shock values in the 75th and 25th percentiles, respectively, associated with a median market volatility shock. The results show country governance is a key determinant of the impact of the liquidity channel on asset returns, as stronger governance facilitates investors' trading activity and enables information to be incorporated in security prices more efficiently. There is also evidence that the influence of the liquidity channel is stronger in markets with higher levels of market volatility and lower trading volume, and in countries with no short-selling constraints and more high-frequency trading. It is also more pronounced during crisis periods.

In summary, this essay reveals that stock liquidity is an important channel through which market volatility indirectly affects stock returns around the globe, which is distinct from the direct impact of volatility on returns. The influence of the liquidity channel varies across diverse institutional environments and over time. These findings have

implications for market participants and policymakers focusing on volatility, liquidity, and asset returns.

6.1.4 Essay Four

The fourth essay investigates market-wide liquidity and trading activity in China. A number of features of the Chinese market make it an interesting setting in which to consider liquidity and trading activity. First, Chinese listed firms tend to have a high level of non-tradable ownership; state owners have a relatively low incentive to trade unrestricted stocks and act as liquidity providers (Peng, Wei, and Yang, 2011). Second, short selling was prohibited in the Chinese market until March 2010, since then only selected stocks have been allowed to be sold short. Prior studies, such as Charoenrook and Daouk (2005) and Beber and Pagano (2013), show short selling constraints distort trading volume and liquidity. Third, the Chinese stock market is dominated by retail investors, who contribute to more than 80% of the trading volume in the market (Hilliard and Zhang, 2015), while institutional investors are the key players in mature markets such as the US. Retail investors exhibit speculative trading characteristics, and their trading behaviour historically differs from institutional investors (Kelly and Tetlock, 2017).

This essay finds trading activity in China increases more in up markets than in down markets. The results show an increase in the share volume of 8.62% and an increase in trading value of 9.58% for a one standard deviation increase in a positive market return, whereas a one standard deviation decrease in a negative market return leads to a 2.98% increase in the share volume and a 1.62% increase in trading value. The findings support the literature suggesting that less sophisticated retail investors exhibit stronger disposition effects, the tendency to hold winner stock longer than loser stocks (e.g. Dhar and Zhu, 2006). In more recent times, trading activity is significantly lower before holidays and

higher afterward, which also can be explained by the overrepresentation of retail investors' trading. As noted in Meneu and Pardo (2004), retail traders are reluctant to buy shares before holidays.

While both short selling and margin trading boost trading activity in China, short selling also increases bid-ask spreads (indicating lower market liquidity). This finding supports earlier studies providing evidence that short sellers in China are likely to be informed traders (e.g. Chang, Luo, and Ren, 2014). Accordingly, their trading enlarges the information asymmetry component of the bid-ask spread. In addition, the essay documents the increased impact of global factors in the Chinese market, supporting prior studies on the success of China's recent policy changes and reforms aiming at improving its market efficiency and liquidity.

6.2 Future areas of research

The first essay of this thesis discusses empirical evidence on liquidity issues in international markets, and highlights areas for future liquidity research. However, the essay focuses on liquidity of stocks, and it does not consider liquidity in international bond, derivatives, or foreign exchange markets (e.g. Mayordomo, Rodriguez-Moreno, Pena, 2014). Moreover, there has been increased research attention on the liquidity link between asset classes (e.g. Syamala, Reddy, and Goyal, 2014). A comprehensive review of existing studies on liquidity in international non-equity asset classes and liquidity dynamics across asset classes in international markets can offer a promising route toward a better understanding of liquidity issues.

The second essay uses the VIX index to proxy for risk perceptions internationally. Section 3.2.3 discusses alternative risk perception indicators and show these measures are

highly correlated. Despite VIX being widely used as a proxy for global risk perception (e.g. Sari, Soytas, and Hacihasanoglu, 2011; Mayordomo, Rodriguez-Moreno, and Pena, 2014), future research can use alternative risk measures and investigate whether the documented results depend on the choice of VIX as the risk perception measure. Future studies may also examine the relative importance of global and local risk perceptions.

The third essay provides evidence that market-specific characteristics are important in determining the impact of liquidity channel through which market volatility affects stock returns. However, the list of market characteristics is not exhaustive. As the trading environments and techniques are evolving in a rapid pace, the investigation of other determinants of the role of the liquidity channel is an important field for further research.

The final essay of this thesis investigates market liquidity and trading activity in China. The essay shows gradually increased market liquidity and trading activity over time and documents the increased impact of global factors in China, which echoes with China's recent reforms and policy changes aiming at improving the market's integration and liquidity (e.g. the Shanghai/Shenzhen-Hong Kong Connect Programme). Future studies may further investigate to what extent the improvements in China differ from the global mean, and/or the average of its emerging market counterparts. Another possible avenue for future research is to investigate whether and to what extent the influence of market integration/fragmentation on liquidity depends on market-specific characteristics, provided the evidence of a positive impact of market fragmentation on liquidity in more developed markets (e.g. Aitken, Chen, and Foley, 2017).

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APPENDIX A

FOR ESSAY ONE

Appendix A.1: Liquidity measures

This table outlines key liquidity measures referenced in our paper.

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 Eq.(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 Eq.(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, Chuang, and Lin (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, Chuang, and Lin (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 Eq.(2.7) in Holden et al. (2014)	Smith et al. (2006), Pan et al. (2012)	Tick size changes
Slope coefficient λ	See Eq.(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
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 (2010), Hearn (2009), Hearn (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

APPENDIX B

FOR ESSAY TWO

Appendix B.1: Correlations with US VIX

Panel A reports the start date of each international VIX index, and the monthly correlations between the US VIX index and the international indices. Panel B shows monthly correlations on international corporate bond spreads and the US VIX. We consider the US corporate bond spread and four regional corporate bond spreads based on the regional sub-indices of the BofA Merrill Lynch Emerging Markets Corporate Plus Index. We collect international VIX indices data from Datastream, and credit spread data from Bank of America Merrill Lynch via the Federal Reserve Bank of St. Louis.

Panel A: International VIX indices		
Index name	Start date	Correlation
FTSE 100 Volatility Index	2000-01-04	0.9612
Nikkei Stock Average Volatility Index	1998-01-05	0.8468
HSI Volatility Index	2010-07-16	0.9066
CAC 40 Volatility Index	2000-01-03	0.9222
VDAX-New Volatility Index	1992-01-02	0.8839
S&P/ASX Volatility Index	2008-01-02	0.9600
S&P/TSX 60 VIX Volatility Index	2010-10-18	0.9153
AEX Volatility Index	2000-01-03	0.9036
Vsmi Volatility Index	1999-01-04	0.9151
Vkospi Volatility Index	2009-04-13	0.9160
Sixvx Volatility Index	2004-05-07	0.9553
India Volatility Index	2008-03-03	0.8424
Mexico Volatility Index	2004-03-26	0.8548
RTS Volatility Index	2006-01-10	0.8163
South Africa Volatility Index	2007-02-01	0.9465
Belgium 20 Volatility Index 'Dead'	2000-01-03	0.9233
VSTOXX Volatility Index	1999-01-04	0.9210
Average		0.9053

Panel B: Regional corporate bond spreads		
Region	Start date	Correlation
Asia	1998-12-31	0.7167
Latin America	1998-12-31	0.7471
Europe, the Middle East, and Africa	1998-12-31	0.6922
US	1998-12-31	0.7156
Average		0.7179

Appendix B.2: Correlation matrices

This table contains the correlation matrices of independent variables for Equation (3) and Equation (5), respectively.

Panel A: VIX and international market liquidity

	VIX	*DEV_ MKT*	*GDP_ PER_ CAP*	*TRADE _OPEN NESS*	*SEG MENT ATION*	*INST IT_OWNER*	*GOVER NANCE*	*SHORT _SELL ING*	*MKT_ MAKER*	*GROWTH _VOLA*	*EXCH ANGE_ RATE*	*MKT _CAP*	*MKT _VOL*
DEV_MKT	0.0000												
GDP_PER_CAP	0.0152	0.7905											
TRADE_OPENNESS	0.0043	0.1979	0.3038										
SEGMENTATION	0.0856	-0.1056	-0.0881	-0.0420									
INSTIT_OWNER	0.0000	0.1358	0.2050	0.1144	0.1323								
GOVERNANCE	-0.0036	0.7784	0.8551	0.3500	-0.1514	0.3801							
SHORT_SELLING	-0.0182	-0.4943	-0.5658	-0.1375	0.1584	0.0928	-0.5063						
MKT_MAKER	-0.0009	0.3691	0.4311	-0.0704	-0.1438	0.3515	0.3832	-0.2348					
GROWTH_VOLA	0.0000	-0.4368	-0.2140	0.1756	0.1999	0.3202	-0.3235	0.3368	-0.2495				
EXCHANGE_RATE	0.0139	-0.0581	-0.0613	-0.0362	0.0275	-0.0047	-0.0744	0.0435	-0.0316	0.0542			
MKT_CAP	-0.0365	0.5043	0.5627	0.0083	-0.3490	-0.1146	0.4095	-0.5066	0.2903	-0.4216	-0.0726		
MKT_VOL	0.0245	0.5372	0.5753	0.0263	-0.2029	0.0687	0.5030	-0.5781	0.3224	-0.4452	-0.0728	0.8185	
MKT_PRICE	-0.0760	0.4205	0.5596	0.0092	-0.1117	0.0432	0.5014	-0.3298	0.4127	-0.1707	-0.0181	0.3857	0.3589

Panel B: Market attributes and impact of VIX

	DEV_ MKT	*GDP_ PER_ CAP*	*TRADE _OPEN NESS*	*SEG MENT ATION*	*INST IT_OW NER*	*GOVER NANCE*	*SHORT _SELL ING*	*MKT_ MAKER*	*INDI VIDUA LISM*	*UNCER T_AVO ID*	*GROW TH_VO LA*	*EXCH ANGE _RATE*	*MKT _CAP*	*MKT _VOL*
GDP_PER_CAP	0.8334													
TRADE_OPENNESS	0.2153	0.2989												
SEGMENTATION	-0.3382	-0.2932	-0.0965											
INSTIT_OWNER	0.1358	0.2348	0.1208	0.3373										
GOVERNANCE	0.7980	0.9061	0.3521	-0.4554	0.3866									
SHORT_SELLING	-0.3363	-0.4848	-0.1022	0.2705	0.1580	-0.4059								
MKT_MAKER	0.2975	0.4000	-0.0293	-0.2127	0.3133	0.2935	-0.3875							
INDIVIDUALISM	0.5123	0.6211	-0.0645	-0.3872	0.2435	0.6843	-0.3465	0.2695						
UNCERT_AVOID	-0.1870	-0.0922	-0.4270	0.2957	-0.1494	-0.2510	-0.0658	0.1088	-0.1828					
GROWTH_VOLA	-0.4224	-0.2091	0.1910	0.6438	0.3202	-0.3381	0.2515	-0.0487	-0.4337	0.1750				
EXCHANGE_RATE	-0.4676	-0.3507	-0.2385	0.6195	-0.0607	-0.4560	0.1470	-0.0629	-0.3697	0.3468	0.4119			
MKT_CAP	0.5233	0.4233	-0.1025	-0.5597	-0.2183	0.3670	-0.3108	0.1505	0.2115	-0.2512	-0.5450	-0.2754		
MKT_VOL	0.6470	0.5670	-0.0654	-0.5819	0.0485	0.5418	-0.3637	0.2279	0.4386	-0.2096	-0.5710	-0.3951	0.8531	
MKT_PRICE	0.3456	0.5186	-0.0246	0.1294	0.0433	0.3445	-0.3839	0.4001	0.3109	0.2771	-0.0325	-0.0396	0.1646	0.2280

Appendix B.3: Non-US evidence and local VIX evidence

In Models (1), (3), (5), and (7) of Panel A, we regress non-US monthly liquidity on the US VIX. In Models (2), (4), (6), and (8), we calculate a value-weighted average of the non-US implied volatility indices over the 2000-2015 period and regress non-US monthly liquidity on non-US global implied volatility. In Panel B, we replace US VIX with 16 international VIX indices and re-estimate our time-series regressions in Table 4. Liquidity measures are value- and equal-weighted on market capitalisation across individual stocks within each market. We report coefficients on VIX (i.e. βVIX) for 16 countries that have a local VIX Index. VW (EW) refers to the monthly market liquidity being value- (equal-) weighted. Numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

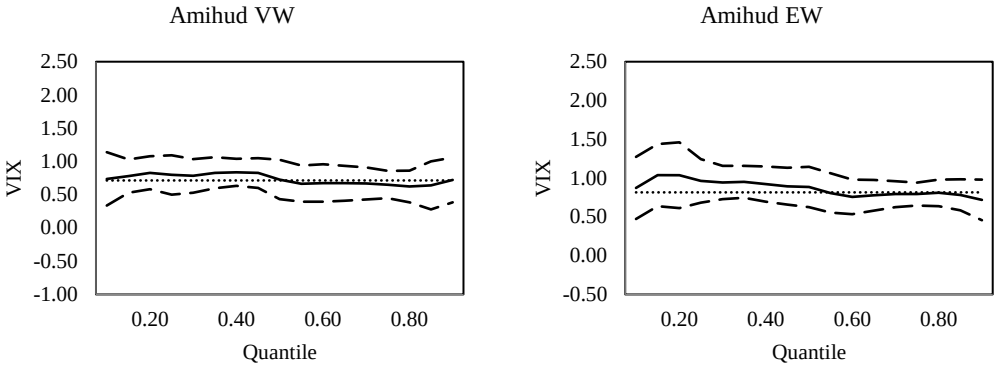
Panel A: Non-US risk perceptions and non-US liquidity

	Non-US Amihud				Non-US spread			
	VW		EW		VW		EW	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	-5.7208***	-6.7976***	-3.8784***	-3.9280***	-6.0241***	-6.3019***	-4.4257***	-4.6365***
	(-18.08)	(-17.15)	(-12.93)	(-12.33)	(-31.35)	(-25.95)	(-21.20)	(-19.67)
US VIX	0.7232***		0.8278***		0.4028***		0.2725***	
	(8.19)		(10.03)		(7.14)		(5.11)	
Non-US global VIX		1.0273***		0.8656***		0.4762***		0.3445***
		(14.10)		(13.40)		(7.50)		(5.35)
Number of countries	56	56	56	56	55	55	55	55
R-squared	0.0166	0.027	0.0271	0.0261	0.0198	0.0229	0.0095	0.0126

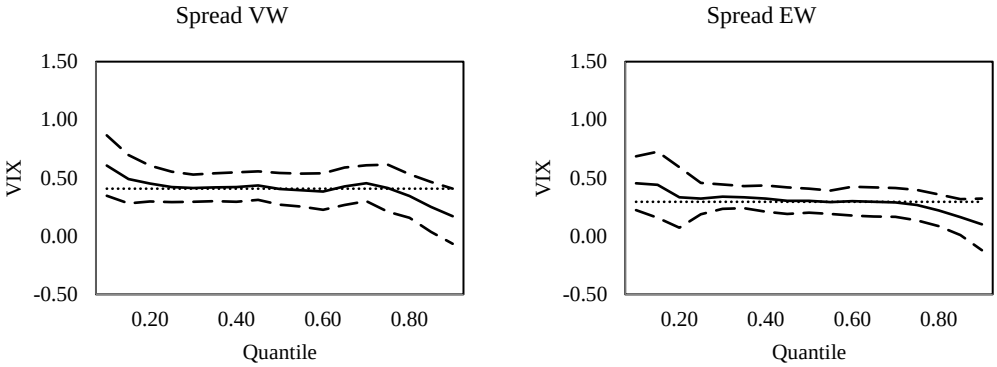
Appendix B.3 (continued)

Panel B: Risk perceptions and liquidity by country: international VIX indices

	Amihud		US spread	
	VW	EW	VW	EW
Australia	0.1125	0.3249**	0.4607***	0.5975***
Belgium	1.4486***	1.0965***	0.6657***	0.7084***
Canada	0.5644***	-0.0520	0.4599***	0.4017***
France	1.3606***	0.9863***	0.6000***	0.3570***
Germany	1.2990***	1.7985***	0.6433***	0.3160***
Hong Kong	0.8858***	1.1374***	0.2338***	0.3444***
Japan	1.6790***	1.9870***	0.5958***	0.9825***
Netherlands	1.5635***	1.0247***	0.9624***	0.6898***
South Korea	1.0596***	1.2246***	0.2129***	0.5530***
Sweden	1.3492***	1.1376***	0.6319***	0.5631***
Switzerland	1.1563***	1.1302***	0.7632***	0.7981***
United Kingdom	0.9148***	0.8842***	0.4415***	0.3334***
United States	0.0488	0.0580	0.6664***	0.7238***
India	0.3943***	0.3410***	0.3474**	0.2389**
Mexico	0.7400***	0.5385***	0.4012***	0.3280***
South Africa	1.4645***	0.9384***	1.0107***	0.4457***
Average	1.0026	0.9097	0.5686	0.5238
% Positive	100.00%	93.75%	100.00%	100.00%
% Positive significant	87.50%	0.88%	100.00%	100.00%



(A) Amihud results



(B) Spread results

Appendix B.4: Quantile regressions. The graph plots the quantile against the coefficient estimate on VIX. The solid lines represent the coefficient estimate, and the dashed lines are the 95% confidence bands. The dotted horizontal line denotes the OLS estimates that do not vary with the quantile.

Appendix B.5: Daily risk perceptions and global liquidity

This table presents our panel regression results using daily liquidity measures. Following Chung and Chuwonganant (2014), we include lag and lead VIX. We address the issue of time zones and the day-of-the-week effects by including one-day lagged data for Western Hemisphere countries and day-of-the-week dummies. VW refers to the monthly market liquidity being value-weighted. Numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

	Amihud VW			Spread VW		
	VIX_t	VIX_{t-1}	VIX_{t+1}	VIX_t	VIX_{t-1}	VIX_{t+1}
DEV_MKT	0.2471***	0.1214***	0.1620***	0.1681***	0.0373	0.1799***
	(6.51)	(2.83)	(4.19)	(8.73)	(1.37)	(6.69)
GDP_PER_CAP	0.2470***	0.1491***	0.1749***	0.1673***	0.0335	0.1665***
	(6.32)	(3.49)	(4.63)	(8.71)	(1.28)	(6.40)
TRADE_OPENNESS	0.2189***	0.1274***	0.1920***	0.1633***	0.0443	0.1912***
	(5.49)	(2.67)	(4.29)	(8.65)	(1.62)	(7.03)
SEGMENTATION	0.2334***	-0.0007	0.1154***	0.1405***	-0.0208	0.1696***
	(5.47)	(-0.02)	(2.69)	(7.18)	(-0.74)	(6.81)
INSTIT_OWNER	0.2344***	0.1984***	0.2241***	0.1734***	0.0295	0.2358***
	(4.98)	(3.48)	(3.44)	(9.22)	(0.83)	(6.57)
GOVERNANCE	0.2541***	0.2409***	0.2432***	0.1633***	0.0724***	0.1975***
	(6.27)	(4.88)	(6.04)	(8.39)	(2.75)	(7.27)
SHORT_SELLING	0.2515***	0.1422***	0.1806***	0.1653***	0.0527*	0.1910***
	(6.48)	(3.18)	(4.31)	(9.58)	(1.87)	(7.00)
MKT_MAKER	0.2365***	0.1299**	0.1754***	0.1590***	0.0333	0.1812***
	(5.05)	(2.44)	(3.59)	(7.95)	(1.13)	(5.69)
GROWTH_VOLA	0.2390***	0.1301***	0.1719***	0.1641***	0.0513*	0.1944***
	(5.96)	(3.04)	(4.07)	(8.87)	(1.83)	(7.15)
EXCHANGE_RATE	0.2146***	0.1231**	0.1590***	0.1554***	0.0395	0.1679***
	(4.86)	(2.24)	(3.16)	(6.67)	(1.24)	(4.80)
MKT_CAP	0.2278***	0.0834**	0.1359***	0.1551***	0.0258	0.1704***
	(6.38)	(2.12)	(4.21)	(7.81)	(1.00)	(7.65)
MKT_VOL	0.2493***	0.1339***	0.3012***	0.1631***	0.0326	0.2476***
	(6.88)	(3.57)	(7.50)	(8.77)	(1.34)	(9.64)
MKT_PRICE	0.2269***	0.0733*	0.1518***	0.1548***	0.0277	0.1849***
	(5.53)	(1.69)	(3.77)	(8.06)	(1.04)	(7.05)

APPENDIX C

FOR ESSAY THREE

Appendix C.1: Variable definitions and data sources

This table describes our explanatory variables.

Variable	Description
Panel A: Effects of Volatility and Liquidity Shocks on Stock Returns	
IVOSHOCK	Stock idiosyncratic volatility shock, computed as $IVOSHOCK_{i,t}$ = ($IVO_{i,t}$ - $AVGIVO_{i\|t-12,t-1}$)/$AVGIVO_{i\|t-12,t-1}$, where $IVO_{i,t}$ is the idiosyncratic volatility, estimated from the market model in Bali and Cakici (2008), of stock *i* in month *t* and $AVGIVO_{i\|t-12,t-1}$ is the average of *IVO* for stock *i* from months *t* - 12 to *t* - 1. Source: Datastream.
DVOLSHOCK	Stock dollar volume shock, computed as $DVOLSHOCK_{i,t}$ = ($DVOL_{i,t}$ - $AVGDVOL_{i\|t-12,t-1}$)/$AVGDVOL_{i\|t-12,t-1}$, where $DVOL_{i,t}$ is the dollar trading value of stock *i* in month *t* and $AVGDVOL_{i\|t-12,t-1}$ is the average of *DVOL* for stock *i* from month *t* - 12 to *t* - 1. Source: Datastream.
MKTRET	Value-weighted average of stock returns within a market in a given month. Source: Datastream.
MKTAMISHOCK	Monthly market *AMISHOCK*, computed as $MKTAMISHOCK_t$ = -($MKTILLIQ_t$ - $AVGMKTILLIQ_{t-12,t-1}$)/$AVGMKTILLIQ_{t-12,t-1}$, where $MKTILLIQ_t$ is the value-weighted average of stock log-transformed Amihud values in month *t* and $AVGMKTILLIQ_{t-12,t-1}$ is the average of $MKTILLIQ_t$ from months *t* - 12 to *t* - 1. Source: Datastream.
MKTSPRSHOCK	Monthly market *SPRSHOCK*, computed as $MKTSPRSHOCK_t$ = -($MKTSPREAD_t$ - $AVGMKTSPR_{t-12,t-1}$)/$AVGMKTSPR_{t-12,t-1}$, where $MKTSPREAD_t$ is the value-weighted average of stock closing spreads in month *t* and $AVGMKTSPR_{t-12,t-1}$ is the average of $MKTSPREAD_t$ from months *t* - 12 to *t* - 1. Source: Datastream.
BETA	Historical beta of stock *i* in month *t*. Source: Datastream.
SMKTCAP	Market capitalization of stock *i* in month *t*. Source: Datastream.
MAXRET	Maximum daily return of stock *i* in month *t* - 1. Source: Datastream.
REVISE	Return of stock *i* in month *t* - 1. Source: Datastream.
MOMENT	Cumulative return of stock *i* over months *t* - 12 to *t* - 2. Datastream.
STDTO	Standard deviation of monthly turnover over the past 12 months for stock *i* in month *t*. Monthly turnover is calculated as the share volume divided by the number of shares outstanding. Source: Datastream.
BVTOPRI	Ratio of the book value to price for stock *i* in month *t*. Source: Datastream.
Panel B: Market Attributes and the Role of Liquidity Providers	
MKTVOLA	Standard deviation of daily value-weighted market returns in month t. Source: Datastream.
MKTDVOL	Total trading value in a market in month *t*. Source: Datastream.
MKTCAP	Market capitalization of firms listed in a market in month *t*. Source: Datastream.
GOVERNANCE	Average of the six components of the Worldwide Governance Indicators in a given year. Source: World Bank.
GDP_PER_CAP	Gross domestic product (GDP) per capita in the previous year. Source: World Bank, World Economic Outlook.
DEVELOPMENT	An annual stock market development index is constructed based on the ratio of market capitalization to the GDP, the ratio of the stock traded value to the GDP, the turnover ratio, the number of listed firms, and the concentration ratio (ratio of the market capitalization of the 10 largest stocks to total market capitalization). Source: World Bank, Datastream.
OPENNESS	A proxy for market openness, computed as (Export + Import)/GDP in the current year. Source: World Bank.
SEGMENTATION	A monthly equity market segmentation measure is constructed for each market as per Bekaert, Harvey, Lundblad, and Siegel (2011). Source: Datastream.
SHORT_SELLING	A time-varying dummy variable set to one if short selling is prohibited and zero otherwise. Source: Jain, Jain, McInish, and McKenzie (2013), Charoenrook and Daouk (2005).
MKTMAKER	A time-varying dummy variable set to one for markets in the presence of market makers and zero otherwise. We surveyed the main stock exchange(s) when we are unsure of their trading mechanism. Source: Survey answers from main exchanges and exchange webpages.

Appendix C.2: Correlation matrix

This table shows the correlation matrices of the independent variables of Equation (7).

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
[2] *MKT_DVOL*	-0.0405								
[3] *MKT_CAP*	-0.1666	0.8043							
[4] *GOVERNANCE*	-0.2303	0.5796	0.4749						
[5] *GDP_PER_CAP*	-0.2467	0.6760	0.6453	0.8774					
[6] *DEVELOPMENT*	-0.1555	0.3469	0.5151	0.1405	0.1088				
[7] *OPENNESS*	-0.1178	0.1039	0.0916	0.2508	0.2077	0.2666			
[8] *SEGMENTATION*	0.1024	-0.3888	-0.4366	-0.3642	-0.3139	-0.2845	-0.1195		
[9] *SHORT_SELLING*	0.1458	-0.5645	-0.5318	-0.5653	-0.6755	-0.0948	-0.1303	0.3549	
[10] *MKT_MAKER*	-0.2188	0.3858	0.2479	0.3952	0.4284	-0.1977	-0.1755	-0.2380	-0.3143

Appendix C.3: Market attributes and the role of liquidity providers: multivariate analysis

This table presents our regression results for multivariate analysis. Standard errors are clustered by country and time. The variables *MKTDVOL* and *MKTCAP* are logarithmically-scaled.

Panel A: Dependent variable - $(\beta_2 + \beta_3 VOLASHOCK_{50})(AMISHOCK_{75} - AMISHOCK_{25})$				
	[1]	[2]	[3]	[4]
MKTVOLA	0.6375*	0.4391**	0.4316*	0.0098
	(1.73)	(2.04)	(1.73)	(0.07)
MKTDVOL	-0.0025*			
	(-1.83)			
MKTCAP		-0.0016		
		(-1.17)		
GOVERNANCE		0.0023		
		(0.99)		
GDP_PER_CAP				-0.0009
				(-0.62)
DEVELOPMENT	0.0016	0.0007	-0.0012	
	(0.36)	(0.19)	(-0.36)	
OPENNESS	0.0013		0.0022*	0.0015
	(1.01)		(1.89)	(1.02)
SEGMENTATION	-0.0477		-0.0665	0.0083
	(-0.73)		(-0.69)	(0.11)
SHORT_SELLING			0.0168	
			(1.05)	
MKT_MAKER				-0.0008
				(-0.20)
Constant	0.0481***	0.0471*	0.0172***	0.0299***
	(3.25)	(1.89)	(3.19)	(2.69)
Obs	182	156	182	135
R^2	0.0182	0.0522	0.0280	0.0180

Panel B: Dependent variable - $(\beta_2 + \beta_3 VOLASHOCK_{50})(SPRSHOCK_{75} - SPRSHOCK_{25})$				
	[1]	[2]	[3]	[4]
MKTVOLA	-0.4991	0.0294	-0.4721	-0.4482
	(-1.50)	(0.15)	(-1.65)	(-1.55)
MKTDVOL	0.0008			
	(1.51)			
MKTCAP		-0.0011		
		(-1.28)		
GOVERNANCE		0.0058***		
		(3.88)		
GDP_PER_CAP				0.0012
				(1.03)
DEVELOPMENT	0.0021	0.0023	0.0031	
	(0.90)	(1.23)	(1.44)	
OPENNESS	-0.0009		-0.0014	-0.0009
	(-0.93)		(-1.32)	(-0.80)
SEGMENTATION	0.1366		0.1493	-0.0224
	(0.87)		(1.01)	(-0.27)
SHORT_SELLING			-0.0067**	
			(-2.24)	
MKT_MAKER				0.0006
				(0.27)
Constant	0.0043	0.0268	0.0145***	0.0067
	(0.99)	(1.58)	(2.79)	(0.54)
Obs	128	130	128	102
R^2	0.0505	0.1651	0.0770	0.0669

Appendix C.4: Impact of market maker services

Following the approach of Chung and Chuwonganant (2017), we test whether the influence of market makers on the impact of the liquidity channel is more time-series based in seven markets, by adding the interaction term *VOLASHOCK* × *AMISHOCK* × *MMS* to Equation (6), where MMS is a dummy variable set to one over a one-year period following the introduction of market maker services in a given country, and zero for a one-year pre-period. According to our survey answers, exchange websites and the literature, nine of the 41 sample countries introduced market maker programmes during our sample period; however, France and Italy do not have sufficient data over the one-year pre- and/or post-event windows.

Panel A: *AMISHOCK*

	VOLASHOCK	*AMISHOCK*	*VOLASHOCK* × *AMISHOCK*	*VOLASHOCK* × *AMISHOCK* × *MMS*	Controls	Obs	R^2
Singapore	-0.0160*	0.0500***	-0.0219	0.0515	YES	8067	0.2592
	(-1.76)	(4.34)	(-0.71)	(1.35)	YES		
South Korea	0.0147	0.0112*	0.0291	0.0073	YES	26872	0.2732
	(0.31)	(1.79)	(0.88)	(0.19)	YES		
Austria	-0.0256***	0.0385***	-0.0227	0.0274	YES	1340	0.2418
	(-3.13)	(3.24)	(-0.55)	(0.62)	YES		
Israel	0.0106	0.0831***	0.0770*	-0.0501	YES	4721	0.3236
	(1.03)	(4.27)	(1.73)	(-0.91)	YES		
Norway	-0.0252	0.1109***	0.2590***	-0.2953**	YES	2346	0.2584
	(-1.20)	(5.00)	(2.66)	(-2.37)	YES		
Sweden	0.0426	0.1423***	-0.0358	-0.0538	YES	6312	0.2560
	(1.43)	(8.21)	(-0.82)	(-0.74)	YES		
Turkey	-0.0427***	0.0454***	0.1206	-0.1541*	YES	6294	0.4650
	(-3.13)	(2.84)	(1.60)	(-1.76)	YES		

Panel B: *SPRSHOCK*

	VOLASHOCK	*AMISHOCK*	*VOLASHOCK* × *SPRSHOCK*	*VOLASHOCK* × *SPRSHOCK* × *MMS*	Controls	Obs	R^2
Singapore	-0.0131*	0.0216**	-0.0072	0.0503	YES	7053	0.2218
	(-1.67)	(2.32)	(-0.24)	(1.37)	YES		
South Korea	-0.0377	0.0009	0.2004**	-0.2101**	YES	26048	0.2683
	(-1.37)	(0.08)	(2.53)	(-2.35)	YES		
Austria							
Israel							
Norway	-0.0058	0.0700***	0.1012	-0.1374	YES	2273	0.2682
	(-0.24)	(5.26)	(1.28)	(-1.31)	YES		
Sweden	0.0279	0.0673***	-0.0519***	0.0185	YES	5253	0.2611
	(1.22)	(5.37)	(-2.58)	(0.51)	YES		
Turkey	-0.0403***	0.0066	0.1037*	-0.0803	YES	6442	0.4634
	(-3.57)	(0.62)	(1.66)	(-1.22)	YES		

APPENDIX D

FOR ESSAY FOUR

Appendix D.1: Descriptive statistics of market liquidity and trading activity
This table presents summary statistics for levels of the following market liquidity and trading activity measures: Amihud ratio, spread, price (CNY), share volume (millions), and trading value (millions of CNY). The terms EW and VW refer to daily market liquidity being equal and value weighted, respectively.

	Number of stocks	Amihud	Spread	Price (CNY)	Share volume (million)	Trading value (CNY million)
Panel A: Full sample EW						
Mean	1572	0.0039	0.0037	6.6578	8.4513	63.4965
SD	717	0.0135	0.0054	3.7285	7.5056	91.8302
Median	1459	0.0004	0.0024	6.1655	6.3862	26.8124
Minimum	343	0.0000	0.0007	1.7861	0.0074	0.0320
Maximum	2891	0.5521	0.0869	26.3895	53.5713	794.7306
Panel B: Full sample VW						
Mean	1572	0.0006	0.0024	7.8314	31.5750	257.5136
SD	717	0.0020	0.0024	4.0236	43.0491	433.2272
Median	1459	0.0001	0.0019	6.9847	18.3006	89.1586
Minimum	343	0.0000	0.0006	2.2522	0.0249	0.1542
Maximum	2891	0.0856	0.0449	26.6579	540.6371	4462.3610

Appendix D.2: Time-series regressions: the Shanghai Stock Exchange

This table presents our baseline time-series regression results for the Shanghai Stock Exchange. The independent variables are as defined in Table 5. We use the Cochrane–Orcutt (1949) procedure to correct for first-order serial dependence in residuals. The numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

Panel A: Shanghai A shares

	ΔAmihud		ΔSpread		ΔShare volume		ΔTrading value	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MKT_RET+	1.4612***	5.6913***	-2.2239***	-4.3170***	11.3887***	8.0733***	12.1761***	8.7998***
	(2.75)	(5.91)	(-14.63)	(-26.90)	(37.83)	(25.75)	(41.33)	(28.25)
MKT_RET-	-17.2546***	-17.2559***	-4.3975***	-4.0714***	-3.3639***	-2.7714***	-2.3700***	-1.6666***
	(-32.84)	(-22.24)	(-29.17)	(-31.94)	(-11.33)	(-10.96)	(-8.17)	(-6.63)
MA_MKT+	2.2211**	2.3675	2.2709***	2.7255***	-0.3792	1.3029**	-0.4060	1.1410**
	(2.02)	(1.37)	(7.23)	(9.77)	(-0.60)	(2.35)	(-0.65)	(2.07)
MA_MKT-	6.3006***	6.8156***	3.0264***	4.0447***	-1.0587	-1.4181**	-1.3585**	-1.7704***
	(5.27)	(3.87)	(8.85)	(14.17)	(-1.54)	(-2.50)	(-2.01)	(-3.15)
MA_ABMKT	-9.1733***	-10.6425***	-1.2464***	0.5164***	-7.3822***	-5.7728***	-7.4111***	-5.7233***
	(-12.46)	(-8.90)	(-5.92)	(2.66)	(-17.45)	(-14.99)	(-17.75)	(-14.98)
MONDAY	0.1626***	0.2291***	-0.0150**	-0.0024	-0.0336**	0.0114	-0.0347***	0.0118
	(6.40)	(6.23)	(-2.12)	(-0.39)	(-2.46)	(0.93)	(-2.67)	(0.96)
TUESDAY	-0.0379*	-0.0149	0.0048	0.0076	-0.0067	0.0309***	-0.0047	0.0278***
	(-1.82)	(-0.47)	(0.82)	(1.46)	(-0.59)	(2.98)	(-0.43)	(2.69)
WEDNESDAY	0.0056	0.0183	0.0027	0.0086*	0.0088	0.0220**	0.0094	0.0192*
	(0.27)	(0.58)	(0.47)	(1.66)	(0.77)	(2.14)	(0.86)	(1.87)
THURSDAY	-0.0069	0.0374	0.0122*	0.0242***	0.0187	0.0297**	0.0163	0.0243**
	(-0.27)	(1.02)	(1.73)	(3.89)	(1.37)	(2.41)	(1.25)	(1.97)
HOLI	0.1272***	0.0896**	-0.0054	-0.0037	-0.0528***	0.0069	-0.0530***	0.0076
	(4.86)	(2.32)	(-0.73)	(-0.59)	(-3.51)	(0.55)	(-3.58)	(0.62)
Δ*PRIME_RATE*		26.8864		0.4876		-25.1431***		-23.6108***
		(0.95)		(0.11)		(-2.74)		(-2.59)
Δ*TERM_SPR*		-11.2618		-1.2038		3.9254		4.3863
		(-0.87)		(-0.57)		(0.93)		(1.05)
GDP		-0.1141		0.0022		-0.0051		-0.0064
		(-1.45)		(0.17)		(-0.20)		(-0.25)
GDP(1-2)		0.0765		0.0097		-0.0162		-0.0163
		(1.55)		(1.21)		(-1.01)		(-1.03)

CPI		-0.0123		0.0121		-0.0348**		-0.0321**
		(-0.25)		(1.50)		(-2.17)		(-2.02)
CPI(1-2)		0.0038		-0.0156***		-0.0114		-0.0067
		(0.12)		(-3.05)		(-1.13)		(-0.66)
Constant	-0.0156	-0.0523*	0.0043	-0.0074*	0.0002	-0.0241***	0.0011	-0.0213**
	(-0.92)	(-1.95)	(0.90)	(-1.66)	(0.02)	(-2.73)	(0.12)	(-2.42)
Obs	5212	2547	5206	2545	5214	2547	5214	2547
Adj R^2	0.2121	0.2021	0.2592	0.5816	0.2276	0.2241	0.2643	0.2649

Panel B: Shanghai B shares

	ΔAmihud		ΔSpread		ΔShare volume		ΔTrading value	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MKT_RET+	-0.1706	5.0056***	-4.9290***	-7.0907***	13.0524***	11.1759***	13.9614***	12.0296***
	(-0.27)	(6.48)	(-20.56)	(-18.28)	(33.29)	(23.68)	(35.87)	(25.63)
MKT_RET-	-14.2305***	-18.3588***	-2.8459***	-2.9999***	-8.4340***	-7.1622***	-7.4788***	-6.2467***
	(-20.68)	(-25.55)	(-11.81)	(-8.88)	(-19.97)	(-16.36)	(-17.84)	(-14.35)
MA_MKT+	2.4884*	4.8681***	2.8966***	3.0504***	0.5333	0.6763	0.2693	0.5267
	(1.95)	(3.52)	(6.14)	(4.52)	(0.65)	(0.78)	(0.33)	(0.61)
MA_MKT-	2.7623*	2.8407*	2.2476***	3.7815***	0.4342	1.2792	0.6799	1.1892
	(1.84)	(1.72)	(4.14)	(4.74)	(0.45)	(1.24)	(0.71)	(1.16)
MA_ABMKT	-7.5387***	-12.5276***	0.5575	1.9620***	-11.0579***	-9.3464***	-10.8857***	-9.3645***
	(-8.08)	(-12.28)	(1.64)	(4.00)	(-18.50)	(-14.63)	(-18.37)	(-14.74)
MONDAY	0.1576***	0.1459***	0.0026	-0.0181	-0.0923***	-0.0070	-0.0931***	-0.0071
	(4.26)	(3.73)	(0.21)	(-1.00)	(-4.72)	(-0.32)	(-4.78)	(-0.33)
TUESDAY	-0.1754***	-0.1422***	0.0018	0.0090	0.0409**	0.0076	0.0353**	0.0006
	(-5.93)	(-4.49)	(0.18)	(0.62)	(2.44)	(0.41)	(2.12)	(0.03)
WEDNESDAY	0.0094	0.0022	-0.0011	0.0115	-0.0159	-0.0108	-0.0229	-0.0142
	(0.32)	(0.07)	(-0.11)	(0.80)	(-0.95)	(-0.59)	(-1.38)	(-0.79)
THURSDAY	-0.0158	0.0398	0.0115	0.0223	0.0086	0.0023	0.0068	-0.0040
	(-0.42)	(1.01)	(0.92)	(1.23)	(0.44)	(0.11)	(0.35)	(-0.19)
HOLI	0.0849**	0.0675*	0.0140	-0.0012	-0.0009	0.0116	0.0022	0.0174
	(2.41)	(1.92)	(1.16)	(-0.08)	(-0.04)	(0.53)	(0.10)	(0.80)
Δ*PRIME_RATE*		18.4220		-5.7532		-28.8593*		-23.2187
		(0.69)		(-0.47)		(-1.78)		(-1.44)

Δ*TERM_SPR*		-12.6662		-6.5503		6.5863		9.1250
		(-1.03)		(-1.17)		(0.88)		(1.23)
GDP		0.0475		-0.0293		-0.0020		0.0053
		(0.63)		(-0.85)		(-0.04)		(0.12)
GDP(1-2)		0.0832*		0.0095		0.0440		0.0450
		(1.83)		(0.45)		(1.56)		(1.60)
CPI		-0.0318		0.0266		-0.0433		-0.0483*
		(-0.68)		(1.23)		(-1.53)		(-1.72)
CPI(1-2)		0.0233		0.0044		-0.0309*		-0.0274
		(0.81)		(0.34)		(-1.73)		(-1.54)
Constant	0.0116	-0.0095	-0.0001	-0.0028	0.0140	0.0050	0.0160	0.0086
	(0.49)	(-0.38)	(-0.01)	(-0.24)	(1.04)	(0.34)	(1.20)	(0.59)
Obs	5076	2545	5009	2514	5076	2545	5076	2545
Adj R^2	0.1126	0.2388	0.1498	0.2085	0.2025	0.2128	0.2188	0.2279

Appendix D.3: Time-series regressions: Shenzhen Stock Exchange

This table presents our baseline time-series regression results for the Shenzhen Stock Exchange. The independent variables are as defined in Table 5. We use the Cochrane–Orcutt (1949) procedure to correct for first-order serial dependence in the residuals. The numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

Panel A: Shenzhen A shares

	ΔAmihud		ΔSpread		ΔShare volume		ΔTrading value	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MKT_RET+	1.0093*	3.4406***	-2.2799***	-4.7624***	10.7049***	7.3208***	11.6066***	8.1738***
	(1.89)	(3.66)	(-7.25)	(-28.42)	(33.30)	(24.86)	(37.07)	(28.05)
MKT_RET-	-18.0183***	-16.8015***	-3.8604***	-4.4569***	-2.7149***	-2.0016***	-1.6843***	-0.9361***
	(-35.64)	(-22.33)	(-12.85)	(-33.14)	(-8.92)	(-8.48)	(-5.68)	(-4.01)
MA_MKT+	4.2518***	5.8076***	1.3580**	2.0741***	0.0360	1.4358***	-0.0941	1.2611**
	(3.99)	(3.55)	(2.19)	(7.18)	(0.05)	(2.77)	(-0.15)	(2.47)
MA_MKT-	5.5028***	3.0039*	3.1765***	4.8151***	-1.7020**	-1.2787**	-1.9997***	-1.5693***
	(4.85)	(1.76)	(4.73)	(15.68)	(-2.43)	(-2.37)	(-2.93)	(-2.94)
MA_ABMKT	-10.1297***	-11.7526***	-0.6931	0.9252***	-7.0646***	-5.0286***	-7.0667***	-5.0193***
	(-13.99)	(-9.86)	(-1.64)	(4.39)	(-15.79)	(-13.35)	(-16.20)	(-13.49)
MONDAY	0.1536***	0.1272***	0.0148	-0.0026	-0.0171	0.0164	-0.0179	0.0161
	(6.17)	(3.45)	(1.04)	(-0.41)	(-1.23)	(1.45)	(-1.32)	(1.43)
TUESDAY	-0.0448**	-0.0693**	0.0122	0.0003	0.0018	0.0404***	0.0025	0.0388***
	(-2.19)	(-2.25)	(1.04)	(0.06)	(0.16)	(4.22)	(0.21)	(4.08)
WEDNESDAY	0.0283	-0.0010	-0.0006	-0.0018	0.0083	0.0244**	0.0085	0.0226**
	(1.40)	(-0.03)	(-0.05)	(-0.34)	(0.70)	(2.57)	(0.74)	(2.40)
THURSDAY	0.0022	0.0022	0.0193	0.0050	0.0264*	0.0314***	0.0225*	0.0270**
	(0.09)	(0.06)	(1.35)	(0.79)	(1.90)	(2.78)	(1.67)	(2.41)
HOLI	0.0976***	0.0359	-0.0047	-0.0025	-0.0448***	-0.0044	-0.0439***	-0.0001
	(3.79)	(0.98)	(-0.32)	(-0.39)	(-2.83)	(-0.38)	(-2.84)	(-0.01)
Δ*PRIME_RATE*		48.4887*		10.5031**		-29.7316***		-28.2177***
		(1.79)		(2.21)		(-3.50)		(-3.35)
Δ*TERM_SPR*		-0.8550		-3.3112		5.3449		6.5239*
		(-0.07)		(-1.51)		(1.36)		(1.68)
GDP		-0.0565		-0.0109		0.0046		0.0018
		(-0.74)		(-0.82)		(0.19)		(0.07)
GDP(1-2)		0.0484		0.0123		-0.0047		-0.0019
		(1.03)		(1.48)		(-0.31)		(-0.13)

CPI		-0.1042**		-0.0044		-0.0332**		-0.0317**
		(-2.20)		(-0.52)		(-2.23)		(-2.16)
CPI(1-2)		0.0089		-0.0136***		-0.0116		-0.0101
		(0.30)		(-2.59)		(-1.23)		(-1.08)
Constant	-0.0158	0.0064	-0.0031	0.0013	-0.0056	-0.0282***	-0.0048	-0.0262***
	(-0.94)	(0.24)	(-0.32)	(0.27)	(-0.57)	(-3.38)	(-0.50)	(-3.18)
Obs	5199	2547	5124	2532	5202	2547	5202	2547
Adj R^2	0.2421	0.2041	0.0677	0.5947	0.1865	0.2195	0.2275	0.2768

Panel B: Shenzhen B shares

	ΔAmihud		ΔSpread		ΔShare volume		ΔTrading value	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MKT_RET+	-2.5745***	1.7465*	-4.8253***	-7.2825***	12.5680***	11.9527***	13.4943***	12.9635***
	(-3.71)	(1.76)	(-19.08)	(-19.00)	(27.99)	(22.76)	(30.26)	(24.97)
MKT_RET-	-15.3327***	-19.2993***	-3.1865***	-4.1978***	-6.9995***	-7.1833***	-6.2003***	-6.5311***
	(-20.40)	(-21.44)	(-12.30)	(-12.42)	(-14.49)	(-15.13)	(-12.92)	(-13.92)
MA_MKT+	-1.1641	2.7198	2.3574***	2.9896***	0.5299	-0.5175	0.5254	-0.6698
	(-0.84)	(1.47)	(4.77)	(4.43)	(0.57)	(-0.52)	(0.57)	(-0.68)
MA_MKT-	9.3974***	7.1895***	2.6078***	4.5289***	-0.8114	2.3284**	-1.0227	2.0141*
	(5.74)	(3.45)	(4.44)	(5.81)	(-0.75)	(2.07)	(-0.95)	(1.82)
MA_ABMKT	-4.0388***	-8.6820***	0.3107	1.8190***	-9.9078***	-8.9885***	-10.0598***	-9.3600***
	(-3.97)	(-6.31)	(0.88)	(3.59)	(-14.63)	(-12.10)	(-14.98)	(-12.79)
MONDAY	0.1776***	0.1214***	-0.0084	-0.0052	-0.0682***	0.0055	-0.0648***	0.0005
	(4.56)	(2.94)	(-0.68)	(-0.33)	(-3.08)	(0.27)	(-2.94)	(0.03)
TUESDAY	-0.1089***	-0.1436***	-0.0234**	-0.0100	0.0528***	0.0276	0.0461**	0.0114
	(-3.46)	(-4.23)	(-2.31)	(-0.79)	(2.80)	(1.60)	(2.46)	(0.66)
WEDNESDAY	-0.0187	-0.0157	-0.0195*	-0.0189	-0.0091	-0.0138	-0.0133	-0.0231
	(-0.60)	(-0.47)	(-1.95)	(-1.53)	(-0.49)	(-0.80)	(-0.71)	(-1.36)
THURSDAY	0.0105	0.0307	-0.0026	0.0063	0.0144	0.0210	0.0126	0.0089
	(0.27)	(0.74)	(-0.21)	(0.40)	(0.65)	(1.03)	(0.57)	(0.44)
HOLI	0.0339	0.0385	0.0263**	0.0310**	0.0063	0.0440**	0.0073	0.0452**
	(0.89)	(0.99)	(2.07)	(2.23)	(0.25)	(2.11)	(0.29)	(2.19)
Δ*PRIME_RATE*		23.4304		11.2110		-38.5754**		-42.4980***
		(0.80)		(1.07)		(-2.51)		(-2.80)

Δ*TERM_SPR*		6.2139		3.5240		13.4322*		13.3593*
		(0.46)		(0.73)		(1.90)		(1.91)
GDP		-0.2972***		-0.0043		0.0274		0.0138
		(-3.63)		(-0.14)		(0.64)		(0.33)
GDP(1-2)		0.1566***		-0.0038		0.0364		0.0206
		(3.12)		(-0.21)		(1.36)		(0.78)
CPI		0.0132		0.0146		-0.0332		-0.0269
		(0.26)		(0.79)		(-1.24)		(-1.01)
CPI(1-2)		0.0020		-0.0009		-0.0319*		-0.0267
		(0.06)		(-0.07)		(-1.87)		(-1.59)
Constant	-0.0025	-0.0065	0.0163**	0.0063	-0.0038	-0.0098	-0.0017	0.0005
	(-0.10)	(-0.23)	(2.02)	(0.60)	(-0.25)	(-0.69)	(-0.11)	(0.04)
Obs	4984	2547	4917	2516	5088	2547	5088	2547
Adj R^2	0.1199	0.19	0.1435	0.2504	0.1485	0.2002	0.1654	0.2222

Panel C: ChiNext shares

	ΔAmihud		ΔSpread		ΔShare volume		ΔTrading value	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MKT_RET+	11.2281***	11.3036***	-7.9451***	-7.9581***	7.4209***	7.3728***	8.2283***	8.1875***
	(8.51)	(8.56)	(-20.88)	(-20.85)	(20.45)	(20.28)	(23.21)	(23.05)
MKT_RET-	-18.3454***	-18.4367***	-5.2981***	-5.3045***	-2.3519***	-2.3311***	-1.0694***	-1.0548***
	(-15.99)	(-16.06)	(-15.85)	(-15.84)	(-7.47)	(-7.40)	(-3.48)	(-3.43)
MA_MKT+	6.3491**	6.3323**	3.8418***	3.8387***	0.4248	0.3959	0.3225	0.2841
	(2.51)	(2.51)	(5.69)	(5.68)	(0.64)	(0.60)	(0.50)	(0.44)
MA_MKT-	0.7931	0.6441	6.9854***	7.0220***	-0.5725	-0.5347	-1.0432	-0.98727003
	(0.30)	(0.24)	(9.43)	(9.41)	(-0.81)	(-0.76)	(-1.52)	(-1.44)
MA_ABMKT	-15.9854***	-15.8272***	2.0375***	2.0807***	-4.8428***	-4.8402***	-4.8024***	-4.7976***
	(-8.19)	(-8.11)	(3.91)	(3.98)	(-9.46)	(-9.44)	(-9.63)	(-9.62)
MONDAY	0.0695	0.0737	0.0112	0.0107	0.0071	0.0057	0.0078	0.0064
	(1.29)	(1.37)	(0.61)	(0.58)	(0.44)	(0.35)	(0.48)	(0.40)
TUESDAY	-0.0859*	-0.0850*	0.0132	0.0123	0.0370***	0.0369***	0.0383***	0.0381***
	(-1.78)	(-1.76)	(0.88)	(0.82)	(2.69)	(2.67)	(2.83)	(2.82)
WEDNESDAY	-0.0520	-0.0486	0.0052	0.0037	0.0197	0.0201	0.0185	0.0188
	(-1.08)	(-1.01)	(0.35)	(0.25)	(1.44)	(1.46)	(1.38)	(1.40)

THURSDAY	-0.0659	-0.0685	0.0319*	0.0312*	0.0276*	0.0283*	0.0285*	0.0292*
	(-1.23)	(-1.28)	(1.73)	(1.69)	(1.70)	(1.74)	(1.78)	(1.82)
HOLI	0.0388	0.0236	-0.0054	-0.0085	-0.0208	-0.0184	-0.0216	-0.01955819
	(0.64)	(0.39)	(-0.33)	(-0.52)	(-1.30)	(-1.15)	(-1.39)	(-1.25)
Δ*PRIME_RATE*		119.1628*		23.1112		-32.5769*		-32.3993*
		(1.92)		(1.31)		(-1.91)		(-1.95)
Δ*TERM_SPR*		54.5169		0.9293		4.3953		2.8840018
		(1.62)		(0.09)		(0.47)		(0.32)
GDP		-0.0735		0.0050		-0.0138		-0.0229
		(-0.61)		(0.14)		(-0.42)		(-0.70)
GDP(1-2)		-0.0726		-0.0280		0.0122		0.0078
		(-0.93)		(-1.30)		(0.59)		(0.38)
CPI		0.0677		-0.0300		-0.0275		-0.0237
		(0.88)		(-1.34)		(-1.29)		(-1.14)
CPI(1-2)		-0.0581		0.0008		0.0033		0.0042
		(-1.14)		(0.06)		(0.24)		(0.32)
Constant	0.0245	0.0261	-0.0091	-0.0066	-0.0255**	-0.0242*	-0.0242**	-0.0229*
	(0.55)	(0.59)	(-0.69)	(-0.50)	(-2.08)	(-1.96)	(-2.02)	(-1.89)
Obs	1614	1614	1598	1598	1614	1614	1614	1614
Adj R^2	0.1567	0.1582	0.4678	0.4675	0.2166	0.2169	0.2818	0.2822

Appendix D.4. Time-series regressions: post-2010 period

China started to allow short selling and margin trading for selected stocks on March 31, 2010. In this table, we re-estimate our baseline time-series regressions for the period after March 31, 2010.Independent variables are as defined in Table 5. In Panel B, we test whether the days preceding holidays and the days following holidays have different effects. We use the Cochrane/Orcutt method to correct first-order serial dependence in residuals. Numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

	ΔAmihud		ΔSpread		ΔShare volume		ΔTrading value	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MKT_RET+	7.4181***	7.5410***	-5.1125***	-5.1081***	8.2322***	8.1672***	9.0856***	9.0271***
	(6.08)	(6.18)	(-20.41)	(-20.35)	(18.61)	(18.43)	(21.03)	(20.85)
MKT_RET-	-15.5060***	-15.5835***	-5.6013***	-5.5993***	-3.1817***	-3.1348***	-1.8923***	-1.8493***
	(-15.70)	(-15.79)	(-27.61)	(-27.59)	(-8.88)	(-8.75)	(-5.41)	(-5.28)
MA_MKT+	6.8001***	6.7768551	2.7840***	2.8695***	2.1301***	2.2072***	1.8566**	1.9141**
	(3.07)	(3.06)	(6.06)	(6.24)	(2.66)	(2.76)	(2.39)	(2.46)
MA_MKT-	2.278292	2.1732742	6.1543***	6.1335***	-1.4920*	-1.3745*	-1.8926**	-1.7743**
	(1.02)	(0.97)	(13.26)	(13.18)	(-1.85)	(-1.70)	(-2.41)	(-2.25)
MA_ABMKT	-12.5130***	-12.4114***	0.9660***	0.9551***	-5.8690***	-5.8407***	-5.8078***	-5.7778***
	(-7.78)	(-7.74)	(2.90)	(2.87)	(-10.10)	(-10.07)	(-10.27)	(-10.22)
MONDAY	0.1523***	0.1528***	0.0022	0.0021	0.02342538	0.0221	0.02319282	0.0219
	(3.69)	(3.70)	(0.26)	(0.25)	(1.55)	(1.46)	(1.56)	(1.47)
TUESDAY	-0.05392015	-0.05599175	-0.0012	-0.0015	0.0272**	0.0272**	0.0248**	0.0247**
	(-1.53)	(-1.59)	(-0.17)	(-0.22)	(2.12)	(2.12)	(1.98)	(1.96)
WEDNESDAY	-0.0070	-0.0103	0.0046	0.0040	0.0153	0.0154628	0.0121	0.01197987
	(-0.20)	(-0.29)	(0.65)	(0.56)	(1.21)	(1.21)	(0.97)	(0.96)
THURSDAY	0.0053	0.0020	0.0235***	0.0232***	0.0300**	0.0306**	0.0258*	0.0262*
	(0.13)	(0.05)	(2.84)	(2.80)	(1.99)	(2.03)	(1.74)	(1.77)
HOLI	0.03867216	0.02996158	-0.0012	-0.0020	-0.0045405	-0.0038	-0.00212008	-0.0014
	(0.94)	(0.73)	(-0.15)	(-0.24)	(-0.31)	(-0.26)	(-0.15)	(-0.10)
Δ*PRIME_RATE*		105.4803**		11.8197		-28.1453*		-26.0018*
		(2.48)		(1.35)		(-1.82)		(-1.72)
Δ*TERM_SPR*		8.7047		-6.9078		-4.6813		-5.3759
		(0.34)		(-1.32)		(-0.51)		(-0.59)
GDP		-0.13292043		-0.0067		-0.0078		-0.0087
		(-1.58)		(-0.39)		(-0.26)		(-0.29)
GDP(1-2)		0.07070271		0.0138		-0.0194		-0.0182
		(1.33)		(1.26)		(-1.01)		(-0.97)

CPI		0.00368929		-0.0053		-0.0337*		-0.031112
		(0.07)		(-0.47)		(-1.68)		(-1.59)
CPI(1-2)		-0.0268		-0.01186487		-0.0077		-0.0031
		(-0.76)		(-1.63)		(-0.60)		(-0.25)
Constant	-0.0208	-0.0191	-0.0101	-0.00920115	-0.0313***	-0.0283**	-0.0279***	-0.0253**
	(-0.69)	(-0.63)	(-1.64)	(-1.49)	(-2.86)	(-2.57)	(-2.61)	(-2.35)
Obs	1518	1518	1518	1518	1518	1518	1518	1518
Adj R^2	0.1741	0.1760	0.6205	0.6210	0.1935	0.1953	0.2441	0.2454

Appendix D.5: Global factors: the Shanghai Stock Exchange

This table presents the effects of global factors (global liquidity and VIX) on the market liquidity of the Shanghai Stock Exchange. The numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

Panel A: Shanghai A shares

Panel A1: Without local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	0.0586	0.1639***	-0.0622	0.2341	0.0685*	0.0681**	0.1501**	0.0820**
	(0.88)	(3.00)	(-0.31)	(1.57)	(1.67)	(2.45)	(2.13)	(2.50)
ΔGLOB_FACTOR$_{t-1}$	-0.0578	0.0892	-0.0792	-0.4085***	0.0709	0.0219	-0.0841	-0.0132
	(-0.82)	(1.61)	(-0.42)	(-2.79)	(1.63)	(0.77)	(-1.24)	(-0.41)
ΔGLOB_FACTOR$_{t+1}$	-0.1050	0.0673	0.2200	0.2694*	0.0120	0.1009***	0.0114	0.0734**
	(-1.49)	(1.21)	(1.17)	(1.84)	(0.28)	(3.57)	(0.17)	(2.27)
Constant	-0.0007	-0.0010	-0.0007	-0.0009	-0.0003	-0.0005	-0.0003	-0.0005
	(-0.10)	(-0.13)	(-0.10)	(-0.12)	(-0.12)	(-0.28)	(-0.11)	(-0.28)
Obs	2420	2503	2420	2503	2416	2501	2416	2501
Adj R^2	0.0003	0.0027	-0.0004	0.0049	0.001	0.0052	0.0012	0.0046

Panel A2: With local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	0.0323	0.0688	0.0780	-0.0492	0.0615	-0.0118	0.1049	-0.0346*
	(0.56)	(1.43)	(0.43)	(-0.38)	(1.59)	(-0.69)	(1.52)	(-1.70)
Δ*GLOB_FACTOR*$_{t-1}$	-0.0689	0.0190	-0.0625	-0.3519***	0.0737*	-0.0227	-0.0682	0.0051
	(-1.12)	(0.40)	(-0.37)	(-2.78)	(1.79)	(-1.30)	(-1.03)	(0.25)
Δ*GLOB_FACTOR*$_{t+1}$	-0.0802	0.0469	0.0663	-0.0686	0.0284	0.0300*	0.0533	-0.0127
	(-1.30)	(0.98)	(0.39)	(-0.54)	(0.69)	(1.72)	(0.81)	(-0.64)
MKT_RET+	-1.3280**	3.1978***	-1.3347**	3.1376***	-0.9298***	-4.7729***	-0.9336***	-4.7894***
	(-2.18)	(3.53)	(-2.19)	(3.47)	(-3.72)	(-33.26)	(-3.73)	(-33.34)
MKT_RET-	-18.3038***	-19.3097***	-18.2889***	-19.4437***	-4.2605***	-3.8400***	-4.2627***	-3.8669***
	(-24.44)	(-25.63)	(-24.41)	(-25.66)	(-13.52)	(-32.70)	(-13.53)	(-32.68)
MA_MKT+	1.6961	5.1510***	1.7404	5.0644***	2.2456***	2.9983***	2.2875***	3.0092***
	(1.16)	(3.18)	(1.19)	(3.13)	(3.67)	(12.07)	(3.74)	(12.07)

MA_MKT-	5.5922***	6.5765***	5.5220***	6.6197***	1.8843***	3.3762***	1.7856**	3.4034***
	(3.25)	(3.87)	(3.21)	(3.90)	(2.61)	(12.93)	(2.47)	(12.99)
MA_ABMKT	-8.4409***	-10.9613***	-8.4671***	-10.8050***	-2.3742***	0.4908***	-2.4090***	0.5021***
	(-8.95)	(-9.42)	(-8.98)	(-9.30)	(-6.00)	(2.74)	(-6.08)	(2.80)
MONDAY	0.0910**	0.2210***	0.0936**	0.2209***	-0.0239*	0.0006	-0.0238*	0.0007
	(2.47)	(6.49)	(2.49)	(6.50)	(-1.78)	(0.11)	(-1.73)	(0.12)
TUESDAY	-0.0682**	-0.0214	-0.0743**	-0.0244	0.0045	0.0122***	-0.0004	0.0127***
	(-2.36)	(-0.75)	(-2.55)	(-0.86)	(0.41)	(2.70)	(-0.04)	(2.83)
WEDNESDAY	-0.0012	0.0149	0.0040	0.0170	-0.0010	0.0075*	-0.0010	0.0076*
	(-0.04)	(0.53)	(0.14)	(0.60)	(-0.09)	(1.67)	(-0.09)	(1.69)
THURSDAY	-0.0371	0.0247	-0.0387	0.0231	-0.0018	0.0224***	-0.0027	0.0226***
	(-1.01)	(0.73)	(-1.05)	(0.68)	(-0.13)	(4.10)	(-0.20)	(4.15)
HOLI	0.1725***	0.1086***	0.1725***	0.1096***	-0.0044	-0.0001	-0.0040	-0.0003
	(4.59)	(3.11)	(4.60)	(3.15)	(-0.28)	(-0.01)	(-0.25)	(-0.06)
Constant	0.0120	-0.0495**	0.0121	-0.0511**	0.0125	-0.0070*	0.0137	-0.0073*
	(0.52)	(-2.02)	(0.52)	(-2.08)	(1.41)	(-1.80)	(1.53)	(-1.89)
Obs	2420	2503	2420	2503	2416	2501	2416	2501
Adj R^2	0.2471	0.2612	0.2464	0.2630	0.1120	0.6258	0.1117	0.6253

Panel B: Shanghai B shares

Panel B1: Without local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	0.1330	0.1046*	-0.4951	0.2235	-0.0342	0.1562***	0.1737*	0.2675***
	(1.16)	(1.86)	(-1.50)	(1.41)	(-0.65)	(2.75)	(1.91)	(3.89)
Δ*GLOB_FACTOR*$_{t-1}$	-0.1524	0.0295	0.0103	-0.2885*	0.0687	0.0621	-0.1000	-0.1572**
	(-1.29)	(0.50)	(0.03)	(-1.88)	(1.23)	(1.05)	(-1.15)	(-2.34)
Δ*GLOB_FACTOR*$_{t+1}$	-0.2287*	0.1087*	0.6779**	0.3855**	-0.0136	0.2213***	-0.0761	0.1870***
	(-1.93)	(1.85)	(2.15)	(2.51)	(-0.25)	(3.76)	(-0.88)	(2.79)
Constant	-0.0027	-0.0016	-0.0028	-0.0016	0.0001	-0.0009	0.0002	-0.0009
	(-0.23)	(-0.22)	(-0.25)	(-0.21)	(0.04)	(-0.26)	(0.05)	(-0.26)
Obs	2299	2488	2299	2488	2263	2466	2263	2466
Adj R^2	0.0017	0.0011	0.0012	0.0049	-0.0003	0.0066	0.0004	0.0129

Panel B2: With local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	0.0473	0.0129	-0.1615	-0.0746	-0.0678	0.0855*	0.1381	0.1337**
	(0.42)	(0.26)	(-0.48)	(-0.53)	(-1.35)	(1.69)	(1.54)	(2.17)
Δ*GLOB_FACTOR*$_{t-1}$	-0.1784	-0.0167	-0.1116	-0.3048**	0.0541	0.0141	-0.0579	-0.1083*
	(-1.54)	(-0.32)	(-0.35)	(-2.23)	(1.02)	(0.27)	(-0.68)	(-1.81)
Δ*GLOB_FACTOR*$_{t+1}$	-0.2133*	0.0530	0.2935	0.02781794	-0.0111	0.1628***	-0.1213	0.1133*
	(-1.84)	(1.02)	(0.94)	(0.20)	(-0.21)	(3.12)	(-1.43)	(1.90)
MKT_RET+	-3.4576***	2.9845***	-3.4808***	3.0638***	-3.3247***	-7.3286***	-3.3133***	-7.3054***
	(-3.39)	(3.81)	(-3.41)	(3.91)	(-10.74)	(-19.41)	(-10.71)	(-19.33)
MKT_RET-	-9.7737***	-18.1690***	-9.7343***	-18.3033***	-2.4220***	-2.7802***	-2.3812***	-2.6927***
	(-7.56)	(-24.08)	(-7.50)	(-24.00)	(-6.74)	(-8.27)	(-6.60)	(-7.94)
MA_MKT+	-0.6511	6.0079***	-0.4987	5.8614***	3.0649***	3.0194***	3.0628***	2.9796***
	(-0.28)	(4.15)	(-0.22)	(4.05)	(4.48)	(4.44)	(4.47)	(4.38)
MA_MKT-	2.4046	3.4005**	2.2520203	3.3913*	0.4742	3.6727***	0.4480	3.6129***
	(0.89)	(1.96)	(0.84)	(1.96)	(0.61)	(4.69)	(0.58)	(4.61)
MA_ABMKT	-2.5553	-11.7553***	-2.6310115	-11.7202***	-0.5554	2.1154***	-0.5538	2.1338***
	(-1.54)	(-10.58)	(-1.58)	(-10.57)	(-1.13)	(4.13)	(-1.13)	(4.17)
MONDAY	0.1777***	0.1181***	0.1737**	0.1153***	0.0256	-0.0238	0.0340*	-0.0247
	(2.62)	(3.05)	(2.52)	(2.98)	(1.42)	(-1.41)	(1.85)	(-1.46)
TUESDAY	-0.2263***	-0.1219***	-0.2316***	-0.1245***	-0.0089	0.0081	-0.0093	0.0051
	(-4.21)	(-3.90)	(-4.27)	(-3.99)	(-0.62)	(0.59)	(-0.64)	(0.37)
WEDNESDAY	0.0122	-0.0067	0.0231	-0.0042	-0.0145	0.0131	-0.0103	0.0145
	(0.23)	(-0.22)	(0.43)	(-0.14)	(-1.01)	(0.97)	(-0.71)	(1.08)
THURSDAY	-0.0639	0.0084	-0.0704	0.0077	-0.0059	0.0125	-0.0024	0.0127
	(-0.94)	(0.22)	(-1.04)	(0.20)	(-0.33)	(0.74)	(-0.13)	(0.75)
HOLI	0.1145	0.0588	0.1137	0.0583	0.0422**	-0.0053	0.0443**	-0.0058
	(1.63)	(1.64)	(1.62)	(1.63)	(2.20)	(-0.34)	(2.31)	(-0.37)
Constant	0.0206	0.0059	0.0219	0.00542747	0.0029	0.0017	-0.0002	0.0023
	(0.48)	(0.24)	(0.50)	(0.22)	(0.24)	(0.15)	(-0.01)	(0.20)
Obs	2299	2488	2299	2488	2263	2466	2263	2466
Adj R^2	0.0635	0.2225	0.0620	0.2241	0.1033	0.2225	0.1033	0.2231

Appendix D.6: Global factors: the Shenzhen Stock Exchange

This table presents the effects of global factors (global liquidity and VIX) on the market liquidity of the Shenzhen Stock Exchange. We exclude ChiNext in this table, since the data on ChiNext stocks start in November 2009. The numbers in parentheses are t-statistics. * = significance at the 10% level; ** = significance at the 5% level; *** = significance at the 1% level.

Panel A: Shenzhen A shares

Panel A1: Without local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	0.0356	0.1213**	-0.2593	0.5226***	0.0085	0.0864***	0.21607486	0.1270***
	(0.52)	(2.21)	(-1.28)	(3.49)	(0.10)	(2.92)	(1.45)	(3.70)
Δ*GLOB_FACTOR*$_{t-1}$	-0.0450	0.0210	-0.0364	-0.3718**	0.1875**	0.0396	0.0445	-0.0355
	(-0.62)	(0.38)	(-0.19)	(-2.54)	(2.03)	(1.33)	(0.31)	(-1.04)
Δ*GLOB_FACTOR*$_{t+1}$	-0.1270*	0.0539	0.5178***	0.2565*	0.0703	0.1072***	0.0934	0.0780**
	(-1.76)	(0.97)	(2.67)	(1.75)	(0.77)	(3.60)	(0.65)	(2.29)
Constant	-0.0006	-0.0009	-0.0006	-0.0009	0.0001	-0.0006	0.0001	-0.0006
	(-0.08)	(-0.12)	(-0.09)	(-0.12)	(0.02)	(-0.33)	(0.02)	(-0.33)
Obs	2407	2503	2407	2503	2348	2497	2348	2497
Adj R^2	0.0004	0.0009	0.0022	0.0082	0.0005	0.0057	0.0004	0.0081

Panel A2: With local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	-0.0039	0.0209	-0.0346	0.2425*	0.0020	-0.0013	0.2303	0.0101
	(-0.07)	(0.45)	(-0.20)	(1.89)	(0.02)	(-0.07)	(1.49)	(0.45)
Δ*GLOB_FACTOR*$_{t-1}$	-0.0398	-0.0524	-0.0436	-0.3219**	0.1750*	-0.0120	0.0751	-0.0113
	(-0.65)	(-1.11)	(-0.26)	(-2.58)	(1.90)	(-0.63)	(0.51)	(-0.52)
Δ*GLOB_FACTOR*$_{t+1}$	-0.1029*	0.0175	0.3305**	-0.0416	0.0807	0.0282	0.0639	-0.0020
	(-1.68)	(0.37)	(1.97)	(-0.33)	(0.88)	(1.48)	(0.43)	(-0.09)
MKT_RET+	-0.4080	0.8945	-0.4518	0.9784	-0.6549	-4.9523***	-0.6505	-4.9597***
	(-0.64)	(1.01)	(-0.71)	(1.10)	(-1.12)	(-31.18)	(-1.11)	(-31.22)
MKT_RET-	-19.8698***	-19.7751***	-19.8348***	-19.6888***	-2.5810***	-4.0841***	-2.6037***	-4.0828***
	(-27.52)	(-27.04)	(-27.51)	(-26.78)	(-3.85)	(-31.50)	(-3.89)	(-31.32)
MA_MKT+	1.6819	7.0502***	1.7553	6.9123***	1.1339	2.0940***	1.1376	2.0955***
	(1.15)	(4.53)	(1.20)	(4.44)	(0.85)	(7.60)	(0.86)	(7.59)
MA_MKT-	8.3624***	4.2772***	8.2267***	4.2377***	1.4410	4.1517***	1.2946	4.1568***

	(5.21)	(2.61)	(5.13)	(2.59)	(0.97)	(14.28)	(0.88)	(14.27)
MA_ABMKT	-8.7887***	-11.2690***	-8.8283***	-11.2060***	-1.5519*	0.9068***	-1.6195*	0.9139***
	(-9.42)	(-9.93)	(-9.49)	(-9.89)	(-1.83)	(4.50)	(-1.91)	(4.53)
MONDAY	0.1779***	0.1413***	0.1715***	0.1415***	0.0427	0.0004	0.0457	0.0005
	(5.01)	(4.08)	(4.75)	(4.09)	(1.41)	(0.07)	(1.48)	(0.09)
TUESDAY	-0.0246	-0.0865***	-0.0278	-0.0925***	0.0273	0.0024	0.0226	0.0022
	(-0.86)	(-3.05)	(-0.97)	(-3.27)	(1.10)	(0.49)	(0.90)	(0.45)
WEDNESDAY	0.0668**	0.0018	0.0686**	0.0054	0.0049	0.0046	0.0012	0.0048
	(2.35)	(0.06)	(2.39)	(0.19)	(0.20)	(0.94)	(0.05)	(1.00)
THURSDAY	0.0136	0.0043	0.0100	0.0054	0.0360	0.0041	0.0366	0.0043
	(0.39)	(0.12)	(0.28)	(0.16)	(1.19)	(0.70)	(1.21)	(0.72)
HOLI	0.1647***	0.0998***	0.1643***	0.0985***	-0.0049	0.0055	-0.0022	0.0052
	(4.20)	(2.99)	(4.20)	(2.96)	(-0.14)	(0.93)	(-0.06)	(0.89)
Constant	-0.0395*	-0.0095	-0.0369	-0.0097	-0.0127	-0.0008	-0.0115	-0.0009
	(-1.73)	(-0.39)	(-1.61)	(-0.39)	(-0.64)	(-0.19)	(-0.58)	(-0.21)
Obs	2407	2503	2407	2503	2348	2497	2348	2497
Adj R^2	0.2913	0.2859	0.2918	0.2876	0.0093	0.6008	0.0096	0.6002

Panel B: Shenzhen B shares

Panel B1: Without local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	0.0079	0.0361	-0.5819	0.5377***	0.0074	0.0848*	0.07536605	0.2126***
	(0.06)	(0.58)	(-1.63)	(3.15)	(0.11)	(1.69)	(0.70)	(3.53)
Δ*GLOB_FACTOR*$_{t-1}$	0.0900	0.0556	0.0434	-0.3992**	-0.0095	0.0354	-0.1042	-0.0409
	(0.68)	(0.88)	(0.13)	(-2.40)	(-0.14)	(0.69)	(-1.00)	(-0.70)
Δ*GLOB_FACTOR*$_{t+1}$	0.1156	0.0359	0.4754	0.5420***	-0.0134	0.1497***	-0.0775	0.1376**
	(0.87)	(0.56)	(1.39)	(3.25)	(-0.19)	(2.90)	(-0.75)	(2.34)
Constant	0.0009	-0.0014	0.0009	-0.0013	-0.0023	-0.0004	-0.0022	-0.0004
	(0.07)	(-0.17)	(0.07)	(-0.16)	(-0.55)	(-0.13)	(-0.54)	(-0.13)
Obs	2193	2503	2193	2503	2158	2487	2158	2487
Adj R^2	-0.0009	-0.0008	0.0003	0.0119	-0.0014	0.0029	-0.0007	0.0086

Panel B2: With local factors

	ΔAmihud				ΔSpread			
	GLBILLQ		VIX		GLBILLQ		VIX	
	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005	Pre-2005	Post-2005
Δ*GLOB_FACTOR*$_t$	-0.0624	-0.0642	-0.5607	0.04266875	-0.0058	0.0117	0.0922	0.0324
	(-0.50)	(-1.16)	(-1.57)	(0.27)	(-0.09)	(0.27)	(0.86)	(0.60)
Δ*GLOB_FACTOR*$_{t-1}$	0.0536	-0.0016	0.2326	-0.4417***	-0.0052	-0.0083	-0.1190	-0.0070
	(0.42)	(-0.03)	(0.69)	(-2.93)	(-0.08)	(-0.18)	(-1.16)	(-0.13)
Δ*GLOB_FACTOR*$_{t+1}$	0.1564	-0.0133	0.0450	0.0991	-0.0072	0.0665	-0.0989	0.0314
	(1.22)	(-0.23)	(0.13)	(0.66)	(-0.11)	(1.46)	(-0.97)	(0.60)
MKT_RET+	-4.0715***	-1.0133	-3.9894***	-0.9245	-3.6315***	-6.8054***	-3.6314***	-6.8227***
	(-3.95)	(-1.01)	(-3.87)	(-0.92)	(-9.94)	(-18.56)	(-9.92)	(-18.59)
MKT_RET-	-12.3735***	-20.6218***	-12.5955***	-20.6037***	-2.2649***	-3.5190***	-2.2566***	-3.4684***
	(-9.90)	(-21.72)	(-10.01)	(-21.29)	(-5.50)	(-10.56)	(-5.45)	(-10.21)
MA_MKT+	-3.2655	4.8461**	-3.3516	4.6274**	1.8213**	2.6591***	1.8637**	2.6722***
	(-1.52)	(2.55)	(-1.56)	(2.44)	(2.41)	(4.02)	(2.47)	(4.03)
MA_MKT-	10.5269***	8.0406***	10.6849***	7.7611***	1.4929	4.3538***	1.4433	4.3207***
	(4.01)	(3.74)	(4.07)	(3.61)	(1.60)	(5.87)	(1.54)	(5.81)
MA_ABMKT	-1.4313	-8.2253***	-1.4755	-8.1246***	-0.0200	1.9680***	-0.0342	1.9730***
	(-0.92)	(-5.55)	(-0.95)	(-5.50)	(-0.04)	(3.83)	(-0.07)	(3.84)
MONDAY	0.2122***	0.1626***	0.1895**	0.1614***	-0.0022	-0.0068	0.0029	-0.0070
	(2.93)	(3.86)	(2.58)	(3.84)	(-0.11)	(-0.46)	(0.14)	(-0.47)
TUESDAY	-0.1062*	-0.1052***	-0.0884	-0.1059***	-0.0392**	-0.0002	-0.0419**	-0.0008
	(-1.83)	(-3.07)	(-1.51)	(-3.10)	(-2.28)	(-0.01)	(-2.40)	(-0.07)
WEDNESDAY	-0.0131	-0.0122	-0.0278	-0.0042	-0.0168	-0.0109	-0.0121	-0.0107
	(-0.23)	(-0.36)	(-0.48)	(-0.12)	(-0.98)	(-0.93)	(-0.70)	(-0.91)
THURSDAY	-0.0387	0.0584	-0.0440	0.0593	-0.0136	0.0126	-0.0121	0.0127
	(-0.54)	(1.38)	(-0.61)	(1.41)	(-0.67)	(0.85)	(-0.59)	(0.86)
HOLI	0.0590	0.0385	0.0542	0.0361	0.0285	0.0332**	0.0288	0.0329**
	(0.77)	(0.97)	(0.71)	(0.91)	(1.15)	(2.45)	(1.16)	(2.43)
Constant	0.0095	-0.0282	0.0140	-0.0311	0.0198	0.0014	0.0180	0.0017
	(0.21)	(-1.00)	(0.31)	(-1.11)	(1.45)	(0.14)	(1.31)	(0.17)
Obs	2193	2503	2193	2503	2157	2487	2157	2487
Adj R^2	0.0884	0.2022	0.0888	0.2051	0.0825	0.2292	0.0833	0.2286