Short Selling and Margin Trading in the Chinese Stock Market

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By

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Abstract

Just as market regulators around the world adopt a more rigorous attitude towards short selling and margin trading, Chinese authorities at its first time approve trades on margin in the domestic stock market. With this introduction event, we conduct three empirical studies regarding short selling and margin trading in the A-share market. The first study examines the impact of the dual introduction on feedback trading behaviour and stock volatility dynamics of the underlying stocks. With a combination of the heterogeneous trader model and GARCH-type models, we highlight the conditional nature of return persistence stemming from feedback trading behaviour. Our findings indicate that the introduction of short selling and margin trading contribute to a moderated level of unconditional positive autocorrelation and conditional positive feedback trading. Besides, no evidence shows that the two mechanisms destabilise the stock market by increasing the volatility persistence in stock returns. Rather, the two mechanisms support the informational efficiency and contribute to the stabilisation of the stock market.

With more precise data of each mechanism's trading activity, the second study investigates the different impacts of short selling and margin trading on the degree of feedback trading and returns volatility at three levels, the individual stock level, the portfolio level, and the market level. Also, we study the impact differences between the trading activity of retail margin investors and that conducted by institutional margin investors. Our results indicate that neither short-selling activity nor margin-trading activity increases positive feedback trading among studied stocks. However, an increasing impact of short selling on negative feedback trading is observed. The strategy of negative feedback trading adopted by short sellers is not conducive to market stability since it does not involve evaluation of a security's intrinsic value. We also find that margin-trading activity has a significant increasing impact on the level of volatility, while short-selling activity has a slightly decreasing impact. Besides, it reveals that retail investors who have a lower level of financial literacy are more prone to feedback trading strategies. During the stable and booming periods, trades on margin conducted by institutional investors are positively related to a lower level of returns volatility. During the bearish and

crash periods, the participation of retail margin investors leads to a higher level of negative feedback trading.

Our third study estimates the determinants of short selling and margin trading respectively with panel regressions of a hierarchical approach. We argue that short-selling (or margin-trading) activity is a function of various factors at both firm and market level. Taking together with control variables, the firm-level factors considered include past short-selling/margin-trading activity, past stock returns, stock returns volatility, financial ratios, ex-dividend date event, industry classification, insider trading event, stock analyst recommendations, block trading event, whereas the market-level factors include past market performance and investor sentiment. We find that short-selling activity is significantly related to past short-selling activity (+), past stock returns (+), historical volatility (-), EPS (-), financial industry stocks (+), insider sale (+), analyst upgrade (+), block plus-tick order (+), past market performance (+) and CCI (-). While margin-trading activity is decided by past margin-trading activity (+), past stock returns (+), historical volatility (-), EPS (+), ex-dividend date event (-), financial stocks (+), insider purchase (+), analyst upgrade (-), block plus-tick order (+), past market performance (+) and market turnover (+). These results provide crucial insights into the nature of information advantages that lead to abnormal returns earned by short sellers and margin traders.

Declaration

The material contained in the thesis has not been previously submitted, either in whole or in part, for a degree or qualification in this or any other institution.

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List of Abbreviations

BaFin	The Federal Financial Supervisory Authority
CAPM	Capital Asset Pricing Model
CCAPM	Consumption Capital Asset Pricing Model
CCI	Consumer Confidence Index
CSRC	China Securities Regulatory Commission
DY	Dividend Yield
EGARCH	Exponential Generalized Autoregressive Conditional Heteroskedasticity
EPS	Earnings Per Share
FSA	Financial Services Authority
FTSE	The Financial Times Stock Exchange
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GARCH-GJR	Generalized Autoregressive Conditional Heteroskedasticity -Glosten, Jagannathan, and Runkle
GICS	Global Industry Classification Standard
ICB	Industry Classification Benchmark
IPO	Initial Public Offering
MLR	Margin-loans Ratio
MLV	Margin-loans Value
MT	Margin Trading
NASDAQ	The Nasdaq Stock Market
NYSE	The New York Stock Exchange
OTC	Over-The-Counter
PTBR	The Price-to-book Ratio
SEC	Securities and Exchange Commission
SS	Short Selling
SSR	Short-sales Ratio
SSV	Short-sales Value
SSE	Shanghai Stock Exchange
SZSE	Shenzhen Stock Exchange
TRBC	Thomson Reuters Business Classification
TSE	Tokyo Stock Exchange

Chapter 1: Introduction

1.1 Overview

The stock market will benefit firms and investors if the potential risks of investment and the related expected returns can be identified through the pricing mechanism of the market. As a necessity to market efficiency and market completeness, short selling and margin trading play a significant role in the stability of the stock market. With a history of hundreds of years, these two mechanisms exert profound influences on the capital markets and all related market participants. By providing new trading mediums of the stock market, short selling and margin trading undoubtedly contribute to the price discovery progress (*e.g.*, Miller 1977; Harrison and Kreps 1978; Jarrow 1980; Figlewski 1981; Rabb and Schwager 1993; Kempf and Korn 1998). Trading activities of these two mechanisms help increase the market volume and reduce liquidity risk (Woolridge and Dickinson 1994).

During the two recent financial crises, the global financial crisis of 2007-08 and the European debt crisis 2009-10, regulators in many countries have imposed bans/constraints on short-selling activities to prevent further excessive declines in stock prices. In the announcement of the 2008 ban on naked short selling, the U.S. Securities and Exchange Commission (SEC) asserted that panic selling occurred during the subprime crisis. “As a result, the prices of securities may artificially and unnecessarily decline well below the price level that would have resulted from the normal price discovery process.” These comments of SEC reveal that the U.S. regulators consider short sellers as akin to positive feedback traders who increase price deviations from the fundamental value of a stock. While governments and the social media blame short sellers for their reinforcement in stock market downturns, the academic literature demonstrates that short sales bans and constraints distort market efficiency and lead to issues like stock overvaluation.

Short selling is the trading activity of shorting a borrowed stock without owning it. Investors are motivated to generate shorting positions when they are extremely confident about the negative news of the underlying stock. Short selling is well documented in the current literature from several aspects. A group of studies testify that short selling improves the flow of private information into stock prices and increases price efficiency (*e.g.*, Miller 1977; Harrison and Kreps 1978; Figlewski 1981; Diamond and Verrecchia 1987; Chen *et al*. 2002; Duffie *et al*. 2002; Hong and Stein 2003; Scheinkman and Xiong 2003; Chang *et al*. 2007; Sharif *et al.* 2012; Boehmer and Wu 2013). They demonstrate that bearish investors are forced to remain out of the market when short lending is not sufficiently available, thereby allowing bullish buyers to bid at a higher price level. However, Bris *et al*. (2007) argue that short selling may not be easily practised in the market due to the restrictiveness of a bunch of factors. The legal prohibitions like the up-tick trading rule, a lack of stock lending, and a high level of transaction costs can all be stumbling blocks of short selling transactions. A branch of literature exploits the changes in short sales regulations to study the economic implications of short selling. Their findings show that the short sales bans/constraints decrease the market quality (*e.g.*, Autore *et al.* 2011; Bohl *et al.* 2012; Boehmer *et al.* 2013; Beber and Pagano 2013; Bohl *et al.* 2013). During May 2005 and April 2006, the U.S. SEC implemented a regulatory experimental program, Regulation SHO, to allow pilot stocks exempt from short-sale price tests, including the tick test *etc*. A group of studies employ this one-year pilot program as an exogenous shock to investigate the impact of short selling on several perspectives, including market quality (Alexander and Peterson 2008; Diether *et al.* 2009b), short-sale strategies and return predictability (Diether *et al.* 2009a), news media and manipulation (Engleberg *et al*. 2012), bond yields (Kecskés *et al.* 2012), equity issues and investment (Grullon *et al.* 2015), and earnings management (Fang *et al.* 2015). All these researches implicitly assume that investors in the stock markets who do not confront short-sale bans/constraints and are thus silent considering the impacts of such bans/constraints.

It is well argued that short sellers are informed traders, and the level of short interests predicts future stock returns. As twin brother of short sellers, margin traders are neglected by most of researchers. Investors will buy a stock if they feel optimistic about the future of the underlying firm. When the good news is quite precise and extremely bullish, investors tend to act further by building up a leveraged long position. Normally, margin traders borrow money from their

registered security companies; sometimes they also finance from other possible resources. Similar to short selling, the legitimacy and regulations of margin trading have long been concerns to the public. The controversy over margin requirements attracted a lot of attention of regulators, market participants, and academia right after the market crash of 1987. Considered as potentially informative investors, margin traders are often blamed for their speculative practice. The conservative conception believes that margin trading activities may produce excess volatility and destabilise the market. However, the currently empirical findings of margin trading are mixed. With data of U.S. OTC stocks, Seguin (1990) finds that the eligibility of margin trading does not lead to a higher level of volatility or improved liquidity and price informativeness. Hardouvelis and Peristiani (1992) study the Japanese market demonstrating that a higher level of margin requirements helps deter market speculators and this regulatory change does not incur market instability. Lee and Yoo (1993) find no significant relationship between the margin requirements and stock returns volatility in both Korean and Taiwan stock markets. There are many studies arguing that margin loans constraints lead to price undervaluation and limit trading volume. With a CCAPM benchmark valuation, Cuoco (1997) finds that stocks under short sales constraints are overvalued, while stocks under margin loans constraints are undervalued. Geanakoplos (2003) shows that the initial price of an asset is much lower when margin loans constraints are severe. Basak and Croitoru (2006) document that the binding investment restrictions, including short sales constraints and margin loans constraints, disrupt the normal trading activities of investors. Garleanu and Pedersen (2011) theoretically and empirically demonstrate that assets with high margin requirements are cheaper than their low-margin counterparts.

As mentioned above, most of the current literature chooses to study short selling and margin trading separately. However, as trading mediums under the margin account, these two mechanisms are closely related. With opposite trading directions, transactions of short selling and margin trading both involve the leveraged positions. Due to the leveraged positions used and the quantity of trading service involved, short sellers and margin traders must bear higher commissions and extra costs. Because of this, short sellers and margin traders are often considered as informed investors who potentially own private information related to the firm's fundamentals. The literature in both fields have documented that these two types of transactions contain advanced information (*e.g.*, Aitken *et al.* 1998, Arnold *et al.* 2005, Huang and Wu 2009, Shyu *et al.* 2017; Mayhew *et al.* 1995). Surprisingly, in the literature scholars rarely study the

issues of short selling and margin trading together. On 31st March 2010, the China Securities Regulatory Committee (CSRC) formally launched the long-awaited pilot program of short selling and margin trading in the domestic market. A designated list of 90 blue-chip stocks on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) start to be eligible for transactions of short selling and margin trading. This event provides us with a good opportunity to investigate short selling and margin trading further by considering their influences on each other and the interactions between the two.

1.2 Objectives

This thesis includes three empirical studies. These three studies are highly related to each other, with each one having its own focuses. The first empirical study examines the impact of the dual introduction on feedback trading behaviour and stock volatility dynamics of the underlying stocks. Unlike existing literature which mainly focuses on short sales constraints and margin requirements in the developed markets, our study provides direct evidence for the impact of the introduction of short selling and margin trading on an emerging market. While the first study analyses the impact of the dual introduction on feedback trading and returns volatility dynamics, our second empirical study adopts the separate activity data of these two mechanisms aiming to distinguish the impacts of short selling and margin trading on the level of feedback trading and volatility. Besides, with this study, we further investigate that whether the trading behaviour of different groups of margin investors, literally the retail and the institutional traders, makes different impacts on the level of feedback trading and returns volatility. Most of the early studies on short selling and margin trading are US-centric and rely on monthly data. In the first two studies of the thesis, we adopt daily stock data and activity data of short selling and margin trading in the Chinese A-share market to examine the impacts and the determinants of short selling and margin trading.

To justify the role of short sellers and margin traders in the financial markets, our third study adopts a panel analysis of the hierarchical approach to identify the determinants of short selling and margin trading respectively. A widespread literature documents that short sellers and

margin traders are integral to the functioning of an efficient financial market. Though most regulators agree that trades on margin play an essential role to ensure market efficiency, many of them do not hesitate to limit short-selling and margin-trading activities. A wealth of bans and constraints on short selling and margin trading emerge especially during financial turbulences and market crashes. This paradoxical phenomenon is most likely due to a lack of understanding about what motivates short sellers and margin traders to make their investment decisions. In other words, the key question is whether motivations of these two types of traders are fundamental-related.

1.3 Major Findings and Contributions

Our first study examines the impact of the dual introduction on feedback trading and stock volatility dynamics of the designated stocks. With a combination of the heterogeneous trader model (Sentana and Wadhwani 1992) and GARCH-type models, we document that the introduction of short selling and margin trading lead to a moderated level of unconditional positive autocorrelation and conditional positive feedback trading. This finding to some extent agrees with the conclusion obtained by Chang *et al*. (2013). Although the term positive feedback trading is not mentioned, the paper finds that rather than identify trends, Chinese margin traders seem only capture very short-term undervaluation, and there is no evidence that they do it in a consistently rational way. This implies that Chinese margin traders have no potential role of being positive feedback traders. Besides, there is no evidence that the two mechanisms increase the volatility persistence in stock returns and destabilise the stock market. Instead, the two mechanisms support the informational efficiency and contribute to the stabilisation of the stock market. In contrast to findings of Wang (2011), which documents an increased volatility after the dual introduction with a measure of variance ratio, we obtain the same result as Sharif *et al.* (2013) and Chang *et al*. (2013) that the level of volatility in stock returns is reduced by short selling and margin trading. This study contributes to the literature in several aspects: Above all, we initially study the relationship between the introduction of short selling and margin trading and feedback trading behaviour. With a combination of the heterogeneous trader model and GARCH-type models, we highlight the conditional nature of return persistence stemming from feedback trading behaviour. Second, with the adoption of

GARCH-type models, we study both the level and the structural changes in stock returns volatility. Third, we explore the impact differences between short selling and margin trading on feedback trading by investigating parameter differences conditional on negative and positive historical returns.

With more detailed data of each mechanism's daily trading activity, the second empirical study investigates the different impacts of short selling and margin trading on the degree of feedback trading and returns volatility at the individual stock level, the portfolio level, and the market level. We also study the impact differences between the trading activity of retail margin investors and that conducted by their institutional counterparts. Our results show that neither short-selling activity nor margin-trading activity increases positive feedback trading among studied stocks. However, an increasing impact of short-selling activity on negative feedback trading is observed. The strategy of negative feedback trading adopted by short sellers is not conducive to market stability since it does not involve evaluation of a stock's intrinsic value. We find that short-selling activity has a slightly decreasing impact, while margin-trading activity has a significantly increasing impact on returns volatility. In the previous literature of common stock trading, Lakonishok et al. (1992) document that pension managers do not pursue destabilising practices like positive feedback trading; while Grinblatt et al. (1995) find that 77% of mutual funds are momentum investors in the U.S. market. Our results reveal that the retail investors who are less financially educated tend to conduct more irrational trades than institutional investors. During stable and flourishing periods, trades on margin conducted by institutional investors are positively related to a lower level of returns volatility. During bearish and crash periods, the trading activities by retail margin investors leads to a higher level of negative feedback trading. This study contributes to the academic literature in the following four ways: First, this study fills the gap in the literature by studying the distinct impacts of short-selling activity and margin-trading activity on feedback trading behaviour. Second, our study extends the literature of volume-price relationship with the activities of short selling and margin trading. Third, we initially study the impact differences between the trading activity of retail margin investors and that conducted by institutional margin investors on feedback trading behaviour and stock returns volatility. Lastly, we investigate the relationships of short-selling/margin-trading activities, feedback trading and returns volatility not only at the individual stock level but also at market and portfolio levels.

Our third study investigates the determinants of short selling and margin trading with the pooled regressions of a hierarchical approach. We argue that short-selling/margin-trading activity is a function of various factors at both firm and market levels. Taking together with control variables, the firm-level determinants considered include past short-selling (margin-trading) activity, past stock returns, stock returns volatility, financial ratios, ex-dividend date event, industry classification, insider trading event, stock analyst recommendations, block trading event, whereas the market-level factors include past market performance and investor sentiment. We find that short-selling activity is significantly related to past short-selling activity, past stock returns, historical volatility, EPS, industry classification, insider sale, analyst upgrade, block plus-tick order, past market performance and CCI. While margin-trading activity is decided by past margin-trading activity, past stock returns, historical volatility, EPS, ex-dividend date event, industry classification, insider purchase, analyst upgrade, block plus-tick order, past market performance and market turnover. These results provide additional insights into the nature of information advantages that lead to abnormal returns earned by short sellers and margin traders. In general, our third study makes three major contributions to the current literature: First, we initially investigate the determinants of margin-trading activity at both firm-specific and market-level. Since short selling and margin trading share many similarities from both trading mechanism and investor characteristics. We study the two mechanisms with comparisons. Second, we introduce several additional firm-specific factors to the determinants of short-selling/margin-trading activity. The new firm-specific factors include industry classification, insider trading events, stock analyst recommendations, and block trading events. Third, we add a new market-level factor, the investor sentiment, to the determinants of short-selling/margin-trading activity.

1.4 Structure of the Thesis

The remainder of this thesis is organised as follows: Chapter 2 firstly reviews the literature of short selling and margin trading and then presents the background information of the Chinese A-share stock market and the 2010 dual introduction event of short selling and margin trading.

Chapter 3 empirically examines the impact of the introduction event on feedback trading and stock volatility dynamics of the designated stocks. With more precise trading data, Chapter 4 investigates the different impacts of short-selling activity and margin-trading activity on the level of feedback trading and returns volatility independently at three different levels. An analysis of the impact differences between the trading activity of retail margin investors and that conducted by institutional margin investors is also included in this chapter. Chapter 5 studies the determinants of short selling and margin trading with the pooled regressions of a hierarchical approach. Chapter 6 summaries our three empirical studies and states the limitations of this thesis and the recommendations for further research.

Chapter 2: Literature Review

2.1 Short Selling

2.1.1 A brief review of short selling

The issue whether selling a security that an investor does not own is justifiable has elicited a standing controversy. Beginning as early as the 1600s, the debate about the merits of short selling has been ongoing for around 400 years among investors, traders, market regulators, academia and various market participants in the stock market. It captures public attention especially amid the market downturn, while fades away when a rush of bull market arrives, at which time investors restore faith then value short selling as a contributor to market efficiency. The attitude of regulators towards short selling reflects both sides of the debate. On the one hand, regulators give open recognition and support to short selling. The UK Financial Services Authority (FSA) (2002) assesses short selling as an important and indispensable investment activity that plays a crucial role in sustaining market efficiency. It claims that either market-wide ban or prohibitions for certain stocks on short selling are illegitimate, even in times of market turmoil.

Additionally, a common belief held among market regulators is that short sales constraints, with its capacity of curtailing speculative excesses and reducing opportunities for market manipulation, conduce to market stabilisation. During times of market stress, regulators worldwide resort to trading constraints or outright bans on short selling to stem declines and excessive volatility in stock prices. Ever since the U.S. Securities and Exchange Commission (SEC) imposed a temporary ban on short selling during the 2008 subprime crisis, the costs and benefits of short sales ban are under even greater scrutiny. It is interesting to note that the former Chairman of the SEC, Christopher Cox regards the 2008 ban as the biggest mistake of his tenure. The SEC Commissioner Kathleen Casey shows her agreement by pointing out that instead of improving market conditions, the 2008 ban created significant distortions and

disruption in the US securities markets. However, European regulators seem not be convinced by this view, as many of them reintroduced short sales ban to tackle the European debt crisis during 2010-2011.

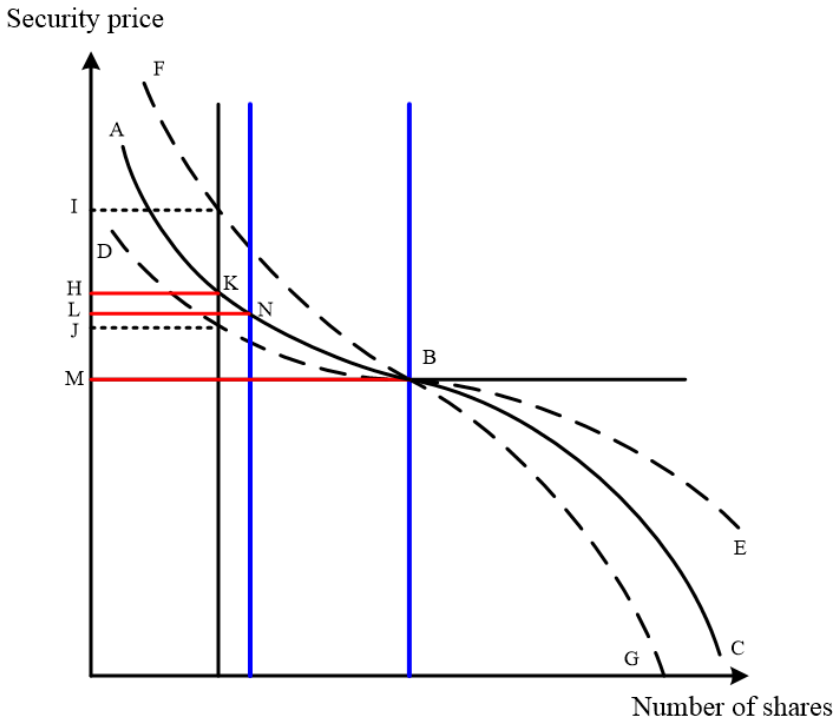
Given the controversial role of short selling, a vast volume of literature debates over issues like whether short sales constraints induce an upward bias in asset valuation, or it, in fact, reduces price efficiency and brings financial stabilisation to the market. On the one side, restrictions on short selling are considered to be unfavourable to the processes of price discovery and information transmission (*e.g.*, Miller 1977; Diamond and Verrecchia 1987; Hong and Stein 2003). The proponents of short selling put forward that without allowance for market participants to sell shorts, the efficiency of portfolio construction would not be able to obtain. However, the opponents deem short sellers as a form of 'skeletons at the feast' or even a 'pecuniary vampire' of capitalism. They argue that short selling destabilises market by reducing market liquidity and exacerbating market volatility; in extreme cases, it may lead to market crashes (*e.g.*, Bierman 1991).

2.1.2 Short sales constraints and asset prices

The literature on short sales constraints emanates from the overvaluation hypothesis put forward by Miller (1977). In his seminal work, Miller develops a model with heterogeneous expectations to detail how overpricing forms under short-sales constrains. He argues that a sufficient amount of short sales could increase the supply of a security until its price is forced down to the equilibrium value, see Figure 1. However, in the presence of constraints when pessimists are restricted from acting on their own beliefs, stock prices only reflect partial valuations of the most optimistic investors. This consequently turns into overvaluation, which proportionately increases with the degree of opinion divergence among investors. Later theoretical works extend the overvaluation hypothesis by examining it in the equilibrium settings (Harrison and Kreps 1978; Jarrow 1980; Figlewski 1981). In the seminal paper by Harrison and Kreps (1978), with the assumption of heterogeneous expectations with no short sales, no Bayesian learning, and infinite wealth, the equilibrium asset price generally exceeds

the most optimistic investor's present value of future dividend stream. Rabb and Schwager (1993) initially focus on the issue of the eligibility of short selling and the degree of the completeness of a market system. By building a model with spanning payoff vectors, they find that if assets are restricted to short selling transaction, the set of attainable payoff vectors is substantially reduced. Kempf and Korn (1998) find that the eligibility of short selling is an influential determinant of asset mispricing.

Figure 2.1 The market clearing price of a security with binding short sales constraints



Source: Miller (1977)

In accordance with the overvaluation hypotheses, a bulk of empirical work find results that confirm the negative abnormal returns after implementation of some form of short sales constraints (*e.g.*, Figlewski and Webb 1993; Asquith and Meulbroek 1995; Dechow *et al.* 2001; Danielsen and Sorescu 2001; Chen *et al.* 2002; Jones and Lamont 2002; Aitken *et al.* 1998; Desai *et al.* 2002; Gopalan 2003; Ofek *et al.* 2004; Chang *et al.* 2007; Cohen *et al.* 2007; Nagel 2005; Ali and Trombley 2006;Boehme *et al.* 2006; Berkman *et al.* 2009; Berkman and Koch 2008; Boulton and Braga-Alves 2010; Chen and Rhee 2010; Tseng 2010; Saffi and Sigurdsson 2010; Lim 2011). Other studies support the overvaluation hypothesis partly (*e.g.*, Brent *et al.*

1990; Asquith *et al.* 2005; Diether *et al.* 2007). However, there are also works find no significant relationship between sales constraints and stock prices (*e.g.*, Battalio and Schultz 2006; Diether *et al.* 2009b; Kaplan *et al.* 2010). Furthermore, by comparing the characteristics of stock returns in 111 countries, Charoenrook and Daouk (2005) provide conflicting findings with the overvaluation hypothesis. They find increased aggregate stock returns in short selling available countries, although they agree with that allowing for short selling in the market enhance the informational efficiency.

2.1.3 Short sales constraints and informational efficiency

Widespread theoretical and empirical evidence suggests that short sellers are integral to the efficient functioning of financial markets. For the capital asset pricing model (CAPM), if without the standard assumption of unlimited lending and borrowing at the risk-free rate, it cannot be realised in the real market. Black (1972) argues that with unrestricted short selling, the mean-variance efficiency of the market portfolio is preserved in the absence of a riskless security (*inter alia*, Kwan 1995; Elton and Gruber 2000; Fama and French 2004). Being different from Miller (1977), Diamond and Verrecchia (1987) present a rational expectations model in which sales constraints do not give rise to the bias in stock prices but reduce the speed of price discovery. They point out that the impact of short sales constraints on how quickly the private information being incorporated into the price is of particular significance for negative information. Similar results are derived by later theoretical work in very different settings (*e.g.*, Bai *et al.* 2006; Gallmeyer and Hollifield 2008). Many empirical papers find results supporting the idea that stock prices cannot adequately incorporate diverse information in the presence of short sales constraints (*e.g.* Geczy *et al.* 2002; Jones and Lamont 2002; Reed 2002; Ofek *et al.* 2003; Isaka 2007; Chang *et al.* 2007). With data of the Paris Bourse exchange, Biais *et al.* (1999) find stocks subject to short sales constraints reflect good news significantly faster than bad news. Bris *et al.* (2007) conduct a global study based on 47 equity markets demonstrating that adverse information is faster incorporated into prices in markets where short selling is allowed. Boehmer and Wu's (2013) find that a higher short-sales order flow increases the informational efficiency of the stock pricing process.

Further to this point, a number of studies investigate the informational contents of short selling. The consensus is that short sellers possess superior information than ordinary traders. Diamond and Verrecchia (1987) argue that since short sales proceeds cannot be directly used for investment, short sellers never short for liquidity reasons. This signifies that relatively less uninformed traders exist among short sellers. Several empirical studies confirm this view with evidence that heavily shorted stocks are underperformed (*e.g.*, Jones and Lamont 2002; Asquith *et al.* 2005; Saffi and Sigurdsson 2011). Focusing on transactions taken by individuals, Boehmer *et al.* (2008) conclude that short sellers are on average better-informed traders who contribute to efficient stock pricing. Similarly, Diether *et al.* (2009) find that heavily shorted stocks usually have negative future returns, which implies that short sellers are not only capable of correcting transient overreactions, but also predict future stock performance.

2.1.4 Short sales ban and market quality

As the market situation worsened and stock prices fell sharply in the 2008 financial crisis, governments around the world turned to the same scapegoat, short selling. Commencing in the US on July 15, 2008, the US regulators announced an emergency order banning naked short selling on 19 large financial firms. Later on September 18, the SEC prohibited all shorting in nearly 800 financial stocks. At the next day on September19, the UK FSA launched a ban targeting both covered and naked short selling at 34 financial stocks. Bans in other markets followed soon: Australia, Taiwan and Korea banned short selling on all stocks; Canada, Norway, Ireland, Denmark, Russia, Pakistan and Greece banned short selling on leading financial stocks; France, Italy, Portugal, Luxembourg, The Netherlands, Austria and Belgium banned naked shorting on leading financial stocks; and Japan banned naked short selling on all stocks. To tackle the European debt crisis in 2010-2011, similar bans were reintroduced in France, Belgium, Italy, and Spain. On May 19, 2010, the German BaFin extended naked short sales bans on government bonds and CDS market.

Several papers have examined whether the short sales ban launched by the SEC in September 2008 is conducive to price's restoration. Autore *et al.* (2010a), Boulton and Braga-Alves (2010), Gagnon and Witmer (2010) and Harris *et al.* (2009) all find supporting evidence. However,

clear results can hardly be obtained since the Troubled Assets Relief Program and other programs were announced on the same day by the SEC. In contrast to these findings, Boehmer *et al.* (2013) find that the US short sales ban fails to support stock prices with an analysis of stocks later added to the ban list; instead, it causes side effects on the already turbulent markets by retarding price discovery and reducing market liquidity. In perhaps the most comprehensive analysis of global 2008-2009 bans, Beber and Pagano (2013) find that among 30 countries short sales bans lead to economically and statistically significant disruptions in market liquidity and slow down price discovery on negative news. Mattatocci and Sampagnaro (2011) find consistent evidence in Italian markets that severe ban on short selling reduces the amount of information incorporated into stock prices.

2.2 Margin Trading

2.2.1 A brief review of margin trading

With less attention being paid by the pubic than short sellers in recent years, margin traders also have a history of being blamed for producing excess volatility and market destabilisation due to their potential role of informative speculators. The first regulation to manage market-wide margin trading is the 1934 act enacted by the Federal Reserve in response to the 1929 stock market crash. The purpose of this act is to cut excess credit, curb speculative behaviour, and thus reduce stock price volatility. In history, the Fed has adjusted the margin requirements for 23 times, and the margin requirements maintain at 50% since 1974. After the 1987 stock market crash, the relationship between margin requirements and stock market quality has been fiercely discussed. Market regulators tend to introduce more stringent margin requirements to intimidate speculators. The Federal Reserve is then empowered to adjust the initial margin levels to reduce the excess volatility of stock trading. Since then, a batch of research has emerged to study the relationship between regulations of margin trading and stock market volatility. Although a large proportion of margin trading literature concentrates on the link between margin changes and stock volatility, the mixed results leave this issue elusive.

2.2.2 Margin requirements and volatility

Hardouvelis (1988) shows a significant inverse relationship between initial margin requirements and stock market volatility. In contrast, several studies with application of different methodologies assert that no convincing evidence shows that margins affect volatility in the long run (*e.g.,* Schwert 1989). As the securities purchased on margin serve as collaterals, Chowdhry and Nanda (1998) model that margin requirements itself can increase market instability. They point out that if the margin requirements are rigid enough, random fluctuations in stock prices may lead to forced liquidation, finally resulting in excess volatility.

Empirical evidence is highly mixed. Notably, Hardouvelis (1990) suggest that a decrease in margin level causes greater market volatility. Likewise, Hardouvelis and Peristiani (1992) find that higher margin requirements in Japan lead to a reduction in the conditional volatility of daily stock returns. With Japanese data as well, Lee and Yoo (1993) find that margin decrease would lead to significant increase in stock volatility. Hardouvelis and Theodossiou (2002) specify the negative link between margin requirements and volatility further by arguing it only exists during bull and normal market. Kofman and Moser (2001) provide indirect support to Hardouvelis and Theodossiou (2002) which shows an inverse relationship between margin levels and price reversal. However, Ferris and Chance (1988) report the same direction of changes in margin requirements and stock volatility. With data of a sample of small over-the-counter stocks, Seguin (1990) finds that stocks eligible for margin trading have lower price volatility and better market quality. Both Schwert (1989) and Hsieh and Miller (1990) criticise the findings of Hardouvelis (1990) by pointing out defects in his methodology. When a corrected form of the methodology is applied, no link between margin requirements and stock volatility is found. The relationship also displays insignificant and weak in the cases of Korea and Taiwan markets in Lee and Yoo (1993).

2.3 The Chinese Stock Market

2.3.1 Establishment of Stock Exchanges

The original stock market in mainland China was halted during the cultural revolution in the early 1970s, as capitalism was considered as a sign of the Western world. In 1978, Deng Xiaoping started the reform by launching the opening-up policy, taking the first cautious step towards the free-market economy. Before the establishment of official exchanges, securities were traded in the illicit market without any trading regulations or protections for investors. In the 1990s, China establishes the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE). On 19 December 1990, SSE, as the first government-approved securities market, was established to allow investors and enterprises to participate in securities trading. The SSE adopted a non-profit corporate membership system to deal with spot trading, which at the moment did not include derivative securities. In 1987, the Shenzhen Development Bank started to issue shares to the public. In the following three years, more issues were floated and actively traded in the OTC market in Shenzhen (Wang *et al*. 2014). The unique role of Shenzhen special economic zone led to the formal establishment of the SSE in July 1991. Many OTC markets are shut down in an effort to centralise market activities in the two new-built exchanges.

With the further liberalization of the national economy, the Chinese securities market has developed rapidly in the last two decades. By the ending of the year 2016, the market capitalisation of the SSE had already surmounted USD 4.1 trillion, and the SZSE had a market capitalisation of over USD 3.2 trillion. In terms of total market capitalisation, the SSE ranked 4th in the world and ranked 2nd largest in Asia following the Tokyo Stock Exchange (TSE).

2.3.2 A-share Market

The two stock exchanges, the SSE and the SZSE, both have the A-share and the B-share markets. The key difference is that A-shares are denominated in Chinese Yuan while B-shares are denominated in foreign currency, *e.g*. US dollars in the SSE and Hong Kong dollars in the

SZSE. From a regulatory standpoint, the other main distinction between the two was that A-shares are only allowed to be bought and sold by domestic investors, while the B-share market was only open to foreign investors. In order to improve the investment climate in domestic markets, in later 2001, the Chinese securities authority opens the B-share market to individual domestic investors. And in 2003, a scheme was introduced whereby qualified foreign institutional investors were allowed to buy A-shares (Su 2003). However, both markets remain unilateral trading till 31st March 2010, on which the long-awaited introduction scheme of short selling and margin trading are finally launched.

2.3.3 Short Selling and Margin Trading in China

"China's capital markets and financial services industry have achieved significant progress in the past two decades. In particular, new markets and businesses launched in recent years, including the split-share-structure, the second-board market, margin trading and short selling have played important roles in promoting all-round economic and social development."

– Wang Qishan, The former Vice Premier of The People's Republic of China[1]

Introduction Event

The eligibility of short selling and margin trading transactions has been in appeal by domestic investors in China for a long time. A series of rules and regulations contemplating short selling and margin trading were prepared and issued since the year 2005. On 30th June 2006, the CSRC (China Securities Regulatory Commission) issued '*The Trial Administrative Measures for Short Selling and Margin Trading Business of Securities Companies*'. The document states applying requirements of securities companies for margin account business and basic rules of

1 A translated excerpt of the press release "To Ensure the Smooth Launch of Stock Index Futures", 9th April 2010. *The China's Securities Journal*.

margin transactions. However, the preparatory process of margin transactions has been stalled for a while since the CSRC did not receive formal approval from the state council at that time. The preparatory process of short selling and margin trading recommenced on 5th October 2008, when the CSRC released a press stating that margin transactions of short selling and margin trading would be soon approved on a trial basis. On 31st October 2008, the CSRC followed up with new regulations about changes to the scope of securities companies' business, which came into effect later on 1st December 2008.

On 23 January 2010, the CSRC took the long-awaited action of issuing "*Trial Guidelines of Short Selling and Margin Trading*", which lays out qualification requirements for securities companies that wish to carry on margin transactions business. The requirements include: 1) the net capital of the securities company must be at least 5 billion Chinses Yuan in the last six months; 2) the rating of the securities company has to be in the A class, which was evaluated and approved by the CSRC. There are only 31 securities companies rated A at the end of 2009; and 3) the securities company needs to pass all systems tests conducted by the CSRC, which basically assesses the capability of the company's computer systems to deal with short selling and margin trading transactions. On 12th 2010, a list of designated securities and collaterals for the trial scheme was published by the SSE and the SZSE. On 19th March 2010, the CSRC announced approval for six securities companies to the pilot scheme of short selling and margin trading. After the SSE and the SZSE respectively issued guidance on pilot members and started to accept trading applications, the trail scheme of short selling and margin trading finally made its debut on 31st March 2010.

Development

The Chinese securities market was greeted in the new year by a breaking announcement from the CSRC. Released on 28th January 2010, an announcement discloses that the state council has agreed in principle to the trial scheme of short selling, margin trading and stock index futures trading. This is a crucial step in the Chinese securities market's long march towards greater market liquidity and further market integrity. After an intense preparation of two months, the pilot scheme of short selling and margin trading officially commenced on 31st

March 2010. A designated list of 90 blue-chip stocks[2] in the SSE and the SZSE start to be eligible for transactions of short-selling and margin-trading. Since the first announcement of the list, five key revisions have been made on the designated stocks by March 2017. This expands eligible stocks from the original 90 stocks to the current 950 stocks. Also, the number of qualified securities companies that are allowed to participate in margin transactions have been expanded from 6 to 25.

As the second largest economy, increasing attention to the Chinese stock markets have been paid by worldwide investors. In the last two years, huge fluctuations including surges and slumps in stock prices in this powerful emerging market have never stopped. Since 15th June 2015, the first round of collapse in stock prices in both A-share and B-share markets took place. In the following months, the SSE A-Share Index and the SZSE A-Share Index both plummet to its lowest level in the year of 2015. One-third of the value of A-shares on the SSE was lost within one month. Major crash aftershocks occurred on black Mondays of 27th July and 24th August. By 8th to 9th July, the Shanghai stock market had fallen 30 percent over three weeks. More than half of the listed companies (around 1400) had filed for a trading halt to prevent further losses. The value of Chinese stock markets continued to drop despite efforts had been made by regulators to reduce the fall. After three stable weeks, the Shanghai index fell again on 27th July by 8.5 percent, marking the largest fall since 2007.

On this occasion, the authority took bold actions to rein in margin trading and banned short selling, threatening to prosecute violators and those who were spreading false rumours about the market. On 1st July 2015, the CSRC made a revision to the original "*Administrative Measures for Short Selling and Margin Trading Business of Securities Companies*". This revision raises the requirements of opening margin account in the stock market, stipulating that

2 Blue-chip stocks are the stocks of large, nationally recognised and financially sound companies that have operated for many years. They typically have a large market capitalisation and they are normally the market leaders in the sectors. Blue-chip stocks are considered as less volatile investments than owning shares in ordinary companies without a blue-chip status, because blue-chip companies have a reliably institutional status in the economy.

only investors who had an asset value of at least 500,000 Chinese Yuan in his common stock account in the past 20 days can apply for a margin account. On 3rd August 2015, the trading rules of short selling were changed by the SSE and the SZSE from T to T+1 trading, which aims to limit high-frequency trades thereby reducing market volatility. From then, the more stringent supervisions of securities companies have been implemented, a number of securities companies has been fined for non-compliance with rules and regulations during their business activities related to margin transactions. Taking the CITIC Securities as an example, it has been punished a fine of three hundred million Chinese Yuan in May 2017, since it violates the regulations by allowing investors who have less than 6-month trading experience in common stocks to open margin accounts.

Unique rules and regulations

In "*Detailed Rules for Implementation of Pilot Short Selling and Margin Trading*," the CSRC stipulates the tick rule, which refers to the declared selling (purchasing) prices for shortable (marginable) securities should be higher (lower) than the last transaction prices. Besides, the duration of either of these two transactions should be no more than six months. The duration limit implies that an investor must close his transaction within six months. In this case, an investor has to sell securities to raise money, or through direct payment to terminate his margin trading transaction by six months. This could lead to more frequent and short-term investments, which in turn cause larger transaction costs.

Besides, the naked short selling is strictly prohibited in the A-share market. An investor is forbidden to sell shortable securities that he does not own or exceed the number that he has. When the transaction balance of a stock reaches one-quarter of its market capitalisation, the exchanges are entitled to suspend it from trading in the next day. When the balance drops below 20% of its market capitalisation, trading will be resumed. The naked short selling limit and the amount limit are designed to prevent stock price manipulation and for better risk control. Both stock exchanges have legal right to suspend trading of certain underlying securities, market-level short selling and margin trading to ensure a steady operational environment of the stock market.

Market reactions

Generally speaking, the eligibility of short selling and margin trading has been warmly welcomed by market participants in the A-share market. There is no doubt that Chinese stock market benefits from the dual introduction. Short selling and margin trading turn the previous unilateral market to a more advanced bilateral market, and they are expected to add significant liquidity to the Chinese securities market and enhance price discovery mechanism in the long run. The Chinese stock market ceases being a long-positions only market, meaning that investors would be able to profit from bullish as well as bearish markets. This would allow investors to cope with market risks more efficiently and attract more funds and institutional investors onshore and offshore to invest in Chinese securities.

Chapter 3：The Impact of Short Selling and Margin Trading on Feedback Trading and Volatility Dynamics

3.1 Introduction

3.1.1 Motivation

Just as market regulators around the world adopt a more rigorous attitude towards short selling and margin trading, Chinese authorities at its first time approve trades on margin in the domestic stock market. On 31st March 2010, the China Securities Regulatory Committee (CSRC) formally launched the long-awaited pilot program of short selling and margin trading in the A-share market. A designated list of 90 leading stocks on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) start to be eligible for short-selling and margin-trading transactions. Since its first announcement, five major revisions have been made on the designated list by March 2017, expanding eligible stocks from the original 90 blue-chips to 950 constituent stocks. In late 2011, the CSRC declared complete success of the pilot program of short selling and margin trading, finally making these two trial mechanisms routine practice in the Chinese stock market.

The uniqueness of this introduction event is that the CSRC introduces short selling and margin trading at the same time. Any investor who wants to trade by either of these two mechanisms needs to register a margin account with an approved security company at the very first place. Through the mechanism of margin trading, investors are able to construct a leveraged long position by borrowing capital from security companies. Unlike short sellers who incorporate negative information into the market, margin traders hold positive expectations towards stock and make profits from conventional practice of going long. One thing that short sellers and margin traders have in common is that both of them are viewed as speculators in the academic literature. This point can be readily understood from the high costs of these two types of transactions. It is believed that the motivation for investors who use such expensive investing

instruments is more likely to be speculation rather than arbitrage or hedging. The literature documents that both of short seller and margin traders are more sophisticated and informed traders compared to ordinary investors (*e.g.*, Wang 2011; Boehmer and Wu 2013). It argues that a higher possibility of increased volatility might stem from the speculative market behaviour of short sellers and margin traders.

3.1.2 Gaps and Contributions

The current study aims to examine the impact of China's 2010 dual introduction of short selling and margin trading on feedback trading and stock returns volatility of the underlying stocks. Unlike existing literature which mainly focuses on short sales constraints and margin requirements in the developed markets, our study provides direct evidence for the impact of the introduction of short selling and margin trading on an emerging market. The research contributes to the literature in several aspects:

Above all, we are the first to investigate the relationship between the introduction of short selling and margin trading, and feedback trading behaviour in the literature. Particularly, among all extant research focusing on China's 2010 reform of short selling and margin trading, none of them studies the impact of the dual introduction on feedback trading behaviour. A great deal of literature provides evidence that the domestic Chinese investors engage in non-fundamental trading, especially positive feedback trading. By using daily data of stock returns, we firstly study the overall impact of the initiation of short selling and margin trading to examine whether the degree of positive feedback trading is significantly changed before and after the event. With a combination of the heterogeneous trader model (Sentana and Wadhwani 1992) and GARCH-type models, we highlight the conditional nature of return persistence stemming from feedback trading behaviour. Our paper thus at its first stage addresses the interaction between feedback trading behaviour and the stock returns volatility.

Bohl *et al.* (2013) investigate the impact of short sales constraints during the 2008 crisis on feedback trading in six developed countries. Unlike previous literature that reports unconditional autocorrelations, it studies the conditional nature of return changes interact with feedback trading behaviour. Following Bohl *et al.* (2013), we adopt the heterogeneous model to examine potential changes in the degree of positive feedback trading derived from the 2010 reform. To the best of our knowledge, Bohl *et al.* (2013) is the only study that applies the heterogeneous trader model to the literature of short selling. Our study aims to extend the literature by investigating the impact of short-selling introduction together with another simultaneously introduced mechanism, margin trading. Methods including control group, sub-periods comparison and event dummy approach are used to achieve this goal.

Second, with the adoption of GARCH-type models, our study examines both the level and structural changes in stock returns volatility. In the current literature, three event-type studies examine the impact of China's 2010 dual introduction on changes of stock returns volatility more or less. With an adoption of the range-based measure to calculate volatility difference, Sharif *et al*. (2013) argue that the removal of bans on short selling and margin trading decreases stock returns volatility generally. With two control groups, one selected from the remaining ineligible stocks in the Chinese mainland market and the others selected from the cross-listed eligible stocks in the Hong Kong market, the comparative results between the treatment and control stocks of the changes on volatility are not always consistent. Chang *et al.* (2013) uses the standard deviation to examine the changes in the level of returns volatility. They confirm that together with a lower frequency of extreme stock returns, the level of stock returns volatility is decreased in both up and down markets after the ban-lifting. In sharp contrast, Wang (2011) documents an increased volatility after the dual introduction with a measure of variance ratio. The mixed results of these papers leave the relationship between the dual introduction of short selling and margin trading and volatility elusive.

Besides, although extant works study the impact of China's 2010 reform on changes in the level of volatility, none of them investigates further by considering variation takes place in the nature of returns volatility. The current literature is thus not able to answer the question whether the changes observed in the level of volatility among designated stocks indeed stabilise or

destabilise the stock market. GARCH models are adopted in the paper to fill this gap. At the theoretical level, Ross (1989) stresses the relationship between information flow and volatility by pointing out that any change in the rate of information impacts stock price volatility directly. With an application of GARCH models, Antoniou and Holmes (1995) point out that an increase in the level of underlying stocks' volatility after the introduction of futures trading is not necessarily a bad thing. The parameters contained in GARCH models indicate that an increasing impact on the level of volatility is the consequence of an improvement in the rate of information flow. If we achieve the same result as Sharif *et al.* (2013) and Chang *et al*. (2013) that the level of volatility in stock returns reduces after the 2010 introduction, GARCH models, similarly, enable us to examine the issue further by observing changes in the persistence of information in returns volatility. Hence, we can estimate whether the reduction in volatility implies a stabilising effect on the market.

Third, we probe into the impact differences between short selling and margin trading on feedback trading behaviour by investigating parameter differences conditional on negative and positive historical returns. Although the term positive feedback trading has not been mentioned, Chang *et al*. (2013) provide some evidence that both short sellers and margin traders in China involve with technical analysis as a trading strategy when they make investment decisions. Notably, short sellers are more inclined to use technical analysis to select stocks and time the market than margin traders do. Unlike Change *et al*. (2013), we distinguish the impact of short selling and margin trading on feedback trading behaviour by adopting an additional dummy that is respectively connected with positive historical returns and negative historical returns. The intuition underlying this analysis is that short selling prevails more when there are negative historical returns, while margin trading is more likely to be exercised by investors following up on positive returns.

3.1.3 Research Questions

The practice of short selling and margin trading was banned in China before 31st March 2010. That the bans on both mechanisms are lifted overnight for a common designated list of stocks

allows us to conduct an event-based study on the impact of the two. Our study attempts to shed light on the event of China's 2010 dual introduction by addressing three important issues:

Question 1: Whether and to what extent the introduction of short selling and margin trading influences the degree of feedback trading behaviour?
Question 2: Whether and to what extent the introduction of short selling and margin trading affects the level and the nature of underlying stocks' returns volatility?
Question 3: Whether the impact of short selling on feedback trading behaviour is different from that of margin trading?

The first research question aims to examine the impact of the dual introduction on feedback trading behaviour among investors. Due to the strategy of feedback trading is simply based upon past stock returns, the academic perceives it as a typical type of irrational behaviour. De Long *et al*. (1990) argue that the presence of positive feedback traders destabilises securities market by driving prices away from fundamentals. Understanding how the dual introduction affects feedback trading is thus of particular interest to regulators who launch the reform with the aim of market stabilisation. Being viewed as informed traders, short sellers arguably behave more as contrarian traders in their securities investment. A few of research employing US data provide evidence that short sellers are contrarian traders who trade against past stock performance (*e.g.*, Dechow *et al.* 2001; Diether *et al.* 2009a; Boehmer and Wu 2013). In consideration of different market setting, the same characteristics might not be shared by Chinese traders. As the literature is still silent about the relationship between short selling, margin trading and investors' feedback trading behaviour, it would be valuable to investigate the question whether the eligibility of the two mechanisms has a direct influence on the degree of feedback trading behaviour.

The second question focuses on the changes in volatility dynamics among designated stocks. As one of the major objectives for Chinese regulators to inaugurate the scheme is to stabilise its domestic stock markets, the close link between market stability and stock price volatility gives us a reasonable motivation to assess the reform by examining the changes in stock returns volatility before and after the event. Among the multitudinous literature on short selling, little

attention has been paid to the relationship between short selling and stock returns volatility. Although some insights are provided by Ho (1996), Henry and McKenzie (2006) and Bohl *et al*. (2012), the empirical results are highly mixed. A few recent papers focusing short sales bans during the 2008 crisis mentions the issue of changes in stock price volatility; however, the question is not fully addressed, and the results of their analysis are not conclusive. With unique data from an emerging market during an economically peaceful period, our research provides evidence on the relationship of short selling and volatility dynamics from a new perspective.

The third research question is set to investigate the issue whether there are different impacts between short selling and margin trading on feedback trading behaviour. To achieve this purpose, we analyse daily returns data by studying the question of whether the impact of the dual introduction on feedback trading varies dependent on negative and positive historical returns. With trades on margin, it is commonly believed that short selling dominates margin trading under negative market condition while margin trading becomes the prevailing practice in uptrend market. Bearing this basic fact in mind, we link short selling to the changes conditional on negative historical returns while link margin trading with the positive ones to observe the separate impact of each mechanism on feedback trading behaviour. Far from being a perfect method to distinguish impacts of the two newly introduced mechanisms on feedback trading, this analysis enables us to gain an initial insight of the impact differences on feedback trading behaviour between the two.

The remainder of the paper is organised as follows: Section 2 reviews the literature of short selling and margin trading and represents extant discussions about the relationship between either of the two mechanisms and the feedback trading behaviour, and stock return volatility. Three research hypotheses are developed and stated at the end of this section. Section 3 introduces information about the data sample and the construction of control group. Methodology including the baseline model, extended models, testing methods and relevant robustness tests are outlined in section 4. The empirical results are represented and discussed in section 5. Section 6 concludes the paper with a recommendation for future research.

3.2 Literature Review and Hypothesis Development

3.2.1 Short Selling, Feedback Trading and Volatility

Short selling and feedback trading

Without directly focusing on feedback trading behaviour, a few papers study the relationship between short sellers' trading strategies and technical analysis. Some argue that short sellers are contrarians, who take up contrary positions with borrowing stocks following successively positive returns and buying stocks when price declines. Diether *et al.* (2009a) document intensified shorts following higher historical return performance, especially when the stock becomes a cross-sectional winner. Following Diether *et al.*, Lee and Wang (2013) study the behaviour of foreign short sellers in Korean stock markets and find that foreign short sellers are contrarians whose large shorting predicts short-term future returns. Zheng (2009) employs intraday transaction data of short sales from the NYSE to examine short selling around company quarterly earnings announcements. The results illustrate that short sellers act as contrarian traders after positive earnings surprises. Boehmer and Wu (2013) study short sellers' behaviour during extreme price movements of single shortable stocks, finding that short sellers are contrarian traders no matter how stock prices fluctuate. The findings of Bohl *et al.* (2013) suggest that short sales bans in six countries during the 2008 crisis intensify conditional positive feedback trading among investors, which is exactly the opposite to regulators' view that short sales ban is a legitimate tool to stabilise the market in times of turmoil.

However, there is also evidence that short sellers are momentum traders or positive feedback traders. Another significant finding from Zheng (2009) is that short sellers act as momentum traders after negative earnings surprises announced by firms. Unlike Boehmer and Wu (2013) who study short sellers' behaviour during extreme price movements of single stocks, Blau *et al.* (2010) use data of market indices to define extreme stock price movements and obtain an opposite finding that short sellers are positive feedback traders during episodes of volatile

markets. From another perspective, Shkilko *et al.* (2012) study short sellers' behaviour around extreme intraday return movements, observing that short sellers are momentum traders when they face large intraday declines. With contrary evidence of short sellers' feedback trading strategies at hands, further investigation about how short sellers behave in such an immature market would be valuable.

Short selling and volatility

The relationship between short selling and stock returns volatility is a contentious issue but has not received enough academic attention. Ho (1996) finds that the daily volatility of stock returns increases when short sales constraints are imposed in Singapore market during 1985–1986 crises. It argues that short sales constraints can temporarily limit the effects of bearish sentiments on stock prices. But once bearish sentiments take hold, the decline in prices will be magnified by long selling. The volatility in stock returns then increases as a result. Scheinkman and Xiong (2003) set up a behavioural model with heterogeneous traders who show overconfidence to private information. When short sales constraints are lifted, both of trading volume and stock price volatility substantially decrease. In accordance with the theoretical model of Abreu and Brunnermeier (2002), Boulton and Braga-Alves (2010) find that the naked short sales ban on 19 leading financial firms required by the SEC on July 2008 led to an increase in daily volatility among covered stocks. Bohl *et al.* (2012) adopt asymmetric GARCH models and a Markov switching model, finding that short sales bans in the Taiwanese markets raise the volatility in falling markets.

Other studies obtain different conclusions. Both Alexander and Peterson (2008) and Diether *et al.* (2009b) investigate the removal of short sales constraints or price tests, with a finding of insignificant or weak augments in intraday and daily price volatility. Similarly, a recent paper by Lee and Wang (2013) studies the behaviour of foreign short sellers in Korean markets and find that foreign investors' short-selling activities do not increase volatility. This again provides evidence against the common belief that short selling destabilises the market. However, Henry and McKenzie (2006) study the Hong Kong market where only a list of stocks is allowed for short selling, finding that with allowance for a period of short selling, the market exhibits

greater price volatility and exacerbated volatility asymmetry. Using a direct measure of sales constraints, Chang *et al.* (2007) obtain consistent conclusions in Hong Kong market. It documents a higher volatility but less positive skewness of designated stocks which are at the short selling list. Concentrating on large negative price reversals that occur on newsless days, Shkilko *et al.* (2008) find that short selling is abnormally aggressive during such reversals and the magnitude of price reductions is substantially increased by short selling activities. The mixed results of current empirical analyses do not provide clear guidance for the relationship between short selling and stock returns volatility.

3.2.2 Margin Trading, Feedback Trading and Volatility

Margin introduction and feedback trading

The only one study so far examines the relationship between margin introduction and feedback trading is Chang *et al.* (2013). Focusing on China's 2010 introduction of short selling and margin trading, it finds that Chinese margin traders rely less on technical analysis than Chinese short sellers. Their findings indicate that Chinese margin traders do not trade on momentum, but only on temporal under-pricing. Nevertheless, they do not identify trends in historical returns. And there is no sufficient evidence that margin traders in the A-share market consistently capture short-term under-pricing stocks implied by contemporaneous returns in a rational way.

Margin introduction and volatility

Margin trading has been viewed as a destabilising strategy in traditional wisdom, due to its potential role of involving speculative activities. However, almost all empirical studies support the practice of margin trading. By adopting a sample of NASDAQ small-cap firms and OTC issues which meet the lowest requirements for margin trading, Alexander *et al.* (2004) find no

significant impact of margin introduction on market liquidity and volatility. But the information environment of the marginable stocks improves substantially upon the introduction. By studying the addition of OTC issues to the marginable list, Seguin (1990) observes no increase in stock volatility. He finds that even though margin eligibility has produced an extra 30% volume of stocks, both volatility and noise decrease. Besides, market liquidity, the flow of information and market depth all have been enhanced. With an observation that marginable stocks in NASDAQ, in fact, decreased less than the ineligible ones during the 1987 crash, Seguin and Jarrell (1993) claim that margin trading conduces to market stabilisation. Therefore, the general finding is that there is a negative relationship between margin trading and stock market volatility.

3.2.3 Hypothesis Development

Extant literature on China's 2010 introduction

A few studies have examined the impact of China's 2010 introduction of short selling and margin trading on market conditions. Zhou and Wong (2012) study the impact of short selling on stock prices finding that short selling mechanism provides a desirable tool for informed traders to correct overpricing, which eventually helps mitigate the occurrence of price bubbles in Chinese stocks markets. Wang (2011) focuses on the introduction of margin trading to examine the effects of margin trading on trade informativeness and market liquidity. He finds that the eligibility of margin trading leads to more information-based trading and less market liquidity, which implies that the uninformed investors are discouraged by informed margin traders. Wang (2012) investigates whether idiosyncratic stock risk deters investors from shorting on negative information. His findings provide strong support for the idea that idiosyncratic risk of single stock deters arbitrageurs who own negative information from selling short in overvalued stocks.

The impact of short selling and margin trading on feedback trading

A large volume of literature documents that Chinese domestic investors engage in positive feedback trading. Mei *et al.* (2005) and Fong (2008) provide evidence that there is more intensive positive feedback trading in Chinese stock markets than in foreign developed markets. One paper has studies the relationship between China's 2010 introduction and technical analysis adopted by Chinese traders. With data of short-selling and margin-trading activities (*e.g.*, daily short turnover, daily covered short), Chang *et al.* (2013) find strong evidence that short sellers in China adopt technical analysis to make investment decisions, but Chinese margin traders do not rely on technical analysis as much as short sellers do. Although the term feedback trading has not been mentioned, the results of their work imply links between the eligibility of short selling or margin trading and investors' feedback trading behaviour. Chang *et al.* (2013) find that Chinese short sellers employ technical analysis to select stocks and to time the market. Following a downward trend, they sell current winner stocks with temporal overpricing and cover short positions of stocks which are current losers. These findings indicate that Chinese short sellers are intraday contrarian traders.

However, margin traders in China do not identify trends. They seem only capture very short-term undervaluation, and no evidence shows that they do it in a consistently rational way. Somehow this finding illustrates that Chinese margin traders have no potential to be positive feedback traders. Besides, since it is generally believed that margin traders are more informed than normal traders, and informed traders are more likely to make investment decisions on their private information, margin traders are more likely to be contrarian traders who do not make investment decisions by following market trends. We thus predict that the introduction of margin trading reduces positive feedback trading in the Chinese stock markets or at least leave it unchanged but improve informational efficiency to some level. The first hypothesis of our study is:

Hypothesis 1: The degree of positive feedback trading reduces when short selling and margin trading are allowed.

Instead of studying the separate impact of short selling and margin trading on feedback trading behaviour, which will be analysed in detail in a later section, the first research question aims

to fill the gap by investigating the integral impact of these two mechanisms on feedback trading with daily adjusted closing price. With a combination of the heterogeneous trader model and GARCH-type models, our paper addresses the interaction between stock price volatility and feedback trading behaviour among short sellers and margin traders.

The impact of short selling and margin trading on volatility

Three papers examine the impact of China's 2010 dual introduction on stock returns volatility. With the range-based measure, Sharif *et al.* (2013) calculate the volatility difference and argue that the introduction of short selling and margin trading decreases the volatility level in general. Since only a small group of 90 stocks are eligible for the two mechanisms in the first batch, two control groups are constructed to compare with the treatment group: with one chosen from the rest ineligible stocks in mainland China, while the other chosen from cross-listed stocks in the Hong Kong market. However, the results of volatility changes between the types of two comparisons are not always consistent. When comparisons are taken by using the mainland control group, the level of volatility appears a clear decline after the introduction. While when the Hong Kong control group is employed, the volatility differential between the treatment and control groups based on 3-month pre-event and post-event period windows exhibits strongly positive in the down-side market, which presents a significant increase in volatility.

Consistent with the general finding of Sharif *et al.* (2013), Chang *et al.* (2013) use standard deviation to examine changes in volatility. It documents a substantial drop in volatility both in up- and down-markets after the ban lifted; a lower frequency of extreme stock returns is also observed. Further, the authors adopt daily volatility to measure uncertainty, which is defined as the difference in the daily high and low price divided by the high price. They find that short-selling transactions are normally accompanied by higher volatility and spread, which is consistent with the view that short sellers possess private information; however, a negative coefficient on the daily volatility and a positive on the spread is found for margin traders. In sharp contrast to Sharif *et al.* (2013), Wang (2011) uses the measure of intraday variance ratio

finding that volatility among designated stocks is increased by the introduction of short selling and margin trading. Based on the literature discussed above, our second hypothesis is:

Hypothesis 2: The stock price volatility decreases when short selling and margin trading are allowed.

Although major evidence shows a negative relationship between the dual introduction and stock price volatility, mixed results still leave this relationship unclear. Since all three extant studies focus on changes in the volatility level rather than changes in the nature of the stock returns volatility, this study adopts GARCH-type models to fill this gap. If our study obtains consistent results with Sharif *et al.* (2013) and Chang *et al.* (2013) that the level of volatility among designated stocks decreases after the 2010 reform, GARCH-type models would enable us to have a closer look at whether this reduction in stock price volatility indeed implies a stabilising effect of the introduction of short selling and margin trading. This is of particular interest to Chinese regulators who initiate the 2010 reform for market stabilisation.

The separate impacts of short selling and margin trading on feedback trading

Since short selling and margin trading are initiated by the CSRC at the same event day, the daily stock price data adopted in the study, in fact, contains both groups of innovations which are brought about by short selling and margin trading separately. Rather than study the combined impact of both introduced mechanism as stated in previous two hypotheses, here we attempt to study the separate impact of short selling and margin trading on feedback trading behaviour. Both of short selling and margin trading belong to margin transactions, of which the investments are conducted in a margin account. It is arguably believed that short selling dominates margin trading following with negative historical returns; otherwise, margin trading becomes more prevalent. In order to distinguish the impact of short selling (margin trading) from the dual introduction, we link short selling to the changes related to negative (positive) historical returns. In other words, to split the impact brought about by short selling and margin trading individually, we study the impact differences of the dual introduction conditional on past returns with opposite directions. With findings of Bohl *et al.* (2013) and Chang *et al.*

(2013), which are previously mentioned in 3.2.1 and 3.2.3 respectively, the third hypotheses are:

Hypothesis 3: The introduction of short selling/margin trading decreases the degree of positive feedback trading.

3.3 Data

3.3.1 Institutional Setting

Since its foundation in the 1990s, the Chinese stock market had operated as a unilateral market with legal prohibition on short selling and margin trading for 20 years. Together with regulators of the two major exchanges in mainland China, the CSRC launches a pilot scheme of short selling and margin trading on 31st March 2010, allowing qualified investors to trade on margin at the very first time. The ban lifting of short selling and margin trading for a designated list of stocks overnight by the CSRC provides us with a great chance to conduct an event analysis of the changes brought about by the two mechanisms. A designated list of 90 constituent stocks including 50 stocks from the SSE and 40 from the SZSE starts to be eligible for transactions of short selling and margin trading. The list has been approved and revised at five times by March 2017, with substantial expansion from the original 90 stocks to a significant number of 950 stocks. Appendix 3.1 shows all listing adjustments for short selling and margin trading during the entire reform. All relevant indices in the two stock exchanges in China are listed in Appendix 3.2. The company profiles and detailed listing adjustments of the 90 designated stocks in the first batch are reported in Appendix 3.3.

The 2010 reform is proposed to inject credit into the domestic stock markets. It aims to integrate more information into securities prices, thereby promoting market stability as a whole. The stringent requirements imposed by the CSRC during the reform highlights its cautious approach to process the trial scheme. As its primary regulations, stocks must meet several criteria to obtain the eligibility of short selling and margin trading. According to the detailed

rules and regulations promulgated by the SSE, eligible stocks must satisfy various criteria in aspects of size, liquidity and volatility. Only the largest stocks with the highest liquidity and

Table 3.1 Requirements of stocks to be eligible for short selling and margin trading

Regulator	Official Document	Requirements
CSRC & SSE Authority	Listing requirements of short selling and margin trading, "Detailed rules and regulations for margin transaction Pilot Scheme", issued on 21/08/2006	1. The stock has been listed for at least three months on the underlying index; 2. The stock has at least 200 million public floats, or the market value (the free float market capitalisation) should be at least 800 million Yuan; 3. The stock has at least 4,000 shareholders; 4. Daily turnover of the stock is 20% higher than its index turnover; 5. None of the following has happened in the past three months: a). Daily price fluctuation exceeds 4% of the increase (decrease) standard index daily level; b). Price fluctuation is five times or more than the standard index fluctuation.
SSE Authority	Requirements of index inclusion, "SSE 180 and 50 Index Methodology", firstly launched in 02/01/2004	1. Stocks are ranked by total market capitalisation and trading value; 2. Top 50 will be selected except for stocks with abnormal market performance.
SZSE Authority	Requirements of index inclusion, "Compiling Methodology for the series of SZSE Component Indices", firstly launched in 05/05/1995	1. The stock must have been listed for at least six months on the exchange; 2. Stocks are ranked by total market capitalisation and free float market capitalisation; 3. Top 10 with no massive swings or fluctuations in the stock prices during the observation period.

the lowest volatility are targeted. As a result, a designated list of 90 stocks including 50 stocks in the SSE 50 Index and 40 in the SZSE Component Index was approved for the first batch by the CSRC. The two indices mentioned above were designed to comprise stocks with the largest capitalisation, the highest liquidity and the most compelling industry representativeness. Thus, besides requirements of the dual introduction of short selling and margin trading, all selected 90 stocks must meet inclusion criteria of the two indices. The detailed rules and requirements for stocks to be eligible for short selling and margin trading are given in Table 3.1.

3.3.2 Sample Data

The sample span of this study is eight years from 31/03/2006 to 31/03/2014. Although six batches and several small changes have been taken in the designated list since its first announcement, we only adopt the first batch of 90 stocks as our research focus. The decision is made with consideration of the most representativeness of the original 90 stocks and sufficient length of data duration, which is particularly crucial for time series analysis. The daily adjusted closing price of the first batch of 90 constituent stocks including all stocks of the Shanghai 50 Index and the Shenzhen 40 Index are collected.

However, only data of 32 stocks out of the 90 stocks on the initially designated list is adopted. Four issues leading to the significant data loss need to be explained: Firstly, due to the late foundation of the Chinese equity markets, 30 stocks lack data in an earlier stage of our sample period. With the fact that both the SSE and the SZSE are founded in the early of 1990s, 30 stocks have not been listed on the relevant exchange at the start date of our sample span. These firms became listed subsequently in the following two and half years (see Appendix 3.3). To keep sample duration for individual stocks same, the 30 stocks are removed out of our sample. Secondly, 11 stocks among the remaining 60 stocks in the first batch have been deleted at least once during our sample span of the continuous reform implementation (see Appendix 3.1). To maintain data continuity and to avoid data contamination, we exclude the stock's data once it has been deleted from the designated list, no matter whether it rejoins the list in a later batch or not. Thirdly, two of the remaining 49 stocks delisted during our sample range.

Fourthly, 15 out of the rest 47 stocks have abnormal data, which is mainly caused by high frequencies of non-trading days. This feature of the Chinese data can be explained by two reasons: 1) there are less annual transaction days in the Chinese stock markets. This is particularly because Chinese stock exchanges are not only closed at weekends, but in main national holidays (such as the Labour Day in May and the national day in Oct), which normally lasts 3-7 days; 2) the listed stocks in Chinese exchanges seems more likely to be suspended due to firm's operation issues. The two reasons lead to strings of zeros appearing in the log difference of the 47 stocks' time series of daily price data. The descriptive statistics of the 15 stocks with the heaviest frequency of non-trading days tend to be abnormal, and all of them obtains no convergence in GARCH regression.

The information for rules and regulations of the dual introduction scheme is collected from the official websites of the SSE and the SZSE. The data of daily adjusted closing price, total market capitalisation, free float market capitalisation, the number of public floats, daily trading volume, daily turnover and daily price fluctuation of all stocks in both Shanghai Stock Exchange A-Share Index and Shenzhen Stock Exchange A-Share Index for our treatment and control groups are obtained from the WIND database.

3.3.3 Control Group Selection

As one of the existing studies about China's 2010 reform, Sharif *et al.* (2013) adopt similar characteristics matching to select control stocks for the 90 designated stocks. Following procedures taken by Boulton *et al.* (2010), the authors first require matched candidates belong to the same industry. Then for all A-shares listed in the SSE and the SZSE, they calculate the same measures adopted by Boulton *et al.* (2010), including the mean market value, closing stock price, volatility of daily return and daily turnover. However, these variables are not in line with Chinese regulators' requirements for designated stocks for short selling and margin trading. Obviously, there are significant differences between the chosen criteria for selecting

shortable/marginable stocks in China and selecting stocks for short sales bans in the U.S. markets. A simple adotion of the same factors in various settings seems lack of consideration.

Following Sharif *et al.* (2013), we apply similar characteristics matching to select control stocks, but with the selection criteria stemmed from the requirements stipulated by the CSRC and regulators of the two exchanges. First, a few requirements for the qualification of eligible stocks for short selling and margin trading are set by the CSRC and the SSE regulators. These items can be check at Table 3.1. Another fact about the designated list is that it completely covers stocks in the Shanghai 50 Index and the Shenzhen 40 Index. With much earlier implementation dates than the 2010 dual introduction, we understand that the two indices are not particularly constructed for the reform. But we still choose to consider inclusion requirements of both indices when conduct the control group selection since the later batches of stocks being added to the designated list are also from similarly relevant indices. The index construction documents of the two indices clearly state their stock selection requirements. Table 3.1 summarises all pertinent requirements that a common stock must meet or exceed to be eligible for short selling and margin trading under the 2010 reform.

With reference to the basic requirements for designated stocks promulgated by the CSRC, and index inclusion criteria for both the Shanghai 50 Index and the Shenzhen 40 Index, we adopt following variables as selection criteria to implement our similar characteristics matching: total market capitalisation, free float market capitalisation, daily trading volume, the number of public floats, daily turnover and the daily price**.** The variable daily turnover is included because of the high liquidity requirement by the CSRC. Since collected data of each variable are daily data, the time series of each variable is converted into a daily average over the 250 trading days prior to the listing date 12th Feb 2010.

3.3.4 Descriptive Statistics

The descriptive statistics of the remaining 32 stocks together with its control counterparts are separately provided in Panel A, A1 and Panel B, B1 of Appendix 3.4. The comparative analysis is done with the pre-event and post-event estimates of the constructed time series. Among all 32 treatment stocks, 13 of them are from the Shanghai 50 Index, and the rest 19 stocks are from the Shenzhen 40 Index. Four industrial portfolios based on related industries and one general portfolio includes all 32 object shares are constructed according to the portfolio approach. The descriptive statistics of the treatment times series and their control counterparts are respectively represented in A2, A3 and B2, B3 of Appendix 3.4. Besides the analysis of the industrial portfolios and the all-share portfolio, comparisons based on individual stocks are also performed. As mentioned in McKenzie *et al.* (2001), analysis of stock indices is useful in assessing market-wide impacts, but effects on the underlying can be dissipated across stock constituents in the index, making the true effect hardly to be detected. The influence of short selling and margin trading on feedback trading and volatility dynamics might be more noticeable at the individual stock level.

The descriptive statistics of the 32 adopted stocks together with their control counterparts are represented in Appendix 3.4. The daily stock returns are calculated as the logarithmic difference $R_t = 100 \times ln(P_t/P_{t-1})$. The statistics including the mean return, the minimum and the maximum return, the standard deviation, skewness, excess kurtosis, the Jarque-Bera statistic, the Ljung–Box statistics LB(12), the ARCH test, the JOINT test, together with serial correlations at different lags are reported. Table 3.2 is used to provide descriptive summaries of key statistics with the percentage of significance.

With the statistical results concerning the data's distributional pattern, we can easily see that the return distributions of our adopted stocks departure from normality. More than half of stocks display significant skewness, and all stocks show significantly excess kurtosis in both groups. The non-normal return distributions is also strongly supported by the significant JB statistics of all the time series analysed. Although only a little more than half of the results of the Ljung-Box $\chi 2$ statistics for 12 lags of individual stocks display significance, the significant LB(12) are found for most indices returns, except for the financial portfolios in both treat and control groups. This indicates significant temporal dependencies in the first moment of

portfolio returns distribution. The results of ARCH statistics for both groups show complete significance. The results of the JOINT test of individual stocks rarely show significant asymmetries in conditional volatility, which suggests that the basic GARCH model may even fit A-share returns data better than the more complicated asymmetric ones. Moreover, a simple autoregressive model AR(5) is estimated and reported in Appendix 3.4. The coefficient results of serial correlation at different lags t =1, 2, 3, 4, 5 show different levels of significance. For the serial correlation at lag 1, 28.13% treatment stocks and 37.50% control stocks have positive coefficient results. This indicates that to some extent, positive feedback trading exists in stock returns in the A-share market. Nevertheless, further investigation is required to examine the extent of interaction between serial correlations and volatility.

Table 3.2 Descriptive statistics

Percentage of Significance	Skew	Kurt	JB	LB(12)	ARCH	JOINT	Serial correlation at lag 1
Panel A: Treatment Group							
Individual Stocks (32)	65.63%	100.00%	100.00%	56.25%	100.00%	15.63%	28.13%
Industrial Portfolios (4)	100.00%	100.00%	100.00%	75.00%	100.00%	25.00%	0.00%
All-share Index (1)	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%	0.00%
Panel B: Control Group							
Individual Stocks (32)	59.38%	100.00%	100.00%	68.75%	100.00%	25.00%	37.50%
Industrial Portfolios (4)	100.00%	100.00%	100.00%	75.00%	100.00%	75.00%	0.00%
All-share Index (1)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%

Notes: The sample period is from 31/03/2004 to 31/03/2014. The observations of each time series are 1942. The percentage of statistical significance in this table includes statistics with significance at the levels of 10%, 5% and 1%. Details of all related statistics is presented at Appendix 3.4.

3.4 Methodology

3.4.1 The Baseline Model

The heterogeneous trader model

Sentana and Wadhwani (1992) model heterogeneous behaviour of two types of investors, smart money traders who make their investment decisions within a rational mean-variance framework, and feedback traders who react to previous price changes rather than making investment decisions on the fundamentals. The demand for stocks held by smart money traders (S_t) is determined by a mean-variance model:

$$S_t = \frac{(E_{t-1}R_t - \alpha)}{\mu\sigma_t^2} \tag{3.1}$$

Where $E_{t-1}R_t$ denotes the expectation on stock return in period *t*, α is the risk-free rate. The $\mu\sigma_t^2$ is the risk premium, modelled as a positive function of the stock price's conditional variance σ_t^2 and the coefficient of risk aversion μ.

The relative holdings of feedback traders (F_t) are determined by the following equation:

$$F_t = \gamma R_{t-1} \tag{3.2}$$

Where R_{t-1} denotes return in the previous period. The value of γ captures the type and degree of feedback trading behaviours*:* $\gamma > 0$ refers to the case of positive feedback trading, which means buying stocks after price increases and selling stocks after price declines. $\gamma < 0$ indicates negative feedback trading, which is in line with the common 'buy low-sell high' strategy. It is noteworthy that feedback trading behaviour of either type has the impact of moving price away from its fundamental value. Hence, if the introduction of short selling and margin trading promote feedback trading behaviour among the designated stocks, further regulations may need to be considered by market regulators.

Market clearing requires that all stocks are held by:

$$S_t + F_t = 1 \tag{3.3}$$

Together with equation (3.1), (3.2) and (3.3) and an assumption of rational expectations, this implies:

$$R_t = \alpha + \mu\sigma_t^2 - \gamma\mu\sigma_t^2 R_{t-1} + \varepsilon_t \tag{3.4}$$

Where ε_t stands for a zero-mean residual, and all other terms are defined as above.

In a market with both smart money traders and feedback traders, the return equation contains an additional term R_{t-1}, which implies that stock returns display autocorrelations. The pattern of autocorrelation in the stock returns depends on the type of feedback trading captured by the value of γ. With $\gamma > 0$, stock returns are negatively autocorrelated and positive feedback trading is involved; while with $\gamma < 0$, stock returns are positively autocorrelated and negative feedback trading is involved instead. The extent to which the stock returns autocorrelation varies with is closely related to the level of stock price volatility $\mu\sigma_t^2$.

With further consideration of autocorrelation caused by market frictions, equation (3.4) can be modified to an empirical version:

$$R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{t-1} + \varepsilon_t \qquad (3.5a)$$

Where R_t denotes the returns of individual stock in day *t,* and σ_t^2 is the conditional variance of returns. In order to accommodate non-normalities, the residual is assumed to follow a Student's *t*-distribution. The coefficient φ_0 captures unconditional autocorrelation induced by potential market frictions, such as thin-trading, nonsynchronous trading and transaction costs (Bohl *et al*. 2013). The coefficient $\varphi_1 = -\gamma\mu$ presents the conditional autocorrelation caused by feedback trading, which is closely related to the level of volatility in stock returns. A significantly negative (positive) value of φ_1 implies a phenomenon of positive (negative) feedback trading. The conditional positive feedback trading is the core concern here since it amplifies price deviations from its fundamental in times of high conditional variance, which may lead to market downturns as a result.

GARCH-type models

To take into account volatility clustering and ARCH effects, equation (3.5a) is jointly estimated with GARCH-type models. GARCH models are employed to study changes in price volatility in terms of nonsynchronous trading, conditional heteroscedasticity in returns, and asymmetric responses to the positive and negative news. Following Chau *et al.* (2014), rather than adopting a particular type of univariate GARCH model, extensive specification tests are taken to determine the most appropriate model among three versions of GARCH models, including the standard symmetric GARCH model (Bollerslev 1986), the asymmetric exponential GRACH model (Nelson 1991) and the asymmetric GJR-GARCH model (Glosten 1993).

GARCH:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \tag{3.6a}$$

EGARCH:

$$\log(\sigma_t^2) = \alpha_0 + \alpha_1 \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \beta log(\sigma_{t-1}^2) \tag{3.7a}$$

GJR-GARCH:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma X_{t-1} \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \tag{3.8a}$$

The extensive tests including the log-likelihood function (log L), Akaike information criterion (AIC) and Schwarz Bayesian criterion (BIC) are conducted to select the most appropriate model for adopted time series data (see Appendix 3.5.A and B). The results of both AIC and BIC show that the basic GARCH (1, 1) is the best performing model for all adopted series, while the statistics of log L indicates that GJR-GARCH is the second prior one. Thus, we adopt a combined model of the heterogeneous trader model with GARCH (1, 1) as our baseline model, and apply the GJR-GARCH (1, 1) later as a robustness test.

3.4.2 The Two-period Approach

$$R_t = \alpha + \mu \sigma_t^2 + (\varphi_0 + \varphi_1 \sigma_t^2) R_{t-1} + \varepsilon_t \tag{3.5a}$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (3.6a)$$

The models described in equations (3.5a) and (3.6a) are estimated for both the pre-event and post-event periods and estimated coefficients of them are compared. With the consideration that factors other than the dual introduction event may also affect the concerned coefficients in our analysis, *t*-tests on the significance of differences in φ_1 between the treatment and the control groups are performed.

The heterogeneous trader model is used to analyse our first hypothesis that the degree of feedback trading is reduced by the eligibility of short selling and margin trading. With a voluminous literature claiming that positive feedback trading exists in the Chinese A-share market, we expect that the market environment is with significantly positive feedback trading before our study event, $\varphi_1 < 0$. Our second hypothesis is that stock price volatility decreases when short selling and margin trading are allowed. The coefficients α_1 and β in GARCH (1, 1) model of equation (3.6a) describe the features of the conditional volatility of returns. By using GARCH-type models, we can not only investigate the question whether the level of volatility among the designated stocks is decreased but also examine structural changes in volatility in terms of the rate of information flows and volatility persistence. If the dual introduction leads to an improvement in information flow and a moderation in the impacts of feedback traders and other noise traders as expected, reductions in the value of α_0, β, γ , φ_0, and in the absolute value of φ_1, together with an increase in the coefficient α_1 would be observed.

The estimation results of five key coefficients φ_0, φ_1, α_0, α_1, β are reported in Appendix 3.6.A and B**.** To allow a distinction to be drawn between negative feedback trading and positive feedback trading, results are reported separately for coefficient φ_1, of which the positive value $\varphi_{1\,(\text{positive})}$ represent negative feedback trading, and the negative value $\varphi_{1\,(\text{negative})}$ stands for positive feedback trading. The estimated parameters along with the *P*-values of the nonparametric Kruskal-Wallis statistics, which examines whether the coefficients in the pre-event period are significantly different from that in the post-event period, and the *t*-statistics on the equality of the estimated coefficients between the treatment and control groups are also reported**.**

3.4.3 The Heaviside Indicator Approach

In our empirical analysis, three different approaches with respective advantages are conducted to estimate the time series of return R_t. Following Antoniou *et al.* (2005), we firstly modify the baseline model with Heaviside indicators. To formally test the hypothesis that changes in φ_0 and φ_1 after the introduction are statistically significant, we add the Heaviside indicator function to both the return and the variance equations of the baseline model:

$$R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_{0,1} I_t + \varphi_{0,2}(1 - I_t) + \left(\varphi_{1,1} I_t + \varphi_{1,2}(1 - I_t)\right)\sigma_t^2\right] R_{t-1} + \varepsilon_t \qquad (3.5b)$$

$$\sigma_t^2 = \alpha_{0,1}\, I_t + \alpha_{0,2}(1 - I_t) + \left[\alpha_{1,1}\, I_t + \alpha_{1,2}(1 - I_t)\right]\varepsilon_{t-1}^2 + \left[\beta_1\, I_t + \beta_2(1 - I_t)\right]\sigma_{t-1}^2 \qquad (3.6b)$$

Where I_t is the Heaviside indicator function taking value one before the introduction date and zero afterwards. The two extended models given by equation (3.5b) and (3.6b) enable us to use the full sample data to conduct the regression analysis, which would greatly improve data utilization efficiency. Also, the Heaviside indicators added allow us to investigate changes happened in each concerned coefficient in the variance equation before and after the introduction. The following hypotheses can be tested directly: $\mathrm{H}_{0,1} : \varphi_{0,1} = \varphi_{0,2}$, $\mathrm{H}_{0,2} : \varphi_{1,1} = \varphi_{1,2}$, $\mathrm{H}_{0,3} : \alpha_{0,1} = \alpha_{0,2}$, $\mathrm{H}_{0,4} : \alpha_{1,1} = \alpha_{1,2}$, and $\mathrm{H}_{0,5} : \beta_1 = \beta_2$. The estimated parameters along with Wald statistics for $\mathrm{H}_{0,1}$, $\mathrm{H}_{0,2}$, $\mathrm{H}_{0,3}$, $\mathrm{H}_{0,4}$ and $\mathrm{H}_{0,5}$, and *t*-statistics for the equality of the feedback trading model coefficients between the treatment and the control group are reported in Appendix 3.7.A and 3.7.B.

3.4.4 The Differentiated Impact Model

We investigate the separate impact of short selling and margin trading on feedback trading behaviour by studying the impact differences of the dual introduction conditional on positive

and negative historical returns. A combination of the heterogeneous trader model with Heaviside indicators and basic GARCH (1, 1) model with an event dummy help us to achieve the purpose. In the spirit of Gulen and Mayhew (2000), a multiplicative dummy is adopted to study the changes in volatility levels caused by the introduction of short selling and margin trading:

$$R_t = \alpha + \mu\sigma_t^2 + \{\varphi_{0,1}^{+} I_t + \varphi_{0,2}^{+}(1 - I_t) + [\varphi_{1,1}^{+} I_t + \varphi_{1,2}^{+}(1 - I_t)]\sigma_t^2\} R_{t-1}^{+} + \{\varphi_{0,1}^{-} I_t + \varphi_{0,2}^{-}(1 - I_t) + [\varphi_{1,1}^{-} I_t + \varphi_{1,2}^{-}(1 - I_t)]\sigma_t^2\} R_{t-1}^{-} + \varepsilon_t \quad (3.5c)$$

$$\sigma_t^2 = (1 + \alpha_L D_t)(\alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2) \quad (3.6c)$$

Where the dummy variable D_t is equal to one when the introduction is in place and zero otherwise. The main focus of our study is parameter $\varphi_{1,2}^{+}$ and $\varphi_{1,2}^{-}$, which distinctly represents the level of conditional feedback trading after the dual introduction dependent on historical positive and historical negative returns. Since the fact that short selling dominates margin trading following negative historical returns while margin trading becomes more prevailing with the positive historical returns, we link short selling to the changes related to negative returns and link margin trading to the other to investigate the different impact of short selling and margin trading on feedback trading behaviour. Similar to the previous derivation, a positive sign of the estimates of $\varphi_{1,2}^{+}$ or $\varphi_{1,2}^{-}$ suggests occurrence of negative feedback trading, while the case of negative sign implies a degree of positive feedback trading.

The estimation results along with the *P*-values of Kruskal-Wallis statistics, Wald statistics and *t*-statistics are reported in Appendix 3.8.A and B. The nonparametric Kruskal-Wallis statistics and Wald statistics are adopted to examine whether the coefficients of individual time series in the pre-period are significantly different from that in the post-period. The t-statistics of parametric t-test that examine the equality of the estimated coefficients in the post-period between the treatment and control groups are shown in the rightmost column.

3.4.5 Robustness Tests

The Heaviside indicator approach with different window specifications

Further estimations are undertaken to check the robustness of our results. In regard to the sample range, a two-year window and a three-year window either side of the introduction event are adopted to compare with the original four-year window. From the findings of Chau *et al.* (2008) which study the impact of the introduction of Universal Stock Futures on underlying market dynamics, we understand that the qualitative findings related to feedback trading for two-year and four-year window are generally consistent, but in some cases, there might be differences in the significance of the results on the unconditional volatility α_0. It argues that with a two-year window, the post-event α_0 might be insignificantly different from its pre-event value. The estimated parameters for both the treatment and control groups of all-share index along with the *p*-values of Kruskal-Wallis statistics and Wald statistics are reported in Appendix 3.9.A and B.

Estimation results of asymmetric GARCH-type model

With the recognition that the best performing model among three presented GARCH-type models for our data is the basic GARCH (1,1) model, we use the second best-fit model GJR-GARCH (1,1) indicated by the log-likelihood ratio statistic to test the robustness of our results (see Appendix 3.5.A and 3.5.B). The GJR-GARCH version of the Heaviside indicator approach is:

$$R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_{0,1} I_t + \varphi_{0,2}(1 - I_t) + \left(\varphi_{1,1} I_t + \varphi_{1,2}(1 - I_t)\right)\sigma_t^2\right] R_{t-1} + \varepsilon_t \qquad (3.5b)$$

$$\sigma_t^2 = \alpha_{0,1}\, I_t + \alpha_{0,2}(1 - I_t) + \left[(\alpha_{1,1}\, I_t + \alpha_{1,2}(1 - I_t)\right]\varepsilon_{t-1}^2 + [(\gamma_1\, I_t + \gamma_2(1 - I_t)]X_{t-1}\varepsilon_{t-1}^2 +$$
$$[(\beta_1\, I_t + \beta_2(1 - I_t)]\sigma_{t-1}^2 \qquad (3.6d)$$

With an additional asymmetry coefficient γ, the GJR-GARCH version of the feedback trading model with Heaviside indicators allows for asymmetric responses of volatility to news innovations. The estimated parameters for both the treatment and the control groups of industrial portfolios along with the Wald statistics and *t*-statistics are reported in Appendix 3.10.

3.5 Empirical Results

According to the approaches elaborated above, three sets of regressions are conducted to address three research questions regarding the impact of the introduction of short selling and margin trading on feedback trading and stock volatility dynamics. Appendix 3.6.A and B present the immediate and calculated GARCH estimation results of the baseline model for individual stocks, industrial portfolios and all-share index in the pre-event and post-event periods; Appendix 3.7.A and B present the immediate and calculated GARCH estimates of the Heaviside indicator approach for individual stocks and industrial portfolios; Appendix 3.8.A and B present the immediate and calculated GARCH estimation results for individual stocks, industrial portfolios and all-share index of the differentiated impact model conditional on positive and negative historical returns. In terms of robustness tests, Appendix 3.9.A and B present GARCH estimates of the Heaviside indicator approach and the differentiated impact model of the all-share index with 2- and 3-year estimation window; Appendix 3.10 presents GJR-GARCH estimates of the Heaviside indicator approach for industrial portfolios. For all appendix tables, the empirical results for both the treatment and control groups are reported. With Appendices 3.6 - 3.10 being attached at the end of our research, we use Tables 3.3 - 3.5 in the main body of the text to provide more concise and informative information of the main empirical findings.

3.5.1 GARCH Estimation Results of the Two-period Approach

With an application of sub-sample data, Appendix 3.6.A reports GARCH estimates of the two-period approach both for industrial portfolios and the all-share index. Appendix 3.6.B presents summarised GARCH estimation results for 32 individual stocks and four industrial portfolios. Specifically, A1 and B1 are the calculated mean values of key coefficient estimates, while A2 and B2 present the percentage of individual time series for which each coefficient is statistically significant. Here, Table 3.3 summarises the information of the percentage of significant coefficients for individual stocks and industrial portfolios from Appendix 3.6.A and 3.6.B.

Feedback trading

Table 3.3 first comes along with the two parameters governing the autocorrelation of stock returns, φ_0 and φ_1, which are the direct indicator of unconditional correlation and conditional feedback trading, respectively. In terms of the constant component of autocorrelation φ_0, a significant decrease is observed for both the treatment and control groups, which indicates a clear reduction in the unconditional serial correlation for both groups. Especially for the treatment time series, all significant pre-event values of φ_0 turn into insignificant after the introduction event. The calculated results of individual stocks in Panel A provide the most revealing evidence. Compared to a decrement of 3.13% in the percentage of significant coefficients in control group, a six-fold decrement of 18.75% demonstrates among 32 designated stocks. Besides, immediate GARCH estimates in Appendix 3.6.A show that all pre-event coefficients of industrial portfolios and all-share index for the treatment group are positive values. Hence, we conclude that the introduction event of short selling and margin trading decreases positive unconditional autocorrelations among designated stocks. It is noteworthy that in the heterogeneous feedback trading model, a distinction must be recognised between parameters φ_0 and φ_1. Rather than parameter φ_1, which decreases solely due to the moderation of feedback trading behaviour, the parameter φ_0 is designed to capture possible nonsynchronous trading, market frictions and inefficiencies (Antoniou *et al.* 2005). Therefore, here by φ_0, we can see a promoting effect of the dual introduction on the market efficiency.

The parameter of most interest in the study is φ_1, which captures the interaction between conditional variance and autocorrelation. To draw a distinction between positive and negative feedback trading, the results of φ_1 are divided into two categories by the sign of the estimates. From the table, it is clearly seen that no changes occur in the coefficient $\varphi_{1(\text{positive})}$ between the pre-event and post-event periods for both study groups. This indicates an unchanged level of negative feedback trading among investors around the event. However, the results show an

Table 3.3 The two-period approach: percentage of significant coefficients of GARCH estimates

	φ_0		φ_1				α_0		α_1		β	
			φ_1 (positive)		φ_1 (negative)							
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-
Panel A: Individual Stocks (32)												
Treatment	18.75%	0.00%	0.00%	0.00%	9.38%	0.00%	18.75%	31.25%	84.38%	84.38%	100.00%	96.88%
Control	9.38%	6.25%	3.13%	3.13%	0.00%	0.00%	18.75%	21.88%	90.63%	68.75%	100.00%	100.00%
Panel B: Industrial Portfolios (4)												
Treatment	75.00%	0.00%	0.00%	0.00%	50.00%	0.00%	25.00%	25.00%	100.00%	100.00%	100.00%	75.00%
Control	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%	25.00%	100.00%	75.00%	100.00%	75.00%

Notes: This table shows the percentage of significant coefficients of GARCH estimates of the baseline model for the treatment and control groups in the pre-event and post-event periods corresponding to Appendix 3.6.A and 3.6.B. Panel A and B present the result of 32 individual stocks and 4 industrial portfolios, respectively. In particular, the estimated mean equation is given by equation (3.5a) as:$R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{t-1} + \varepsilon_t$. The variance equation is given by equation (3.6a) as: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$. All results are presented at a significance level of 10%.

entirely different situation between the treatment and control groups in terms of the coefficient $\varphi_{1(\text{negative})}$. While a value of 0.00% in the percentage of significant coefficients of φ_1 (negative) keeps unchanged for all control time series, substantial reductions in $\varphi_{1(\text{negative})}$ are observed for all treatment time series. As the 90 designated stocks selected by the CSRC and exchange regulators for short selling and margin trading are the largest blue-chip stocks with the highest liquidity in Chinese A-share market, we thus know that more intensified positive feedback trading are involved with large capitalisation stocks before the 2010 introduction event. The eligibility of short selling and margin trading reduces the level of positive feedback trading among these large-capitalisation stocks substantially. With Kruskal-Wallis test on the equality of the pre-event and post-event coefficients, we can see a significant decrement in the mean value of φ_1 (negative) of individual treatment stocks in Appendix 3.6.B, Panel A, which again confirms the finding. We are thus confident to say that the dual introduction of short selling and margin trading leads to a substantially lower level of conditional positive feedback trading

among investors. This is deemed to enhance financial stability, because that a reduction in feedback trading behaviour implies a moving towards fundamental values in the stock prices.

Volatility

The impact of the dual introduction on stock returns volatility is firstly assessed by a comparison of the unconditional volatility coefficient α_0 in the pre-event and post-event periods. From Table 3.3 Panel A, we see that compared to a small increase of 3.13% among control stocks, the treatment stocks exhibit a quadruple increment of 12.5% in the percentage of significant coefficients of α_0, which implies a substantial augment of unconditional volatility among designated stocks. Also, in Panel B, with an unchanged percentage of significant coefficients in the coefficient α_0 among the treatment portfolios, a more substantial reduction among control portfolios is seen in Panel B. These mixed results lead to a conclusion that the introduction event of short selling and margin trading has no advantages in terms of moderating unconditional volatility.

One of the greatest interests in our study is the changes in the news coefficient α_1 before and after the study event, which would provide an indication of whether the informational efficiency is improved by the eligibility of short selling and margin trading. The results of Appendix 3.6.A, Panel B indicate a general decreasing trend in parameter α_1 in the all-share indices of both study groups. Unlike its control counterpart, a significant value of α_1 of the all-share index is observed for the treatment group after the dual introduction. This implies that the reduction in the news coefficients is not caused by the introduction event. Instead, the eligibility of short selling and margin trading keep the impact of the most recent innovation on stock volatility at a relatively steady level. The summarised estimation results at both stock and portfolio levels in Table 3.3 are consistent with this finding. It shows substantial reductions in the percentage of significant coefficients of α_1 for control stocks and portfolios, while results of α_1 for the treatment group keep unchanged. Although our case shows that the post-event news has less impact than the pre-event news, there is no evidence that the introduction of short selling and margin trading reduces the informational efficiency. Instead, the two newly introduced mechanisms help the treatment stocks to remain their informational efficiency not

as negatively responsive as their control counterparts. This result highlights the necessity of the control group analysis in our paper, which ensures no inappropriate inferences and policy recommendations are reached concerning the impact of short selling and margin trading.

In Table 3.3, the changes in the coefficient of volatility persistence, β, exhibit a similar trend in the treatment and control groups around the introduction event. Only a small difference is shown in the individual stocks level, of which the treatment group exhibits a slight decrease by 3.12% in the percentage of significant coefficient of β after the introduction, compared with an unchanged level in its control counterpart. This indicates that the old news has less impact on returns volatility among the 32 designated stocks. With immediate GARCH estimates, Appendix 3.6.A shows a similar increasing trend in the coefficient of volatility persistence between the treatment and control indices before and after the event, except for the case of General and Services in the treatment group, which decreases from a significant level of 0.8397 to -0.2122. In general, the increments in the value of β of the treatment portfolios are smaller than its control counterparts. Appendix 3.6.B, Panel A presents a contrast result in the mean value of β of industrial portfolios for the treatment group, which decrease from a level of 0.9033 to 0.6609. However, this result could be directly caused by the strange case of General and Services in industrial treatment portfolios. Thus, there is no evidence that the introduction of short selling and margin trading augments volatility persistence, which is commonly considered as an adverse factor to the market stabilisation. The introduced two mechanisms even make a downward trend in the level of volatility persistence.

3.5.2 GARCH Estimation Results of the Heaviside Indicator Approach

Appendix 3.7.A and B report GARCH estimation results of the model of Heaviside indicator approach described by equation (3.5b) and (3.6b) using a whole-sample data. Because that no convergence is obtained in GARCH regression for the treatment all-share index, Appendix 3.7.A only reports immediate GARCH estimates for four portfolios based on related industries. Appendix 3.7.B presents calculated GARCH estimation results of the Heaviside indicator approach for 28 individual stocks and four portfolios. Similarly, since three treatment stocks and one control obtain no convergence under the certain sub-iterations limit in the process of

GARCH regression, only results of 28 stocks are available. Table 3.4 presents the key measure, the percentage of significant coefficients from Appendix 3.7.B. Due to the possibility of neutralisation effect in the measure of mean value, it is only provided as a reference indicator in the appendix.

Feedback trading

In keeping with the results of ϕ_0 for the treatment group in the baseline model, Table 3.4 shows a downward trend in the percentage of significance coefficients of φ_0 for all treatment time series. At both stock and portfolio levels, the coefficient values of φ_0 decrease substantially, which indicates decreased autocorrelations after the introduction event. However, results are not identical for the control group. Unlike a consistent downward trend in the baseline model, an increase of 7.14% in the percentage of significant coefficients of φ_0 is observed among 28 control stocks. It is noted that in Appendix 3.7.A**,** all significant φ_0 for control portfolios remains positive but become insignificant after the introduction event, however, φ_0 turns into negative for three out of four portfolios in the treatment group, and one of the negatives is statistically significant. This means that positive autocorrelations among the treatment objects decrease much greater than its control counterparts, and the eligibility of the two introduced mechanisms may have a potential to increase negative autocorrelations in stock returns. In a later analysis of results of the differentiated impact model, we will see that this adverse potential is mainly derived from short selling rather than margin trading. In this case, we only conclude that the introduction event of short selling and margin trading decrease unconditional positive autocorrelations in stock returns, which is consistent with the results obtained from the baseline model.

Turning to the key coefficient of feedback trading φ_1, results are also presented in two categories divided by positive and negative signs, which represent changes in negative and positive feedback trading accordingly. In consistence with results of the baseline model, no changes are observed in the coefficient $\varphi_{1(\text{positive})}$ for both treatment and control groups. The dual introduction thus shows no favourable effect of lowering the level of negative feedback trading among investors. The results related to positive feedback trading is also in agreement

Table 3.4 The Heaviside indicator approach: percentage of significant coefficients of GARCH estimates

	φ_0		φ_1				α_0		α_1		β	
			φ_1 (positive)		φ_1 (negative)							
	$\varphi_{0,1}$	$\varphi_{0,2}$	$\varphi_{1,1}$	$\varphi_{1,2}$	$\varphi_{1,1}$	$\varphi_{1,2}$	$\alpha_{0,1}$	$\alpha_{0,2}$	$\alpha_{1,1}$	$\alpha_{1,2}$	β_1	β_2
Panel A: Individual Stocks (28)												
Treatment	21.43%	3.57%	0.00%	0.00%	14.29%	7.14%	28.57%	25.00%	92.86%	71.43%	100.00%	100.00%
Control	7.14%	14.29%	3.57%	3.57%	3.57%	10.71%	17.86%	28.57%	92.86%	64.29%	100.00%	85.71%
Panel B: Industrial Portfolios (4)												
Treatment	75.00%	25.00%	0.00%	0.00%	75.00%	0.00%	50.00%	25.00%	100.00%	75.00%	100.00%	75.00%
Control	50.00%	0.00%	0.00%	0.00%	25.00%	0.00%	25.00%	25.00%	100.00%	50.00%	100.00%	100.00%

Notes: This table summarises the calculated GARCH estimates of the Heaviside indicator approach for the treatment and control groups corresponding to Appendix 4.7.A and B. In particular, the estimated mean equation is given by equation (3.5b) as: $R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_{0,1}I_t + \varphi_{0,2}(1-I_t) + \left(\varphi_{1,1}I_t + \varphi_{1,2}(1-I_t)\right)\sigma_t^2\right]R_{t-1} + \varepsilon_t$ .The variance equation is given by equation (6b) as: $\sigma_t^2 = \alpha_{0,1}\,I_t + \alpha_{0,2}(1-I_t) + \left[\alpha_{1,1}\,I_t + \alpha_{1,2}(1-I_t)\right]\varepsilon_{t-1}^2 + [\beta_1\,I_t + \beta_2(1-I_t)]\sigma_{t-1}^2$.Panel A and B present the percentage of individual time series for which each key coefficient is statistically significant at the 10% level of 28 individual stocks and four industrial portfolios, respectively.

with the baseline model. In contrast to a reduction of 7.14% in the percentage of significant coefficients of φ_1 (negative) among treatment stocks, an equivalent growth is seen in the control group. The results of industrial portfolios in Panel B suggest further support. With immediate GARCH estimates of φ_1, Appendix 3.7.A shows the situation much clearer. The negative values of all four treatment portfolios decrease, and three of them turn into positive numbers after the introduction event. And three significant values in the pre-period become insignificant. These empirical results suggest a clear reduction in the level of positive feedback trading among the treatment portfolios. For the control portfolios, although the significantly negative value of Basic Materials portfolio turns into insignificantly positive, the values of the other two portfolios change from positive into negative after the introduction. From the above results of the Heaviside indicator approach, we find that the degree of positive feedback trading is reduced by the two mechanisms, identifying with the outcome obtained from the baseline model which processes regressions with sub-period data.

Volatility

Regards to the coefficient of unconditional volatility α_0, Table 3.4 shows a different result from Table 3.3 of the baseline model at the individual stock level. In contrast to an increase in the percentage of significant coefficients among control stocks, a small decline of 3.57% is observed among the treatment stocks. Besides, the portfolio-level results in Panel B show a 25.00% decline among the treatment portfolios, while there is an unchanged figure for the control group. Since mixed results are obtained concerning the percentage of significant coefficients between the two models, the impact of the dual introduction of short selling and margin trading on unconditional volatility in stock returns becomes inconclusive.

Table 3.4, Panel A and B show very similar estimation results of the news coefficient α_1 with Table 3.3. The reductions take place in the percentage of significant coefficients of α_1 for both individual treatment stocks (from 92.86% to 71.43%) and portfolios (100% to 75%) are smaller than its control counterparts (92.86% to 64.29% and 100% to 50%, respectively). Although a downward trend in the news coefficient being observed for all the time series in our study groups, it is clear to see that the decrement occurs in α_1 among designated stocks is smaller than the unlisted stocks. The dual introduction of short selling and margin trading thus supports the informational efficiency of stocks in the treatment group.

In consistence with the estimation results from the baseline model, a similar downward trend in the coefficient of volatility persistence β is found after the introduction event for both the treatment and control indices. However, results of the percentage of significant coefficients of β in Table 3.4, Panel A present a contrast finding to the baseline model. The percentage of significant coefficients of β for the 28 treatment stocks keeps unchanged at 100% level, while a reduction from 100% to 85.71% is found among the control stocks. Nevertheless, results at the portfolio level show a smaller percentage of significant coefficients in the treatment group after the introduction. There thus no clear pattern can be drawn from the changes in the measure of volatility persistence around the introduction event.

3.5.3 The Impact Differences between Short Selling and Margin Trading on Feedback Trading Behaviour

As the third research question of the paper, we attempt to investigate the separate impacts on feedback trading brought about by each mechanism introduced. With the differentiated impact model, the research objective is achieved by studying the impact differences of the dual introduction dependent on negative and positive historical returns respectively. Appendix 3.8.A and B report GARCH estimation results of the differentiated impact model conditional on positive and negative historical returns for both study groups with whole-sample data. Being derived from Appendix 3.8.A and B, calculated results of the percentage of significant coefficients are reported both at the stock and portfolio level in Table 3.5.

Short selling

As it is widely believed that short selling dominates margin trading under the bearish sentiment, we connect short selling transactions with the changes related to negative historical returns. Two notations with a negative superscript sign shown in Table 3.5, φ_0^- and φ_1^-, are parameters indicating the impact of short selling on unconditional and conditional autocorrelations in returns. With regard to the unconditional autocorrelation φ_0^-, a greater reduction in percentage of significant coefficients around the introduction event is found among control stocks at both the stock and portfolio level. Thus, it is likely that unconditional autocorrelation in stock returns increases on the onset of short selling.

The parameter of conditional feedback trading φ_1^- , which indicates the impact of short selling on the interaction between conditional variance and autocorrelations, is of the most interest in the study. In Appendix 3.8.A, no significant estimate of φ_1^- is found for all industrial and general indices in both the pre-event and post-event periods. This implies a very low probability of feedback trading dependent on negative historical returns. Turning to Table 3.5, Panel A, compared to an unchanged level in the treatment group, a substantial fall of 9.37% is seen in percentage significant coefficients in φ_1^- (positive) among control stocks after the introduction

event, which implies a reduction in conditional negative feedback trading among control stocks. This finding implies that short selling shows no positive impact on moderating the degree of negative feedback trading among designated stocks. Regarding the indicator of positive feedback trading φ_1^- (negative), opposite results are found between the treatment and control stocks. The percentage of significant coefficients of φ_1^- (negative) experience an augment from 3.13% to 9.38% for the treatment stocks, while its counterparts in control group remain unchanged. This suggests that designated shortable stocks are likely to experience a higher level of positive feedback trading.

Table 3.5 The differentiated impact model: the percentage of significant coefficients of GARCH estimates

	MT						SS						Vol
	φ_0^+		φ_1^+				φ_0^-		φ_1^-				
			φ_1^+ (positive)		φ_1^+ (negative)		φ_1^- (positive)		φ_1^- (positive)		φ_1^- (negative)		α_L
	$\varphi_{0,1}^+$	$\varphi_{0,2}^+$	$\varphi_{1,1}^+$	$\varphi_{1,2}^+$	$\varphi_{1,1}^+$	$\varphi_{1,2}^+$	$\varphi_{0,1}^-$	$\varphi_{0,2}^-$	$\varphi_{1,1}^-$	$\varphi_{1,2}^-$	$\varphi_{1,1}^-$	$\varphi_{1,2}^-$	
Panel A: Individual Stocks (32)													
Treatment	43.75%	0.00%	0.00%	0.00%	9.38%	6.25%	21.88%	18.75%	3.13%	3.13%	3.13%	9.38%	56.25%
Control	34.38%	12.50%	12.50%	9.38%	6.25%	6.25%	31.25%	12.50%	12.50%	3.13%	6.25%	6.25%	40.63%
Panel B: Industrial Portfolios (4)													
Treatment	100.00%	0.00%	0.00%	0.00%	25.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%
Control	75.00%	0.00%	0.00%	0.00%	25.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%

Notes: This table summarises the calculated GARCH estimates of the differentiated impact model for the treatment and control groups corresponding to Appendix 3.8.A and B. In particular, the estimated mean equation is given by equation (3.5c) as: $R_t = \alpha + \mu\sigma_t^2 + \{\varphi_{0,1}^+ I_t + \varphi_{0,2}^+(1-I_t) + [\varphi_{1,1}^+ I_t + \varphi_{1,2}^+(1-I_t)]\sigma_t^2\}R_{t-1}^+ + \{\varphi_{0,1}^- I_t + \varphi_{0,2}^-(1-I_t) + [\varphi_{1,1}^- I_t + \varphi_{1,2}^-(1-I_t)]\sigma_t^2\}R_{t-1}^- + \varepsilon_t$. The variance equation is given by equation (6c) as: $\sigma_t^2 = (1+\alpha_L D_t)(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$. Panel A and B separately presents the results of 32 individual stocks and 4 industrial portfolios. All results are presented at a significance level of 10%.

Margin trading

Since when it comes to bullish sentiment, margin trading becomes more prevalent than short selling, a link between margin trading and changes bound up with positive historical stock returns is established. In Table 3.5, notations with a positive superscript sign, φ_0^+ and φ_1^+, are coefficients indicating the impact of margin trading on unconditional and conditional autocorrelations in stock returns. Appendix 3.8.A shows that except for the case of General and services index, all significantly positive estimates of φ_0^+ of industrial and all-share indices in the treatment group reduce to an insignificant value in the post-event period. This implies a moderated level of unconditional autocorrelations among designated stocks. The general

results of φ_0^+ for control group also exhibit a declining trend, but with a much smaller decrement. In particular, the value of φ_0^+ of control all-share index remains a significantly positive value after the introduction event, which indicates an occurrence of unconditional positive autocorrelations. These findings are summarised and reported in Table 3.5, Panel B as well. In Panel A, the percentage of significant coefficients of $\varphi_0^+{}_{\text{(positive)}}$ of 32 treatment stocks dramatically reduces from 43.75% to 0.00%, while the control estimate decreases by 25.13%, with a remainder of 12.50%. Therefore, the designated stocks eligible for margin trading conditional on positive returns involve less unconditional autocorrelations in stock returns, which is indicative of an enhancement in market stability.

The coefficient of conditional feedback trading on positive historical returns φ_1^+ indicates the impact of margin trading on the interaction between conditional volatility and autocorrelations. As no results of $\varphi_1^+{}_{\text{(positive)}}$ of the time series in the treatment group show significance in both the pre-event and post-event periods in Table 3.5, we ignore comparison between the two study groups. Switching to the figures related to $\varphi_1^+{}_{\text{(negative)}}$, a larger decline is observed for the treatment group at the individual stock level in Panel A. In comparison of the unchanged level of 6.25% in the control group, a drop from 9.38% to 6.25% in the percentage of significant coefficients of $\varphi_1^+{}_{\text{(negative)}}$ appears among the treatment stocks. In Appendix 3.8.B, the mean value of $\varphi_1^+{}_{\text{(negative)}}$ of 32 treatment stocks for the treatment group shares a similar declining trend with its control counterparts but with a smaller decrement, which implies a lesser increase in the degree of positive feedback trading among the designated stocks. The result can be directly explained as that the dual introduction of short selling and margin trading reduces the level of positive feedback trading following on a positive stock return, which essentially suggests that margin trading exerts an inhibiting effect on positive feedback trading.

This finding to some extent agrees with the conclusion obtained by Chang *et al*. (2013). Although the term positive feedback trading is not mentioned, the paper finds that rather than identify trends, Chinese margin traders seem only capture very short-term undervaluation, and there is no evidence that they do it in a consistently rational way. This implies that Chinese margin traders have no potential role of being positive feedback traders. In the paper of Wang (2011) which focuses on the issue of the eligibility of margin trading on trade informativeness

and market liquidity, finds that the ban lifting of margin trading leads to more information-based trading in Chinese domestic markets. Since margin traders are informed traders who are more likely to make investment decisions on their own private information rather than follow market trends, the activities of margin traders would not exacerbate the degree of positive feedback trading behaviour. Rather, since more information is contained in margin trading activities than normal long buying, margin traders help to enhance informational efficiency. Thus, the Hypothesis 3b that the introduction of margin trading moderates the degree of positive feedback cannot be rejected. Our finding again overthrows the traditional judgement that margin traders are noisy traders in the stock market.

The level of volatility

From estimates of α_L of the all-share index in Appendix 3.8.A, a significant decline is seen for the treatment index compared to an insignificant value for the control group. The calculated percentage of significant coefficients of individual stocks in Panel A, Table 3.5 provides further support to this finding. The percentage of the significance of α_L for 32 treatment stocks is 56.25%, which is obviously higher than the 40.63% in control group. In contrast to findings of Wang (2011), which documents an increased volatility after the dual introduction with a measure of variance ratio, we obtain the same result as Sharif *et al.* (2013) and Chang *et al*. (2013) that the level of volatility in stock returns is reduced by short selling and margin trading. With the daily high and low price divided by the high price as the volatility measure, Chang *et al.* (2013) study the issue further by adopting trade volume data of short selling and margin trading to study the separate change related to the two mechanisms in volatility. Their results indicate that intensified short selling produces higher intraday volatility while margin trading activities lead to a substantial reduction in both the level of volatility and intraday volatility, which is six times bigger than the increase caused by short selling. This implies a combined reducing impact of the two mechanisms on stock returns volatility, which is also consistent with our finding. However, a reduction in the volatility level is not necessarily a good thing, a more detailed analysis is required.

From the seminal paper of Ross (1989), it is acknowledged that increased volatility could be a result of greater information flows, but not necessarily derived from destabilising speculation. With reference to previous findings of the key coefficients related to volatility dynamics α_0, α_1, β, a reduction in the volatility level after the 2010 introduction can be attributed to declines in both coefficients α_0 and α_1. With inconclusive impact on α_0, the results of the base model and the Heaviside approach provide direct evidence that the treatment stocks decrease less in α_1, and decrease more in β. We thus deduce that the greater decline shown in the total level of returns volatility among the treatment stocks is due to a greater decrease in the coefficient of volatility persistence β. It is to say that the introduction of short selling and margin trading imposes a promoting effect on the impact of the recent innovations on returns volatility and an inhibiting effect on the impact of the old news as the same time, both of which would result in an enhancement in the informational efficiency in the market.

3.5.4 Robustness Tests

The Heaviside indicator approach with different window specifications

To test the robustness of the results to different window specifications around the introduction event, we re-estimate the Heaviside indicator model and the differentiated impact model using 2- and 3-year windows. It is expected that tighter window will provide a more rigorous test to the changes story in feedback trading and volatility dynamics of the event. Appendix 3.9.A and B presents GARCH estimates of the Heaviside indicator approach and the differentiated impact model of both treat and control all-share indices with 2- and 3-year estimation window, respectively.

In general, the results reported in Appendix 3.9.A remain qualitatively the same when the 3-year windows are used. The post-event estimates of α_0 and α_1 show as insignificant for both the treatment and control indices, which are not reduced by the introduction event. The estimates of 2-year window show some extent of differences to our 4-year results in ϕ_0 and volatility related coefficients α_0, α_1, β. With a similar trend with the control group, the treatment

index decreases more in the news coefficient. All these differences in volatility and ϕ_0 between the 2-year and the 4-year windows can be explained as that time is needed for a new practice to be familiarized. This is especially crucial for an immature market with a low level of financial literacy. In fact, the daily transaction data of short selling and margin trading, which is available in the official websites of the two stock exchanges, show that the trade volume of short selling and margin trading for the first batch of 90 designated stocks is strikingly low at the first six months of the reform. The estimates of the differentiated impact model with the 2- and the 3-year windows in Appendix 3.9.B indicate qualitatively consistent results. Again, changes in the magnitude of 3-year window estimates show a clearer pattern of the introduction's impact on feedback trading, regardless of conditional on positive or negative historical returns.

Estimation results of other GARCH-type models

It is well known that the volatility process in stock returns often exhibits asymmetries. As mentioned above, this effect can be studied with the Glosten (1993) asymmetric GJR-GARCH model, which is regarded as the second prior model for our research by three information criteria. Appendix 3.10 gives the GJR-GARCH estimates of the Heaviside indicator approach of four industrial portfolios. As a result, this robustness check broadly confirms our previous findings as the significance of differences in all key coefficients remains unchanged. The estimates of the asymmetry coefficient γ in the pre-event and post-event periods for both the treatment and control portfolios demonstrate insignificant values, which is in agreement with the results of the JOINT test that volatility asymmetry is scarce among our object shares. It is noticeable that all post-event estimates of the treatment portfolios get a smaller value than its control counterparts. And compared to the rising tendency in the control group, three out of four treatment portfolios experience a fall. This indicates that no intensified volatility asymmetry in stock returns is caused by the introduction of short selling and margin trading. This finding is exactly opposite to evidence from the Hong Kong market, from which an undermining impact of short selling on asymmetric responses to innovations is found (Henry and McKenzie 2006). To some extent, our finding is identical to evidence from the Taiwanese market, which experiences noticeably increased asymmetry in volatility when short selling restrictions are in place (Bohl *et al*. 2012). Given the results of additional tests undertaken, the general conclusions discussed earlier appear to be robust.

3.6 Conclusions

To improve the domestic stock markets towards greater liquidity, versatility, sophistication and stabilisation, Chinese regulators initiate two long-awaited but controversial practices all at once. An overnight ban lifting over a designated list of stocks for short selling and margin trading in China's 2010 reform provides us with a unique opportunity to conduct event analysis. The paper examines the impact of short selling and margin trading on feedback trading behaviour and stock volatility dynamics. With a combination of the heterogeneous trader model and GARCH model, we highlight the conditional nature of return persistence stemming from feedback trading behaviour.

A unanimous conclusion is obtained from results of the baseline model and the extended model with Heaviside indicators. The dual introduction of short selling and margin trading leads to a clear reduction in unconditional positive autocorrelations and a substantially lower level of positive feedback trading, both of which are considered to be conducive to enhance financial market stability. Further, we explore the different impacts of short selling and margin trading on feedback trading behaviour by investigating the coefficient indicators conditional on positive and negative historical returns. The striking results which contrast to our initial hypotheses are found. The empirical estimates suggest that the designated stocks eligible for short selling experience an increase in both unconditional autocorrelations and positive feedback trading conditional on negative historical returns. While when it comes to negative historical returns which are more likely to be involved with intensive margin trading, substantial declines in both unconditional negative autocorrelation and positive feedback trading are found. Therefore, compared to short selling, margin trading tends to be more favourable to stock market's stabilisation.

With regards to the changes demonstrate in volatility, a significant reduction in the level of stock returns volatility is observed after the dual introduction. However, a similar trend simultaneously displays among the treatment and control stocks. Since factors other than the

introduction event might also affect the key coefficients in our model, control groups are constructed for each individual treatment stocks and portfolios. The detailed GARCH estimates prove that our considerations are not uncalled for. It indicates that for both the treatment and control groups, the increase occurs only in the unconditional volatility, rather than the news coefficient and the volatility persistency. As results of the two-period approach, the designated stocks increase more in unconditional volatility compared to control stocks, which indicates no advantages of the two introduced mechanisms. However, the facts that the designated stocks decrease less in the news coefficients and more in the volatility persistency implies that short selling and margin trading, in fact, play a supporting role in informational efficiency rather than lead to any volatility exacerbation.

In all, our results show that the dual introduction of short selling and margin trading contribute to a moderated level of unconditional positive autocorrelations and conditional positive feedback trading behaviour. And there is no evidence that the two mechanisms destabilise the stock markets by increasing the volatility persistence in stocks returns. Rather, the findings generally agree the view that the two mechanisms support the informational efficiency and help stabilise the stock markets. However, the aggravating impact of short selling on conditional positive feedback trading should not be ignored. And this point, in fact, has been paid close attention by Chinese regulators. The rigorous requirements for the qualification of investors who are eligible for short selling and margin trading have been aggressively reiterated by the CSRC in recent months. The findings of this paper would not only provide important policy implications for Chinese regulators but worldwide regulators who are trapped in a struggle with the issues of short sales constraints or margin requirements. Nevertheless, we realise that the different impact of short selling and margin trading on feedback trading, returns volatility and related issues of China's 2010 reform can be studied further with stricter analysis by adopting the data of transaction activities of each mechanism.

3.7 Appendices

Appendix 3.1 Listing adjustments of stocks eligible for short selling and margin trading

From the start date of the reform to the end date of our sample range (31/03/2010 - 31/03/2017), six major batches of policy adjustment extend the number of stocks eligible for short selling and margin trading from a total number of 90 to 950. Along with these batches, several additions and deletions to the originally designated list are made. The following table reports statistics on the occurrence of these events. The effective date is the day on which a list of designated stocks eligible for short selling and margin trading takes effect. The disclosure date is the day on which the original list or the revised list is announced by the exchange regulators of SSE or SZSE. The following columns show the number of stocks added to or deleted from the list by certain date in SSE or SZSE separately. The total number of stocks remaining on the list on each event time is indicated in the last column.

Effective Date	Disclosure Date	Shanghai Stock Exchange			Shenzhen Stock Exchange			Total
		Added	Deleted	Sub-total	Added	Deleted	Sub-total	
31/03/2010	**12/02/2010**	**50**		**50**	**40**		**40**	**90**
01/07/2010	21/06/2010	4	-4	50	1	-1	40	90
29/07/2010	16/07/2010	1	-1	50			40	90
05/12/2011	**25/11/2011**	**130**		**180**	**58**		**98**	**278**
31/01/2013	**25/01/2013**	**120**		**300**	**102**		**200**	**500**
06/03/2013	05/03/2013		-1	299			200	499
07/03/2013	07/03/2013			299		-1	199	498
29/03/2013	28/03/2013		-1	298			199	497
	29/03/2013			298		-1	198	496
02/05/2013	26/04/2013		-1	297			198	495
03/05/2013	02/05/2013		-1	296			198	494
16/09/2013	**06/09/2013**	**104**		**400**	**102**		**300**	**700**
28/03/2014	27/03/2014		-1	399			300	699
01/04/2014	31/03/2014		-1	398			300	698
29/04/2014	29/04/2014			398		-1	299	697
05/05/2014	30/04/2014		-2	396			299	695
22/09/2014	**12/09/2014**	**104**		**500**	**101**		**400**	**900**
04/12/2014	04/12/2014			500		-1	399	899
11/02/2015	10/02/2015		-1	499			399	898
31/03/2015	30/03/2015		-1	498			399	897
23/04/2015	22/04/2015		-1	497			399	896
29/04/2015	28/04/2015		-1	496			399	895
04/05/2015	30/04/2015		-2	495			399	894
01/12/2015	30/11/2015		-1	494			399	893
	01/12/2015			494		-1	398	892

Appendix 3.1 (continued)

Effective Date	Disclosure Date	Shanghai Stock Exchange			Shenzhen Stock Exchange			Total
		Added	Deleted	Sub-total	Added	Deleted	Sub-total	
11/03/2016	10/03/2016		-1	493			398	891
21/03/2016	18/03/2016			493		-1	397	890
22/03/2016	21/03/2016		-1	492			397	889
25/03/2016	24/03/2016		-1	491			397	888
11/04/2016	08/04/2016			491		-1	396	887
12/04/2016	11/04/2016		-1	490			396	886
20/04/2016	20/04/2016			490		-2	394	884
29/04/2016	28/04/2016		-1	489			394	883
03/05/2016	29/04/2016		-1	488		-2	392	880
04/05/2016	04/05/2016			488		-3	389	877
25/10/2016	25/10/2016			488		−1	388	876
12/12/2016	**02/12/2016**	**40**	**-3**	**525**	**37**		**425**	**950**
17/01/2017	16/01/2017		-1	524			425	949
20/03/2017	19/03/2017		-1	523			425	948
28/03/2017	27/03/2017		-1	522			425	947
29/03/2017	28/03/2017		-1	521			425	946
30/03/2017	29/03/2017		-1	520			425	945
31/03/2017	30/03/2017		-1	519			425	944

Appendix 3.2 Major indices in mainland China

Equity Index	Code	Profile Information	No. of Stocks	Starting Time
Shanghai Stock Exchange				
Shanghai Stock Exchange A-Share Index	000002.SH	A capitalisation-weighted index tracks the daily price performance of all A-shares listed on the SSE that are restricted to local investors and qualified institutional foreign investors.	858 constituents	21/02/1992
Shanghai Stock Exchange 180 Index	000010.SH	A free float-weighted index tracks the daily price performance of the 180 most representative A-share stocks listed on the SSE.	180 constituents	01/07/2002
Shanghai Stock Exchange 50 Index	000016.SH	It consists of 50 most representative A-share stocks from SSE. The objective is to reflect the complete picture of those good quality large enterprises, which are most influential in Shanghai security market.	50 constituents	02/01/2004
Shenzhen Stock Exchange				
Shenzhen Stock Exchange A-Share Index	399107.SZ	A capitalisation-weighted index tracks the daily price performance of all A-shares listed on the SZSE which are restricted to local investors and qualified institutional foreign investors.	897 constituents	04/10/1992
Shenzhen Stock Exchange 40/Component Index	399001.SZ	A Capitalisation-weighted index consists of the 40 top companies that issue A-shares on SZSE.	40 constituents	05/05/1995
Shenzhen Stock Exchange 100 Index	399004.SZ	It consists of 100 representative A-share stocks with largest free float market capitalisation and the most actively traded stocks A-share stocks listed on the SZSE.	100 constituents	31/12/2002

Appendix 3.3 The first batch of 90 designated stocks of short selling and margin trading：company profile and listing adjustments

No.	Code	Stock Name	Industry	IPO Date	Date of Listing Adjustments		
					Deleted	Re-joined	Re-deleted
Shanghai Stock Exchange (50)							
SH01	600000	Shanghai Pudong Development Bank Co., Ltd.	Banks	10/11/1999			
SH02	600005	Wuhan Iron and Steel Company Limited	Industrial Metals & Mining	03/08/1999			
SH03	600015	Hua Xia Bank Co., Limited	Banks	12/09/2003			
SH04	600016	China Minsheng Banking Corp., Ltd.	Banks	19/12/2000			
SH05	600018	Shanghai International Port (Group) Co., Ltd.	Industrial Transportation	20/07/2000	01/07/2010	16/09/2013	
SH06	600019	Baoshan Iron and Steel Co., Ltd.	Industrial Metals & Mining	12/12/2000			
SH07	600028	China Petroleum and Chemical Corporation	Oil & Gas Producers	08/08/2001			
SH08	600029	China Southern Airlines Company Limited	Travel & Leisure	25/07/2003	01/07/2010	05/12/2011	
SH09	600030	CITIC Securities Co., Ltd.	Financial Services	06/01/2003			
SH10	600036	China Merchants Bank Co., Limited	Banks	09/04/2002			
SH11	600048	Poly Real Estate Group Co., Ltd.	Real Estates Investment & Services	31/07/2006*			
SH12	600050	China United Network Communications Limited	Mobile Telecommunications	09/10/2002			
SH13	600089	TEBA Co., Ltd.	Electronic & Electrical Equipment	18/06/1997			
SH14	600104	SAIC Motor Corporation Limited	Automobiles & Parts	25/11/1997			
SH15	600320	Shanghai Zhenhua Heavy Industries CO., LTD	Industrial Engineering	21/12/2000	01/07/2010	05/12/2011	31/01/2013
SH16	600362	Jiangxi Copper Co., Ltd.	Industrial Metals & Mining	11/01/2002			
SH17	600383	Gemdale Corporation	Real Estates Investment & Services	12/04/2001			
SH18	600489	Zhongjin Gold Corporation, Limited	Mining	14/08/2003			
SH19	600519	Kweichow Moutai Co., Ltd.	Beverages	27/08/2001			
SH20	600547	Shandong Gold Mining Co., Ltd.	Mining	28/08/2003			
SH21	600550	Baoding Tianwei Baobian Electric Co., Ltd.	Electronic & Electrical Equipment	28/02/2001	31/01/2013		
SH22	600598	Heilongjiang Agriculture Company Limited	Food Producers	29/03/2002	01/07/2010	05/12/2011	28/03/2014

SH23	600739	Liaoning Chengda Co., Ltd.	General Retailers	20/08/1996			
SH24	600795	GD Power Development Co., Ltd.	Electricity	18/03/1997			
SH25	600837	Haitong Securities Company Limited	Financial Services	24/02/1994			
SH26	600900	China Yangtze Power Co., Ltd.	Electricity	18/11/2003			
SH27	601006	Daqin Railway Co., Ltd.	Industrial Transportation	01/08/2006*			
SH28	601088	China Shenhua Energy Company Limited	Mining	09/10/2007*			
SH29	601111	Air China Limited	Travel & Leisure	18/08/2006*			
SH30	601166	Industrial Bank Co., Ltd.	Banks	05/02/2007*			
SH31	601168	Western Mining Co., Ltd.	Industrial Metals & Mining	12/07/2007*			
SH32	601169	Bank of Beijing Co., Ltd.	Banks	19/09/2007*			
SH33	601186	China Railway Construction Corporation Limited	Construction & Materials	10/03/2008*			
SH34	601318	Ping An Insurance (Group) Company of China, Ltd.	Life Insurance	01/03/2007*			
SH35	601328	Bank of Communications Co., Ltd.	Banks	15/05/2007*			
SH36	601390	China Railway Group Limited	Construction & Materials	03/12/2007*			
SH37	601398	Industrial and Commercial Bank of China Limited	Banks	27/10/2006*			
SH38	601600	Aluminium Corporation of China Limited	Industrial Metals & Mining	30/04/2007*			
SH39	601601	China Pacific Insurance (Group) Co., Ltd.	Life Insurance	25/12/2007*			
SH40	601628	China Life Insurance Company Limited	Life Insurance	09/01/2007*			
SH41	601668	China State Construction Engineering Corporation Limited	Construction & Materials	29/07/2009*			
SH42	601727	Shanghai Electric Group Company Limited	Industrial Engineering	05/12/2008*	29/07/2010	05/12/2011	31/01/2013
SH43	601766	China South Locomotive and Rolling Stock Corporation	Industrial Engineering	18/08/2008*			
SH44	601857	PetroChina Company Limited	Oil & Gas Producers	05/11/2007*			
SH45	601898	China Coal Energy Company Limited	Mining	01/02/2008*			
SH46	601899	Zijin Mining Group Co., Ltd.	Mining	25/04/2008*			
SH47	601919	China COSCO Holdings Company Limited	Industrial Transportation	26/06/2007*	29/03/2013		
SH48	601939	China Construction Bank Corporation	Banks	25/09/2007*			
SH49	601958	Jinduicheng Molybdenum Co., Ltd.	Industrial Metals & Mining	17/04/2008*			
SH50	601988	Bank of China Limited	Banks	05/07/2006*			

Shenzhen Stock Exchange (40)

SZ01	000001	Shenzhen Development Bank Co., Ltd. / Ping An Bank Co., Ltd.	Banks	23/08/1991		
SZ02	000002	China Vanke Co., Ltd	Real Estates Investment & Services	26/08/1991		
SZ03	000024	China Merchants Property Development Co., Ltd	Real Estates Investment & Services	07/06/1993	01/12/2015	
SZ04	000027	Shenzhen Energy Group Co., Ltd.	Electricity	03/09/1993	05/12/2011	31/01/2013
SZ05	000039	China International Marine Containers (Group) Co., Ltd	General Industrials	08/04/1994		
SZ06	000060	Shenzhen Zhongjin Lingnan Nonfemet Co., Ltd.	Industrial Metals & Mining	23/01/1997		
SZ07	000063	ZTE Corporation	Technology Hardware & Equipment	18/11/1997		
SZ08	000069	Shenzhen Overseas Chinese Town Co., Ltd	Travel & Leisure	10/09/1997		
SZ09	000157	Changsha Zoomlion Heavy Industry Science and Technology Co., Ltd	Industrial Engineering	12/10/2000		
SZ10	000338	Weichai Power Co., Ltd.	Industrial Engineering	30/04/2007*		
SZ11	000402	Financial Street Holding Co., Ltd	Real Estates Investment & Services	26/06/1996		
SZ12	000527	GD Midea Holding Co., Ltd.	Household Goods & Home Construction	12/11/1993	31/01/2013	
SZ13	000538	Yunnan Baiyao (Group) Co., Ltd	Pharmaceuticals & Biotechnology	15/12/1993		
SZ14	000562	Hong Yuan Securities Co., Ltd	Financial Services	02/02/1994		
SZ15	000568	Luzhou Lao Jiao Co., Ltd	Beverages	09/05/1994		
SZ16	000623	Jilin Aodong Medicine Industry Croup Co., Ltd.	Pharmaceuticals & Biotechnology	28/10/1996		
SZ17	000630	Tonling Nonferrous Metal Group Stock Co.,Ltd	Industrial Metals & Mining	20/11/1996		
SZ18	000651	Gree Electric Appliances, Inc. of Zhuhai	Household Goods & Home Construction	18/11/1996		
SZ19	000652	Tianjin Teda Co., Ltd	General Industrials	28/11/1996	31/01/2013	
SZ20	000709	Hebei Iron and Steel Co., Ltd	Industrial Metals & Mining	16/04/1997		
SZ21	000729	Beijing Yanjing Brewery Co., Ltd.	Beverages	16/07/1997		
SZ22	000768	Xi'an Aircraft International Corporation	Aerospace & Defense	26/06/1997		
SZ23	000783	Changjiang Securities Co., Ltd.	Financial Services	31/07/1997		
SZ24	000792	Qinghai Salt Lake Potash Co., Ltd.	Chemicals	05/09/1997		
SZ25	000800	Faw Car Co., Ltd	Automobiles & Parts	18/06/1997		
SZ26	000825	Shanxi Taigang Stainless Steel Co., Ltd	Industrial Metals & Mining	21/10/1998	31/01/2013	16/09/2013
SZ27	000839	Citic Guoan Information Industry Co., Ltd	Technology Hardware & Equipment	31/10/1997		

SZ28	000858	Wuliangye Yibin Co., Ltd	Beverages	27/04/1998	
SZ29	000878	Yunnan Copper Industry Co., Ltd	Industrial Metals & Mining	02/06/1998	
SZ30	000895	Henan Shuanghui Investment and Development Co., Ltd.	Food Producers	10/12/1998	
SZ31	000898	Angang Steel Company Limited	Industrial Metals & Mining	26/12/1997	29/03/2013
SZ32	000932	Hunan Valin Steel Co., Ltd.	Industrial Metals & Mining	03/08/1999	01/07/2010
SZ33	000933	Henan Shen Huo Coal Industry and Electricity Power Co., Ltd	Industrial Metals & Mining	01/09/1999	
SZ34	000937	Jizhong Energy Resources Co., Ltd.	Mining	09/09/1999	
SZ35	000960	Yunnan Tin Co., Ltd.	Industrial Metals & Mining	21/02/2000	
SZ36	000983	Shanxi Xishan Coal and Electricity Power Co., Ltd	Mining	26/07/2000	
SZ37	002007	Hualan Biological Engineering Inc.	Pharmaceuticals & Biotechnology	25/06/2004*	
SZ38	002024	Suning Appliance Co.,Ltd.	General Retailers	21/07/2004*	
SZ39	002142	Bank of Ningbo Co., Ltd	Banks	19/07/2007*	
SZ40	002202	Xinjiang Goldwind Science and Technology Co.,Ltd	Alternative Energy	26/12/2007*	

Notes: The time range of our sample is 31/03/2004 to 31/03/2016. While the SSE opened on 19/12/1990 and the SZSE started its operation on 03/07/1991, the relatively late foundation of stock exchanges in China renders some firms appear on the stock market at a considerably late time. * indicates that the stock has a later going public date than the start date of our sample span.

Appendix 3.4 Descriptive statistics of daily stock returns

	Mean	Mini	Max	S.D.	Skew	Kurt	JB	LB(12)	ARCH	JOINT	Serial correlationship at lag				
											1	2	3	4	5
Panel A: 32 Treatment Stocks															
A1：Individual Stocks (32)															
SH02	0.018	-10.572	9.631	1.223	0.097*	1.781***	260.008***	13.777	30.441***	1.510	0.027	-0.015	0.025	0.001	0.034
SH03	0.010	-10.589	9.595	1.280	-0.061	2.205***	394.949***	10.131	46.440***	2.129	0.026	0.000	-0.005	0.004	-0.005
SH04	0.017	-10.536	9.623	0.989	0.077	1.646***	221.255***	11.641	39.812***	3.568	0.024	-0.013	0.008	0.001	0.037
SH06	0.031	-10.596	9.598	1.335	1.111***	12.412***	12865.674***	11.913	56.493***	1.099	0.025	0.003	0.036	0.027	0.031
SH07	0.047	-10.563	9.561	1.345	0.285***	2.662***	599.879***	21.466**	58.464***	13.508*	0.047	0.012	0.018	0.013	0.009
SH09	0.023	-10.554	9.570	1.302	0.040	2.724***	601.063***	23.369***	49.081***	3.207	0.054	0.013	0.033	0.011	0.004
SH10	0.028	-10.544	9.531	0.990	0.326***	1.882***	321.230***	16.156*	61.914***	7.107*	0.032	-0.003	0.003	0.004	0.012
SH14	0.010	-10.588	9.611	1.238	0.178***	1.635***	226.605***	17.812***	58.390***	0.992	0.025	-0.068	0.019	0.018	-0.007
SH16	0.005	-10.567	9.636	1.277	0.121**	2.186***	391.447***	15.148*	105.070***	35.585***	0.047**	-0.028	0.037**	0.034	0.006
SH18	-0.039	-10.602	9.625	0.985	-0.248***	1.347***	166.782***	19.447**	56.357***	2.591	0.024**	-0.051**	0.004	0.055**	-0.026
SH19	0.030	-10.524	9.537	0.986	0.316***	2.886***	706.580***	22.998***	36.442***	3.257	0.026	-0.015	0.005	-0.008	-0.018
SH23	-0.002	-10.562	9.621	1.172	-0.058	1.070***	93.842***	15.276*	67.241***	3.302	0.030	0.003	0.019	-0.003	0.002
SH24	0.017	-10.536	9.587	1.277	0.139**	2.365***	459.107***	14.843*	129.442***	8.179**	0.047**	-0.013	0.029	-0.004	-0.024
SZ02	0.023	-10.569	9.584	1.281	0.133**	2.098***	361.946***	12.727	24.277***	4.785	0.029	-0.005	0.010	0.027	-0.002
SZ03	-0.003	-10.551	9.562	0.995	-0.099*	1.034***	89.689***	7.036	18.271***	3.658	0.013	-0.024	0.004	-0.004	-0.022
SZ06	-0.007	-10.572	9.580	1.204	-0.224***	2.589***	558.857***	14.094	48.897***	0.332	0.040*	0.002	0.032	0.005	-0.027
SZ08	0.001	-10.566	9.552	1.199	-0.031	1.244***	125.603***	14.581	52.596***	4.224	0.038*	0.006	-0.011	-0.047**	-0.027
SZ11	0.003	-10.536	29.845	1.002	0.447***	6.532***	3518.252***	13.270	13.744***	2.742	0.036	-0.027	-0.001	0.008	-0.036
SZ13	0.048	-10.536	14.823	1.316	0.666***	4.379***	1695.772***	27.232***	21.275***	0.297	0.023	-0.060***	-0.022	-0.010	-0.038*
SZ15	0.018	-10.557	9.595	1.261	0.288***	2.339***	469.729***	17.081**	49.995***	4.661	0.025	-0.055**	0.004	0.018	-0.019
SZ17	0.007	-10.576	9.581	1.174	0.039	0.913***	68.062***	15.310*	31.833***	0.608	0.033	-0.010	0.042*	0.044*	-0.005
SZ18	0.019	-10.583	9.561	1.172	0.231*	1.225***	138.904***	27.128***	16.766***	0.747	0.012	-0.073***	-0.024	0.022	-0.005
SZ21	0.011	-10.567	32.980	1.012	1.419***	18.333***	27848.260***	10.245	4.614**	4.144	0.027	-0.022	0.004	0.011	-0.033
SZ25	0.011	-10.582	15.374	0.999	0.298***	1.180***	141.617***	19.917**	53.887***	5.275	0.018	-0.058**	0.025	0.027	-0.007
SZ27	-0.014	-10.576	9.578	1.258	0.011	1.464***	173.526***	8.267	12.595***	6.418*	0.023	-0.030	0.029	0.020	-0.014
SZ28	0.017	-10.536	9.549	1.220	0.044	1.358***	149.926***	14.565	28.976***	4.661	0.019	-0.028	0.015	0.017	-0.005
SZ29	0.011	-10.584	9.590	1.203	0.069	1.511***	186.299***	13.582	71.812***	4.776	0.048**	0.017	0.021	0.023	-0.008
SZ33	-0.018	-10.551	9.583	1.192	-0.198***	0.997***	93.330***	16.740*	22.582***	1.201	0.044*	-0.005	0.013	0.028	-0.017
SZ35	0.007	-10.550	9.560	1.150	0.011	0.730***	43.236***	20.613**	46.008***	2.340	0.044*	-0.014	0.039*	0.035	-0.014
SZ36	-0.001	-10.548	9.574	0.996	0.039	1.049***	89.587***	14.830*	44.329***	0.239	0.047**	-0.012	-0.010	0.022	-0.047*
SZ37	0.023	-10.545	9.553	0.981	0.142**	1.504***	189.596***	14.402	23.064***	0.303	0.021	-0.042*	-0.016	-0.028	-0.006
SZ38	0.019	-10.550	9.599	0.993	0.117**	1.241***	129.068***	20.171**	78.559***	1.721	0.030	-0.038*	0.004	0.011	-0.016

A2：Industrial Portfolios (4)															
Basic Materials (12)	-0.013	-10.308	9.530	1.130	-0.223***	0.653***	50.626***	29.714***	46.197***	1.655	0.022	-0.009	0.046**	0.052**	0.006
Consumer Goods (7)	-0.022	-9.666	9.531	1.158	-0.233***	0.872***	79.188***	23.177***	35.021***	5.372	0.018	-0.042*	0.037	0.015	-0.020
Financial (7)	-0.003	-10.191	9.546	1.192	-0.112*	1.151***	111.422***	12.290	27.242***	4.207	0.021	-0.002	0.013	0.002	0.009
General and Services (6)	-0.025	-9.872	9.519	1.000	-0.373***	0.913***	112.559***	29.539***	81.275***	6.727*	0.020	-0.030	0.048**	0.030	0.012
A3：All-share Index (1)															
32 Index	-0.028	-10.056	9.532	1.188	-0.347***	1.132***	142.678***	30.986***	37.603***	4.478	0.019	-0.020	0.052**	0.040*	0.010

Appendix 3.4 (Continued)

Panel B: 32 Control Stocks															
	Mean	Mini	Max	S.D.	Skew	Kurt	JB	LB(12)	ARCH	JOINT	Serial correlations at lag				
											1	2	3	4	5
A1：Individual Stocks (32)															
SH02	-0.013	-10.645	9.646	1.168	-0.079	1.391***	158.747***	11.007	81.596***	0.533	0.022	-0.028	0.028	0.031	0.034
SH03	-0.033	-10.665	17.508	0.955	-0.011	4.473***	1619.678***	14.859*	66.629***	0.911	0.029	-0.019	0.020	0.027	-0.006
SH04	-0.017	-10.588	9.659	1.302	-0.090	1.911***	298.207***	11.406	20.073***	4.104	0.062***	-0.019	0.007	0.027	-0.007
SH06	0.015	-10.604	9.591	1.255	0.195***	1.758***	262.573***	20.270**	84.198***	1.352	0.055**	-0.014	0.047**	0.0439*	-0.012
SH07	-0.020	-10.562	39.727	0.970	1.504***	22.805***	42817.302***	6.662	2.957*	5.341	0.033	0.010	0.008	0.015	-0.013
SH09	-0.024	-10.638	9.614	1.214	-0.176***	1.578***	211.754***	20.949**	51.424***	1.166	0.031	0.016	0.002	0.007	-0.054**
SH10	-0.021	-10.600	9.593	1.205	-0.196***	1.149***	119.406***	14.883*	34.526***	1.527	0.025	-0.031	0.018	0.015	-0.013
SH14	-0.014	-10.573	9.580	1.216	-0.013	1.543***	192.712***	8.152	38.113***	1.857	0.007	-0.039*	-0.009	0.001	0.001
SH16	0.005	-10.567	9.636	1.277	0.121**	2.186***	391.447***	15.148*	105.070***	35.585***	0.047**	-0.026	0.036	0.039	0.008
SH18	-0.040	-10.602	9.625	0.986	-0.248***	1.346***	166.782***	19.447**	56.357***	2.591	0.024	-0.052**	0.004	0.055**	-0.026
SH19	-0.074	-10.587	9.598	1.409	-0.224***	3.906***	1251.343***	26.678***	46.205***	5.052	0.023	-0.089***	0.006	-0.001	-0.024
SH23	-0.028	-10.567	9.580	1.240	-0.246***	1.285***	153.333***	12.209	40.815***	1.549	0.021	-0.028	0.034	-0.007	-0.017
SH24	-0.002	-10.570	9.585	0.982	0.216***	4.379***	1567.278***	14.481	60.705***	2.126	0.032	-0.040*	0.024	0.042*	-0.024
SZ02	-0.003	-10.621	9.629	1.255	0.009	2.045***	338.661***	14.435	76.414***	5.677	0.023	-0.013	-0.011	-0.005	-0.020
SZ03	-0.003	-10.661	9.675	1.265	0.044	2.027***	333.318***	21.694***	65.145***	7.513*	0.042*	-0.006	0.002	-0.001	-0.020
SZ06	-0.001	-10.584	9.577	1.158	0.035	0.975***	77.308***	33.558***	68.175***	3.360	0.034	-0.039*	0.049**	0.040*	0.001
SZ08	-0.015	-10.658	9.633	1.288	-0.056	1.815***	267.835***	11.220	25.136***	5.676	0.021	-0.032	0.026	0.006	-0.047**
SZ11	-0.022	-10.578	10.026	1.246	-0.199***	2.001***	336.977***	16.106*	69.818***	7.697*	0.050**	-0.024	-0.009	0.001	-0.020
SZ13	-0.009	-10.563	18.083	0.976	0.193***	3.193***	837.538***	19.369**	66.413***	2.708	0.057**	-0.026	0.015	0.011	-0.019
SZ15	-0.025	-10.578	14.280	1.321	0.035	3.280***	871.383***	27.213***	27.213***	72.846***	0.047*	0.031	0.033	0.041*	-0.063***
SZ17	0.008	-10.585	9.663	1.331	0.412***	3.695***	1160.345***	20.977**	59.939***	0.822	0.036	-0.038*	0.019	0.040	0.013
SZ18	-0.009	-10.592	9.568	0.973	-0.030	1.341***	145.949***	25.661***	50.135***	0.995	0.017	-0.057**	0.041*	-0.042*	-0.032
SZ21	-0.018	-10.581	9.659	1.178	-0.037	0.981***	78.394***	22.825***	53.789***	9.874**	0.029	-0.026	-0.028	0.031	-0.049**
SZ25	-0.009	-10.580	9.685	1.389	0.240***	3.813***	1195.178***	32.673***	110.615***	12.957***	0.084***	-0.083***	0.046**	-0.006	0.013
SZ27	-0.035	-10.607	9.605	0.987	-0.351***	1.559***	236.775***	4.422	47.150***	8.359**	0.018	-0.001	-0.003	-0.008	-0.024
SZ28	-0.020	-10.576	9.605	1.282	-0.071	1.626***	215.814***	17.971**	37.634***	7.863**	0.046**	-0.025	0.021	-0.014	-0.021
SZ29	0.003	-10.611	10.159	1.224	0.212***	2.879***	685.499***	6.357	57.812***	2.238	0.010	0.006	0.014	0.020	-0.002
SZ33	-0.010	-10.605	9.601	1.131	-0.148***	0.845***	65.044***	11.584*	76.699***	1.755	0.018	0.008	-0.008	0.034	0.033
SZ35	0.018	-10.574	9.589	1.187	0.130**	1.335***	149.756***	14.830*	64.072***	2.344	0.038*	-0.007	0.005	0.044*	-0.039*
SZ36	0.004	-10.579	9.555	1.210	0.023	1.140***	105.392***	14.904*	42.571***	0.478	0.046**	-0.028	0.017	0.033	0.003
SZ37	0.009	-10.553	9.581	0.990	0.104*	1.334***	147.658***	21.105*	48.166***	0.421	0.034	-0.059***	0.004	-0.028	-0.036
SZ38	-0.018	-10.661	9.733	1.294	-0.062*	2.180***	386.146***	23.138***	120.133***	5.057	0.044*	-0.027	0.023	0.020	-0.017

A2：Industrial Portfolios (4)															
Basic Materials (12)	-0.067	-10.544	9.519	1.188	-0.633***	1.130***	233.424***	21.596**	71.876***	7.855*	0.011	-0.002	0.043*	0.051**	0.014
Consumer Goods (7)	-0.103	-10.062	9.553	1.250	-0.872***	1.802***	509.240***	15.058*	68.871***	6.392*	0.021	-0.026	0.021	0.023	0.009
Financial (7)	-0.064	-10.556	9.545	1.190	-0.629***	1.076***	222.072***	13.537	41.175***	5.954	0.019	-0.010	0.026	0.021	-0.024
General and Services (6)	-0.054	-9.039	8.206	0.993	-0.661***	1.707***	377.679***	28.381***	94.920***	11.762***	0.023	-0.029	0.045**	0.034	-0.015
A3：All-share Index (1)															
32 Index	-0.104	-9.872	9.543	1.245	-0.859***	1.688***	469.757***	21.364**	75.666***	11.162**	0.012	-0.009	0.045*	0.036	0.008

Notes: Summary statistics of daily stock returns of designated stocks eligible for short selling and margin trading (Panel A) and its control counterparts (Panel B) are provided. Mean, Min, Max, S.D., Skew, Kurt and JB are the sample mean, minimum, maximum, standard deviation, skewness, excess kurtosis and Jarque-Bera normality test, respectively. LB(12) is the Ljung-Box $\chi 2$ statistics for 12 lags calculated for stock returns. ARCH is the Lagrange Multiplier test for ARCH effects and distributed as $\chi 2$ with one degree of freedom. The JOINT test is a test initiated by Engle and Ng (1993) for potential asymmetries in conditional volatility. Serial correlation at lag t (1, 2, 3, 4, 5) represents autocorrelation relationships of individual return series. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Appendix 3.5.A Results of specification tests for three GARCH-type models

No.	GARCH(1,1)			EGARCH(1,1)			GJR-GARCH(1,1)		
	log L	AIC	BIC	log L	AIC	BIC	log L	AIC	BIC
SH02	-4245.6241	**2.0213**	**2.0442**	-4527.3624	2.0234	2.0492	**-4243.6591**	2.0223	2.0481
SH03	-4464.4499	**2.0494**	**2.0724**	-4579.0761	2.0515	2.0773	**-4459.8654**	2.0504	2.0763
SH04	-4239.4550	**1.8224**	**1.8454**	-4371.6865	1.8245	1.8503	**-4238.7771**	1.8234	1.8493
SH06	-3978.2937	**1.7522**	**1.7752**	-4237.0998	1.7543	1.7802	**-3976.7359**	1.7533	1.7791
SH07	-4091.5451	**1.8080**	**1.8310**	-4285.3175	1.8101	1.8360	**-4088.2600**	1.8091	1.8349
SH09	**-4767.2792**	**2.2959**	**2.3189**	-4884.2077	2.2980	2.3238	-4769.0125	2.2969	2.3228
SH10	-4235.4278	**1.8352**	**1.8582**	-4388.2086	1.8373	1.8632	**-4235.3453**	1.8363	1.8621
SH14	-4715.5011	**2.2099**	**2.2329**	-4807.1178	2.2120	2.2379	**-4714.7807**	2.2110	2.2368
SH16	-4921.3874	**2.5802**	**2.6031**	-5081.4536	2.5823	2.6081	**-4921.2685**	2.5812	2.6070
SH18	-4848.8541	**2.5130**	**2.5360**	-5014.7126	2.5151	2.5410	**-4848.7501**	2.5141	2.5399
SH19	-4197.6130	**1.6399**	**1.6629**	-4237.5310	1.6420	1.6679	**-4197.4985**	1.6410	1.6668
SH23	-5044.3257	**2.5594**	**2.5824**	-5174.6879	2.5615	2.5873	**-5045.6363**	2.5604	2.5863
SH24	-4081.0835	**1.7621**	**1.7851**	-4271.6376	1.7642	1.7901	**-4081.9969**	1.7632	1.7890
SZ02	-4574.8985	**2.1142**	**2.1371**	-4696.7629	2.1163	2.1421	**-4575.4226**	2.1152	2.1410
SZ03	-4961.1457	**2.4155**	**2.4385**	-5038.6261	2.4176	2.4435	**-4961.0549**	2.4166	2.4424
SZ06	-4958.1233	**2.4915**	**2.5144**	-5098.6430	2.4936	2.5194	**-4958.6944**	2.4925	2.5183
SZ08	**-4822.7498**	**2.3174**	**2.3403**	-4915.1792	2.3195	2.3453	-4823.3325	2.3184	2.3442
SZ11	-4517.1989	**2.1705**	**2.1935**	-4690.6932	2.1726	2.1984	**-4517.1247**	2.1715	2.1974
SZ13	-4234.1447	**1.7382**	**1.7612**	-4300.1712	1.7403	1.7661	**-4231.4526**	1.7392	1.7651
SZ15	**-4566.7602**	**2.0564**	**2.0794**	-4636.9024	2.0585	2.0843	-4566.9739	2.0574	2.0833
SZ17	-4901.0218	**2.4177**	**2.4407**	-5015.6130	2.4198	2.4456	**-4901.4667**	2.4187	2.4446
SZ18	-4536.5913	**1.9812**	**2.0042**	-4611.6731	1.9833	2.0092	**-4536.5622**	1.9823	2.0081
SZ21	-4307.1922	**1.9232**	**1.9461**	-4414.9554	1.9253	1.9511	**-4306.9097**	1.9242	1.9500
SZ25	-4946.7739	**2.4166**	**2.4395**	-5048.9009	2.4186	2.4445	**-4946.2303**	2.4176	2.4434
SZ27	**-4846.6434**	**2.3835**	**2.4064**	-4962.1189	2.3855	2.4114	-4847.1890	2.3845	2.4103
SZ28	**-4466.2302**	**1.9959**	**2.0189**	-4566.2108	1.9980	2.0238	-4466.4487	1.9969	2.0228
SZ29	**-4915.5824**	**2.5161**	**2.5391**	-5090.1571	2.5182	2.5440	-4916.6676	2.5171	2.5430
SZ33	**-4927.0301**	**2.3910**	**2.4140**	-5007.5781	2.3931	2.4189	-4927.2760	2.3920	2.4179
SZ35	-5130.4613	**2.6448**	**2.6678**	-5260.9422	2.6469	2.6728	**-5130.0000**	2.6459	2.6717
SZ36	-4833.9800	**2.3603**	**2.3833**	-4974.9689	2.3624	2.3882	**-4833.8063**	2.3613	2.3872
SZ37	-4536.6786	**1.9919**	**2.0149**	-4574.0459	1.9940	2.0198	**-4534.0765**	1.9929	2.0188
SZ38	-4709.4044	**2.1786**	**2.2015**	-4788.6672	2.1806	2.2065	**-4709.3884**	2.1796	2.2054

Notes: Log L, AIC and BIC are the log-likelihood function, Akaike information criterion and Schwarz Bayesian Criterion respectively. Figures in bold represent the best performing model of the stock based on certain information criteria. Figures in shading indicate that no convergence can be obtained of the stock during regression of specific GARCH-type model.

Appendix 3.5.B Best performance GARCH specifications based on log L, AIC and BIC

No.	log L	AIC	BIC
SH02	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH03	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH04	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH06	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH07	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH09	GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH10	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH14	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH16	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH18	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH19	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH23	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SH24	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ02	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ03	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ06	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ08	GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ11	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ13	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ15	GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ17	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ18	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ21	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ25	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ27	GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ28	GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ29	GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ33	GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ35	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ36	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ37	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
SZ38	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)
Total	GJR-GARCH(1,1)	GARCH(1,1)	GARCH(1,1)

Appendix 3.6.A The two-period approach: GARCH estimation results

	φ_0		φ_1		α_0		α_1		β		t-Test
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	φ_1 (Post-)
Panel A: Industrial Portfolios											0.453
Basic Materials (12)											
	0.1615**	-0.0083	-0.0108*	0.0054	0.1248	0.0462	0.0748***	0.0326***	0.9126***	0.9497***	
Treatment	(2.224)	(-0.074)	(-1.672)	(0.140)	(1.314)	(1.541)	(3.756)	(2.779)	(34.473)	(50.888)	
	0.1445**	-0.0106	-0.0058	0.0172	0.1889	0.0360	0.1178***	0.0236*	0.8741***	0.9652***	
Control	(2.361)	(-0.096)	(-1.387)	(0.549)	(1.168)	(0.794)	(2.968)	(1.720)	(18.628)	(37.979)	
Consumer Goods (7)											
	0.1267**	0.0119	-0.0110	-0.0134	0.0917	0.0549	0.0712***	0.0276**	0.9158***	0.9465***	
Treatment	(2.128)	(0.087)	(-1.506)	(-0.218)	(1.556)	(1.322)	(3.466)	(2.564)	(35.164)	(36.188)	
	0.1137*	0.0691	-0.0047	-0.0024	0.3159*	0.1506*	0.1399***	0.0421**	0.8457***	0.9040***	
Control	(1.955)	(0.606)	(-1.206)	(-0.067)	(1.737)	(1.664)	(3.365)	(2.559)	(16.710)	(21.426)	
Financial (7)											
	0.0499	-0.0504	-0.0043	0.0050	0.0592	0.0632	0.0480***	0.0206**	0.9452***	0.9594***	
Treatment	(0.735)	(-0.328)	(-0.633)	(0.105)	(0.975)	(1.224)	(3.195)	(2.132)	(48.678)	(44.305)	
	-0.0096	0.5574	0.0032	-0.1775	0.1039	0.0800	0.0605*	0.0162	0.9315***	0.9591***	
Control	(-0.121)	(0.900)	(0.539)	(-0.195)	(0.743)	(0.714)	(1.830)	(0.756)	(21.551)	(17.512)	
General and Services (6)											
	0.2096***	0.0500	-0.0153**	-0.0103	0.2369**	3.0321***	0.1268***	-0.0386*	0.8397***	-0.2122	
Treatment	(2.997)	(0.379)	(-1.960)	(-0.178)	(2.492)	(3.075)	(5.027)	(-1.719)	(25.278)	(-0.553)	
	-0.0283	0.0445	0.0023	-0.0067	0.1186*	0.0344	0.1205***	0.0223*	0.8711***	0.9576***	
Control	(-0.449)	(0.297)	(0.327)	(-0.080)	(1.845)	(1.064)	(4.029)	(1.806)	(26.769)	(33.045)	
Panel B: All-share Index											
	0.1183*	-0.1064	-0.0111*	0.0369	0.0998*	0.0313	0.0865***	0.0189**	0.9014***	0.9670***	
Treatment	(1.874)	(-0.706)	(-1.667)	(0.538)	(1.916)	(1.345)	(4.279)	(2.058)	(37.982)	(58.497)	
	0.0959*	0.1282	-0.0041	-0.0343	0.1875	0.0397	0.1268**	0.0204	0.8683***	0.9636***	
Control	(1.683)	(0.754)	(-1.025)	(-0.513)	(1.237)	(0.911)	(2.461)	(1.478)	(15.350)	(33.451)	

Notes: This table presents the maximum likelihood estimates of the baseline model for treatment and control groups of both industrial portfolios and the all-share index in the pre- and post- periods. The sub-sample range is 31/03/2004 - 30/03/2010 and 31/03/2010 - 31/03/2016 respectively. The number of observations for the pre-period is 1459 and is 1458 for the post-period. (Since no convergence is obtained in the GARCH regression for the financial portfolio in control group, the estimated results are not reported with consideration of inaccuracy.)

In particular, the estimated mean equation is given by equation (3.5a) as: $R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{t-1} + \varepsilon_t$. The variance equation is given by equation (6a) as: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$.

Errors are assumed to follow the student's *t* distribution that allows for fat fails. The estimated *t*-statistics are shown in parentheses.

The values of related test statistics are also reported. The *t*-value of *t*-test that examines the equality of the estimated coefficients of conditional feedback trading in the post-period between treatment and control groups for four industrial portfolios is shown in the rightmost column. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.6.B The two-period approach: summarised GARCH estimation results

	φ_0		φ_1				α_0		α_1		β		*t*-Test
			φ_1 (positive)		φ_1 (negative)								
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	φ_1 (negative, Post-)
Panel A: Individual Stocks (32)													-1.248
A1: Mean Value of Key Coefficients													
Treatment	0.0726	0.0144	0.0008	0.0084	-0.0194	-0.0038	0.2845	0.3109	0.0854	0.0359	0.8975	0.9014	
		<0.007>***		<0.003>***		<0.000>***		<0.064>*		<0.000>***		<0.002>***	
Control	-0.0057	-0.0217	0.0027	0.0172	-0.0053	-0.0046	0.4489	0.3357	0.0898	0.0565	0.8896	0.8917	
		<0.809>		<0.004>***		<0.019>**		<0.383>		<0.000>***		<0.327>	
A2: Percentage of Significant Coefficients													
Treatment	18.75%	0.00%	0.00%	0.00%	9.38%	0.00%	18.75%	31.25%	84.38%	84.38%	100.00%	96.88%	
Control	9.38%	6.25%	3.13%	3.13%	0.00%	0.00%	18.75%	21.88%	90.63%	68.75%	100.00%	100.00%	
Panel B: Industrial Portfolios (4)													-1.968
B1: Mean Value of Key Coefficients													
Treatment	0.1369	0.0008	0.0000	0.0052	-0.0104	-0.0118	0.1281	0.7991	0.0802	0.0106	0.9033	0.6609	
Control	0.0551	0.0343	0.0027	0.0172	-0.0053	-0.0046	0.1817	0.0737	0.1097	0.0294	0.8806	0.9423	
B2: Percentage of Significant Coefficients													
Treatment	75.00%	0.00%	0.00%	0.00%	50.00%	0.00%	25.00%	25.00%	100.00%	100.00%	100.00%	75.00%	
Control	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%	25.00%	100.00%	75.00%	100.00%	75.00%	

Notes: This table summarises the GARCH estimation results of the baseline model for treatment and control groups of both individual stocks and industrial portfolios in the pre-event and post-event periods. The sample details and same basic estimation techniques are given in Appendix 3.6.A. The calculated mean values of coefficient estimates of 32 individual designated stocks are presented in A1 of Panel A, while the calculated estimation results of 4 industrial portfolios and its counterpart control stocks are presented in B1 of Panel B. A2 and B2 present the percentage of individual time series for which each key coefficient is statistically significant at the 10% level.

In particular, the estimated mean equation is given by equation (3.5a) as: $R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{t-1} + \varepsilon_t$. The variance equation is given by equation (6a) as: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$.

The *P*-values of the nonparametric Kruskal-Wallis statistics <show in angle brackets> examines whether the coefficients of individual stocks in the pre-period are significantly different from the post-period. The *t*-statistics that test on the equality of the estimated coefficients of conditional positive feedback trading in the post-period between treatment and control groups for four industrial portfolios and 32 individual stocks are shown in the rightmost column. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.7.A The Heaviside indicator approach: GARCH estimation results for industrial portfolios

	φ_0		φ_1		α_0		α_1		β		*t*-Test
	$\varphi_{0,1}$	$\varphi_{0,2}$	$\varphi_{1,1}$	$\varphi_{1,2}$	$\alpha_{0,1}$	$\alpha_{0,2}$	$\alpha_{1,1}$	$\alpha_{1,2}$	β1	β2	$\varphi_{1,2}$
Basic Materials (11)											1.221
	0.2126***	-0.0095	-0.014**	0.0084	0.2627	0.0355	0.0824***	0.0277**	0.8914***	0.9572***	
Treatment	(2.638)	(-0.099)	(-2.062)	(0.242)	(1.280)	(1.555)	(3.173)	(2.186)	(20.895)	(52.225)	
		<3.185>*		<0.404>		<1.157>		<3.544>*		<1.811>	
	0.1899***	0.0021	-0.008*	0.0152	0.2947	0.0222	0.1107***	0.0201	0.8661***	0.9725***	
Control	(3.138)	(0.022)	(-1.958)	(0.590)	(1.436)	(0.379)	(3.171)	(0.843)	(17.720)	(23.844)	
		<2.822>*		<0.792>		<1.285>		<3.546>*		<2.023>	
Consumer Goods (6)											
	0.1485**	0.0084	-0.0125*	-0.0103	0.1104*	0.0472	0.0690***	0.0270**	0.9129***	0.9511***	
Treatment	(2.477)	(0.056)	(-1.771)	(-0.157)	(1.658)	(1.038)	(3.603)	(2.016)	(35.023)	(31.180)	
		<0.730>		<0.001>		<0.508>		<3.280>*		<0.811>	
	0.1441**	0.0575	-0.006	-0.000	0.3135*	0.1461**	0.1184***	0.0449***	0.8463***	0.9090***	
Control	(2.331)	(0.508)	(-1.285)	(-0.007)	(1.697)	(1.984)	(3.211)	(2.901)	(16.182)	(26.682)	
		<0.508>		<0.031>		<0.628>		<3.139>*		<0.863>	
Financial (6)											
	0.0557	-0.0553	-0.0046	0.0078	0.0886	0.0446	0.0486***	0.0160*	0.9448***	0.9671***	
Treatment	(0.865)	(-0.347)	(-0.734)	(0.146)	(1.108)	(1.482)	(2.982)	(1.715)	(46.162)	(54.401)	
		<0.425>		<0.054>		<0.22>		<2.689>		<0.55>	
	-0.001	0.6462	0.0026	-0.2059	0.1398	0.0448	0.0628**	0.0083	0.9265***	0.9774***	
Control	(-0.014)	(0.842)	(0.437)	(-0.837)	(0.861)	(0.184)	(2.059)	(0.250)	(21.685)	(9.057)	
		<0.686>		<0.714>		<0.093>		<1.547>		<0.189>	
General and Services (5)											
	0.2321***	-0.1030*	-0.0170**	0.0551	0.2734**	3.3853***	0.1233***	-0.0351	0.8387***	-0.3809	
Treatment	(3.295)	(-0.828)	(-2.236)	(0.953)	(2.349)	(4.832)	(4.664)	(-1.136)	(22.323)	(-1.310)	
		<5.715>**		<1.526>		<19.663>***		<14.237>***		<17.777>***	
	0.0024	0.0392	0.0005	-0.003	0.1343	0.0341	0.1119***	0.0230	0.8696***	0.9581***	
Control	(0.039)	(0.294)	(0.086)	(-0.054)	(1.422)	(0.763)	(3.510)	(1.141)	(23.335)	(22.435)	
		<0.063>		<0.004>		<0.669>		<5.935>**		<2.036>	

Notes: This table presents the maximum likelihood estimates of the Heaviside indicator approach for both treatment and control groups of industrial portfolios. The sample range is 31/03/2006 - 31/03/2014, and the number of observations is 1942. The same basic estimation techniques are given in Appendix 3.6.A.

In particular, the estimated mean equation is given by equation (3.5b) as: $R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_{0,1} I_t + \varphi_{0,2}(1 - I_t) + \left(\varphi_{1,1} I_t + \varphi_{1,2}(1 - I_t)\right)\sigma_t^2\right] R_{t-1} + \varepsilon_t$. The variance equation is given by equation (3.6b) as: $\sigma_t^2 = \alpha_{0,1}\, I_t + \alpha_{0,2}(1 - I_t) + \left[\alpha_{1,1}\, I_t + \alpha_{1,2}(1 - I_t)\right]\varepsilon_{t-1}^2 + \left[\beta_1\, I_t + \beta_2(1 - I_t)\right]\sigma_{t-1}^2$

The following hypotheses on the equality of the estimates of five key coefficients in the pre- and post-period are tested by Wald statistics, which are reported in the angle brackets <>: $H_{0,1} : \varphi_{0,1} = \varphi_{0,2}$, $H_{0,2} : \varphi_{1,1} = \varphi_{1,2}$, $H_{0,3} : \alpha_{0,1} = \alpha_{0,2}$, $H_{0,4} : \alpha_{1,1} = \alpha_{1,2}$, and $H_{0,5} : \beta_1 = \beta_2$. The *t*-statistics that tests on the equality of the estimated coefficients of conditional feedback trading in the post-period between treatment and control groups for four portfolios is shown in the rightmost column. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.7.B The Heaviside indicator approach: summarised GARCH estimation results

	φ_0		φ_1 (positive)		φ_1 (negative)		α_0		α_1		β		*t*-Test
	$\varphi_{0,1}$	$\varphi_{0,2}$	$\varphi_{1,1}$	$\varphi_{1,2}$	$\varphi_{1,1}$	$\varphi_{1,2}$	$\alpha_{0,1}$	$\alpha_{0,2}$	$\alpha_{1,1}$	$\alpha_{1,2}$	β_1	β_2	$\varphi_{1,2}$ (negative)
Panel A: Individual Stocks (28)													
A1: Mean Value of Key Coefficients													
Treatment	0.0733	0.0201 <0.028>**	0.0009	0.0109 <0.002>***	-0.0042	-0.0219 <0.000>***	0.3464	0.6521 <0.015>***	0.0888	0.0308 <0.000>***	0.8911	0.8236 <0.001>***	-1.095
Control	0.0039	-0.0183 <0.577>	0.0029	0.0095 <0.018>**	-0.0032	-0.0144 <0.041>**	0.5569	0.5282 <0.302>	0.0949	0.0613 <0.001>***	0.8805	0.8234 <0.658>	
A2: Percentage of Significant Coefficients													
Treatment	21.43%	3.57%	0.00%	0.00%	14.29%	7.14%	28.57%	25.00%	92.86%	71.43%	100.00%	100.00%	
Control	7.14%	14.29%	3.57%	3.57%	3.57%	10.71%	17.86%	28.57%	92.86%	64.29%	100.00%	85.71%	
Panel B: Industrial Portfolios (4)													
B1: Mean Value of Key Coefficients													
Treatment	0.1622	-0.0399	0.0000	0.0238	-0.0121	-0.0103	0.1838	0.8782	0.0808	0.0089	0.8970	0.6237	0.879
Control	0.0839	0.1863	0.0016	0.0153	-0.0073	-0.0701	0.2206	0.0618	0.1010	0.0241	0.8771	0.9543	
B2: Percentage of Significant Coefficients													
Treatment	75.00%	25.00%	0.00%	0.00%	75.00%	0.00%	50.00%	25.00%	100.00%	75.00%	100.00%	75.00%	
Control	50.00%	0.00%	0.00%	0.00%	25.00%	0.00%	25.00%	25.00%	100.00%	50.00%	100.00%	100.00%	

Notes: This table summarises the GARCH estimation results of the Heaviside indicator approach for treatment and control groups of both individual stocks and industrial portfolios. The sample details are given in Appendix 3.7A, and the same basic estimation techniques are in Appendix 3.6.A. The calculated mean values of coefficient estimates of 28 individual designated stocks are presented in A1 of Panel A, while the calculated estimation results of four industrial portfolios and its control counterparts are presented in B1 of Panel B. A2 and B2 present the percentage of individual time series for which each key coefficient is statistically significant at the 10% level.

In particular, the estimated mean equation is given by equation (3.5b) as: $R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_{0,1} I_t + \varphi_{0,2}(1 - I_t) + \left(\varphi_{1,1} I_t + \varphi_{1,2}(1 - I_t)\right)\sigma_t^2\right] R_{t-1} + \varepsilon_t$. The variance equation is given by equation (3.6b) as: $\sigma_t^2 = \alpha_{0,1} I_t + \alpha_{0,2}(1 - I_t) + \left[\alpha_{1,1} I_t + \alpha_{1,2}(1 - I_t)\right]\varepsilon_{t-1}^2 + [\beta_1 I_t + \beta_2(1 - I_t)]\sigma_{t-1}^2$

The *P*-values of the nonparametric Kruskal-Wallis statistics <show in angle brackets> examines whether the calculated coefficients of individual stocks in the pre-period are significantly different from the post-period. The *t*-statistics that test on the equality of the estimated coefficients of conditional positive feedback trading in the post-period between treatment and control groups for four industrial portfolios and 28 individual stocks are shown in the rightmost column. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.8.A The differentiated impact approach: GARCH estimation results

	φ_0^+		φ_1^+		φ_0^-		φ_1^-		α_L	*t*-Test	
	$\varphi_{0,1}^+$	$\varphi_{0,2}^+$	$\varphi_{1,1}^+$	$\varphi_{1,2}^+$	$\varphi_{0,1}^-$	$\varphi_{0,2}^-$	$\varphi_{1,1}^-$	$\varphi_{1,2}^-$		$\varphi_{1,2}^+$	$\varphi_{1,2}^-$
Panel A: Industrial Portfolios										0.006	0.063
Basic Materials (12)											
	0.4072***	0.1061	-0.0173	-0.0014	-0.1707	-0.0604	0.0036	-0.0016	-0.0197		
Treatment	(3.96)	(0.847)	(-1.627)	(-0.040)	(-1.067)	(-0.552)	(0.238)	(-0.050)	(-1.609)		
		<0.539>		<7.734>***		<0.000>		<0.956>			
	0.4504***	0.1821	-0.0163	0.0125	-0.1308***	-0.1196	0.0034	0.0073	-0.0137**		
Control	(4.744)	(1.390)	(-1.801)	(0.415)	(-2.766)	(-1.223)	(0.497)	(0.254)	(-2.461)		
		<2.943>*		<37.978>***		<0.0143>		<2.649>			
Consumer Goods (7)											
	0.3556***	-0.1200	-0.0209	0.0670	-0.1180	0.1379	-0.0007	-0.0906	-0.0167		
Treatment	(3.947)	(-0.816)	(-1.476)	(1.215)	(-1.167)	(0.824)	(-0.053)	(-1.398)	(-1.488)		
		<1.114>		<10.017>***		<3.092>*		<0.935>			
	0.3314***	0.0441	-0.0110	0.0187	-0.0740	0.0402	-0.0008	-0.0068	-0.0267		
Control	(3.364)	(0.336)	(-1.157)	(0.574)	(-0.749)	(0.309)	(-0.113)	(-0.217)	(-1.547)		
		<0.000>		<6.901>***		<0.285>		<0.565>			
Financial (7)											
	0.2659**	0.0935	-0.0178	-0.0199	-0.2141**	-0.1716	0.0117	0.0224	-0.0159		
Treatment	(2.494)	(0.593)	(-1.448)	(-0.425)	(-1.813)	(-1.185)	(0.950)	(0.536)	(-1.671)		
		<1.213>		<7.632>***		<0.382>		<2.317>			
	0.0771	0.2724	0.0057	-0.0814	-0.1435	0.2376	0.0066	-0.0759	-0.0200		
Control	(0.743)	(1.353)	(0.635)	(-1.554)	(-1.059)	(1.023)	(0.626)	(-1.200)	(-1.259)		
		<0.012>		<1.490>		<0.004>		<0.003>			
General and Services (6)											
	0.4093***	0.4151	-0.0312*	-0.0990	-0.0158	-0.1361	-0.0019	0.0177	-0.0420		
Treatment	(3.437)	(1.508)	(-1.760)	(-1.028)	(-0.119)	(-1.019)	(-0.137)	(0.488)	(-1.368)		
		<2.551>		<5.775>*		<1.098>		<1.726>			
	0.2079***	0.1285	-0.0076	-0.0041	-0.2483**	-0.0734	0.0154	0.0139	-0.0226		
Control	(2.601)	(0.872)	(-0.643)	(-0.065)	(-2.340)	(-0.655)	(1.020)	(0.295)	(-1.476)		
		<0.955>		<11.187>***		<0.046>		<1.324>			
Panel B: All-share Index										-0.684	0.210
	0.4376***	0.0484	-0.0270**	0.0149	-0.2794**	-0.1378	0.0136	0.0108	-0.0190*		
Treatment	(4.484)	(0.263)	(-1.981)	(0.199)	(-2.377)	(-0.932)	(0.919)	(0.177)	(-1.760)		
		<0.528>		<21.028>***		<0.001>		<3.551>*			
	0.4232***	0.2458*	-0.0162*	-0.0194	-0.1824*	-0.0864	0.0054	0.0015	-0.0177		
Control	(4.558)	(1.808)	(-1.772)	(-0.494)	(-1.723)	(-0.538)	(0.604)	(0.031)	(-1.313)		
		<2.018>		<14.837>***		<0.097>		<2.343>			

Notes: This table presents the maximum likelihood estimates of the differentiated impact model conditional on positive and negative historical returns for treatment and control groups of both industrial portfolios and the all-share index. The sample details are given in Appendix 3.7.A., and the same basic estimation techniques are in Appendix 3.6.A.

In particular, the estimated mean equation is given by equation (3.5c) as: $R_t = \alpha + \mu\sigma_t^2 + \{\varphi_{0,1}^+ I_t + \varphi_{0,2}^+(1-I_t) + [\varphi_{1,1}^+ I_t + \varphi_{1,2}^+(1-I_t)]\sigma_t^2\}R_{it-1}^+ + \{\varphi_{0,1}^- I_t + \varphi_{0,2}^-(1-I_t) + [\varphi_{1,1}^- I_t + \varphi_{1,2}^-(1-I_t)]\sigma_t^2\}R_{t-1}^- + \varepsilon_t$. The variance equation is given by equation (3.6c) as: $\sigma_t^2 = (1+\alpha_L D_t)(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$

Wald statistics are reported in the angle brackets <>, which examine the following hypotheses: $H_{0,1}: \varphi^+{}_{0,1} = \varphi^+{}_{0,2}$, $H_{0,2}: \varphi^+{}_{1,1} = \varphi^+{}_{1,2}$, $H_{0,3}: \varphi^-{}_{1,1} = \varphi^-{}_{1,2}$, and $H_{0,4}: \varphi^-{}_{1,1} = \varphi^-{}_{1,2}$. The *t*-statistics that test on the equality of the estimated coefficients of conditional feedback trading conditional on positive and negative historical returns in the post-period between treatment and control groups are shown separately in the rightmost column. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.8.B The differentiated impact approach: summarised GARCH estimation results

	φ_0^+		φ_1^+				φ_0^-		φ_1^-				α_L	*t*-Test	
			φ_1^+ (positive)		φ_1^+ (negative)				φ_1^- (positive)		φ_1^- (negative)				
	$\varphi_{0,1}^+$	$\varphi_{0,2}^+$	$\varphi_{1,1}^+$	$\varphi_{1,2}^+$	$\varphi_{1,1}^+$	$\varphi_{1,2}^+$	$\varphi_{0,1}^-$	$\varphi_{0,2}^-$	$\varphi_{1,1}^-$	$\varphi_{1,2}^-$	$\varphi_{1,1}^-$	$\varphi_{1,2}^-$		$\varphi_{1,2}^+$ (negative)	$\varphi_{1,2}^-$ (negative)
Panel A: Individual Stocks (32)															
A1: Mean Value of Key Coefficients															
Treatment	0.1449	0.0351	0.0052	0.0096	-0.0054	-0.0168	-0.0370	-0.0099	0.0047	0.0188	-0.0068	-0.0219	-0.0257	3.466***	0.013
		<0.000>***		<0.165>		<0.004>***		<0.485>		<0.001>***		<0.001>***			
Control	0.0549	-0.0034	0.0062	0.0122	-0.0066	-0.0197	-0.0932	-0.0222	0.0057	0.0176	-0.0048	-0.0220	-0.0353		
		<0.072>*		<0.001>***		<0.071>*		<0.028>**		<0.002>***		<0.035>**			
A2: Percentage of Significant Coefficients															
Treatment	43.75%	0.00%	0.00%	0.00%	9.38%	6.25%	21.88%	18.75%	3.13%	3.13%	3.13%	9.38%	56.25%		
Control	34.38%	12.50%	12.50%	9.38%	6.25%	6.25%	31.25%	12.50%	12.50%	3.13%	6.25%	6.25%	40.63%		
Panel B: Industrial Portfolios (4)															
B1: Mean Value of Key Coefficients															
Treatment	0.3595	0.1237	0.0000	0.0671	-0.0218	-0.0401	-0.1298	-0.0575	0.0077	0.0200	-0.0013	-0.0461	-0.0235	0.054	-0.475
Control	0.2668	0.1568	0.0057	0.0157	-0.0116	-0.0427	-0.1494	0.0212	0.0085	0.0106	-0.0009	-0.0414	-0.0207		
B2: Percentage of Significant Coefficients															
Treatment	100.00%	0.00%	0.00%	0.00%	25.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%		
Control	75.00%	0.00%	0.00%	0.00%	25.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%		

Notes: This table summarises the GARCH estimation results of the differentiated impact model conditional on positive and negative historical returns for treatment and control groups of both individual stocks and industrial portfolios. The sample details are given in Appendix 3.7.A., and the same basic estimation techniques are in Appendix 3.6.A. The calculated mean values of coefficient estimates of 32 individual designated stocks are presented in A1 of Panel A, while the calculated estimation results of four industrial portfolios and its control counterparts are presented in B1 of Panel B. A2 and B2 present the percentage of individual time series for which each key coefficient is statistically significant at the 10% level.

In particular, the estimated mean equation is given by equation (3.5c) as: $R_t = \alpha + \mu\sigma_t^2 + \{\varphi_{0,1}^+ I_t + \varphi_{0,2}^+(1-I_t) + [\varphi_{1,1}^+ I_t + \varphi_{1,2}^+(1-I_t)]\sigma_t^2\}R_{it-1}^+ + \{\varphi_{0,1}^- I_t + \varphi_{0,2}^-(1-I_t) + [\varphi_{1,1}^- I_t + \varphi_{1,2}^-(1-I_t)]\sigma_t^2\}R_{t-1}^- + \varepsilon_t$. The variance equation is given by equation (3.6c) as: $\sigma_t^2 = (1+\alpha_L D_t)(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$.

The *P*-values of the nonparametric Kruskal-Wallis statistics <show in angle brackets> examines whether the calculated coefficients of individual stocks in the pre-period are significantly different from the post-period. The *t*-statistics that test on the equality of the estimated coefficients of conditional positive feedback trading conditional on positive and negative historical returns in the post-period between treatment and control groups for four industrial portfolios and 32 individual stocks are shown separately in the rightmost column. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.9.A The Heaviside indicator approach for all-share index with 2- and 3-year estimation window: GARCH estimation results

	φ_0		φ_1		α_0		α_1		β	
	$\varphi_{0,1}$	$\varphi_{0,2}$	$\varphi_{1,1}$	$\varphi_{1,2}$	$\alpha_{0,1}$	$\alpha_{0,2}$	$\alpha_{1,1}$	$\alpha_{1,2}$	β_1	β_2
Panel A: 2-year window										
	0.1716*	0.0293	-0.0137	-0.0147	0.0886	0.0389	0.0748***	0.0200	0.9151***	0.9633***
Treatment	(1.754)	(0.129)	(-1.309)	(-0.163)	(1.134)	(1.011)	(3.113)	(1.433)	(32.145)	(42.089)
		<0.314>		<0.000>		<0.241>		<3.415>*		<1.349>
	0.1617*	0.1713	-0.0085	-0.0354	0.1281	0.1843	0.1080***	0.0431*	0.8828***	0.9011***
Control	(1.720)	(0.732)	(-1.286)	(-0.521)	(1.075)	(1.329)	(2.645)	(1.930)	(20.421)	(17.880)
		<0.001>		<0.156>		<0.080>		<1.958>		<0.071>
Panel B: 3-year window										
	0.1724**	-0.1151	-0.0132	0.0399	0.1564	0.0211	0.0774***	0.0129	0.9046***	0.9762***
Treatment	(2.090)	(-0.567)	(-1.594)	(0.405)	(1.263)	(1.226)	(3.164)	(0.821)	(25.921)	(46.074)
		<1.764>		<0.291>		<1.013>		<4.188>**		<2.250>
	0.1367**	0.0636	-0.0052	-0.0131	0.3626	0.0619	0.1235***	0.0249	0.8432***	0.9535***
Control	(2.264)	(0.343)	(-1.173)	(-0.205)	(1.289)	(0.586)	(3.243)	(0.935)	(14.673)	(15.686)
		<0.131>		<0.014>		<0.730>		<4.089>**		<1.254>

Notes: This table presents the maximum likelihood estimates of the Heaviside indicator approach for both treatment and control groups of all-share index with 2- and 3-year estimation window. For the 2-year window regression, the sample range is 01/04/2008- 30/03/2012 and the number of observations is 975. For the 3-year window regression, the sample range is 02/04/2007- 29/03/2013 and the number of observations is 1460.

In particular, the estimated mean equation is given by equation (3.5b) as: $R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_{0,1} I_t + \varphi_{0,2}(1 - I_t) + \left(\varphi_{1,1} I_t + \varphi_{1,2}(1 - I_t)\right)\sigma_t^2\right] R_{t-1} + \varepsilon_t$. The variance equation is given by equation (3.6b) as: $\sigma_t^2 = \alpha_{0,1}\, I_t + \alpha_{0,2}(1 - I_t) + \left[(\alpha_{1,1}\, I_t + \alpha_{1,2}(1 - I_t)\right]\varepsilon_{t-1}^2 + [(\beta_1\, I_t + \beta_2(1 - I_t)]\sigma_{t-1}^2$.

Wald statistics reported in the angle brackets <> examine the following hypotheses: $H_{0,1} : \varphi_{0,1} = \varphi_{0,2}$, $H_{0,2} : \varphi_{1,1} = \varphi_{1,2}$, $H_{0,3} : \alpha_{0,1} = \alpha_{0,2}$, $H_{0,4} : \alpha_{1,1} = \alpha_{1,2}$, and $H_{0,5} : \beta_1 = \beta_2$. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.9.B The differentiated impact approach for all-share index with 2- and 3-year estimation window: GARCH estimation results

	φ_0^+		φ_1^+		φ_0^-		φ_1^-		α_L
	$\varphi_{0,1}^+$	$\varphi_{0,2}^+$	$\varphi_{1,1}^+$	$\varphi_{1,2}^+$	$\varphi_{0,1}^+$	$\varphi_{0,2}^+$	$\varphi_{1,1}^+$	$\varphi_{1,2}^+$	
Panel A: 2-year window									
	0.3705***	-0.0211	-0.0201	0.025	-0.0906	0.0207	-0.0034	-0.0321	-0.0099
Treatment	(2.946)	(-0.082)	(-1.081)	(0.313)	(-0.577)	(0.093)	(-0.174)	(-0.404)	(-0.761)
		<0.012>		<4.985>**		<0.232>		<0.320>	
	0.3622***	0.0093	-0.0074	0.0231	-0.1039	0.2098	-0.0041	-0.0518	-0.0071
Control	(2.612)	(0.047)	(-0.523)	(0.531)	(-0.590)	(0.947)	(-0.337)	(-0.980)	(-0.385)
		<0.364>		<3.249>*		<0.992>		<0.022>	
Panel B: 3-year window									
	0.4456***	-0.0731	-0.0233	0.0595	-0.2318	-0.1324	0.0087	-0.0005	-0.0136
Treatment	(3.273)	(-0.360)	(-1.347)	(0.768)	(-1.579)	(-0.705)	(0.488)	(-0.007)	(-1.221)
		<0.036>		<9.746>***		<0.262>		<1.399>	
	0.3996***	0.0134	-0.0104	0.035	-0.1427	0.0329	0.0009	-0.0282	-0.0209
Control	(3.466)	(0.071)	(-1.002)	(0.676)	(-1.083)	(0.183)	(0.097)	(-0.550)	(-0.904)
		<0.004>		<7.236>***		<0.686>		<0.496>	

Notes: This table presents the maximum likelihood estimates of the differentiated impact model conditional on positive and negative historical returns for both treatment and control groups of the all-share index with 2- and 3-year estimation window. The sample details are given in Appendix 3.9.A., and the same basic estimation techniques are in Appendix 3.6.A.

In particular, the estimated mean equation is given by equation (3.5c) as: $R_t = \alpha + \mu\sigma_t^2 + \{\varphi_{0,1}^+ I_t + \varphi_{0,2}^+(1-I_t) + [\varphi_{1,1}^+ I_t + \varphi_{1,2}^+(1-I_t)]\sigma_t^2\}R_{t-1}^+ + \{\varphi_{0,1}^- I_t + \varphi_{0,2}^-(1-I_t) + [\varphi_{1,1}^- I_t + \varphi_{1,2}^-(1-I_t)]\sigma_t^2\}R_{t-1}^- + \varepsilon_t$. The variance equation is given by equation (3.6c) as: $\sigma_t^2 = (1+\alpha_L D_t)(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$.

Wald statistics reported in the angle brackets <> examine the following hypotheses: $H_{0,1}: \varphi^+{}_{0,1} = \varphi^+{}_{0,2}$, $H_{0,2}: \varphi^+{}_{1,1} = \varphi^+{}_{1,2}$, $H_{0,3}: \varphi^-{}_{1,1} = \varphi^-{}_{1,2}$, and $H_{0,4}: \varphi^-{}_{1,1} = \varphi^-{}_{1,2}$. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 3.10 The Heaviside indicator approach for industrial portfolios: GJR-GARCH estimation results

	φ_0		φ_1		α_0		α_1		γ		β		*t*-Test
	$\varphi_{0,1}$	$\varphi_{0,2}$	$\varphi_{0,1}$	$\varphi_{0,2}$	$\alpha_{0,1}$	$\alpha_{0,2}$	$\alpha_{1,1}$	$\alpha_{1,2}$	γ_1	γ_2	β_1	β_2	$\varphi_{1,2}$
Basic Materials (12)													1.307
	0.2537***	-0.0189	-0.0163** (-	0.0124	0.4418	0.0306	0.0633***	0.0181	0.0493	0.0194	0.8621***	0.9589***	
Treatment	(2.771)	(-0.200)	2.460)	(0.369)	(1.336)	(1.481)	(2.680)	(1.66)	(0.928)	(1.628)	(15.476)	(54.250)	
		<4.313>		<0.704>		<1.520>		<2.831>*		<0.298>		<2.566>	
	0.1889***	0.1259	-0.0073*	-0.0051	0.3510	0.2367	0.0991***	0.0095 (0.204)	0.0332	0.0501	0.8521***	0.9084	
Control	(3.014)	(0.709)	(-1.818)	(-0.164)	(1.255)	(0.232)	(3.182)		(0.697)	(0.343)	(14.721)	(3.309)	
		<0.097>		<0.004>		<0.010>		<2.983>*		<0.012>		< 0.037>	
Consumer Goods (7)													
	0.1538**	0.058	-0.0128*	-0.0235	0.1169	0.2210	0.0627***	-0.0269	0.0112	0.1415	0.9115***	0.8515***	
Treatment	(2.536)	(0.937)	(-1.804)	(-1.324)	(1.577)	(0.450)	(3.288)	(-0.373)	(0.396)	(0.831)	(37.402)	(3.486)	
		<1.119>		<0.276>		<0.050>		<1.435>		<0.626>		<0.064>	
	0.1494**	0.0478	-0.0065	0.0047	0.3269*	0.3854	0.1021**	-0.0529	0.0229	0.1482	0.8450***	0.8326***	
Control	(2.418)	(0.560)	(-1.373)	(0.205)	(1.874)	(0.988)	(2.528)	(-1.037)	(0.510)	(1.349)	(17.828)	(5.750)	
		<0.954>		<0.229>		<0.021>		<5.651>**		<1.176>		<0.007>	
Financial (7)													
	0.0622	-0.0517	-0.0049	0.0067	0.1181	0.0452	0.0435***		0.0154	0.0012	0.9385	0.9671	
Treatment	(0.959)	(-0.273)	(-0.895)	(0.102)	(0.803)	(-0.895)	(3.143)	0.0152 (1.939)	(0.419)	(0.082)	(27.669)	(41.053)	
		<0.311>		<0.031>		<0.194>		<3.162>*		<0.106>		<0.388>	
	-0.0152	0.6213	0.0035	-0.1970	0.1114	0.0619	0.0709**		0.0155	0.0025	0.9308***	0.9703***	
Control	(-0.180)	(0.944)	(0.586)	(-0.882)	(0.591)	(0.192)	(2.497)	0.0086 (0.279)	(0.562)	(0.142)	(20.594)	(7.193)	
		<0.929>		<0.809>		<0.012>		<2.043>		<0.252>		<0.064>	
General and Services (6)													
	0.2442***	-0.0981	-0.0167***	0.0532	0.3310***	3.4042***	0.0942***	-0.0372	0.0698	0.0020	0.8219***	-0.3874	
Treatment	(3.912)	(-0.778)	(-2.665)	(0.893)	(2.728)	(3.069)	(5.552)	(-1.002)	(1.443)	(0.043)	(21.226)	(-0.840)	
		<5.753>**		<1.373>		<7.603>***		<11.190>***		<0.943>		<6.757>	
	-0.0082	0.064	0.001	-0.0156	0.1004	0.0346	0.1355***	0.0034	-0.044*	0.0253	0.8801***	0.9620	
Control	(-0.158)	(0.504)	(0.142)	(-0.227)	(1.319)	(0.275)	(4.212)	(0.139)	(-1.649)	(0.682)	(29.269)	(8.621)	
		<0.276>		<0.056>		<0.129>		<14.606>***		<2.126>		<0.496>	

Notes: This table presents the GJR-GARCH estimates of the Heaviside indicator approach for both treatment and control groups of industrial portfolios. The sample details are given in Appendix 3.7.A, and the same basic estimation techniques are in Appendix 3.6.A.

In particular, the estimated mean equation is given by equation (3.5b) as: $R_{it} = \alpha + \mu\sigma_t^2 + \left[\varphi_{0,1} I_t + \varphi_{0,2}(1 - I_t) + \left(\varphi_{1,1} I_t + \varphi_{1,2}(1 - I_t)\right)\sigma_t^2\right] R_{it-1} + \varepsilon_t$. The variance equation is given by equation (3.6d) as: $\sigma_t^2 = \alpha_{0,1} I_t + \alpha_{0,2}(1 - I_t) + \left[(\alpha_{1,1} I_t + \alpha_{1,2}(1 - I_t)\right]\varepsilon_{t-1}^2 + [(\gamma_1 I_t + \gamma_2(1 - I_t)]X_{t-1}\varepsilon_{t-1}^2 + [(\beta_1 I_t + \beta_2(1 - I_t)]\sigma_{t-1}^2$.

The following hypotheses on the equality of the estimates of six key coefficients in the pre- and post-period are tested by Wald statistics, which are reported in the angle brackets <>: $H_{0,1} : \varphi_{0,1} = \varphi_{0,2}$, $H_{0,2} : \varphi_{1,1} = \varphi_{1,2}$, $H_{0,3} : \alpha_{0,1} = \alpha_{0,2}$, $H_{0,4} : \alpha_{1,1} = \alpha_{1,2}$, $H_{0,5} : \gamma_1 = \gamma_2$, and $H_{0,6} : \beta_1 = \beta_2$. The *t*-statistics that test on the equality of the estimated coefficients of conditional feedback trading in the post-period between treatment and control groups for four portfolios are shown in the rightmost column. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Chapter 4: Short-selling and Margin-trading Activities, Feedback Trading and Stock Returns Volatility

4.1 Introduction

4.1.1 Motivation

When financial crisis and market collapse comes, short selling and margin trading always intrigue debatable arguments among regulators, academics, and investors. As credit trades, short sellers and margin traders are usually blamed for causing massive declines, panic selling and unusual return growth. To deal with downturns in the market at the peak of crisis or to stabilise the market when it shows a sign of overheating, financial regulators frequently turn to restrictions on these two types of mechanisms, sometimes even impose bans. On the other hand, the existing literature mostly suggests that short selling is a necessary tool to correct the mispricing when prices drift away from its fundamental values, and both of short selling and margin trading contribute to the efficient function of stock markets (Saffi and Sigurdsson 2010, Bris *et al.* 2007, Chang *et al*. 2007, Beber and Pagano 2013, Chang *et al.* 2014; Wei and Li 2016). Most of the research concludes that constraints on short selling lead to decreased liquidity and a higher level of volatility, both of which are detrimental to the market quality.

With more rigorous attitude towards short selling and margin trading around the world, Chinese authorities at its first time approve trades on margin in the domestic stock markets. On March 31, 2010, the China Securities Regulatory Committee (CSRC) formally launched the long-awaited pilot scheme of short selling and margin trading in the A-share market. A designated list of 90 blue-chip stocks on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) starts to be eligible for short-selling and margin-trading transactions. The uniqueness of this event is that short selling and margin trading are introduced at the same time. As an event study, Chapter 3 analyses the impact of the dual introduction on feedback trading behaviour and stock returns volatility among object stocks. With separate activity data of these

two mechanisms, this chapter aims to distinguish the impacts between short selling and margin trading on feedback trading and volatility. Besides, we further explore that whether the different groups' trading behaviour of margin investors, *i.e.*, retail and institutional traders, makes different impact on feedback trading and returns volatility.

4.1.2 Gaps and Contributions

Except for the most recent literature which can get access to a higher frequency data under reg-SHO, previous US-focused studies can only adopt monthly data of short-selling activity. While previous literature of short selling and margin trading typically considered US data, our research adopts the daily information of short selling and margin trading of Chinese A-shares. As the Chinese stock market is a major financial market in the burgeoning Asian region, its study would provide an interesting alternative perspective to the previous US-centric studies. This study contributes to the academic literature in the following ways:

First, we extend the literature by studying the distinct impacts of short-selling and margin-trading activity on feedback trading behaviour. Despite the interests of short selling and margin trading in recent years, there is little evidence in the literature on what short sellers and margin traders do. Diether e*t al.* (2009a) investigate trading strategies adopted by short sellers in the US, finding that short-selling activity is strongly positive to previous returns. This indicates that short sellers trade on short-term price overreactions. Our paper studies the issue from another perspective. With daily data of short-selling activity, we aim to see whether the activity level of short selling causes changes to the degree of feedback trading behaviour. As for the literature of margin trading, we are the first to study the relationship between margin-trading activity and feedback trading behaviour.

Second, our study extends the literature of volume-price relationship with activities of short selling and margin trading. The positive relationship between spot-trading volume and stock price volatility is well-documented in the equity literature. Chordia and Swaminathan (2000)

provide evidence that the relationship between past stock returns and stock trading volume is attributed to the rate at which the stock incorporates information. Henry and McKenzie (2006) claim that the volume-price relationship, the relationship between stock price volatility and trading volume is nonlinear and asymmetric, and one important source of this asymmetry arises from activities of traders in the market who engages in short selling. In their paper, the question about whether the volume-price relationship responds differently to short-selling activity is tested at the very first time. The relationship between stock price volatility and short-sales volume in the Hong Kong stock market is investigated. However, three dummy variables are adopted to study the presumed relationship. This approach makes the results of their work general, leaving a pronounced gap in the literature. With the daily activity of short selling (margin trading), we are the first paper that investigates the long-horizon impact of the daily activity of short selling (margin trading) on stock returns volatility.

Third, we further study the impact differences between the trading activity of retail margin investors[3] and that conducted by institutional margin investors on feedback trading behaviour and stock returns volatility. A large body of literature documents that retail and institutional investors react differently to past price performance, and their trading involves momentum and contrarian strategies. Our study extends the literature by focusing retail and institutional investors' trading on certain types of trading mechanisms - short selling and margin trading.

4.1.3 Research Questions

Our study aims to investigate the relationships between short-selling (margin-trading) activity, feedback trading behaviour and stock returns volatility with the event of 2010 dual introduction of short selling and margin trading in the Chinese stock market. The accessibility of several types of activity data of trades on margin enables us to investigate the relationships further. The research questions are as follows:

[3] Margin investors infer to investors who make investment on a margin account. They are either short sellers or margin traders in the Chinese A-share market in the current study.

Question 1: Whether and to what extent the level of short-selling activity influences the degree of feedback trading and the level of stock returns volatility?
Question 2: Whether and to what extent the level of margin-trading activity influences the degree of feedback trading and the level of stock returns volatility?
Question 3: Whether and to what extent the relative ratio of short-selling to margin-trading activities influences the degree of feedback trading and the level of stock returns volatility?
Question 4: Do short-selling and margin-trading activities conducted by retail investors affect feedback trading behaviour and stock returns volatility differently from that conducted by institutional investors?

The major findings of this study are summarised as follows. We find no evidence that activity of short selling (margin trading) increases positive feedback trading among studied stocks and market indices, but we document an increasing impact of short-selling activity on negative feedback trading. As for stock returns volatility, short-selling activity seems to have a slightly decreasing impact on volatility, while margin-trading activity has a significantly increasing impact. After being scaled by margin-trading activity, the results of short-selling activity on feedback trading and returns volatility keep unchanged. The number of margin account separately opened by retail and institutional investors has no significant impact on feedback trading during stable and bullish periods. When the growth rate of account number held by institutional investors is greater than their counterparts, the level of returns volatility decreases. During downturns and crash periods, the participation of retail margin investors leads to a higher level of negative feedback trading in the market.

The rest of the study is organised as follows. The next section briefly discusses the literature of the relationships between the activity of short selling (margin trading), feedback trading and stock returns volatility. Section 4.3 describes the data set and Section 4.4 describes the methodology adopted. Section 4.5 presents the empirical findings and discusses these findings. Results of robustness tests are also given in this section. Section 4.6 concludes the study.

4.2 Literature Review and Hypothesis Development

4.2.1 Short-selling Activity, Margin-trading Activity and Feedback Trading

Delong *et al.* (1990) argue that the strategy of positive feedback trading is irrational, which leads to significant deviations in stock prices. On the contrary, some argue that traders need a certain amount of time to absorb new information in the market, so the current market price does not reflect all information. In this case, the positive feedback trading behaviour among investors may be rational. Badrinath and Wahal (2002) find that when the positive feedback behaviour leads to price deviations from its fundamental value, the rational arbitrageurs correct this bias with the help of negative feedback strategy, and the positive feedback traders cannot arbitrage from trading anymore. However, it is generally believed that both strategies of positive feedback trading and negative feedback trading are irrational since both of them could cause price deviations from a stock's fundamental value.

Short-selling activity and feedback trading

In the academic literature, short sellers are widely viewed as informed traders (*e.g.*, Dechow *et al.* 2001, Christophe *et al.* 2010, Karpoff and Lou 2010, Shkilko *et al.* 2012, Engelberg *et al.* 2012, Kecskés *et al*. 2013). With the initial model of Diamond and Verrecchia (1987), the informedness of short sellers has been extensively examined. Dechow *et al*. (2001) find that short sellers are able to use information beyond low fundamental-to-price ratio, which directly implies temporary stock overpricing. The evidence manifests that short sellers avoid shorting stocks with low fundamental-to-price ratio when the low ratio is attributable to momentarily low fundamentals. This result is consistent with the hypothesis of Lakonishok *et al.* (1994) that naive traders are likely to be over-optimistic about the future returns of stocks with low fundamental-to-price ratios. In addition to the ability to predict future stock performance, Diether *et al*. (2009b) discover that short sellers are able to recognise transient market overreactions. All these evidences indicate that short sellers are sophisticated traders who play a critical role in keeping stock prices in line with fundamentals.

While Diether et *al.* (2009a) show that short sellers are contrarian traders in both contemporaneous and past returns, Blau *et al.* (2010) find that short selling increases on large down days and decreases on large up days suggesting that during extreme market movements, short sellers tend to follow the crowd. In chapter 3, we have examined the introduction of short selling on feedback trading behaviour. In this chapter, however, with daily data of short-selling activity, we aim to explore the relationship between the magnitude of short-selling activity and feedback trading behaviour. Since short sellers are widely accepted as informed traders in previous literature, we conjecture that daily short-selling activity contains useful information about the stock's fundamental value. Thus, we here propose that short-selling activity decrease positive feedback trading rather than increase it.

Margin-trading activity and feedback trading

Due to the relatively high costs of margin transactions, margin traders receive similar comments as to short sellers. Both of these two types of investors are considered as sophisticated traders in stock markets. However, the literature in margin-trading activity is very rare. With weekly data of margin transactions at firm-level, Hirose *et al*. (2009) study the Japanese market and document that margin traders follow positive feedback trading for small-firm stocks while follow negative feedback trading for large-firm stock. The study object of our study is the 90 blue-chip stocks designated in the pilot scheme of margin transactions. Thus, we propose that margin-trading activity in the current A-share market should lead a lower level of positive feedback trading behaviour among investors. Building on the above arguments, we propose the empirical hypothesis as follows:

Hypothesis 1a: Short-selling activity inhibits positive feedback trading behaviour.
Hypothesis 1b: Margin-trading activity inhibits positive feedback trading behaviour.

4.2.2 Short-selling Activity, Margin-trading Activity and Stock Returns Volatility

Positive feedback trading behaviour can induce autocorrelations and increase volatility in stock returns. If a large number of market participants are involved in positive feedback trading strategies, stock prices will deviate markedly and persistently from their fundamental values. Recent studies present evidence of positive feedback trading (*i.e.*, buying during market upsides and selling during market declines) in developed stock markets. Koutmos and Saidi (2001) find positive feedback trading existing in emerging stock markets as well, but mostly during market declines. During bearish periods, stock returns autocorrelations become negative, and volatility rises substantially. The volatility level is in all cases higher during market declines, suggesting that feedback trading behaviour may be partially responsible. As mentioned in the previous section, we argued that both short-selling and margin-trading activities decrease positive feedback trading behaviour. Thus, we are reasonable to speculate that the activities of these two mechanisms would lead to a lower level of volatility in stock returns.

Short-selling activity and stock returns volatility

We now consider the short selling literature. As one of the essential links in the chain of financial innovations, short selling is viewed as an indispensable mechanism of the stock market. Short-selling transactions not only prominently promotes liquidity of the stock exchanges, but also provides an efficient channel for price discovery. Miller (1977) shows that when short sales ban exists and market traders hold heterogenous beliefs, traders without corresponding advanced information of the stock are not able to reflect pessimism into the stock price. In consistent with Miller (1977), Hong and Stein (2003) find that short sales constraints make the information absorbing progress in stock prices much slower. For this reason, stock prices cannot fully reflect the market information, especially the negative ones. Further, Bris *et al*. (2007) find that after the lifting of the short sales ban, the negative information is much easier to be reflected into stock prices and the frequency of stock crash is lower. Although these studies do not provide direct evidence between the relationship of short-selling and stock returns volatility, we can see the implications behind these findings clearly: taking the long view, short-selling activity would not lead to raises in the volatility level.

A branch of literature studies the relationship between short sales bans/restrictions and stock returns volatility. They find evidence that short sales ban/restrictions would not help inhibit volatility increasing in stock returns, especially during the decline periods (*e.g.*, Ho 1996; Scheinkman and Xiong 2003; Boulton and Braga-Alves 2010; Bohl *et al.* 2012). However, two studies find the contrary findings in the Hong Kong market. Henry and McKenzie (2006) and Chang *et al.* (2007) document that after the ban lifting of short selling on a list of stocks, the market exhibits greater returns volatility and volatility asymmetry. Only a few of studies investigate the relationship between short-selling activity and volatility. Liao and Yang (2005) investigate the relationship between short selling and stock prices in the Taiwanese stock markets, and they find a long-term stable cointegration between short-selling transactions and the stock index. Short selling mechanism does not exacerbate the volatility of the stock market. Using daily short sales data in the Turkish market, Sobaci *et al*. (2014) find increased short-selling activity is associated with decreased volatility under the unconditional volatility proxy. These studies argue that short sellers are informed traders who can provide efficient information to the market price, and in the long-run, it would help market stability. In our work, we adopt the conditional measure of volatility, and we propose that short-selling activity has a negative relationship with the volatility level.

Margin-trading activity and stock returns volatility

Studies focus on margin-trading activity and stock returns volatility are rare. In the literature, however, a branch of work studies the relationship between margin introduction and stock returns volatility. Seguin (1990) studies the addition of OTC issues to the marginable list, finding that even though margin eligibility has produced an extra 30% volume, both volatility and noise decrease. Seguin and Jarrell (1993) document that marginable stocks in NASDAQ decreased less than their counterparts during the 1987 crash, and claim that margin-trading activity conduces to market stabilisation even during the market downturns. While Alexander *et al.* (2004) find no significant impact of margin introduction on volatility, the flow of information, liquidity, and market depth all have been improved substantially upon the introduction. Due to its potential role of speculation involvement, margin trading has been viewed as a destabilising mechanism in traditional wisdom. But all extant empirical studies seem to take the side of margin trading. We thus propose that there is a negative relationship

between margin-trading activity and stock returns volatility. Therefore, we propose the hypothesis as the following:

Hypothesis 2a: Short-selling activity has a negative relationship with stock returns volatility.
Hypothesis 2b: Margin-trading activity has a negative relationship with stock returns volatility.

4.2.3 Margin Account Ownership, Feedback Trading and Stock Returns Volatility

Scholars are often intrigued by the trading behaviour of retail and institutional investors in the financial markets. There is a plenty of evidence shows that previous price performance brings strong impacts on how retail and institutional investors trade. The existing studies show that retail and institutional investors systemically exhibit different reactions to previous price performance and in the degree to which they follow positive feedback trading or negative feedback trading strategies. In this section, we study this issue by concentrating the research objects only with margin investors (short sellers and margin traders).

Retail margin investors, feedback trading and stock returns volatility

In finance literature, retail investors have long been considered as noise traders. Tons of studies investigate the trading behaviour of retail investors from various perspectives, and many of them argue that retail investors are less informed and usually trade for non-informational reasons. For example, Barberis and Xiong (2009) demonstrate that the disposition effect is one of the most robustly key facts about trading behaviour of retail investors[4]. Ng and Wu (2007) study the Chinese stock markets to analyse the trading behaviour of 4.74 million individual and institutional investors across Mainland China. Their results show that only trading activities of

[4] The disposition effect refers to the tendency of market investors to sell stocks that have increased in value, while keeping stocks whose price has declined.

institutions and wealthiest individuals can affect future stock's trend, but Chinese retail investors at large have no predictive power for future stock returns.

To my best knowledge, only one study in the literature of margin trading and short selling has investigated the relationship between retail margin investors (including margin traders and short sellers) and their trading strategies. With weekly data of Japanese stocks at both stock-level and market-level analysis, Hirose *et al*. (2009) find that retail margin traders exhibit positive feedback trading, and this finding is strongly significant for small-firm stocks. But no evidence is shown that retail short sellers follow positive feedback trading. From the above argument and empirical findings, we conjecture that individual margin investors are less informed/sophisticated traders who are more vulnerable to market trends compared to their institutional counterparts. Thus, we propose that there is a positive relationship between trading activities of retail margin investors and positive feedback trading/stock returns volatility.

Institutional margin investors, feedback trading and stock returns volatility

The literature of the U.S. market indicates that institutions are more prudent investors and are more likely to invest in large-cap and high-liquid shares, and they exhibit a clear preference for stocks with low volatility (*e.g*., Arbel *et al.* 1983; Falkenstein 1996; Han and Kumar 2008). However, the findings of the relationship between institutional trading and positive feedback trading have mixed results. Grinblatt *et al*. (1995) document that 77% mutual funds are partial momentum traders, buying stocks that are past winners, but most of them did not sell past losers. Whereas Lakonishock *et al*. (1992) find that pension managers do not strongly follow feedback trading strategies. But one general perception is that institutional investors are rational traders compared to their retail counterparts, as institutions are more likely to have more information channels for future changes in stocks' values (*e.g*., Grinblatt and Titman 1989, 1993; Daniel *et al*. 1997; Nofsinger and Sias 1999; Wermers 1999, 2000; Chen *et al.* 2000; Chen *et al.* 2001; Bennett *et al*. 2003; Boehmer and Kelley 2009).

There are also a few of papers focus on the Chinese market. Ng and Wu (2007) analyse the trading behaviour of 4.74 million retail and institutional investors across Mainland China. Their results indicate that Chinese institutional investors are momentum traders, whereas less-wealthy retail investors at large are contrarian investors. Besides, a small group of wealthiest retail investors tend to behave like institutions when purchase stocks, and behave like less-wealthy individuals when sell. However, Li and Wang (2010) find a negative relationship between institutional trading and volatility in the domestic markets. And they document institutional investors do not systematically adopt the positive feedback trading strategy. In brief, Chinese institutional investors are as prudent as their U.S. counterparts, and more likely to invest in large-cap and less-risky stocks.

The most recent empirical literature of short selling in the U.S. assumes that short-selling activity depends on stock ownership by mutual funds and institutions (*e.g.*, D'avolio 2002, Asquith *et al*. 2005, Nagel 2005, Kot 2014). These works assume either that most shares of lendable stocks are from institutional owners or that the number of institutions holding a particular stock is a proxy for heterogeneous expectations. There are very few studies have covered the issue of the strategies adopted by institutional margin investors. Boehmer *et al.* (2008) find that around 75 percent of short sales are executed by institutional investors, while retail investors only represent less than 2% in the U.S. market. They argue that since the majority of short sellers in the market are institutions, short sellers as a group are supposed to be more sophisticated traders. With data from the Taiwanese stock markets, Lin and Lin (2014) document that institutional margin traders exhibit positive feedback trading in large declines and price rises. Although the empirical results about our study question seem somewhat mixed, we still get enough reasons to consider institutional investors at large are well-informed and more sophisticated than their retail counterparts. We thus develop our third hypotheses as follows:

Hypothesis 3a: The retail margin investors have an increasing impact on positive feedback trading behaviour and stock returns volatility.

Hypothesis 3b: The institutional margin investors have a decreasing impact on positive feedback trading behaviour and stock returns volatility.

4.3 Data

4.3.1 Sample Data

The introduction date of short selling and margin trading to the Chinses A-share market is 31/03/2010. The sample range of short-selling and margin-trading activities data in this study is four years from 31/03/2010 to 31/03/2014. Although activity data is in available to early 2016, we chose to exclude the crash time in the A-share market of 2015 to 2016, and keep the sample window as the same in the first empirical chapter. Four types of activity data of short selling and margin trading are adopted. The activity data of short selling includes: (1) the short interest/the (circulated) market value and (2) the short-sales value/total trading value, while for margin trading, they are (3) the margin interest/the (circulated) market value and (4) the margin-loans value/total trading value, are obtained from the WIND database. The daily adjusted closing price and total market capitalisation of all stocks list in the A-share market including the first batch of 90 designated stocks are collected from Datastream.

However, only the data of 76 stocks on the originally designated list is used. Two issues cause this significant data loss. Firstly, 13 stocks among 90 stocks in the first batch have been deleted at least once during our sample span of the continuous reform implementation (see Appendix 4.1). In order to maintain data continuity and to avoid data contamination, the data of those stocks are excluded once it has been deleted from the designated list, no matter whether it re-joins the list in a later batch or not. Besides, one stock in Shenzhen Stock Exchange delisted from the stock market, so no more trading data is available. Thus, we have daily data of 76 individual stocks adopted.

4.3.2 Descriptive Statistics

Among all 76 treatment stocks, 43 of them are from the Shanghai 50 Index and the rest 33 are from the Shenzhen 40 Index. As mentioned in McKenzie *et al.* (2001), analysis of stock indexes is useful in assessing market-wide impacts, but effects on the underlying can be dissipated across stock constituents in the index, making the true effect hardly to be detected. Hence, the influence of short selling and margin trading on feedback trading and volatility dynamics might be more noticeable at the individual stock level. Thus, we carry on the investigation with individual stock data. Also, the portfolio index (SS & MT Index) and the market level index (A-share Index) is used. With the development of the introduction scheme of short selling and margin trading in 2010, the total number of stocks on the designated list for the two newly introduced mechanisms have been expanded from 90 stocks to 900 stocks by 22/09/2014. As an equally-weighted portfolio, the SS & MT Index, which contains all shortable and marginable stocks at the moments is calculated for this study.

The descriptive statistics of the remaining 76 stocks together with two indexes are separately provided in Appendix 4.1. The daily stock returns are calculated as the logarithmic difference $R_t = 100 \times \ln(P_t/P_{t-1})$. The statistics of individual stocks including the mean return, the minimum and maximum return, the standard deviation, skewness, excess kurtosis, the Jarque-Bera statistic, the Ljung–Box statistics LB(10), the ARCH test, together with the JOINT test are reported in Panel A in Appendix 4.1. Table 4.1 in the main body of the text is used to provide descriptive summaries of individual stock returns data with both the average value and the percentage of significance. Panel B and C are the immediate descriptive statistics for the two indexes.

With statistical results concerning the shape of the distribution of the data, we can easily see that the distributions of adopted stock returns departure from normality. More than half of stocks display significant skewness, and all stocks show significantly excess kurtosis in both groups. The conclusion of non-normal returns distribution is also strongly supported by significant JB statistics of all stocks. Although only less than one-third results of the Ljung-Box $\chi 2$ statistics for ten lags for individual stocks display significance, significant LB(10) are found for both two indexes returns. This indicates significant temporal dependencies in the first moment of portfolio returns distribution. The results of ARCH statistics for both individual stocks and indexes returns show a level 100% significance, which implies that there are still

temporal dependencies in the higher moment of the return distribution. The results of the JOINT test show that only 15.79% individual stocks show significant asymmetries in conditional volatility, which suggests that the basic GARCH model fit the Chinese stock returns data even better than the more complicated asymmetric ones. This can be supported by the insignificant results at the portfolio and market level. A common understanding is that feedback trading behaviour leads to autocorrelations of stock returns. To examine its legitimacy, a simple autoregressive model AR(5) is estimated and reported. The coefficient results of serial correlations at different lags are quite low, but the result with lag t =1 shows the highest level of significant autocorrelations in stock returns series (27.63%). Nevertheless, further investigation is required to examine the extent of interaction between serial correlations and volatility.

Table 4.1 Descriptive statistics of daily stock returns

	Skew	Kurt	JB	LB(10)	ARCH	JOINT	Serial corr at lag 1
A：Individual Stocks (76)							
Percentage of Significance	65.79%	100.00%	100.00%	39.47%	100.00%	15.79%	27.63%
B：Portfolio Level (1)							
SS & MT Portfolio	-0.870***	3.961***	1135.793***	12.296*	46.972***	3.317	0.018
C：Market Level (1)							
A-share Index	-0.595***	1.701***	261.511***	14.336**	159.201***	1.308	0.013

Notes: The sample period is from 31/03/2010 to 31/03/2014. The observations of each time series are 1456. The percentage of statistical significance in this table includes statistics with significance at the levels of 10%, 5% and 1%. Details of all related statistics are presented in Appendix 4.1.

Table 4.2 shows the basic summary statistics of daily short-selling and margin-trading activities, with four different measures presented. It is easy to notice that the trading amount of margin trading is obviously larger than that of short selling. At the individual stock level, the mean value of the short turnover is 1.823%, while for margin turnover is 10.839%. At the index level, the total daily short turnover is minor at 0.745%, while the total daily margin turnover is more than eight times of its counterpart at 6.098%.

To study the fourth question, monthly data of the number of margin account opened by retail and institutional investors are collected from the WIND database. The statistics of monthly

ownership of margin account are presented in Table 4.3. We use the number of margin account separately owned by retail and institutional investors to see whether the number differences of these two types of account influence feedback trading behaviour and stock volatility in a different way. It is known that the number of observations is supposed to be sufficient for GARCH-type estimation; however, in terms of this data type, only 68 observations can be used

Table 4.2 Summary statistics of daily short-selling and margin-trading activities

	Mean	Min	Max	S.D.
A：Individual Stocks (76)				
A1: Short-selling Activities				
The short interest ratio (%)	0.020%	0.000%	0.086%	0.019%
The short-sales ratio (%)	1.823%	0.000%	14.402%	2.174%
A2：Margin-trading Activities				
The margin interest ratio (%)	1.971%	0.001%	7.501%	1.670%
The margin-loans ratio (%)	10.839%	0.000%	42.669%	8.000%
B：SS & MT Portfolio (1)				
B1: Short-selling Activities				
The short interest ratio (%)	0.010%	0.000%	0.029%	0.008%
The short-sales ratio (%)	0.745%	0.000%	3.627%	0.729%
B2：Margin-trading Activities				
The margin interest ratio (%)	1.334%	0.000%	4.721%	1.288%
The margin-loans ratio (%)	6.098%	0.002%	19.258%	5.207%

Notes: The sample period of short-selling and margin-trading activities is from 31/03/2010 to 31/03/2014. The observations of each time series are 1456. The original data of the four ratio measures at individual stock level is downloaded directly from WIND database, while the ratios at portfolio level are calculated by the author.

Table 4.3 Statistics of monthly ownership of margin account

Sample period	31/01/2011 - 31/03/2016		Observations	68
	Mean	Min	Max	S.D.
A：Retail Investors				
The final total account	2,529,966	49,200	7,528,404	2,093,700
The newly opened account	123,237	6,743	723,262	131,085
B：Institutional Investors				
The final total account	5,293	277	12,917	3,515
The newly opened account	263	40	890	180

Notes: The sample range of monthly ownership of margin account is from 31/01/2011 to 31/03/2016. The observations of each time series are 68. For each type of margin account, two types of data are available, which are both presented in the table.

Table 4.4 Statistics of daily degree of participation in margin transactions

Sample period	24/05/2015 - 31/03/2016		Observations	222
	Mean	Min	Max	S.D.
Retail Investors	3,903,175	3454057	4,068,000	147,686
Institutional Investors	7435	6151	8361	605

Notes: The sample range of daily degree of participation in margin transactions is from 24/05/2011 to 31/03/2016. The observations of each time series are 222.

since the very start of short selling and margin trading to the current date. We thus adopt a daily dummy variable to measure the relative account number between the two different groups of investors. Nevertheless, in a later robustness test, we adopt daily data of degree of participation of retail investors and institutional investors in margin transactions, which is presented in Table 4.4. Although the sample period is only available for ten months, the observations are 222, which is sufficient for a GARCH regression.

4.4 Methodology

4.4.1 The Baseline Model

Like the first empirical chapter, the heterogenous model (Sentana and Wadhwani 1992) is adopted as the baseline model in this chapter. With the results of GARCH specification presented in Appendix 4.2.A and 4.2.B, a combination of the heterogeneous trader model and the basic GARCH (1,1) model is used:

$$R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{t-1} + \varepsilon_t \quad (4.1a)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (4.1b)$$

4.4.2 Short-selling and Margin-trading Activities

To study the impact of short-selling (margin-trading) activity on feedback trading behaviour more precisely, in this study we apply activity data of each type of margin transactions into the original feedback trading model as in (4.2a). The coefficient φ_0 presents unconditional autocorrelations induced by potential market frictions. The coefficient $\varphi_1 = -\gamma\mu$ captures the conditional autocorrelations caused by feedback trading, which is linked closely to the level of volatility in stock returns. A significantly negative value of φ_1 implies a phenomenon of positive feedback trading, while a significantly positive one implies negative feedback trading. The conditional positive feedback trading is what we focus in this study, since it amplifies price deviations from its fundamental in times of high conditional variance, which could lead to market depression as a result. φ_2 is the conditional autocorrelations associated to margin activities.

Schwert (1990) initiates a model involving an iterative procedure that allows for unbiased estimation of daily standard deviations conditional on observable variables. To evaluate relationships between futures trading activity and stock price volatility, Bessembinder and Seguin (1992) include several activity variables to the standard deviation equation of Schwert's model, for instance, the spot-trading volume, the futures trading volume and the open interest of futures trading. Similar to Bessembinder and Seguin (1992), we integrate trading activity elements of short selling (margin trading) to the variance equation as in (4.2b**):**

$$R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 A_{t-1}\sigma_t^2)R_{t-1} + \varepsilon_t \qquad (4.2a)$$

$$\sigma_t^2 = (1 + \gamma A_{t-1})(\alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2) \quad (4.2b)$$

Where the A_{t-1} denotes the activity of short selling (margin trading) at t-1. Taking short selling for instance, a significantly negative φ_2 means that short-selling activity brings about more feedback trading behaviour, while a significantly positive γ indicates a higher level of stock volatility along with short-selling trades.

4.4.3 The Relative Importance of Short-selling and Margin-trading Activities

In this model, the variable of the activity level of short selling (margin trading) is replaced by a relative ratio of short turnover to margin turnover, which suggests the relative trading magnitude of short selling to margin trading. The model, therefore, is written as:

$$R_t = \alpha + \mu \sigma_t^2 + \left[\varphi_0 + \varphi_1 \sigma_t^2 + \varphi_2 \frac{SS_{t-1}}{MT_{t-1}} \sigma_t^2\right] R_{t-1} + \varepsilon_t \quad (4.3a)$$

$$\sigma_t^2 = (1 + \gamma \frac{SS_{t-1}}{MT_{t-1}})(\alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2) \quad (4.3b)$$

Where the $\frac{SS_{t-1}}{MT_{t-1}}$ is the relative change of short turnover to margin turnover at t-1. A significantly negative φ_2 indicates that short-selling activity leads to more positive feedback trading behaviour. A significantly positive γ indicates that a higher level of short-selling activity increases the volatility level in stock returns.

Further, the impacts of short-selling (margin-trading) activity on feedback trading and returns volatility are investigated at three different levels in our study: the individual stock level, the portfolio level which covers all eligible transactions of shortable (marginable) stocks at the moment, and the market level which contains but is not limited to all designated shortable

(marginable) stocks. Almost all studies in the literature that examine short selling and its impact on the stock market is at the individual stock level. And the consensus is short sellers are contrarian traders. There have been only a few studies which attempted to analyse such relationship at market level. This is quite surprising because aggregate shorting may be a better indicator of short-selling activity in the market. As emphasised by Lamont and Stein (2004), it is true that under certain situations some stocks could be difficult to go short, but it is not necessary to be the same case for others. The authors construct aggregate measures of short selling and investigate their relationships with the market return. Their results demonstrate that total short interest is negatively correlated with the market index. Since Lamont and Stein (2004) use low-frequency data, questions arise regarding the extent to which the results reflect implications of short-selling activity to the market. To improve this data disadvantage, Lynch *et al*. (2014) investigate whether aggregate short-sales contain information about future market returns with daily shorting data. They also find that short sellers trade with the market but not against. The conclusions of both studies are intriguing as they reveal that short sellers in the aggregate are not contrarian traders. This finding is in sharp contradiction with suggestions of cross-sectional studies. The substantial differences between implications of the cross-sectional and aggregate-level studies about short selling highlight the need for further analysis in this issue.

4.4.4 Margin Account Ownership

The margin account in the Chinese stock market is currently designed to do margin trading, short selling, and normal stock transactions as normal stock accounts. However, unlike the margin rules in Japanese and Taiwanese stock markets, where cash deposit is a compulsory part of margin, the whole margin can be structured only with securities collateral under the margin regulations in the A-share market. Besides, an individual investor who wants to apply for a margin account is required to own a normal stock account firstly. After at least six-month investment experience with normal stocks via normal account, he then is allowed to apply for a parallel margin account, which is used as an account mainly for short-selling and margin-trading transactions. It is worthy to note that margin investors are required to keep their normal account even after they have opened the margin one. In this case, if any of them want to do

normal stock trading as the same time with short selling and margin trading, they will normally carry on normal stock trading via the normal account rather than the margin one.

To study the fourth research question, we integrate the element of the margin account number of different groups into the baseline model. In this model, a dummy variable is adopted to suggest the relative account number of retail to institutional investors. The model is written as:

$$R_t = \alpha + \mu\sigma_t^2 + [\varphi_0 + \varphi_1 D_{t-1}\sigma_t^2 + \varphi_2(1 - D_{t-1})\sigma_t^2]R_{t-1} + \varepsilon_t \quad (4.4a)$$

$$\sigma_t^2 = (\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)[1 + \gamma_1 D_{t-1} + \gamma_2(1 - D_{t-1})] \quad (4.4b)$$

Where the D_{t-1} is equal to one, when the growth number of retail account is greater than that of institutional account, and zero otherwise. The turnover of account measures of retail investors and institutional investors are calculated and used.

4.4.5 Robustness and Alternative Measures

Estimation results of asymmetric GARCH-type model

Further estimations are undertaken to check the robustness of our results. Besides the basic GARCH (1,1) model, the log-likelihood ratio statistic indicates that GJR-GARCH (1,1) is the second prior model for our study (see Appendix 4.2.A and B). The GJR-GARCH version of the feedback trading model with short-selling (margin-trading) activity is:

$$R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 A_{t-1}\sigma_t^2)R_{t-1} + \varepsilon_t$$

(4.5a)

$$\sigma_t^2 = (1 + \delta A_{t-1})(\alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma X_{t-1} \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2) \quad (4.5b)$$

With an additional asymmetry coefficient γ, the GJR-GARCH version of the feedback trading model with short-selling (margin-trading) activity allows for asymmetric responses of volatility to news innovations. The estimated parameters for individual stocks and the two indices along with *t*-statistics are reported in Table 4.9.

Degree of participation in margin transactions

As for the margin account ownership model, we use the number of margin account owned by retail and institutional investors to see whether the difference in these two groups' margin accounts influences feedback trading behaviour and stock volatility differently. But for the monthly data of the number of the margin account, only 68 observations can be applied to the GARCH model during our sample range. We thus, in the robustness test, adopt daily data of degree of participation of retail investors and institutional investors in margin transactions to study the fourth research question further. Although the sample period of this data is only available for ten months, the observations are 222, which are sufficient for a GARCH regression. The estimated parameters for both the SS&MT index and the A-share index, along with *t*-statistics are reported in Table 4.10.

4.5 Empirical results

4.5.1 Evidence on Feedback Trading

As can be seen in Table 4.5, the regression results of the basic feedback trading model show no significant feedback trading behaviour among the majority of the studied 76 blue-chip stocks (94.74%). Only 3.95% of the studied stocks show significantly positive feedback trading, while 1.32% stocks show negative feedback trading. Besides, neither the regression results of

the SS & MT Index nor the A-share Index display significance in the coefficient of feedback trading. Lakonishok *et al*. (1992) find some evidence of positive feedback trading in small stocks, but no evidence in the large ones, which usually take large proportion in the institutions' preferred holdings. One of the most obvious reasons for their finding is that window dressings are undertaken by fund managers. Fund managers tend to dump losers among small stocks rather than large stocks to dress up their portfolios, since sponsors are believed to be less sensitive to holdings of poor performing large stocks than to holdings of its small stock counterparts. Our results share the same rationale with Lakonishok's finding. Although it is well known that domestic Chinese stock market is a retail-dominated market, the rationale behind is not changed. In unstable investment environments, retail and institutional investors both tend to keep their positions in large leading stocks rather than small stocks, due to the stability that large stocks can provide. No surprisingly, then, almost no significant feedback trading behaviour among our studied blue-chip stocks are found.

Table 4.5 The baseline model at different levels: GARCH estimation results

A: Individual stocks (76)	φ_1		
	insig%	-%	+%
Percentage of Significance	94.74%	3.95%	1.32%
B: Portfolio Level (1)			
SS & MT Index	0.0052 (0.667)		
C: Market Level (1)			
A-share Index	0.0065 (0.806)		

Notes: The estimated mean equation is given by equation (4.1a) as: $R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.1b) as: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$. The estimated t-statistics are shown in parentheses. The percentage of statistical significance in this table presents statistics with significance at 10% level.

4.5.2 Short-selling and Margin-trading Activities

Being identical to our findings in the baseline model, the regression results of φ_1 with four measures of margin activities in Table 4.6.A show that the majority of stocks (84.21% - 96.05%) has no significant feedback trading behaviour. This finding, however, is inconsistent with findings in previous feedback trading studies of the general Chinese A-share market. By

studying five stock indices, Sutthisit *et al*. (2012) document significant positive feedback trading effect in the Shanghai A-share, the Shenzhen A- and B-share, and the Hong Kong H-share markets, but not in the Hong Kong red-chip stocks[5]. Their evidence suggests that positive feedback trading behaviour is strong in markets where retail investors constitute the majority, which is consistent with prior findings in other emerging and developed markets. Given red-chip H-share is an institution-dominated market, no significant positive feedback trading is found. This implies that different investor structure can cause different trading behaviour. As mentioned in the above section, the different share component of blue-chip stocks in our research may lead to different trading behaviour among investors.

In terms of short-selling activity, we find that short selling has an increasing impact on the degree of negative feedback trading, and a potentially decreasing impact on positive feedback trading among stocks at the same time. Although a percentage of 65.79% stocks shows insignificance on φ_2 with the measure of the scaled short interest, a percentage of 30.26% stocks, as the second conspicuous value, has a significantly positive φ_2 conditioning on insignificant φ_1. Similarly, a total percentage of 18.42% stocks is found positively significant on φ_2 with the measure of short turnover. These regression results imply that short-selling activity has a moderate increasing impact on negative feedback trading. Besides, for both measures of short-selling activity, there are only stocks with a significantly positive value of φ_2 conditioning on significantly negative φ_1. This further suggests that short-selling activity adds an opposing effect on the originally positive feedback trading exists among the studied stocks. Turning to Table 4.6.B, we can see that with the measure of short turnover, the estimated φ_2 of both indices show a significant positive value, which also implies an increasing impact on negative feedback trading.

Koutmos (2014) points out that the current literature of feedback trading has largely ignored negative feedback trading strategy. In general, the negative feedback trading strategy is a

[5] Red-chip stocks are the stocks of companies based in mainland China but are incorporated internationally and listed on the Hong Kong Stock Exchange. In 1992, Hong Kong-based economist Alex Tang coined the term "red chip" by substituting "blue chip" with the word red, which refers to the colour of the national flag of China.

pattern of contrarian investment behaviour. Like positive feedback trading, which theoretically drives stock price further from its fundamental value, the negative feedback trading behaviour also makes the market more volatile, since it is not a strategy based on the company's fundamentals. Our results show that short-selling activity leads to a higher level of negative feedback trading behaviour among studied stocks, which should be taken seriously by the regulator. For individual investors, negative feedback trading can refer to a pattern of behaviour in which a passive outcome, such as carrying on a losing trade, makes an investor start questioning his own skills and discourages him from continuing the trade. The positive relationship between short-selling activity and negative feedback trading in our study reveals that Chinese short sellers are still less experienced in the mechanism of short selling, and even worse, in an unmatured margin markets. To deal with it, a well-established trading system and sound regulations, and good supports of financial education to new investors in margin trades from the regulator side are essential. These can help investors maintain confidence and avoid falling into a negative feedback trading loop even when they are executing a losing trade.

As for the results of margin trading, a total percentage of 9.18% stocks shows significantly positive feedback trading on φ_2 with the scaled margin interest, while only 1.32% stocks show significantly negative feedback trading. With the measure of margin turnover, a percentage of 9.21% stocks has a negative φ_2, conditioning on positive φ_1 and a percentage of 3.95% conditioning on insignificant φ_1. In comparison, only one stock out of 76 shows significantly negative feedback trading. These results may imply that margin-trading activity has a moderate decreasing impact on negative feedback trading and a moderate increasing impact on positive feedback trading. With the measure of margin loan value at portfolio level in Table 4.6.B, the coefficient φ_2 of feedback trading behaviour turns to be insignificant, and there is no evidence showing that margin-trading activity increases positive feedback trading at the index level. Our results of margin-trading activity are mixed with different levels of data.

Regards to the impact of short-selling activity on stock returns volatility, short-selling activity seems to have a decreasing impact on volatility. With both measures of short selling, a percentage of 52.63% - 55.26% stocks having a significant negative value of γ. With the measure of short sale value at portfolio level in A, Table 4.6.B, a significantly negative value

Table 4.6.A The activity model at individual stock level: Percentage of significant coefficients of GARCH estimation results

A: Short-selling Activity (76)		**insig%**			**-%**			**+%**		
The short interest ratio	φ_1	96.05%			2.63%			1.32%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	φ_2	65.79%		30.26%			2.63%			1.32%
	γ	40.79%			52.63%			6.58%		
The short-sales ratio (The short turnover)	φ_1	92.11%			2.63%			5.26%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	φ_2	77.63%		14.47%			2.63%	1.32%		3.95%
	γ	32.90%			55.26%			11.84%		
B: Margin-trading Activity (76)		**insig%**			**-%**			**+%**		
The margin interest ratio	φ_1	89.47%			5.26%			5.26%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	φ_2	85.53%	2.63%	1.32%	2.63%	2.63%		1.32%	3.95%	
	γ	6.58%			1.32%			92.11%		
The margin-loans ratio (The margin turnover)	φ_1	84.21%			3.95%			11.84%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	φ_2	80.26%	3.95%		2.63%		1.32%	2.63%	9.21%	
	γ	40.79%			5.26%			53.95%		

Notes: The estimated mean equation is given by equation (4.2a) as: $R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 A_{t-1}\sigma_t^2)R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.2b) as: $\sigma_t^2 = (1 + \gamma A_{t-1})(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$. The percentage of statistical significance in this table presents statistics with significance at the 10% level.

Table 4.6.B The activity model at portfolio and index level

		φ_1	φ_2	γ
A: Short-selling Activity (2)				
The short interest ratio	SS & MT	-0.0027	0.0143	-0.0010
		(-0.299)	(1.301)	(-0.231)
	A-share	-0.0034	0.0140	-0.0034
		(-0.324)	(1.229)	(-0.904)
The short-sales ratio (The short turnover)	SS & MT	-0.0012	0.0002***	-0.0001**
		(-0.464)	(2.583)	(-1.960)
	A-share	-0.0003	0.0001**	-0.0002
		(-0.096)	(2.366)	(-0.909)
B: Margin-trading Activity (2)				
The margin interest ratio	SS & MT	-0.0083	-0.0001	0.0015**
		(-1.254)	(-1.013)	(2.182)
	A-share	-0.0202	0.0001	0.0043***
		(-0.344)	(0.517)	(5.804)
The margin-loans ratio (The margin turnover)	SS & MT	0.0175***	0.0000	0.0004***
		(2.587)	(0.701)	(4.263)
	A-share	-0.0022	0.0000	0.0004
		(-0.418)	(1.238)	(1.312)

Notes: The estimated mean equation is given by equation (4.2a) as: $R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 A_{t-1}\sigma_t^2)R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.2b) as: $\sigma_t^2 = (1 + \gamma A_{t-1})(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

of γ also support this finding. With a percentage of 92.11% stocks and a percentage of 40.79% stocks have significantly positive values of γ with the two different measures respectively in B, Table 4.6.A, we can see an increasing impact of margin-trading activity on the volatility level of stock returns. This finding is supported by both the portfolio and market level estimates in B, Table 4.6.B, of which three out of four estimated results show a significant positive value of γ. In Chapter 3, with the data of stock prices, we find that the dual introduction of short selling and margin trading has a combined reducing impact on the level of stock returns volatility. By adopt separate activity data of short selling and margin trading, we now gain more detailed insight into the issue, knowing that it is short selling which reduces the level of stock returns volatility, whereas margin trading, in fact, has an increasing impact on volatility.

4.5.3 The Relative Importance of Short Selling and Margin Trading

As the same to the findings in previous models, the regression results of φ_1 of the two measures in the relative model show that most of the stocks have no significant feedback trading. Only a small amount of stocks shows positive feedback trading (2.63%-3.95%) and very few of them are involved with negative feedback trading (1.32%).

The relative importance of short selling and margin trading is expressed by a relative ratio o short-selling activity to margin-trading activity. With this ratio, we can examine whether th relative change in activities between the two mechanisms will have certain impacts on feedbac trading and stock returns volatility. As the short-selling component is placed as the numerato we add the relative ratio into the original feedback trading model to study whether an increas (decrease) in the level of short-selling activity compared to margin-trading activity will influenc feedback trading and stock returns volatility in a certain way. From the results of both measure of the relative ratio in Table 4.7.A, we can see when the relative level of short-selling activit changes, there are slight increases in negative feedback trading (10.53% - 27.63%), whereas onl a percentage of 1.32% - 2.63% stocks display positive feedback trading. However, no significar impact on feedback trading behaviour is observed when we do regressions at the portfolio an

market level in Table 4.7.B. In all, we can say that the relative importance of short selling an margin trading has no impact on positive feedback trading behaviour.

Table 4.7.A The relative importance of short selling and margin trading at individual sto level: Percentage of significant coefficients of GARCH estimation results

The relative activity of short selling and margin trading (76)		insig%	-%	+%
Short interest/margin interest	φ_1	96.05%	2.63%	1.32%
	φ_2	71.05%	1.32%	27.63%
	γ	53.95%	44.74%	1.32%
The short turnover/the margin turnover	φ_1	94.74%	3.95%	1.32%
	φ_2	86.84%	2.63%	10.53%
	γ	30.26%	67.11%	2.63%

Notes: The estimated mean equation is given by equation (4.3a) as: $R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 \frac{SS_{t-1}}{MT_{t-1}}\sigma_t^2\right] R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.3b) as: $\sigma_t^2 = (1 + \gamma \frac{SS_{t-1}}{MT_{t-1}})(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$. The percentage of statistical significance in this table presents statistics with significance at the 10% level.

Table 4.7.B The relative importance of short selling and margin trading at portfolio and ind level: GARCH estimation results

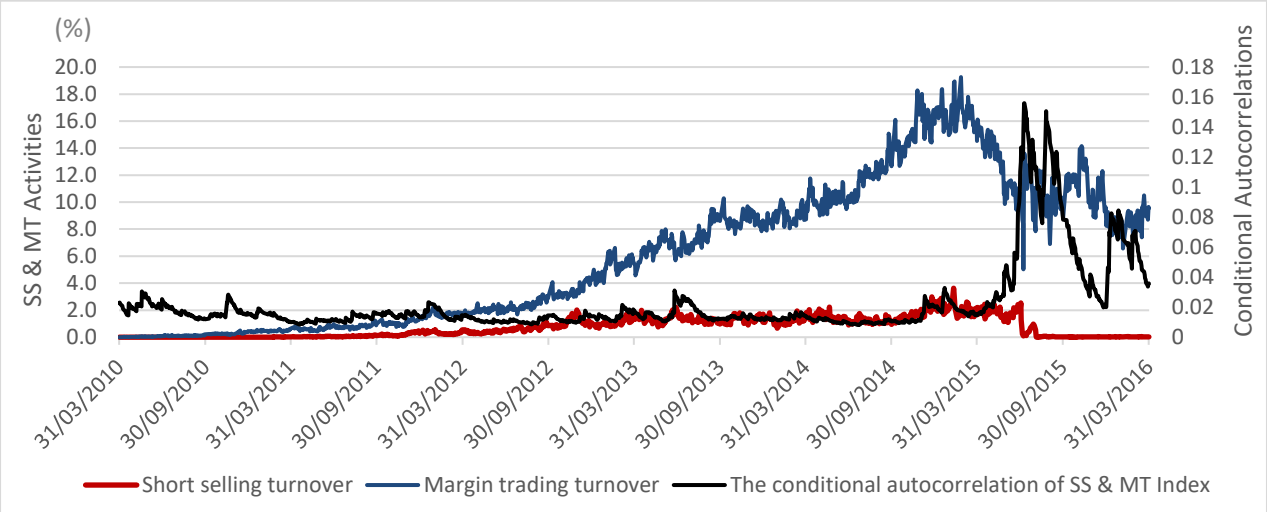
The relative activity of short selling and margin trading (2)		φ_1	φ_2	γ
Short interest/margin interest	SS & MT	0.0066	-0.0066	-0.0081
		(0.766)	(-1.274)	(-1.364)
	A-share	0.0077*	-0.0169	-0.0119
		(1.650)	(-1.121)	(-1.373)
The short turnover/the margin turnover	SS & MT	-0.0001	0.0004	-0.0008
		(-0.011)	(0.791)	(-0.687)
	A-share	0.0037	0.0008	-0.0012
		(0.624)	(0.909)	(-1.027)

Notes: The estimated mean equation is given by equation (4.3a) as: $R_t = \alpha + \mu\sigma_t^2 + \left[\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 \frac{SS_{t-1}}{MT_{t-1}}\sigma_t^2\right] R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.3b) as: $\sigma_t^2 = (1 + \gamma \frac{SS_{t-1}}{MT_{t-1}})(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Figure 4.1 shows the trend of short-selling and margin-trading activities from 31/03/2010 to 31/03/2016. To avoid data contamination, we only adopt activities data from 31/03/2010 to 31/03/2014 in the main regressions of the study, excluding the crash period in the A-share market

during 2015-2016. From the figure, we can clearly see that during the crash period, margin-trading activity fluctuates more frequently than in the normal period, while the activity of short selling fell sharply immediately after the start of the crash in early June 2015 and remains at a

Figure 4.1 Short-selling and margin-trading activities and conditional return autocorrelations



Notes: The red and blue line represents activities of short selling and margin trading, respectively. The black line represents the conditional autocorrelations of the SS & MT Index, $\rho = \varphi_0 + \varphi_1 \sigma_t^2$, extracted from the basic feedback trading model given by equation (4.1a) and (4.1b).

very low volume level. A rough positive relationship between short-selling activity and the conditional return autocorrelations can be seen in the normal period, while no obvious relationship between margin-trading activity and the conditional return autocorrelations is observed. This supports the findings we obtain in Table 4.5, that short-selling activity may lead to an increasing level of negative feedback trading behaviour, while there is no consistent evidence that margin-trading activity exacerbates the level of feedback trading among studied stocks.

4.5.4 Retail and Institutional Ownership of Margin Account

Financial researchers are often intrigued by the trading behaviour of retail and institutional investors. Recent accessibility of proprietary data provides researchers more opportunities to study the issues empirically. A large body of prior research document that retail and institutional investors react differently to past price performance and to some degree they follow momentum and contrarian strategies. Our study extends the literature by focusing retail and institutional investors trading on certain types of trading activities - short selling and margin trading; in other words, we aim to explore that whether trading activities of retail short sellers and margin traders impose impacts on feedback trading and stock returns volatility differently with their institutional counterparts.

Table 4.8 The account model at portfolio and market level: GARCH estimation results

	φ_0	φ_1 (retail)	φ_2 (institutional)	γ_1 (retail)	γ_2 (institutional)
SS & MT Port	-0.0039 (-0.103)	0.0066 (0.808)	0.0058 (0.742)	0.0088 (0.360)	-0.0214* (-1.873)
A-share Index	0.0052 (0.099)	0.0048 (0.168)	0.0066 (0.846)	-0.0138 (-0.703)	-0.0017 (-0.170)

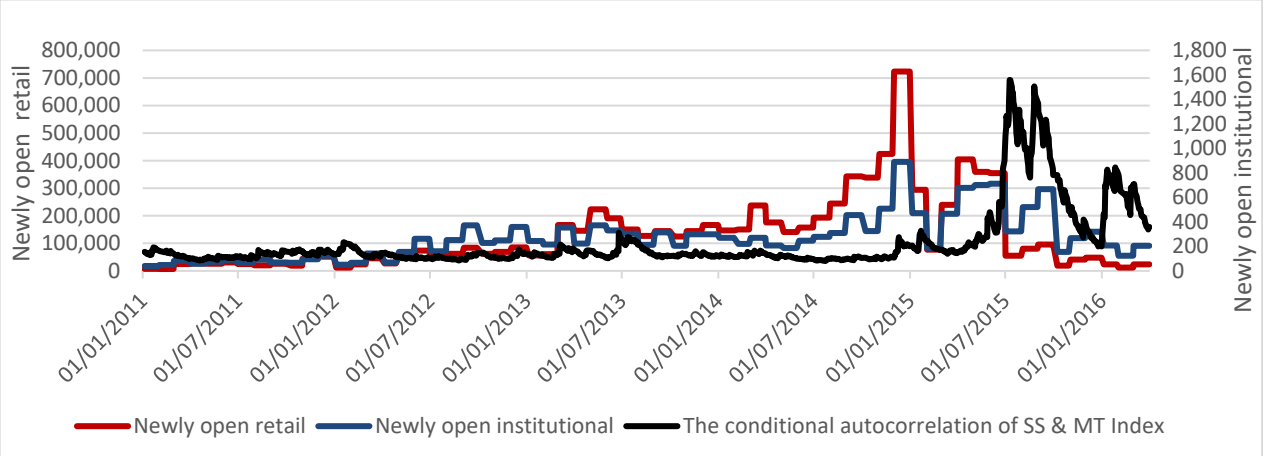
Notes: The estimated mean equation is given by equation (4.4a) as: $R_t = \alpha + \mu\sigma_t^2 + [\varphi_0 + \varphi_1 D_{t-1}\sigma_t^2 + \varphi_2(1 - D_{t-1})\sigma_t^2]R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.4b) as: $\sigma_t^2 = (\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)[1 + \gamma_1 D_{t-1} + \gamma_2(1 - D_{t-1})]$.

With the data of retail and institutional ownership of margin accounts, we investigate the impacts of retail (institutional) margin activities on feedback trading and stock returns volatility. The results of φ_1 and φ_2 in Table 4.8 show that the relative importance of the two types of account has no significant impact on feedback trading behaviour. In the previous literature of common stock trading, Lakonishok et al. (1992) document that pension managers do not pursue destabilising practices like positive feedback trading; while Grinblatt et al. (1995) find that 77% of mutual funds are momentum investors in the U.S. market. Our results show no evidence that retail (institutional) margin investors in China use feedback trading strategy. This finding might partially due to the feature of the designated stocks currently available for trading.

With a significantly negative value of γ_2 at the portfolio level, it implies that when the growth rate of account number held by institutional investors is greater than their retail counterparts, the volatility level decreases. Li and Wang (2010) investigate the short-run relationship between institutional trading and stock returns volatility in the retail-dominated A-share market.

They argue that it is the impact of informational and non-informational institutional trades determines the relationship between returns volatility and institutional trading. And the relationship is negative when informational trading by institutional investors prevails. Since institutional investors are rationally better-informed investors, institutional trading tends to be negatively related to stock returns volatility. Consistent with this hypothesis, the current trading of institutional short sellers and margin traders at a list of designated stocks seems to be informational to the A-share market.

Figure 4.2 The number of margin account and conditional return autocorrelations



Notes: The red and blue line represents the number of margin account owned by retail and institutional investors, respectively. The black line represents the conditional autocorrelations of the SS & MT Index, $\rho = \varphi_0 + \varphi_1 \sigma_t^2$, implied by the basic feedback trading model in equation (4.1a) and (4.1b).

With monthly data of the number of the margin account, no obvious relationship between the newly opened account number held by retail (institutional) investors and the conditional return autocorrelations is observed in Figure 4.2. To check the legitimacy of these results, further investigations with data of a higher frequency is needed.

4.5.5 Robustness Tests

Estimation results of asymmetric GARCH-type model

From Appendix 4.2.A and B, the log-likelihood ratio statistics show us that the asymmetric GJR-GARCH model is the second prior model for our study. To test the robustness of the results of the original activities model of short selling and margin trading, the GJR-GARCH version of the feedback trading model with short-selling (margin-trading) activity are adopted.

Table 4.9A and Table 4.9.B show that the robustness check confirms our previous findings. As for short selling, we find consistent results at all levels that short-selling activity has an increasing impact on the degree of negative feedback trading, and a potentially decreasing impact on positive feedback trading among designated stocks. A percentage of 46.97% - 81.58% stocks demonstrate a lower level of stock return volatility together with short-selling activity. As for the results of margin-trading activity at individual level, a total percentage of 10% - 10.45% stocks show significantly positive feedback trading, while a percentage of only 1.43% - 1.49% stocks show significantly negative feedback trading. Compared to the original level of feedback trading behaviour with φ_1, we may say that margin-trading activity has a moderate decreasing impact on negative feedback trading and a moderate increasing impact on positive feedback trading. However, with the measures at portfolio and market level in Table 4.9.B, all results of the feedback trading coefficient φ_2 are insignificant. Again, our results of margin-trading activity are mixed with different levels of data. We can only conclude that no evidence is shown that margin-trading activity increases positive feedback trading. The level of stock returns volatility is significantly increased by margin-trading activity, which is consistent to our findings in previous sections.

Table 4.9.A The activity model at individual stock level: Percentage of significant coefficients of GJR-GARCH estimation results

A: Short-selling Activity (76)		**insig%**			**-%**			**+%**		
The short interest ratio	ϕ_1	93.42%			3.95%			2.63%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	ϕ_2	76.32%		17.11%	2.63%		1.32%	2.63%		
	γ	13.16%			81.58%			5.26%		
The short-sales ratio (The short turnover)	ϕ_1	90.91%			1.52%			7.58%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	ϕ_2	80.30%		10.61%			1.52%	6.06%	1.52%	
	γ	31.82%			46.97%			21.21%		
B: Margin-trading Activity (76)		**insig%**			**-%**			**+%**		
The margin interest ratio	ϕ_1	92.86%			2.86%			4.29%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	ϕ_2	84.29%	7.14%	1.43%	1.43%		1.43%	1.43%	2.86%	
	γ	8.57%			0.00%			91.43%		
The margin-loans ratio (The margin turnover)	ϕ_1	89.55%			0.00%			10.45%		
		insig%	-%	+%	insig%	-%	+%	insig%	-%	+%
	ϕ_2	83.58%	4.48%	1.49%				4.48%	5.97%	
	γ	46.27%			4.48%			49.25%		

Notes: The estimated mean equation is given by equation (4.5a) as: $R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 A_{t-1}\sigma_t^2)R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.5b) as: $\sigma_t^2 = (1 + \gamma A_{t-1})(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \kappa X_{t-1}\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$. Except for the data of short interest, only a limited number of time series of other types of activity data can obtain convergence by GJR-GARCH model: 66 stocks receive convergence for the data of short sale value, 70 stocks for the data of margin interest, and 67 stocks for the margin loan value. The percentage of statistical significance in this table presents statistics with significance at the 10% level.

From Table 4.10, we notice that there are significantly positive coefficients of ϕ_1 at both portfolio and market level, which indicates a presence of contrarian trading among retail margin investors. As for common stock trading, Odean (1998, 1999) and Barber & Odean (2000) document that retail investors generally demonstrate a strong preference for selling winners and holding losers, except in December when tax-driven selling becomes prevalent. Besides, Sutthisit *et al.* (2012) test all indices that measure Chinese stock markets but find no significant positive feedback trading behaviour in the Hong Kong Red chip market. For all other markets, including A-share, B-share and common H-share, it documents a positive return autocorrelation during less volatile periods, while a negative one during periods of high volatility. This sign reversal implies that the feedback trading styles in the Chinese markets may vary with different market participant structures and market volatility levels. Thus, the

different results of this robustness test and our original regressions might because that the new type of data is obtained from a crash period. Consistent to our finding in section 4.5.4, no significant impact of institutional trading of short selling and margin trading on feedback trading is found. As for the impact on volatility, the results show that even during the crash period, there is no evidence that margin activities conducted by Chinese retail (institutional) investors increase the volatility level of the stock market.

Table 4.9.B The activity model at portfolio and index level

		φ_1	φ_2	γ
A: Short-selling Activity (2)				
The short interest scaled by the market value	SS & MT	-0.0037 (-0.465)	0.0031* (1.735)	-0.0013* (-1.667)
	A-share	-0.0046 (-0.464)	0.0142 (1.276)	-0.0048 (-1.123)
The short sale value scaled by total trading value (The short turnover)	SS & MT	-0.0036 (-1.368)	0.0001 (0.660)	-0.0001* (-1.694)
	A-share	-0.0024 (-0.516)	0.0001 (0.953)	0.0002 (0.831)
B: Margin-trading Activity (2)				
The margin interest scaled by the market value	SS & MT	-0.0045 (-1.611)	0.0001 (1.175)	0.0010** (2.413)
	A-share	-0.0261 (-1.595)	0.0001 (1.384)	0.0027** (2.440)
The margin loan value scaled by total trading value (The margin turnover)	SS & MT	0.0068 (1.156)	0.0001 (1.569)	0.0002*** (4.450)
	A-share	-0.0010 (-1.630)	0.0001 (0.336)	0.0002*** (4.065)

Notes: The estimated mean equation is given by equation (4.5a) as: $R_t = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2 + \varphi_2 A_{t-1}\sigma_t^2)R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.5b) as: $\sigma_t^2 = (1 + \gamma A_{t-1})(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \kappa X_{t-1}\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)$. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Table 4.10 Degree of participation in short selling and margin trading at portfolio and market level: GARCH estimation results

	φ_0	φ_1 (retail)	φ_2 (institutional)	γ_1 (retail)	γ_2 (institutional)
SS & MT Index	-0.1785 (-0.836)	0.0273** (2.008)	0.0138 (0.832)	0.1185 (0.912)	-0.0013 (-0.028)
A-share Index	-0.1647 (-0.964)	0.0245** (2.157)	0.0115 (0.990)	0.1108 (0.998)	-0.0008 (-0.020)

Notes: The estimated mean equation is given by equation (4.10a) as: $R_t = \alpha + \mu\sigma_t^2 + [\varphi_0 + \varphi_1 D_{t-1}\sigma_t^2 + \varphi_2(1 - D_{t-1})\sigma_t^2]R_{t-1} + \varepsilon_t$; The variance equation is given by equation (4.10b) as : $\sigma_t^2 = (\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2)[1 + \gamma_1 D_{t-1} + \gamma_2(1 - D_{t-1})]$.

Degree of participation in margin transactions

We adopt a higher frequency type of data to check the robustness of the account ownership model. With daily data of the degree of participation in margin transactions, we further investigate the impact differences between retail and institutional investors' trading activities on margin. It needs to be pointed out that the sample period of this data type is only available from 24/05/2015 to 31/03/2016, during which a sever stock crash happened in the Chinese A-share market. This characteristic of the data may be one of the reasons that we obtain different results from previous findings.

4.6 Conclusions

From March 2010, a designated list of 90 leading stocks in the SSE and the SZSE start to be eligible for transactions of short selling and margin trading in the Chinese A-share market. After five major listing adjustments, the total number of shortable and marginable stocks had grown from 90 to 900 by the end of March 2016. The relationships between margin activities, feedback trading behaviour and stock returns volatility become interesting to explore. In this study, we first examine whether greater short-selling (margin-trading) activity (open interest and volume) is associated with greater positive feedback trading and stock returns volatility. Then, we investigate the difference between the impact of margin activities of retail and institutional investors on feedback trading behaviour and stock returns volatility.

There is no evidence showing that activity of short selling (margin trading) increases positive feedback trading among studied stocks. However, we document an increasing impact of short-selling activity on negative feedback trading behaviour. As for the impact on stock returns volatility, margin-trading activity has a significant increasing impact on volatility, while short-selling activity seems to have a slightly decreasing impact. After being scaled by margin-trading activity, our results of short-selling activity on feedback trading and volatility keep unchanged. Although evidence shows that neither activity of short selling nor that of margin

trading increase positive feedback trading behaviour in the market, an increased level of negative feedback trading by short-selling activity is far from being a beneficial thing to the market. Being the opposite of what most investors do, negative feedback strategy normally helps make the market less volatile. But in the final analysis, negative feedback trading is not a fundamental-based strategy, which involves evaluation of a security's intrinsic value. In a retail-dominated market like China, to reduce behaviour of simply applying negative feedback strategy and help investors keep confidence even when they are carrying on a losing trade, public financial education of how to develop rational trading plans would be helpful. The recent rules and regulations that simply suppressing short selling have been shown to have a detrimental rather than beneficial impact on markets. To better stock market stabilisation in the A-share market, margin trading seems should be paid more attention in terms of volatility control than short selling. In an emerging market like China, system defects in trading mechanisms and financial regulations are obvious. The behaviour of illegal transactions like inside information leakage often slips below regulator's radar. The introduction of margin trading itself might be beneficial to the market, but lax-regulated margin trading activity could be a problem.

The number of margin account separately opened by retail and institutional investors has no significant impact on feedback trading behaviour during stable and booming periods. When the growth rate of account number held by institutional investors is greater than their counterparts, the level of stock returns volatility decreases. This implies that institutional investors on margin trades in the Chinese stock market are better informed than their retail counterparts. During bearish and crash periods, we document that the participation of retail margin investors leads to a higher level of negative feedback trading in the market. As analysed above, retail investors who are less financial educated than professional institutional investors tend to conduct more irrational trades and bring uncertainty to the market. Our findings have obvious policy implications.

As an extension to our previous empirical work in Chapter 3, this study investigates the impact of short-selling and margin-trading activity on feedback trading and stock returns volatility, separately. With more precise data of each mechanism's activity, the distinctive impact of short selling and margin trading on feedback trading and returns volatility has been studied further.

There are surely limitations of the current study. Since GARCH-type models have been extensively applied in the study, data loss stemming from the nonconvergence issue may cause our empirical results to deviate from the facts. Other volatility measures which can prevent this type of issue to happen should be considered. Our sample data has a few drawbacks. We study the different impact of retail and institutional margin investors with indirect monthly data of the margin account number opened by these two types of investors. A study with more detailed and lower-frequency activity data of different kinds of short-selling and margin-trading investors in other markets would be an addition to the literature.

4.7 Appendices

Appendix 4.1 Descriptive statistics of daily stock returns

	Mean	Min	Max	S.D.	Skew	Kurt	JB	LB(10)	$LB^2(10)$	ARCH	JOINT	Serial correlation at lag				
												1	2	3	4	5
A1：Individual Stocks (76)																
SH01	0.043	-10.558	9.564	1.394	0.173***	2.905***	490.734***	8.469	6.054	20.597***	0.631	0.049*	0.003	0.026	-0.001	-0.013
SH02	0.014	-10.631	9.601	1.163	-0.052	1.198***	76.670***	10.931	18.220**	230.801***	2.947	0.019	-0.009	-0.006	-0.012	-0.003
SH03	0.018	-10.563	9.545	1.344	0.122**	2.702***	423.284***	8.286	9.539	17.402***	1.520	0.054**	0.038	-0.009	0.007	-0.008
SH04	0.047	-10.525	9.544	1.379	0.337***	3.185***	598.724***	9.361	11.213	14.823***	4.029	0.043	-0.006	0.012	0.016	-0.014
SH06	0.025	-10.579	9.598	1.334	0.627***	8.794***	4370.547***	4.660	2.436	187.265***	0.150	0.006	0.002	0.009	0.028	-0.011
SH07	0.027	-10.581	9.563	1.287	0.188***	2.943***	490.687***	7.102	12.343*	40.502***	6.895*	0.036	-0.014	0.007	0.008	-0.024
SH09	0.056	-10.550	9.570	1.410	0.322***	2.235***	316.496***	21.735***	12.235*	59.426***	3.713	0.075***	0.008	0.005	0.017	0.014
SH10	0.035	-10.440	9.554	0.970	0.376***	3.175***	624.037***	12.999*	8.084	33.076***	2.624	0.035	0.005	0.022	0.049*	-0.029
SH11	0.011	-10.599	9.565	0.994	0.044	1.479***	127.515***	11.706	21.110***	12.639***	7.971**	0.034	-0.013	-0.019	0.007	-0.041
SH12	0.031	-10.598	9.625	1.230	0.390***	2.331***	341.733***	7.722	6.909	90.894***	1.142	0.025	-0.013	-0.015	0.021	-0.020
SH13	-0.010	-10.552	9.572	0.988	0.008	1.862***	201.636***	9.528	4.729	43.504***	4.470	0.026	-0.009	0.012	0.000	0.009
SH14	0.004	-11.086	9.550	0.995	0.088	1.652***	156.815***	17.816**	12.032*	13.869***	3.197	0.007	-0.083***	-0.012	0.009	-0.030
SH16	0.008	-10.567	9.555	1.211	0.125*	1.350***	112.006***	13.054*	14.698**	159.771***	8.270**	0.041	-0.024	-0.003	0.043	-0.029
SH17	0.001	-10.575	9.569	0.991	-0.116*	1.567***	145.074***	5.964	5.999	56.43***	1.758	0.013	0.021	-0.028	0.010	-0.011
SH18	0.021	-10.586	9.599	0.994	0.365***	2.695***	453.450***	11.936	2.442	116.118***	1.473	0.047*	0.004	0.012	-0.015	0.002
SH19	0.006	-10.528	9.533	0.992	-0.025	2.793***	469.402***	11.342	11.320	4.154**	2.186	0.032	-0.040	0.013	-0.011	-0.009
SH20	0.019	-11.046	9.558	0.997	0.194***	3.317***	592.133***	13.043*	5.379	123.397***	1.503	0.050*	0.015	0.041	0.005	-0.008
SH23	0.005	-10.548	9.555	0.996	0.050	1.793***	173.859***	12.807*	4.581	56.515***	0.597	0.039	-0.005	0.002	0.035	-0.021
SH24	0.024	-13.643	9.637	1.277	0.192***	3.669***	717.025***	9.960	4.151	147.288***	3.132	0.041	0.020	-0.030	0.019	0.046
SH25	0.054	-10.553	9.576	1.395	0.282***	2.332***	337.281***	18.912***	13.687*	50.352***	1.353	0.084***	0.001	0.010	-0.012	0.011
SH26	0.024	-11.575	7.522	1.223	0.024	2.021***	215.143***	5.376	10.098	62.488***	4.139	0.010	-0.006	-0.017	0.007	0.030
SH27	0.018	-13.966	9.549	1.292	-0.071	3.914***	877.811***	14.502**	4.828	106.316***	2.080	0.022	-0.028	-0.017	-0.048*	-0.023
SH28	0.000	-10.547	9.549	1.341	0.007	3.681***	809.012***	6.967	4.023	108.669***	4.699	0.022	-0.038	0.000	0.018	0.019
SH29	0.025	-10.573	9.595	1.002	0.341***	2.294***	324.077***	11.177	8.059	133.190***	1.718	0.031	0.004	-0.026	0.028	-0.011
SH30	0.033	-10.586	9.579	0.968	0.360***	2.814***	494.810***	14.839**	9.037	19.677***	0.925	0.024	0.011	0.009	-0.005	0.016
SH31	0.000	-10.562	9.560	1.000	-0.052	1.163***	78.305***	11.288	10.654	158.146***	2.906	0.030	-0.020	-0.007	0.029	-0.009
SH32	0.032	-10.522	9.575	1.338	0.375***	3.475***	698.392***	4.543	7.707	20.699***	0.583	0.021	-0.006	0.001	0.004	0.018
SH33	0.027	-10.558	9.569	1.297	0.347***	3.492***	728.269***	13.041*	4.867	162.578***	1.601	0.054**	0.011	0.001	0.045*	0.029
SH34	0.021	-10.540	9.545	0.983	0.092	1.861***	200.503***	12.444*	9.443	25.871***	0.262	0.039	0.000	-0.045*	0.038	-0.014
SH35	0.026	-10.600	9.625	1.420	0.207***	4.581***	1174.247***	13.955*	7.131	38.499***	6.412*	0.063**	0.017	0.031	0.012	-0.048*
SH36	0.024	-10.576	9.588	1.283	0.161**	3.081***	532.448***	20.746***	5.013	195.523***	2.810	0.055**	0.005	0.023	0.047*	0.029
SH37	0.034	-10.513	9.531	1.393	-0.474***	6.928***	2393.047***	4.963	1.526	88.524***	1.371	0.031	-0.011	0.007	0.034	-0.006
SH38	0.019	-10.596	9.623	0.992	0.447***	2.706***	463.170***	12.345*	6.445	136.833***	2.506	0.044	0.014	0.022	0.016	-0.030
SH39	0.017	-10.544	9.526	1.243	0.191***	1.478***	139.453***	11.770	6.449	15.499***	4.655	0.032	-0.012	-0.055**	0.024	-0.002
SH40	0.028	-10.544	9.563	1.300	0.394***	2.506***	408.365***	13.170*	6.064	41.148***	2.333	0.051*	0.004	-0.035	0.048*	-0.016
SH41	0.055	-10.569	9.605	1.291	0.457***	2.407***	365.047***	10.894	4.830	88.024***	3.670	0.035	0.011	-0.015	0.028	0.034
SH43	0.057	-10.575	9.607	1.299	0.522***	3.799***	848.708***	15.579**	8.397	210.494***	1.659	0.057**	-0.009	0.006	0.005	0.043
SH44	0.014	-10.524	9.564	1.353	0.266***	4.211***	1024.369***	7.722	13.465*	56.968***	9.481**	0.039	-0.003	0.008	-0.002	-0.025
SH45	0.012	-10.763	9.573	1.280	0.259***	3.183***	600.481***	5.288	6.390	203.424***	4.302	0.038	-0.004	0.024	0.013	0.026

SH46	0.034	-10.616	9.623	0.996	0.468***	3.056***	562.236***	20.153***	5.939	132.139***	3.480	0.067**	0.038	0.023	0.001	0.040
SH48	-0.009	-10.577	9.566	1.439	-1.034***	9.995***	5643.890***	5.197	2.613	160.677***	1.192	0.042	0.010	-0.009	0.029	-0.009
SH49	-0.004	-10.564	9.609	1.244	0.098	2.234***	299.533***	10.514	10.228	166.387***	5.691	0.056**	-0.017	-0.006	-0.001	-0.014
SH50	0.017	-11.629	9.658	1.425	-0.538***	8.792***	4044.123***	8.063	2.399	94.108***	1.632	0.029	-0.005	0.007	0.006	-0.013
SZ51	0.052	-10.655	9.589	1.365	0.414***	2.700***	439.202***	7.131	14.288**	20.883***	1.640	0.035	0.021	0.007	0.017	-0.033
SZ52	0.032	-10.520	9.549	0.986	0.212***	1.912***	212.573***	7.031	13.672*	43.993***	3.072	0.034	-0.034	-0.022	0.017	-0.028
SZ53	0.011	-11.528	9.571	0.997	0.028	1.461***	106.618***	10.385	12.899*	5.255**	1.785	0.024	0.018	-0.003	-0.008	-0.035
SZ55	0.004	-10.559	9.558	0.993	0.001	1.525***	136.976***	7.397	8.139	61.395***	2.476	0.025	0.001	-0.025	-0.016	0.023
SZ56	0.010	-10.566	9.580	1.002	0.060	2.367***	323.848***	13.364*	17.047**	140.544***	13.086***	0.054*	0.008	0.014	-0.005	-0.033
SZ57	-0.010	-10.600	9.619	0.998	-0.178***	1.714***	178.207***	12.150*	11.071	40.082***	16.177***	0.039	-0.072***	0.034	-0.024	-0.002
SZ58	-0.002	-10.756	9.582	1.001	-0.011	1.721***	166.509***	11.487	5.368	73.782***	0.841	0.024	-0.008	0.007	-0.062**	-0.039
SZ59	0.010	-10.596	9.613	0.979	0.328***	2.535***	398.715***	9.334	4.404	53.435***	0.434	0.048*	0.012	-0.008	0.027	-0.007
SZ60	0.006	-10.546	9.575	1.002	0.066	1.339***	106.810***	7.207	4.743	77.754***	0.493	0.035	-0.012	0.026	-0.031	0.028
SZ61	0.009	-10.548	9.594	0.976	0.028	1.858***	190.527***	11.664	13.406*	164.536***	3.802	0.062**	-0.014	0.012	-0.001	-0.009
SZ63	0.026	-10.538	9.536	0.993	0.464***	2.860***	535.529***	12.131*	6.635	59.195***	4.040	0.004	-0.077***	-0.006	0.017	-0.013
SZ65	-0.006	-13.607	9.548	0.998	-0.289***	2.785***	478.259***	16.385**	1.911	90.703***	2.889	0.016	-0.072***	-0.004	0.020	-0.047
SZ66	0.002	-10.565	9.554	0.995	-0.109*	1.993***	238.217***	10.978	3.277	49.466***	0.496	0.052**	0.007	-0.015	0.022	0.019
SZ67	0.020	-10.476	9.646	1.179	0.216***	1.533***	126.828***	7.490	8.179	26.104***	7.528*	0.045	0.004	-0.019	0.006	-0.001
SZ68	0.026	-15.746	9.546	0.993	0.310***	1.579***	165.662***	14.712**	8.843	69.309***	1.415	0.013	-0.055**	-0.020	-0.012	-0.021
SZ70	0.027	-10.651	9.726	1.006	0.316***	2.689***	406.607***	7.827	4.450	194.145***	6.278*	0.036	-0.009	0.040	0.002	0.041
SZ71	-0.009	-10.564	9.563	0.997	0.046	1.767***	181.099***	9.161	10.545	201.345***	4.566	0.029	-0.045*	0.008	0.006	-0.014
SZ72	0.012	-10.556	9.577	0.995	0.125*	1.316***	104.324***	8.077	7.702	142.499***	2.793	0.037	-0.001	-0.015	-0.022	-0.008
SZ73	0.013	-10.595	9.620	0.967	0.074	2.244***	289.016***	17.870**	6.671	86.662***	3.079	0.081***	0.017	0.008	0.001	-0.028
SZ74	-0.026	-10.555	9.547	0.996	-0.311***	2.140***	284.433***	11.192	9.705	41.829***	8.643**	0.046*	-0.037	-0.015	0.047*	0.015
SZ75	0.015	-10.616	9.581	1.207	0.313***	2.050***	270.992***	15.241**	5.331	137.141***	2.316	0.022	-0.049*	0.027	0.003	0.011
SZ77	-0.006	-10.546	9.586	1.250	0.125*	1.506***	125.554***	10.760	17.449**	7.448***	3.499	0.018	-0.038	0.037	-0.007	-0.032
SZ78	-0.002	-10.554	9.531	0.996	0.005	1.834***	192.388***	18.040**	18.856***	109.560***	5.593	0.008	-0.080***	-0.003	0.025	0.008
SZ79	0.011	-10.573	9.559	0.993	0.107	1.891***	196.325***	15.999**	12.947*	96.724***	7.920**	0.069**	0.032	-0.005	0.038	-0.042
SZ80	-0.013	-10.548	9.554	0.996	-0.178**	2.473***	321.997***	15.540**	16.919**	117.051***	16.847***	0.047*	-0.050*	-0.014	0.031	-0.032
SZ83	-0.015	-10.599	9.583	0.999	-0.115*	1.782***	187.009***	14.712**	6.826	73.450***	0.404	0.035	-0.025	-0.015	0.031	0.003
SZ84	-0.010	-10.549	9.568	0.998	-0.110*	1.153***	80.685***	8.961	10.618	81.216***	0.323	0.032	-0.048*	-0.005	0.013	0.018
SZ85	0.010	-10.569	9.561	1.176	0.053	0.962***	52.253***	17.095**	6.675	175.737***	1.818	0.043	-0.001	0.041	0.026	-0.024
SZ86	-0.009	-10.570	9.610	0.998	-0.020	1.657***	162.894***	8.432	10.182	116.843***	3.503	0.035	-0.034	-0.026	0.021	0.015
SZ87	-0.012	-10.558	9.573	0.995	-0.084	1.995***	237.333***	12.652*	7.608	89.604***	5.574	0.030	-0.042	0.009	-0.039	-0.017
SZ88	0.012	-10.564	9.599	0.989	0.033	1.432***	120.028***	8.937	6.778	92.256***	3.389	0.029	-0.019	0.010	0.003	0.013
SZ89	0.016	-10.543	9.551	1.428	0.152**	3.677***	800.513***	8.796	11.693	13.415***	1.716	0.029	0.014	0.013	-0.008	-0.062**
SZ90	0.007	-10.558	9.614	0.996	0.208***	1.907***	224.541***	7.383	5.350	50.015***	0.245	0.031	0.000	-0.003	0.009	-0.009
A2：Portfolio Level (1)																
SS & MT	-0.052	-12.844	6.488	1.002	-0.870***	3.961***	1135.793***	12.296*	6.363	46.972***	3.317	0.018	-0.033	0.029	0.011	0.032
A3：Market Level (1)																
A-share	-0.051	-10.205	8.294	1.212	-0.595***	1.701***	261.511***	14.336**	11.263	159.201***	1.308	0.013	-0.012	0.025	0.032	0.028

Notes: Summary statistics of daily returns of individual stocks eligible for short selling and margin trading are presented in the first batch, A1; the SS and MT index which is calculated with all shortable and marginable stocks at the moment with a changing number from 90 to 900 stocks during our sample range is presented in A2; and the market index which contains all listed stocks in the A-share market including all shortable and marginable stocks ever on the designated list for short selling and margin trading are provided in A3. Mean, Min, Max, S.D., Skew, Kurt and JB are the sample mean, minimum, maximum, standard deviation, skewness, excess kurtosis and Jarque-Bera normality test, respectively. LB(10) and $LB^2(10)$ are the Ljung-Box $\chi 2$ statistics for ten lags calculated for stock returns. ARCH is the Lagrange Multiplier test for ARCH effects and distributed as $\chi 2$ with 1 degree of freedom. The JOINT test is a test initiated by Engle and Ng (1993) for potential asymmetries in conditional volatility. Serial correlation at lag t (1, 2, 3, 4, 5) represents autocorrelation relationships of individual return series. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 4.2.A Results of specification tests for three GARCH-type models

Name	GARCH (1,1)			EGARCH (1,1)			GJR-GARCH (1,1)		
	log L	AIC	BIC	log L	AIC	BIC	log L	AIC	BIC
SH01	-2795.8739	**1.4950**	**1.5254**	-2847.0530	1.4980	1.5322	**-2794.9720**	1.4965	1.5307
SH02	-2638.9710	**1.8933**	**1.9257**	-2808.0001	1.8965	1.9330	**-2638.7660**	1.8949	1.9314
SH03	-2919.5711	**1.6188**	**1.6491**	-2959.9303	1.6217	1.6558	**-2919.2462**	1.6202	1.6543
SH04	-2730.8858	**1.5045**	**1.5353**	-2784.6311	1.5075	1.5422	**-2730.5510**	1.5060	1.5406
SH06	-2603.4376	**1.6858**	**1.7170**	-2763.8747	1.6888	1.7240	**-2601.9203**	1.6873	1.7225
SH07	-2572.4667	**1.3318**	**1.3629**	-2643.7400	1.3348	1.3698	**-2571.0864**	1.3333	1.3683
SH09	-3292.9832	**2.1010**	**2.1309**	-3333.5935	2.1038	2.1375	**-3292.9782**	2.1024	2.1361
SH10	-2748.0413	**1.3472**	**1.3771**	-2798.2128	1.3501	1.3837	**-2748.0381**	1.3487	1.3823
SH11	-3391.6092	**2.1802**	**2.2103**	-3426.4233	2.1831	2.2170	**-3391.5752**	2.1817	2.2155
SH12	-2833.2626	**1.7534**	**1.7841**	-2940.4741	1.7564	1.7910	**-2833.2404**	1.7549	1.7895
SH13	-3173.5131	**1.9142**	**1.9443**	-3224.6236	1.9171	1.9510	**-3173.3489**	1.9156	1.9495
SH14	-3060.9553	**1.7910**	**1.8216**	-3078.1490	1.7939	1.8284	**-3060.9376**	1.7924	1.8269
SH16	-3291.6628	**2.0624**	**2.0919**	-3385.7784	2.0652	2.0985	**-3290.9264**	2.0638	2.0970
SH17	-3298.1788	**2.1158**	**2.1461**	-3342.6034	2.1187	2.1528	**-3296.4141**	2.1173	2.1513
SH18	-3141.3856	**1.9730**	**2.0031**	-3226.0083	1.9759	2.0098	**-3141.3126**	1.9744	2.0083
SH19	-2980.1607	**1.4192**	**1.4484**	-2993.2580	1.4220	1.4549	**-2979.3797**	1.4206	1.4535
SH20	-2969.9368	**2.1225**	**2.1548**	-3050.9306	2.1256	2.1621	**-2969.9194**	2.1240	2.1604
SH23	-3065.7650	**2.1208**	**2.1528**	-3122.4514	2.1240	2.1600	**-3065.7090**	2.1224	2.1584
SH24	-2571.2586	**1.7105**	**1.7431**	-2639.3613	1.7137	1.7504	**-2570.7588**	1.7121	1.7487
SH25	-3301.4230	**2.1112**	**2.1411**	-3347.2556	2.1141	2.1478	**-3301.4224**	2.1127	2.1463
SH26	-2130.9716	**0.8205**	**0.8531**	-2190.8971	0.8237	0.8604	**-2125.6012**	0.8221	0.8587
SH27	-2665.2312	**1.4911**	**1.5215**	-2785.0799	1.4940	1.5283	**-2664.5997**	1.4925	1.5268
SH28	-2899.4543	**1.6004**	**1.6298**	-2994.1012	1.6032	1.6364	**-2898.6310**	1.6018	1.6349
SH29	-3066.5907	**2.0555**	**2.0862**	-3201.8072	2.0585	2.0931	**-3066.2225**	2.0570	2.0916
SH30	-2964.4025	**1.6463**	**1.6762**	-3015.0816	1.6492	1.6828	**-2964.4023**	1.6477	1.6813
SH31	-3151.6957	**2.0268**	**2.0572**	-3251.0661	2.0297	2.0639	**-3151.6055**	2.0282	2.0624
SH32	-2734.2088	**1.5714**	**1.6028**	-2784.3827	1.5745	1.6098	**-2734.1854**	1.5729	1.6082
SH33	-2975.0529	**2.0152**	**2.0456**	-3122.4144	2.0181	2.0523	**-2974.8654**	2.0167	2.0508
SH34	-2947.0612	**1.6323**	**1.6627**	-2982.8056	1.6352	1.6695	**-2945.4123**	1.6338	1.6680
SH35	-2502.4937	**1.4146**	**1.4458**	-2589.0671	1.4176	1.4528	**-2501.9275**	1.4161	1.4512
SH36	-2871.9826	**2.0347**	**2.0659**	-3018.5992	2.0377	2.0729	**-2871.9623**	2.0362	2.0713
SH37	-2143.8239	**0.9819**	**1.0142**	-2214.6891	0.9850	1.0214	**-2140.9300**	0.9835	1.0197
SH38	-3137.7836	**2.1026**	**2.1331**	-3232.5019	2.1055	2.1399	**-3137.6570**	2.1040	2.1384
SH39	-3155.7893	**1.7397**	**1.7691**	-3188.4386	1.7425	1.7756	**-3155.7348**	1.7411	1.7742
SH40	-3015.9820	**1.7290**	**1.7587**	-3103.7231	1.7319	1.7653	**-3015.9211**	1.7305	1.7637
SH41	-2711.3154	**1.7389**	**1.7703**	-2821.0314	1.7419	1.7773	**-2711.2237**	1.7404	1.7758
SH43	-2969.5231	**2.0950**	**2.1266**	-3073.4276	2.0980	2.1336	**-2969.5166**	2.0965	2.1320
SH44	-2242.0459	**1.1330**	**1.1637**	-2412.4307	1.1361	1.1705	**-2241.2213**	1.1346	1.1690
SH45	-2989.9701	**1.9656**	**1.9959**	-3126.3920	1.9685	2.0026	**-2989.9480**	1.9671	2.0011
SH46	-2819.5142	**1.8301**	**1.8615**	-2922.2013	1.8331	1.8686	**-2819.1848**	1.8316	1.8670
SH48	-2250.5993	**1.2073**	**1.2391**	-2356.8061	1.2104	1.2462	**-2249.6834**	1.2088	1.2446
SH49	-3406.3722	**2.2185**	**2.2480**	-3505.7427	2.2214	2.2546	**-3405.8903**	2.2199	2.2531
SH50	-2105.1130	**1.2016**	**1.2347**	-2225.7919	1.2048	1.2422	**-2104.3259**	1.2032	1.2405
SZ51	-2838.8574	**1.7421**	**1.7736**	-2894.1778	1.7452	1.7806	**-2838.7767**	1.7437	1.7790
SZ52	-2918.7139	**1.7470**	**1.7783**	-2959.3368	1.7501	1.7853	**-2917.0337**	1.7485	1.7837
SZ53	-2868.0763	**2.0920**	**2.1260**	-2886.2156	2.0953	2.1337	**-2865.6175**	2.0936	2.1319
SZ55	-3409.6324	**2.1672**	**2.1970**	-3461.4131	2.1701	2.2036	**-3409.5983**	2.1687	2.2021
SZ56	-3366.1837	**2.3453**	**2.3756**	-3483.6757	2.3482	2.3823	**-3365.9356**	2.3467	2.3808
SZ57	-3317.1598	**2.0897**	**2.1198**	-3359.0620	2.0926	2.1265	**-3316.9124**	2.0912	2.1250
SZ58	-3134.3868	**2.0221**	**2.0531**	-3186.3021	2.0251	2.0600	**-3134.1929**	2.0236	2.0584
SZ59	-3154.4569	**1.9785**	**2.0086**	-3232.4619	1.9814	2.0153	**-3154.0437**	1.9799	2.0138
SZ60	-3205.1945	**1.9137**	**1.9434**	-3274.9283	1.9165	1.9500	**-3205.1291**	1.9151	1.9485
SZ61	-2870.1957	**1.8649**	**1.8963**	-2953.1168	1.8679	1.9033	**-2869.0866**	1.8664	1.9017
SZ63	-2934.5104	**1.4899**	**1.5195**	-2971.5691	1.4927	1.5261	**-2929.2353**	1.4913	1.5246
SZ65	-3149.9006	**1.8097**	**1.8394**	-3189.1718	1.8125	1.8459	**-3148.7104**	1.8111	1.8445
SZ66	-3313.4049	**2.0625**	**2.0921**	-3381.9530	2.0653	2.0987	**-3313.3535**	2.0639	2.0972
SZ67	-2860.3890	**2.0972**	**2.1312**	-2895.1523	2.1006	2.1389	**-2860.3648**	2.0989	2.1371
SZ68	-3064.3351	**1.8247**	**1.8551**	-3119.3998	1.8276	1.8618	**-3064.1661**	1.8262	1.8603
SZ70	-2769.1641	**1.8880**	**1.9203**	-2881.9001	1.8912	1.9276	**-2765.4386**	1.8896	1.9259
SZ71	-2858.1079	**1.5926**	**1.6228**	-2942.1041	1.5955	1.6296	**-2858.0864**	1.5941	1.6281
SZ72	-3371.9763	**2.2893**	**2.3193**	-3473.1203	2.2921	2.3260	**-3369.1162**	2.2907	2.3245
SZ73	-3333.2576	**2.2489**	**2.2793**	-3380.0933	2.2518	2.2861	**-3333.2418**	2.2503	2.2846
SZ74	-3237.0797	**2.0926**	**2.1230**	-3293.9207	2.0955	2.1298	**-3236.9882**	2.0941	2.1283
SZ75	-3485.7808	**2.3446**	**2.3744**	-3565.3004	2.3475	2.3810	**-3485.4185**	2.3461	2.3795

SZ77	-3078.9580	**2.1469**	**2.1789**	-3135.8527	2.1501	2.1861	**-3078.9547**	2.1485	2.1845
SZ78	-2882.6450	**1.5629**	**1.5934**	-2926.0680	1.5658	1.6001	**-2882.6412**	1.5643	1.5986
SZ79	-3052.5720	**2.1116**	**2.1434**	-3117.3762	2.1147	2.1505	**-3051.6687**	2.1131	2.1489
SZ80	-2666.6163	**1.6654**	**1.6986**	-2692.0418	1.6687	1.7060	**-2665.0665**	1.6671	1.7043
SZ83	-3377.6025	**2.2356**	**2.2658**	-3437.8043	2.2385	2.2725	**-3377.6000**	2.2371	2.2710
SZ84	-3456.9091	**2.2428**	**2.2727**	-3507.7707	2.2456	2.2793	**-3456.9077**	2.2442	2.2778
SZ85	-3337.7808	**2.3947**	**2.4259**	-3422.2686	2.3978	2.4328	**-3337.7806**	2.3962	2.4313
SZ86	-3323.8368	**2.0961**	**2.1257**	-3402.0393	2.0990	2.1323	**-3323.2862**	2.0975	2.1308
SZ87	-3216.5546	**1.9204**	**1.9500**	-3268.2681	1.9232	1.9566	**-3216.5534**	1.9218	1.9551
SZ88	-3386.9886	**2.2668**	**2.2968**	-3466.1910	2.2697	2.3034	**-3386.5172**	2.2682	2.3019
SZ89	-3009.8506	**1.7531**	**1.7829**	-3074.5898	1.7560	1.7895	**-3009.8412**	1.7545	1.7881
SZ90	-3371.8875	**2.1464**	**2.1761**	-3432.8992	2.1492	2.1827	**-3371.4614**	2.1478	2.1812
SS & MT	-2698.9419	**1.2219**	**1.2511**	-2787.7059	1.2247	1.2576	**-2697.8915**	1.2233	1.2562
A-share	-2602.3076	**1.1856**	**1.2148**	-2715.1483	1.1884	1.2213	**-2601.9675**	1.1870	1.2199

Notes: Log L, AIC and BIC are the log-likelihood function, Akaike information criterion and Schwarz Bayesian Criterion respectively. Figures in bold represent the best performing model of the stock based on certain information criteria. Figures in shading indicate that no convergence can be obtained of the stock during regression of certain GARCH-type model.

Appendix 4.2.B Best performance GARCH specifications based on log L, AIC and BIC

Name	log L	AIC	BIC
SH01	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH02	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH03	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH04	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH06	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH07	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH09	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH10	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH11	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH12	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH13	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH14	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH16	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH17	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH18	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH19	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH20	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH23	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH24	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH25	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH26	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH27	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH28	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH29	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH30	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH31	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH32	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH33	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH34	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH35	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH36	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH37	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH38	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH39	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH40	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH41	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH43	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH44	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH45	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH46	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH48	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH49	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SH50	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ51	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ52	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ53	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ55	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ56	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ57	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ58	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ59	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ60	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ61	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)

SZ63	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ65	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ66	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ67	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ68	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ70	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ71	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ72	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ73	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ74	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ75	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ77	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ78	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ79	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ80	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ83	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ84	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ85	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ86	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ87	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ88	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ89	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
SZ90	GJR-GARCH (1,1)	GARCH (1，1)	GARCH (1,1)
Total	GJR-GARCH (1,1)	GARCH (1,1)	GARCH (1,1)

Chapter 5: The Determinants of Short-selling and Margin-trading Activities

5.1 Introduction

5.1.1 Motivation

There is a widespread literature which documents that short sellers and margin traders are integral to the efficient functioning of financial markets with both theoretical and empirical evidence. While most financial regulators agree that trades on margin have an important role to play in ensuring market efficiency, many of them do not hesitate to ban or make restrictions on transactions of short selling and margin trading during financial crises[6]. These conflicting ideas are most likely to stem from a lack of understanding about what motivates short sellers and margin traders to make their investment decisions, and whether their motivations are fundamentals-related.

The conventional wisdom treats short sellers and margin traders as sophisticated investors who incur relatively high transaction costs. Short sellers attempt to sell shorts and subsequently repurchase temporarily overvalued securities to make profits, while margin traders borrow

[6] As the market situation worsened and stock prices fell sharply in the 2008 financial crisis, governments around the world turned to the same scapegoat, short selling. Commencing in the US on July 15, 2008, the US regulators announced an emergency order banning naked short selling on 19 large financial firms. Later on September 18, the SEC prohibited all shorting in nearly 800 financial stocks. At the next day on September19, the UK FSA launched a ban targeting both covered and naked short selling at 34 financial stocks. Bans in other markets followed soon: Australia, Taiwan and Korea banned short selling on all stocks; Canada, Norway, Ireland, Denmark, Russia, Pakistan and Greece banned short selling on leading financial stocks; France, Italy, Portugal, Luxembourg, The Netherlands, Austria and Belgium banned naked shorting on leading financial stocks; and Japan banned naked short selling on all stocks. To tackle the European debt crisis in 2010-2011, similar bans are reintroduced in France, Belgium, Italy, and Spain. On May 19, 2010, the German BaFin extended naked short sales bans on government bond and CDS market. As regards margin trading, regulators tend to show different understandings about leverage with an occurrence of market routs. In the 2015 Chinese stock market turbulence, China's regulators attempted to prevent further build-up of leverage in the stock market similar to the borrowing binge that took place earlier this year. In Nov 2015, the CSRC doubled margin requirements to 100 percent as another move to limit financial leverage in the stock market.

undervalued shares from brokers and pay them back after selling the borrowed securities. There is overwhelming evidence show that short sellers successfully identify securities that subsequently underperform the market price (*e.g.* Figlewski and Webb 1993; Asquith and Meulbroek 1996; Atken *et al.* 1998; Dither *et al.* 2009b; Engelberg *et al.* 2012). Margin trading, however, remains a common but relatively understudied status in the literature. A recent paper by Ladley *et al.* (2016) suggests that margin trading adopted by retail investors are not able to make profits but leads to significantly lower skewed returns. They point out that retail margin traders' investment behaviour is more likely to be motivated by short-term hedonic returns. However, the motivations of margin-trading activities are still waiting to be thoroughly studied.

To examine the role of short sellers and margin traders in financial markets, this study attempts to investigate the determinants of short-selling and margin-trading activities together. By identifying information sources of short sellers and margin traders' trading advantages, our study would also have important implications for financial regulators and policymakers, particularly for an emerging market like China.

5.1.2 Gaps and Contributions

The study aims to investigate the determinants of short selling and margin trading respectively. Taking together with control variables, the firm-level determinants of short-selling (margin-trading) activity include past short-selling (margin-trading) activities, past stock returns, stock returns volatility, financial ratios, ex-dividend date events, industry classifications, insider trading events, stock analyst recommendations, block trading events, whereas the market-level factors include past market performance and investor sentiment. We provide crucial additional insights on the nature of information advantages that lead to abnormal returns earned by short sellers and margin traders. Our findings further allow novel inferences about how short sellers and margin traders contribute to price discovery and market efficiency. Generally, this study makes three major contributions to the current literature:

Firm-specific factors

Our first contribution is that we introduce several additional firm-specific factors to the determinants of short-selling (margin-trading) activity. The additional firm-specific factors include industry, insider trading events, stock analyst recommendations, and block trading events. Furthermore, we study the difference between the relationship of positive information and short-selling activities and that of negative information and short-selling activities.

First, we consider industry classification as a potential factor impacting short-selling and margin-trading activities. Financial analysts often divide the stock market into ten to eleven sectors, of which companies having unique dynamics compete with each other directly. In our study, we generally distinguish our sample stocks by financial stocks and non-financial stocks. This consideration is because that the financial stocks arguably has more power to indicate current market conditions. In the 2008 financial crisis, the financial sector experienced one of the hardest blow with companies such as Bear Stearns and Lehman Brothers filing for bankruptcy. After an influx of regulatory rectification and structural reconstruction, the financial sector gradually grows stronger. Economists often associate the overall health of an economy with the health status of its domestic financial sector. If financial companies are weak, there would be a detrimental influence on the average consumer. Therefore, we argue that short sellers and margin traders, who bear relatively high costs when making their investment, are likely to pay more attention to financial stock than to stocks in other industries.

Second, we identify insider trading events as a potential factor which may affect the trading activities of short sellers (margin traders). A small branch of studies in short selling literature focuses on the relationship between short positions and publicly available information. Several extant papers examine short selling behaviour in the context of a specific type of corporate news event. Karpoff and Lou (2010) examine short-selling positions in firms that are investigated for financial misconduct and find that short sellers generally anticipate public announcements of investigations. Christophe *et al.* (2004) study short-selling activity around earnings announcements. They find evidence that short sellers are informed traders who can profit from these events. Similarly, Daske *et al.* (2005) and Boehmer *et al.* (2010) look at short sales around management forecast and earnings announcements. While Daske *et al.* (2005) find

no evidence that short selling transactions concentrate prior to bad news events, Boehmer *et al.* (2010) find some evidence of anticipation, and it documents that a significant fraction of information advantage of short sellers comes from trading around these events. Nagel (2005) investigates the cash-flow changes implied by a vector autoregressive model and finds an asymmetric effect on returns. It indicates that short sellers help incorporate news into stock prices when the short-selling transaction is not constrained.

The above-mentioned literature shed light on a subset of this paper's sample of determinants. While most of the previous studies identify patterns in short selling around a handful of firm fundamental events, our paper aims to uncover patterns in short sellers' activity around a wider range of firm-specific factors. Doing so allows us to speak more generally about short sellers' investment behaviour of certain stocks. Chen *et al*. (2016) show that Chinese short sellers trade more intensely than other traders prior to the news of insider selling, while margin traders trade more heavily prior to insider purchasing. However, Blau and Wade (2012) point out that we cannot say that short seller (margin traders) are informed if there is a similar magnitude of increase prior to insider purchasing (insider selling). We should also find a negative relationship between insider purchasing (insider selling) and short selling (margin trading) to draw the conclusion. Rather than focus on short sales positions prior to insider trading, we extend Chen *et al.* (2016) to examines the magnitude of short-selling (margin-trading) activity after insider trading events from both selling and purchasing sides.

Third, we are the first study to consider stock analyst recommendations as information sources to short sellers (margin traders). Financial analysts play an important part in information transfers in the financial markets. The extant literature suggests that stock analyst recommendations and reports have at least short-term investment value (*e.g.*, Stickle 1995, Womack 1996, Krische and Lee 2000, Barber *et al.* 2001, Jegadeesh *et al.* 2004, Green 2006, Barber *et al.* 2010). Specifically, the stock analyst recommendations, as indirect evidence of the changes in firm fundamentals, is identified as the main factor in our study. We take stock analyst recommendations as the main factor to study the determinants of short-selling and margin-trading activities. The previous studies, which examine the relationship between stock analyst recommendations and short selling, focus on the question whether short positions in the days leading up to analyst downgrades is abnormally high. Christophe *et al.* (2010) investigate the magnitude and significance of short positions prior to analyst downgrades. Their

findings support that short sellers are informed traders who exploit profitable opportunities by receiving tips from analysts of brokerage firms. However, Blau and Wade (2012) criticize this result by pointing out that observing abnormal short-selling activity prior to analyst downgrades is not equivalent to that short sellers are informed in advance, unless short positions are abnormally low prior to upgrades. Inspired by this idea, we investigate the link between stock analyst recommendations and short-selling (margin-trading) activity from both directions of downgrade and upgrade.

Fourth, block trade events are examined as another potential factor to short-selling (margin-trading) activity. Kraus and Stoll (1972) examine whether the price effects accompanying block trades can be ascribed to a change in the underlying value of a stock, which is called information effect; or to a temporary deviation of prices, which is called distribution effect. In their study, blocks are classified into three groups: those that traded below the price prior to the block (minus tick), those that traded at a price equal to the price prior to the block (zero tick) and those that traded at a price above the price prior to the block (plus tick). For plus tick blocks, the evidence indicates that price effects reflect changes in the underlying value of the stock. While the results from minus tick blocks show some form of distribution effect. Within the day, closing price showed a significant average reversal of the block trade price. This result indicates that the majority block trades with minus tick cannot change the fundamental value of a stock. A significant relationship is supposed to be found between plus tick blocks and the two mechanisms studied in our study, while no significant link should be found between minus tick blocks and the two mechanisms.

Market-level factors

Our second major contribution is that we consider an additional factor, the investor sentiment, to the determinants of short-selling (margin-trading) activity at market-level. The relationship between investor sentiment and short-selling (margin-trading) activity is examined. A large amount of literature has documented that investor sentiment affects stock prices (*e.g.* FisherKenneth 2000; Brown and Cliff 2004; Baker and Wurgler 2007). Our paper, however, initially establishes the link between investor sentiment and trading activities on margin. McKenzie and Henry (2012) adopt two macro factors, the lagged market returns and the 3-

month HK-US interest rate differential, to study the determinants of short sales positions. We extend their work not only by examining a considerable number of new factors at both firm-level and market-level, but also using several measures to each factor, which is new in the field of literature. In our study, investor sentiment is proxied by three different measures: (1) Consumer confidence index (CCI); (2) Market trading volume, which is measured by daily market turnover; and the (3) IPO number, which is measured by the number of newly listed shares in the A-share market.

Determinants of margin-trading activity

Our third contribution to the current literature is that we initially investigate the determinants of margin-trading activity at both firm-specific and market-level. Given the importance of margin trading to the integrity of stock markets, little is known about the motivations of their investment behaviour. In March 2010, the CSRC introduced the two mechanisms, short selling and margin trading, all together into the Chinese stock markets. As both mechanisms are using leveraged positions trading on the margin account, regulatory policies regarding these two mechanisms are synchronous and highly related. After stock price crash happened in 2015, participants in the Chinese stock markets start to point their spearhead at trading activities on margin. Short selling and margin trading are considered as misused speculation means, especially when these two mechanisms are in an immature investment environment with obvious regulatory deficiencies like the A-share market. The market participants in the A-share market argue that short sellers and margin traders are better-informed investors, who likely possess inside information that is inaccessible to the public. Besides, short selling and margin trading share many similarities from both trading mechanism and investor characteristics. It is thus meaningful for us to take this chance to study the two mechanisms with comparisons.

5.1.3 Research Questions

In all, the purpose of our study is to provide an empirical assessment of the determinants of short selling and margin trading in an emerging market. The research questions are as follows:

Question 1: Whether and how the firm-specific factors and the market-level factors influence short-selling activity?
Question 2: Whether and how the firm-specific factors and the market-level factors influence margin-trading activity?

5.2 Literature Review

5.2.1 Remarks on Short Sellers

We start from a specific question: Are short sellers information processors or manipulators? Before the most recent financial crisis, economists generally viewed short sellers and margin traders as important contributors to efficient stock prices. The theoretical work by Miller (1977) argues that when short selling is constrained, assets tend to be overvalued. Diamond and Verrecchia (1987) strengthen this idea, pointing out that a market without short selling needs longer time to incorporate negative information into prices. In the past decades, plenty of empirical studies stressing on different issues provide strong support for these claims (Senchack and Starks, 1993; Aitken *et al*., 1998; Desai *et al*., 2002; Cohen *et al*., 2008; Boehmer *et al*., 2008). However, attitudes toward short selling changed dramatically when the financial crisis comes. Short sellers were heavily blamed for active trading right before the fall of stocks. Even financial economists seem less sure of efficiency advantages brought in by short sellers. Goldstein and Guembel (2008) find that opportunistic short sellers drive share prices down, thereby destroying firm value.

Are short sellers advanced information processors, or are they in fact manipulators? The answer to the question hinges on identifying the information that short sellers possess. If short sellers act only on information about firm fundamentals, then it is hard to charge them as manipulators. Previous literature finds that heavier shorting leads to lower returns in the future and worsening

firm fundamentals. But it does not answer the essential question of whether or how much of short sellers' ability to generate excess returns come from information related to firm fundamentals. That is the focus of this study. To be more specific, we investigate and quantify the sources of short sellers' information advantage by combining a seven-year panel of A-share short sales order data. Together with direct factors and three main factors, institutional trading activities, stock analyst ratings and insider trading, which are indirect evidence of the changes in firm fundamentals, we aim to see whether information advantage of short sellers can be attributed to these two types of publicly available information. Our findings can help financial regulators, investors and economists further understand the sources of excess returns made by short sellers.

The past three decades have seen a significant increase in the degree of short selling activity on equity markets. Buying long is the most prevalent method of investment in the stock market. This has many reasons, but the best one is that the market pays quite well over time. Short selling is simply the reverse of buying long, but with an important difference: short sellers must pay interests on borrowed shares. Diamond and Verrechia (1987) suggest that short-sellers will not trade unless they expect the price to fall enough to compensate them for the additional costs and risks of shorting. Short selling is not only more expensive but also riskier than establishing a long position. As believed, short sellers are therefore more likely to be better informed than are investors with long positions. Short sales could occur for a myriad of reasons, but only one of which is a belief by short seller: the share is overvalued relative to its fundamentals. Thus, much of the extant literature focuses on the information content of short sale. Studies including Desai *et al.* (2002), Arnold, *et al*. (2005), and Boehmer *et al.* (2008) document that short interest conveys bearish information of the underlying security because short sellers have information advantages. On the other hand, a popular perspective from Wall Street suggests that short sales are a bullish market indicator due to the nature of short selling.

There are other studies examining how information of firm fundamentals is related to short selling activity. Firms with low ratios of fundamentals, such as earnings-to-price and book-to-market values, are known to have lower future returns. Given the well-documented predictive ability of these ratios, it provides a natural starting point for investigating the information sources of short-sellers. Dechow *et al*. (2001) document that short-sellers position themselves

in the stock of such firms, and cover their positions as the ratios revert to the mean. Christophe *et al*. (2004) show that abnormal short sales prior to negative earnings announcements are negatively related to future returns and argue that short sellers can predict the negative news in earnings announcements. On the contrary, several studies document that short sellers are unable to predict negative announcements but instead increase short positions in response to announcements (*e.g.*, Daske *et al*., 2005; Blau and Pinegar, 2010). Engelberg *et al*. (2012) collect news articles to investigate how short sellers process publicly available information. They find that short sellers are more skilled and efficient information processors, who trade more actively and profitably after news announcements. Boehmer *et al*. (2012) study the issue concentrating on three types of news: earning news, analyst recommendations and analyst forecasts. They show evidence that short sellers significantly anticipate forthcoming news related to a firm's earnings. This suggests that short sellers are not only skilled information processors but also have information advantages. By adopting both direct and indirect news related to fundamentals, our study aims to explore the determinants of short selling activity from a comprehensive point of view.

5.2.2 The Relationship between Short Selling and Margin Trading

The purpose of our study is to investigate the determinants of short-selling and margin-trading activities respectively. In the extant literature, the determinants of short selling have been studied by a few studies, while the literature on margin trading is rather limited. Can the determinants of short selling and margin trading be studied together? There are two reasons why we can: Firstly, the nature of the trading structure of the two allow us to do so. Although with opposite trading directions, both transactions of short selling and margin trading involve leveraged positions taken in a trader's margin account. Due to leveraged positions used and more trading participants involved, traders of these two mechanisms need to bear substantial extra costs. And for this reason, short sellers and margin traders are widely considered as informed investors who might own private channel of information related to firm's fundamentals.

Secondly, the literature in both fields document that these two types of trades contain advanced information (*e.g*., Figlewski and Webb 1993, Aitken *et al.* 1998, Arnold *et al.* 2005, Bris *et al.* 2007, Huang and Wu 2009, Diether *et al*. 2009, Shyu *et al*. 2017; Mayhew *et al.* 1995). Take margin trading as an example, Alexander *et al.* (2004) find that after the level of margin requirements decline, increased margin eligibility generates more leverage opportunities for informed traders who are with finite wealth. With an increase in the information content of trades, the market quality, therefore, is improved. In a broad sense, the motivations of short selling and margin trading can be distinguished by firm-level and market-level reasons. Table 5.1 lists all the potential determinants of short-selling and margin-trading activities.

5.2.3 Firm-specific Independent Factors

Industry classifications

In economics, the term sector is often used to present an essential part of the national economy. And the levels of disclosure in corporate reports are not likely to be identical across all sectors. Investors who want to build exposure to a specific sector can use various investment vehicles to achieve their asset allocation goals. Compared to the sector, another narrower term is industry, which denotes a business section that is trading similar services and goods in direct competition with each other. Markets are segregated into independent sectors using either Global Industry Classification Standard (GICS), Industry Classification Benchmark (ICB) or Thomson Reuters Business Classification (TRBC). According to industry classification of TRBC[7], our study generally distinguishes our sample stocks by financial stocks and non-

[7] The Thomson Reuters Business Classification is an up-to-date industry classification system launched by Thomas Reuters. This market-based classification system covers 72,000 public companies and 2.4 million private companies globally from 130 countries. TRBC is composed of five levels of hierarchical structure, and the highest level is the economic sector. There are total ten economic sectors under TRBC, including basic materials, energy, industrials, cyclical consumer goods and services, non-cyclical consumer goods and services, financials, healthcare, technology, telecommunications services, utilities. Each company is allocated to an industry, which belongs to an industry group, then the business sector, which is a subsection of an overall economic sector.

financial stocks. Under the economic sector financials of TRBC, there are eight industry group: banking services, investment banking and investment services, diversified financial services, insurance, real estate operations, residential and commercial REITs, collective investments and holding companies. By this principle, we divide our sample stocks into the two categories.

There are two reasons why the financial sector or industries is a distinctive factor for us to investigate the determinants of short-selling and margin-trading activities. Firstly, financial companies are powerful to indicate the general market conditions. If financial companies are in poor financial condition, there would be an adverse impact on the ordinary consumption. Financial firms provide loans for businesses, mortgages to homeowners and insurance to consumers. If these activities are depressed, it stunts growth in all other relevant fields like small business, real estate and stock markets. As high transaction cost bearers, short sellers and margin traders are likely to pay more attention to financial stocks rather than others. Secondly, the financial sector in China has experienced rapid development in the past decade, during which the time range of our sample overlaps. In 2007, the industries of real estate and financial services become the most important tax pillars in the domestic economy. In the later year 2015, due to the government's encouragement to public investments, other financial industries like the investment bank and collective funds are further expanded in the economy. With data from the Chinese A-share market, we thus expect a positive relationship between the financial feature of stocks and short-selling (margin-trading) activity.

Insider trading events

The primary reason for investors using the strategy of short selling is speculation. The results of a survey of NYSE in 1947 show that approximately two-thirds of short selling was speculative (McDonald and Baron 1973). In this case, the traditional view of short sellers' trading on negative and presumably inside information about a firm's prospects may not be valid. Instead, Francis *et al*. (2005) show evidence that short sellers are more likely to trade on misperceptions held by the market about the fundamentals of a firm. Except for straightforward accounting data in a firm's financial statements, other ways of public news releases could also show a hint of the future trend of stock price. In this study, we examine the relationship between

one certain type of informational events, insider trading, and short-selling (margin-trading) activity.

Investors in the stock markets usually watch insider purchases and sales of their own firm's stocks closely because these trades may reveal inside information. Khan and Lu (2013) consider short sellers as informed market participants and investigate potential sources of their information. They find significant increases in short positions immediately before large insider sales, but not before small insider sales. The explanation of the abnormal increase in short positions is consistent with the front-running hypothesis facilitated by earlier leakage of information. Chakrabarty and Shkilko (2013) study short-selling activities related to both insider sales and purchases. They find abnormally positive short selling accompanies insider sales, and abnormally negative short selling accompanies insider purchases. They posit that the superior timing of short sellers is consistent with two reasons: monitoring of order flows and obtaining price-relevant information from brokerage firms that execute insider sales.

With a sample of 446 stocks during 2010 to 2014, Chen *et al.* (2016) study the link between insider trading and trades on margin in China. With measures of abnormal trading, they find abnormal short-selling and margin-trading activities both before and after events of insider trading. But in a latter panel regression, the findings become inconsistent. Although abnormal high levels of short positions prior to insider sales is observed, no significant relationship is found for post-event short activity. Also, the relationship between margin trading and insider purchases become significantly negative. The overall empirical results turn to be uninterpretable. Also, they only study the relationships between short selling with insider sales, and margin trading with insider purchase. With reference to Blau and Wade (2012), we cannot say that short seller (margin traders) are informed if there is a similar magnitude of increase prior to insider purchasing (insider selling). Only with evidence that there is a negative relationship between insider purchasing (insider selling) and short selling (margin trading), we can draw the conclusion. Our study aims to complement Chen *et al.* (2016) by studying the links between the two mechanisms and both directions of insider trading events. Thus, we expect a negative (positive) relationship between insider purchases and post-event short-selling (margin-trading) activity, while a positive (negative) one between insider sales and post-event short-selling (margin-trading) activity.

Stock analyst recommendations

Information dissemination in the financial markets is of significant interest to both regulators and financial scholars. It has been well established in the literature that analyst recommendations predict future returns. Stickel (1995) and Womack (1996) find that favourable (unfavourable) changes in analyst recommendations are accompanied by positive (negative) returns at the time of the announcement. Despite bias with eight variables that have predictive powers for future returns, analyst recommendations show incremental predictive power for stock returns (Krische and Lee 2000). Barber *et al*. (2001) document that buying stocks with the most favourable consensus recommendations, along with daily portfolio rebalancing to analyst recommendation changes, can yield annual gross returns greater than four percent. Barber *et al.* (2010) further find that both rating levels and changes in analyst ratings predict future unexpected earnings. Although inconsistency exists between analysts' recommendations, the predictive power of those ratings reflects at least partially analysts' ability to generate valuable private information.

A branch of literature has studied the relationship between short selling and analyst recommendations. Francis *et al*. (2005) find that analysts revise downward earnings forecasts more severely for firms with unexpected high levels of short positions. This evidence suggests that short sellers are able to exploit the market's misperception of firm fundamentals. With a sample of 670 downgrades of Nasdaq stocks, Christophe *et al.* (2010) find abnormal activity levels of short selling prior to the release of analyst downgrades. The increased short sales are significantly related to the subsequent stock price reacting to downgrades. This finding is consistent with the theory in Diamond and Verrecchia (1987) that short sellers are informed traders who can profit by trading shares before the negative information reaches the public. Christophe *et al.* (2010) name their finding as 'the informed front-running hypothesis', arguing that short sellers receive tips from their brokerages about the upcoming analyst downgrades. Boehmer *et al.* (2012) study the sources of short sellers' informational advantage. Similarly, heavier shorting is observed the week before analyst downgrades. Shorting predictability remains after controlling for analyst recommendations, signifying that short sellers know more than stock analysts about firm fundamentals.

While Blau and Wade (2012) question this conclusion that no evidence of a declining short-selling pattern is found prior to analyst upgrades. Engelberg *et al.* (2012) find that a substantial portion of short sellers' trading advantage comes from their superior ability to analyse public information. As short sellers are considered taking better use of public information, we should examine the link between analyst recommendations and short-selling activity from both perspectives. Along with the idea of Blau and Wade (2012), we examine the relationship between stock analyst ratings and short-selling (margin-trading) activity from both sides of downgrade and upgrade. By this way, we can seek further insights into the predictive value of analyst recommendations, enhancing our understanding of how they are employed by different market participants as part of their investment strategy. We propose that short sellers and margin traders take stock analyst recommendations as one source of their information to make their final investment decisions. Thus, we expect that a decline (an increase) occurs in the level of short-selling (margin-trading) activity after an analyst upgrade, while an increase (a decline) occurs after an analyst downgrade.

Block trading events

A block trade in stock markets is a significant order often placed by institutional investors for sale or purchase of a large number of securities in the normal course of the auction market[8]. There is a buyer and A seller in each trade, while a block is purchased or sold is an ambiguous concept. The value of blockage discount rate can be both positive and negative. The majority blocks, however, trade on a negative discount rate (Kraus and Stoll 1972). It is the difference between the market value of a stock and its sale price when transacted under a block trade. Negotiated by the involved institutional investors, blockage discount rate of intraday orders of the same stock can be different, since it incorporates many factors as market liquidity, the size of the trade, and even negotiation issues. A positive blockage discount rate implies the transacted stock is highly coveted by investors, while a significant negative rate indicates unpopularity of the stock among investors. As in fact, the blockage discount rate reflects the

[8] In the US, a block of securities will typically consist of 10,000 shares or debt securities valued over $200,000. As for the minimum requirement of block trade in the Chinese stock markets, it must be consisted of at least 300,000 shares or debt securities valued over RMB2,000,000.

demand and supply status of a stock, we, therefore, adopt it as a sentiment indicator to individual stocks.

Kraus and Stoll (1972) investigate the extent to which block trading taken by institutional investors contributes to or detracts from market efficiencies. They examine whether the price effects accompanying block trades can be ascribed to a change in the underlying value of a stock, which is called information effect; or to a temporary deviation of prices, which is called distribution effect. In their study, blocks are classified into three groups: those that traded below the price prior to the block (minus-tick), those that traded at a price equal to the price prior to the block (zero-tick) and those that traded at a price above the price prior to the block (plus-tick). For plus-tick blocks, the evidence indicates that price effects reflect changes in the underlying value of the stock. While the results from minus tick blocks show some form of distribution effect. Within the day, closing price showed a significant average reversal of the block trade price. Therefore, the majority block trades cannot change the fundamental value of a stock. As widely-considered advanced traders, short sellers and margin traders may able to identify this fact. If so, no significant links would be found between minus tick blocks and the two mechanisms focused in our study. We then expect a negative (positive) relationship between plus-tick blocks and short-selling (margin-trading) activity, whereas a positive (negative) one between minus-tick blocks and short-selling (margin-trading) activity.

5.2.4 Firm-specific Control Factors

Previous margin activities

In addition to stock returns, previous short-selling (margin-trading) activity itself could be a factor which determines the current level of short interest (margin interest). Given the evidence of serial correlation in Appendix 5.2, we expect a negative relationship between previous and current short-selling activities.

Regarding margin trading, margin debt rises and falls with markets. The basis of margin traders for making loans against equities naturally increases when the value of that portfolio goes up. Margin debt declines when the value of that underlying collateral goes down. That is how margin works. Since inertia is well-acknowledged and common in stock returns, a positive relationship is expected between previous and the current level of margin purchases.

Previous stock performance

We may differentiate fundamental traders and technical traders by that the latter typically apply some forms of trading rules to historical price performance to make investing decisions. Diether *et al.* (2009) provide evidence that intensified short-selling activities normally follow positive stock returns in the expectation of a price fall in the next period. A positive feedback trader, however, would extrapolate any trend into the next period. As such, short sellers make transactions following a price fall with the expectation of another negative return in the next period. However, empirical results of feedback trading behaviour of margin traders are mixed. Hirose *et al.* (2009) document that margin traders in Japan follow positive feedback trading behaviour for small-firm stocks and negative feedback trading behaviour for large firm stocks. Although all our 90 sample stocks are blue-chip stocks with the largest capitalisation among the A-share stocks, with the results of Chapter 4 we predict a positive relationship between the historical stock returns and margin-loans positions. Thus, we expect a positive relationship between the lagged stock returns and short-selling (margin-trading) activity.

Firm-level volatility

The stock risks may also be an important factor of short-selling and margin-trading activities. Firstly, it may motivate short sales aimed at reducing exposure to market risk through hedging. Also, it indicates the heterogeneity of investors' beliefs about the value of a stock, which can induce growing transactions of both short-selling and margin-trading activities. Since share specific-risk cannot be directly observed, a proxy variable must be adopted. A few candidates exist in this context, including option implied volatilities, historical volatility, GARCH estimates and intraday trading range. As options trading is currently unavailable in the Chinese

stock markets, we adopt two volatility measures with slightly different definitions, historical volatility and intraday trading range, to see which of them is more relevant to our dependent variables. The former risk is defined as the standard deviation of recent days' price changes, while the latter is the difference between the highest price and the lowest price of a stock on a day. For the historical volatility measure, we expect a negative relationship of it with either of our dependent variables, since a period of volatility may suggest an unsteady trend of future prices. In this case, investing in short-selling and margin-trading positions would be much riskier than the steady period, and the costs of short selling and margin trading would be too high. For intraday measure the trading range, we anticipate a positive relationship between firm-specific risks and short selling, while a negative one with margin trading.

Financial ratios

A large body of evidence demonstrates that ratios of fundamental value to market value systematically predict future stock returns. These ratios compare estimates of intrinsic values based on accounting data to observed market prices. They range from simple data such as earnings per share (EPS) and book-to-market values (*e.g.*, Fama and French, 1995; Lakonishok *et al*., 1994) to ratios based on more sophisticated valuation models (*e.g*., Ohlson, 1995; Frankel and Lee, 1998; Dechow *et al*., 1999). In a rational expectations model as Diamond and Verrecchia (1987), new information of an asset could be quickly and accurately impounded into the price. The positive information will lead stock price to rise, while any negative information leads price to fall. Given the well documented predictive ability of these ratios with respect to future stock returns, they provide a natural starting point for investigating the trading strategies of short sellers and margin traders.

Dechow *et al.* (2001) and Christophe *et al.* (2004) argue that firms with low ratios of fundamentals are known to have systematically lower future stock returns. Thus, investors may monitor firms' fundamentals and sell stocks when their fundamentals decline. The literature suggests that the relevant set of fundamentals may include dividend yield (DY), earnings per share (EPS), the price-to-book ratio (PTBR). We then use these ratios of a firm's fundamental

value as potential motivations of short-selling and margin-trading activities. We expect a negative (positive) relationship between corporate financial indicators and short-selling (margin-trading) activity. Thus, for the first two measures, DY and EPS, a negative (positive) relationship with short-selling (margin-trading) activity is anticipated. The price-to-book ratio attempts to find the value of a company by comparing the stock price of a firm to its accounting value. This ratio is used to identify undervalued or overvalued stocks by taking the market value and dividing it by book value. If the ratio is above 1 then the share is overvalued; if it is less than one, the share is undervalued. Thus, a positive (negative) relationship is anticipated between PTBR and short-selling (margin-trading) activity.

Ex-dividend date

The dividend payments may have a significant impact on the decision process of short sellers since more costs may occur if a short selling transaction is accompanied by dividend payments. During the process of dividend distribution, there are three key dates, which are the record date, the ex-dividend date and the final payment date. The record date is the cut-off date when a firm determines whether their shareholders are eligible to receive a dividend. The shareholders who are on record will then be entitled to receive the dividend declared by the firm. Next to the record date is the ex-dividend date, anyone who holds stocks immediately before this date is entitled to a dividend. In other words, an investor will not receive the dividend on and after this date. Under the mechanism of short selling, investors not only have to pay back the borrowed equities but also give back the dividend payments occur during the entire transaction period. As for margin traders, things go opposite. We thus expect a positive (negative) relationship between the ex-dividend date and short-selling (margin-trading) activity.

5.2.5 Market-level Independent Factors

Investor sentiment

Investor sentiment, defined broadly, is a belief about future cash flows and investment risks that are not justified by the facts at hand. A large amount of literature documents that investor sentiment affects stock prices (*e.g.*, FisherKenneth 2000; Brown and Cliff 2004), but no consensus is reached about how to measure investor sentiment and quantify the effects. Baker and Wurgler (2007) list candidate measures of investor sentiment, including "surveys; mood proxies; retail investor trades; mutual fund flows; trading volume; premia on dividend-paying stocks; closed-end fund discounts; option implied volatility; first-day returns on initial public offerings (IPOs); volume of initial public offerings; new equity issues; and insider trading." With consideration of their relevance and data availability, we choose three measures for the investor sentiment in the A-share market. The first one is consumer confidence index; the second one is market trading volume, which is proxied with market turnover; and the third one is IPO volume, which is proxied with the number of newly listed shares in the A-share market. Shen and Yu (2013) explore the role of investor sentiment in the pricing of a broad set of macro-related risk factors. Qiu and Welch (2004) suggest that the consumer confidence based measure can robustly explain the small-firm return spread and the return spread between stocks held disproportionately by retail investors and those held by institutional investors. Their evidence supports the view that investor sentiment plays a role in financial markets, and especially it is related to stock returns. Short selling is the practice of going short of borrowed stock with the expectation that the stock price will soon fall, allowing short sellers to purchase it back for a profit. More short selling transactions are expected to be taken when investors believe that the stock market is recessing, since a bearish status of the stock market is closely related to future stock returns. Under a bear market, investors tend to hold more shorting positions to make profits. We thus expect a negative (positive) relationship between bullish investor sentiment and short-selling (margin-trading) activity.

5.2.6 Market-level Control Factor

Stock market performance

Another possibility is that technical traders may base their decisions on general market movements rather than those of individual stocks, in which case short-selling and margin-trading activities may be related to previous market returns. The nature of these relationships, however, is not clear. Lamont and Stein (2004) find that total amount of short positions moves counter market trends, that is, short-selling activity falls as the market approaches its peak. This evidence could be taken as support for the view that the market can remain irrational longer than a trader can remain solvent (McKenzie and Henry 2012). While Asensio (2001) argues that a bull market could be a fertile ground for short sellers. As such, short sales positions may increase as a market approaches its peak and these positions would profit from the correction. Unlike short sellers who are typical contrarian traders, margin traders tend to be momentum traders in investing. Therefore, a positive relationship is expected between short-selling (margin-trading) activity and bullish past market performance.

5.3 Data

5.3.1 Sample Data

While the previous literature has typically considered US data, in this study, daily information of short selling and margin trading of Chinese A-shares is used. Brent *et al.* (1990) hypothesized that short sales is induced by speculation, arbitrage and taxation issues surrounding the deferment of capital gains. Using US data from 1974 to 1986, they test each of these three factors in turn. A major limitation of Brent *et al*. (1990) arises from its adoption of monthly data on open short interest. Since the majority of short-sales volume is attributed to short-term investing strategies, using monthly data has obvious deficiencies for the study to capture the effect of daily trading strategies of short selling.

Only from the millennium has a higher frequency investigation about the topic of the determinants of short selling been forthcoming. Diether *et al*. (2009) employ daily data of the first quarter of 2005 of a cross-section of 2185 US equities. They find that short sellers in the

US are contrarian traders and tend to sell shorts following a price increase. The Chinese stock market is a major financial market in the burgeoning Asian region, and its study provides an interesting alternative perspective to the previous US-centric studies. While previous US studies mostly adopt monthly data, except for the more recent literature that has got access to higher frequency data made available under regulation-SHO, daily activity data of short selling and margin trading are available in the A-share market in China.

Our study objects are supposed to be the 90 designated stocks in the first launch of China's 2010 reform of short selling and margin trading. However, only 73 stocks on the originally designated list are adopted in the study. There are three issues causing this significant data loss: First, 13 stocks in the first batch have been deleted at least once during our sample range of the continuous reform implementation. To maintain data continuity and avoid data contamination, data of those stocks are excluded once it is deleted from the designated list. Second, three stocks in Shenzhen Stock Exchange delisted from the stock market, so no more trading data of this stock is available. Third, the stock SZ000933 becomes under special treatment and has no more data of margin transactions from 17/01/2017. Therefore, we adopt short-selling and margin-trading data of remaining 73 individual stocks on the designated list.

The sample period is seven years from 31/03/2010 to 31/03/2017. Daily data of short-sales value (SSV)**,** margin-loans value (MLV)**,** short-sales ratio (SSR) and margin-loans ratio (MLR) are adopted[9]. Besides, the information of industry classifications of individual stocks, analyst recommendations, insider trading events, block trading and IPO volume is downloaded from WIND database. The daily stock data of historical volatility, dividend yield, earnings per share and price-to-book ratio are sourced from Datastream. Other daily data of individual stock and the A-share market, including closing price, market price and market turnover are gathered over the same period. The information of ex-dividend date is from the website of NetEase Finance, and the CCI data is obtained from Eastmoney.

[9] The short-sales ratio (SSR) is defined as the ratio of short-sales value to trading value, while the margin-loans ratio (MLR) is defined as the ratio of margin-loans value to trading value.

For measures without real daily data, we apply dummies to capture their impacts on short-selling and margin-trading activities. The ex-dividend date of individual stocks measured with a date dummy $D_{\text{Ex-dividend date}}$ is added to the model (McKenzie and Henry 2012). As for the measure of industrial type, we adopt the dummy variable $D_{\text{Financials}}$ to capture the financial feature of individual stocks. The insider trading events are measured with three dummy variables in our study: $D_{\text{Insider trading}}$, $D_{\text{Insider purchase}}$ and $D_{\text{Insider sale}}$. An insider trading event is good (bad) news if an insider buys (sells) stocks of his own firm (Chen *et al*. 2016). $D_{\text{Insider trading}}$ is one if either insider purchase or insider sale occurs at day t.

The financial press has long argued that analysts are reluctant to issue unfavourable investment information because they fear harming the potential interest of investment banking, losing informational access to management, and possible negative influences of future trading commissions (McNichols and O'Brien 1997). The academic literature generally suggests that these forces cause analysts to bias their true predictions toward more optimistic views. In China, avoiding negative sense in stock analyst ratings is particularly apparent. The data of analyst ratings of individual stocks and related analyst reports in details are available in Wind database. We use a 7-year data collection of all recommendations of 73 stocks made by analysts from influential brokerages in the A-share market. There are seven scales in the rating in our data of stock analyst recommendations, from negative to positive including sell, weak hold, neutral, hold, advise, accumulate, and buy. We group these scales into three general categories: downgrade, which contains sell and weak hold; neutral, which contains neutral and hold; and upgrade, which contains advise, accumulate and buy. Three dummy variables: $D_{\text{Analyst rating}}$, $D_{\text{Analyst upgrade}}$ and $D_{\text{Analyst downgrade}}$ are adopted in the study. $D_{\text{Analyst upgrade}}$ ($D_{\text{Analyst downgrade}}$) is one if analyst upgrade (analyst downgrade) of the stock occurs in recent two days, otherwise it is zero. $D_{\text{Analyst rating}}$ is one if either analyst upgrade or analyst downgrade occurs in recent two days.

Table 5.1 Potential Determinants of Short-selling and Margin-trading Activity

Determinants					Data			Expected relationships	
Level	Genre	No.	Factors examined	Variables	Type	Frequency	Sources	SS	MT
Firm-level	Control	1	Previous activities on margin	Lagged short-sales ratio	Real	Daily	Wind	+	
				(Lagged margin-loans ratio)	Real	Daily	Wind		+
		2	Previous stock performance	Lagged stock returns	Real	Daily	Wind	+	-
		3	Firm-level volatility	Historical volatility	Real	Daily	Datastream	-	-
				Trading range	Real	Daily	Wind	+	-
		4	Financial ratios	Dividend yield	Real	Daily	Datastream	-	+
				Earnings per share	Real	Daily	Datastream	-	+
				Price-to-book ratio	Real	Daily	Datastream	+	-
		5	Ex-dividend date	$D_{\text{Ex-dividend date}}$	Dummy	Daily	NetEase Finance	+	-
	Independent	6	Industry type	$D_{\text{Financials}}$	Dummy	Daily	Wind	+	+
		7	Insider trading events	$D_{\text{Insider trading}}$	Dummy	Daily	Wind	√	√
				$D_{\text{Insider purchase}}$	Dummy	Daily	Wind	-	+
				$D_{\text{Insider sale}}$	Dummy	Daily	Wind	+	-
		8	Analyst recommendations	$D_{\text{Analyst rating}}$	Dummy	Daily	Wind	√	√
				$D_{\text{Analyst upgrade}}$	Dummy	Daily	Wind	-	+
				$D_{\text{Analyst downgrade}}$	Dummy	Daily	Wind	+	-
		9	Block trades	$D_{\text{Lagged block order}}$	Dummy	Daily	Wind	√	√
				$D_{\text{Lagged plus-tick order}}$	Dummy	Daily	Wind	-	+
				$D_{\text{Lagged minus-tick order}}$	Dummy	Daily	Wind	+	-
Market-level	Control	10	Previous market performance	Lagged market returns	Real	Daily	Wind	+	+
	Independent	11	Investor Sentiment	$D_{\text{Consumer confidence index}}$	Dummy	Monthly	Eastmoney	-	+
				Market turnover	Real	Daily	Wind	-	+
				IPO volume	Real	Daily	Wind	-	+

Notes: This table summarises the factors and their corresponding variables, which are potential determinants of short-selling and margin-trading activities. The rightmost two columns list the expected relationships between the two dependent variables, short-selling (margin-trading) activities, and the examined variables separately. A plus sign '+' indicates a positive relationship between the dependent variable and certain independent variable, while a minus sign '-' indicates a negative one between the two. √ denotes a significant relationship between the dependent variable and the factor examined at the 10% level.

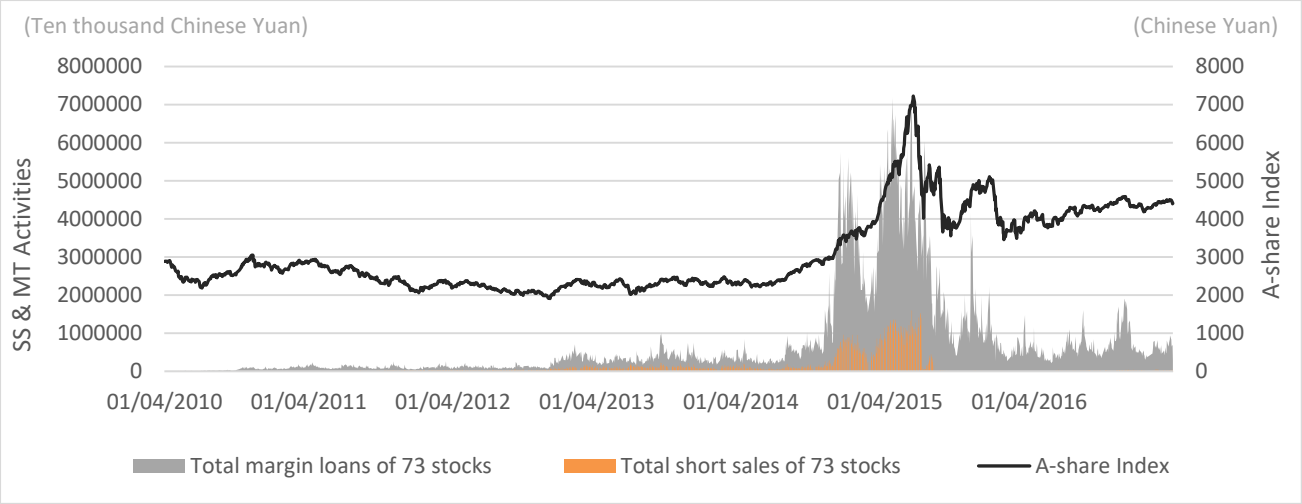
Following Kraus and Stoll (1972)'s approach, we count the total number of each type of block trades daily. A single securities trade on the A-share market can be executed as a block trade if its trading volume is no less than 300,000 shares or the trading value is no less than RMB 2 million (Shenzhen stock exchange, 2016). The separate analyses are conducted for trades over RMB 2 million on minus ticks and plus ticks. Since the block trade discount rate is different by each order, we then apply the information as dummy variables: $D_{\text{Lagged block order}}$, $D_{\text{Lagged plus-tick order}}$ and $D_{\text{Lagged minus-tick order}}$. The reason we use lagged data of block traders is that block trades are only approved and conducted during the after-hours trading period in the A-share market. In this case, the impact of block trading events is deferred to the second day's trading activities on margin. $D_{\text{Lagged block order}}$ is one if either plus-tick order or minus-tick order occurs on the previous day.

5.3.2 Descriptive Statistics

The descriptive statistics of daily stock returns, short-selling and margin-trading activities of the 73 stocks are provided separately in Appendix 5.1. The statistics including the mean, the minimum and the maximum return, the standard deviation, and the Jarque-Bera statistic are reported in Panel A. The stock returns are calculated with the logarithmic difference equation, $R_t = 100 \times ln(P_t/P_{t-1})$. The mean return of 12 out of 73 stocks are negative, and the lowest returns are -0.027 for SZ24 and -0.012 for SH48. The significant JB statistics of all analysed time series strongly support the non-normality of return distributions. Panel B and C are mean values of daily short-selling and margin-trading activities. The two data types of original short-selling activities are short-sales value and short interest, while the data of original margin trading activities are margin-loans value and margin interest. The unit of the four measures is ten thousand Chinese yuan. The average value of daily short sales among studied stocks is 1,536.175, while the average value of daily margin loans is around seven times of its short-selling counterpart at 10,311.441. The mean of short interest is 1,292.674, while the mean of margin interest is 148,854.886. As we can see from the above comparisons, the trading activities of short selling are much lesser than margin trading in the Chinese A-share market during our study period.

Figure 5.1 presents a plot of the total value of daily short sales and margin loans across all 73 object stocks as well as the A-share Index. As can be seen, the A-share market experiences a quite stable period for the first four sample year. After a short period of dramatic increase peaking at ¥7,200 on June 2015, the index declines sharply to a relatively higher level than the original and remains steady. The changes in the index's trend are important, as it suggests that the analysis results of our study are taken across a range of different market conditions.

Figure 5.1 Total Short sales and margin loans across sample stocks and A-share Index



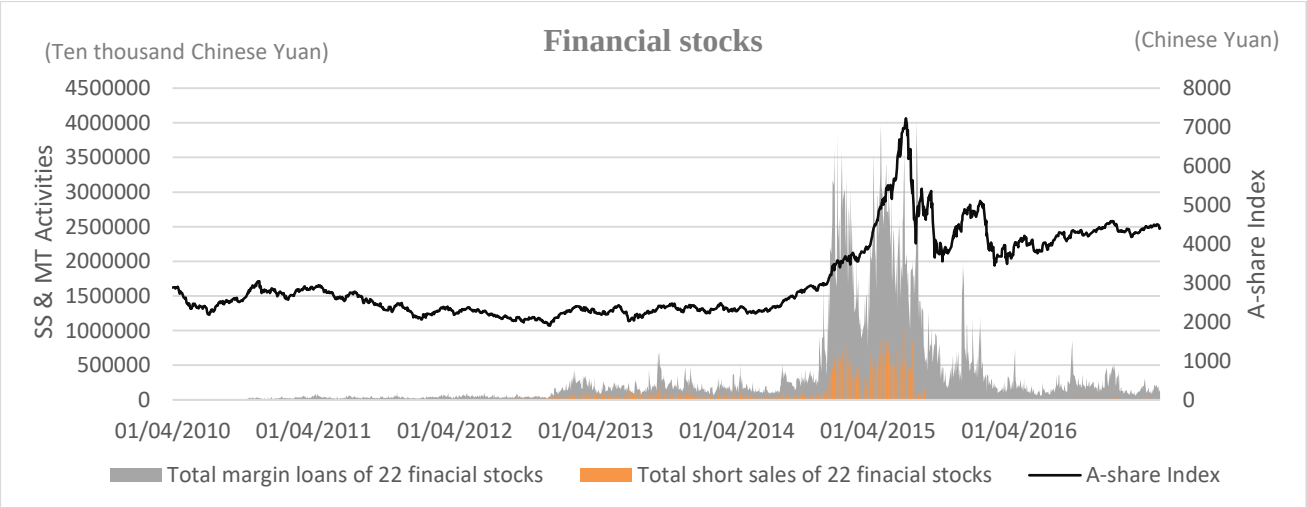
Notes: The black line represents the A-share Index. The orange and grey columns represent activities of short selling and margin trading, respectively.

After the introduction of the two mechanisms in 2010, activities of short selling and margin trading remains a rather low level during the adaptive phase of the first two years. It is noticeable that activities of both margin loans and short sales increase significantly along with the coming of a bull market. Under the bearish market, margin loans decline sharply while short sales keep an increasing trend, which is consistent with the notion that short-selling activities move counter-cyclically (Lamont and Stein 2004).

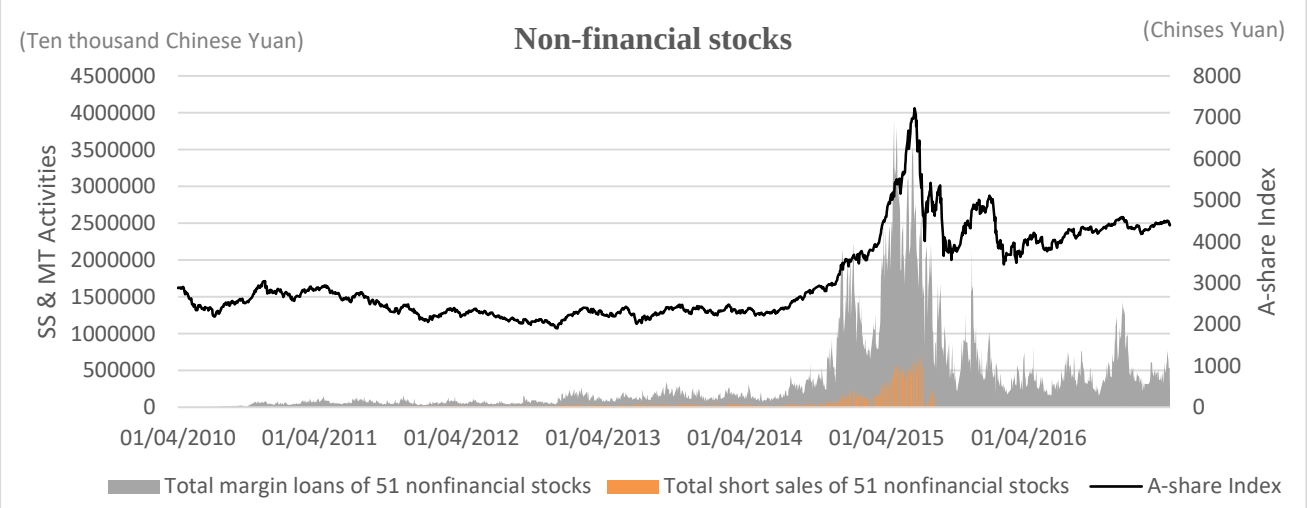
Figure 5.2 plot the total value of daily short sales and margin loans across 22 financial stocks and 51 non-financial stocks of our sample. Although the number of financial stocks in our

sample is at least two times lesser than non-financial stocks, the total trading amount of short selling and margin trading across financial stocks are much higher than its counterparts, especially during times of volatility. This indicates that financial stocks are more attractive to short sellers and margin traders in the Chinese A-share market.

Figure 5.2 Total Short sales and margin loans of 22 financial stocks and 51 non-financial stocks



Notes: The black line represents the A-share Index. The orange and grey columns separately represent daily activities of short selling and margin trading across 22 financial stocks included in our sample.



Notes: The black line represents the A-share Index. The orange and grey columns separately represent daily activities of short selling and margin trading across 51 non-financial stocks included in our sample.

Some stock investors tend to make trading decisions based on previous trades. Similarly, one possible strategy adopted by short sellers and margin traders is to trade stocks based on the previous levels of short interest or margin interest. Appendix 5.2 shows autocorrelations of daily short-selling and margin-trading activities up to the fifth order separately in panel A and panel B. Since short sellers have to close their shorting positions by buying the stock back, the short-sales volume would become an indicator of the future demand of a stock. Similarly, the margin-loans volume would be a signal of the declining price soon, since margin traders must sell current holdings to pay off the borrowed cash. However, it can be clearly seen from the table that both autocorrelations of short-sales value and margin-loans are consistently positive and significant for each stock. The evidence of our study supports the view that both short sellers and margin traders tend to acquire information from previous margin activities.

As market risk is an essential factor influencing securities pricing, short-selling (margin-trading) activities across our studied stocks may have positive correlations. This is because where the market is bearish, both stock prices and margin-trading activities are expected to decline, and speculative short selling may increase. While when a bullish market comes, both stock prices and margin-trading activities tend to grow, and short-selling activities may decrease as a result. Appendix 5.3 presents the correlation matrices for daily short-sales value data and daily margin-loans value data separately in panel A and B. As can be seen, the estimates of both types of transaction are quite high. The average value of the correlation coefficient of short-sales across sample stocks is 0.737, while for margin-loans is at a relatively lower coefficient at 0.706. No instance of negative correlations is observed. This evidence indicates that general market conditions play a significant role in determining the level of margin activities in the A-share market. This issue is considered in more details in the following section.

5.4 Methodology

5.4.1 Hierarchical Panel Regression

Following Diether *et al.* (2009), a pooled regression approach is adopted to estimate the functional relationship of the determinants of short selling (margin trading). By taking the model in equation (1), McKenzie and Henry (2012) study the determinants of short selling by distinguishing factors to information-based and non-information-based factors, which includes past stock performance, past short selling activity, risk, company fundamentals, ex-dividend date, and market returns and short selling. However, our study attempts to identify the potential determinants of short-selling and margin-trading activities by distinguishing investors' motivations to firm-specific and market-wide factors. All factors listed in Table 5.1 are added to the equation (1) to see whether they are significant determinants to short-selling (margin-trading) activity in the Chinese stock markets.

As shown in Table 5.1, some examined factors are proxied by a number of different variables. Following McKenzie and Henry (2012), our study conducts a hierarchical approach to the model design. The hierarchical approach to modelling touches on issues which are currently being developed in the general-to-specific modelling literature (Campos *et al*. 2005). Owing to potential problems with multicollinearity, each variable is tested in turn and a parsimonious model of short-selling (margin-trades) activity is constructed. As a final regression in the study, a model which brings all the significant variables together from the previous analysis is established. In this case, the short-selling (margin-trading) activity has its specified function of statistically significant variables.

Besides, we examine the determinants of margin activities by adopting three sub-regressions of each test: the general regression, the regression focusing on positive information, and the regression focusing on negative information. The main difference between these three sub-regressions is due to three events factors considered in our study: insider trading events, stock analyst recommendations and block trades.

The generic determinants model of short-selling (or margin-trading) activity is specified as:

$$SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t} \quad (5.1)$$

Or

$$MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t} \quad (5.2)$$

Where SS_{it} (MT_{it}) is the logarithm of short-sales value (margin-loans value) for stock *i* on day t. X is a vector of *j* independent variables that theory suggests determining the level of short-selling (margin-trading) activity. αs are parameters to be estimated, and the error term ε_t~N (0,1).

As for the main tests, we choose the scaled data of short-selling and margin-trading activities, short-sales ratio and margin-loans ratio to do the regressions. Although the complete time range of these data is seven years from 31/03/2010 to 31/03/2017, in the main regressions we only adopt five years and three months' data from 04/01/2012 to 31/03/2017. This is because of that during the first two years after the introduction of short selling and margin trading in China, there is a quite small volume of trading on margin and many of the data are discontinuous, which would lead to spurious estimated results.

5.4.2 Robustness Tests

Early studies into the information content of short sales could not establish a significant relationship (Figlewski, 1981; Brent *et al.*, 1990; Figlewski and Webb, 1993; and Woolridge and Dickinson, 1994). Asquith and Muelbroek (1996) argue that the principal reason for this failure is because the level of short selling was too small to be of consequence. It is important for us to consider the level of short-sales volume relative to the market in which they are traded. Thus, we adopt activities data of short-sales ratio and margin-loans ratio during the period 04/01/2012 to 31/03/2017 as our main regressions. In addition to the main tests, we conduct another two groups of robustness tests for the determinants of short selling and margin trading. Firstly, we use the original activity data of short selling and margin trading, short-sales value and margin-loans value, to see if there are any differences between the results. Secondly, with

SSR and MLR data from 31/03/2010 to 31/03/2017, we extend the original time range from five years and three months to seven years.

5.5 Empirical results

As mentioned before, we argue that short-selling (margin-trading) activity is a function of various factors at both firm and market level. Equation (5.1) and (5.2) show a standardized form of the pooled testing equation in which many of these factors are proxied by different variables. To prevent multicollinearity issue, we test each variable in turn. In this case, a parsimonious model of short-selling (margin-trading) activity at the end is chosen as the final regression of the test. For regressions of our main test, we adopt the scaled data, the short-sales ratio (margin-loans ratio) as the dependent variable. And the time range of the data is five years and three months from 04/01/2012 to 31/03/2017.

5.5.1 Determinants of Short-selling Activity

As a starting point for our analysis, the cross-sectional results from estimating equation (5.1) for each individual stock are presented in Table 5.2. Based on event-based factors, three sub-tables under Table 5.2 are reported in the main body. The results of the general regression, the results of the regression focusing on positive information, and the results of the regression focusing on negative information are reported in Table 5.2.A, Table 5.2.B and Table 5.2.C, respectively. We turn to the latter two tables when we discuss the results of event-based factors, otherwise, we focus on Table 5.2.A.

The results of Table 5.2.A are from the general regression of the determinants of short-sales ratio. The first model estimates the relationship between the dependent variable and its own lag. As we can see from the first column, the coefficient of the lagged short-sales ratio is positive and highly significant. This result is consistent with our finding of the significantly

positive autocorrelations of short-selling activity in Appendix 5.2 Compared to the significant result 0.5083 in the Hong Kong market (McKenzie and Henry 2012), the estimated coefficient in our study is higher at 0.7443. This indicates that short-selling activity in mainland China shows high autocorrelation level, which may be due to the differences in market maturity and the development stage of this mechanism. The statistic of adjusted R-squared shows that the explanatory power of this model is 56 percent and the p-value of F-test shows strong significance.

Where technical strategy is employed by investors in the market, past stock price may become an impact factor to the level of short-selling activity. To test this possibility, a one-period lagged return term is added to our second model. The estimated coefficient of the lagged return term is significantly positive, which is consistent with our expectation and the findings by McKenzie and Henry (2012). Diether *et al.* (2009a) find that short-selling activities normally increase following positive stock returns in the expectation of a price fall in the next period. In agreement with Dither *et al*. (2009a), our finding of the positive relationship between the lagged stock return and short-selling activity indicates that short sellers are typically contrarian traders.

The firm-specific risk, which indicates the heterogeneity of investors' views about the value of a stock is also an important factor in short-selling activities. We adopt two volatility measures with different focuses in the study. The first measure is historical volatility, which suggests the risk of the stock for recent days. From the third column, we can see a significantly negative coefficient of historical volatility. Being consistent with our expectation, the relationship between short-selling activity and historical volatility is negative. Since a higher historical volatility may suggest an unsteady trend of stock price movements, investing in short-sales positions would be too risky, and the transaction costs would be too high. A significantly positive coefficient is found for the intraday volatility measure trading range. This result is consistent with our previous expectation and the finding by McKenzie and Henry (2012). It indicates that stocks with higher risks exhibit higher levels of short-selling activities. Since the *t*-statistic of the former measure is higher, we keep historical volatility as the risk measure for further regressions.

The model is then augmented with variables of financial ratios. Firstly, the three variables chosen for our regression, dividend yield, earnings per share and the price-to-book ratio are tested in turn in the model. Then, the three variables are simultaneously included in the regression. A significantly negative coefficient is found for both DY and EPS, while for the PTBR, a significantly positive coefficient is found. All these results are consistent with our expectations and findings by McKenzie and Henty (2012). Our results provide evidence that short-selling activity intensifies when the fundamentals of a stock decline. We eventually keep EPS as the fundamental measure since it has the highest *t*-statistic and the adjusted R-squared value.

The next factor to be included in the main regression is the event of the ex-dividend date. A dummy variable is adopted for this factor. An insignificant coefficient with a positive sign is found for the ex-dividend date dummy. Since on or after the ex-dividend date, short sellers can avoid paying any extra dividend payments to occur during the entire transaction period, we expect a positive relationship between the ex-dividend date and short-selling activity. Our estimated result, however, shows that there is possibly a positive relationship between the two as we expect, but short sellers in the Chinese A-share market seem do not consider the dividend issues as a key factor to their short-sales positions.

Besides the control variables discussed above, we also add potential firm-specific factors which have never been examined in previous studies of the determinants of short-selling activity. Firstly, we extend our model with the factor of individual stock's industry type. More specifically, we adopt a financial dummy to see whether short sellers pay more attention to stocks belong to the financial sector. As we can see from the table, a positive and significant coefficient of the financial dummy is found. This indicates that short sellers tend to have more short-sales positions on financial stocks than stocks in other sectors. As discussed in the literature, financial firms providing loans for businesses, mortgages to homeowners and insurance to consumers, suffice to predict the general market conditions. Besides, the financial sector plays increasingly more important role in the economy of China. Our results provide evidence that financial stocks are more attractive to short sellers due to their influential feature.

We also investigate the relationship between short-sales position and insider trading events. As an event factor, we introduce a date dummy to see whether its occurrence influences the level of short-selling activity. Besides a general regression of the event itself, we run two further regressions separately focusing on the event with positive information (insider purchase) and the event with negative information (insider sale). From Table 5.2.A, an insignificantly positive relationship is found between insider trading event and post-event short-selling activity. It seems further investigation of this factor is needed. By categorising the factor into another two sub-variables, we get the regression results in Table 5.2.B and Table 5.2.C. As can be seen, an insignificantly negative coefficient is found between insider purchase and the dependent variable, while a significantly positive one is found for insider sale. These results are consistent with our expectations and indicate that when short sellers make their investment decisions, they pay closer attention to insider sales than insider purchases. Chen *et al.* (2016) study the link between insider trading and short positions in the A-share market. Focusing on insider sales, they find abnormally high levels of short positions prior to insider sales, but no significant relationship is found for post-event short-selling activity. Our study provides further evidence that short sellers are not only capable of predicting the future trend of stock prices but are also sophisticated traders who can capture the information contained in insider sales.

Another factor included in the model is stock analyst recommendations. Similar to insider trading events, we adopt three date dummies to investigate the relationship between analyst ratings and short-selling activity. First, a positive and significant coefficient is observed for the general factor analyst ratings in Table 5.2.A. Then we do two further regressions to find the reason why this coefficient is significant. As shown in Table 5.2.B and Table 5.2.C, a significant positive coefficient is found for analyst upgrade while an insignificant negative one is found for analyst downgrade. These results indicate that short sellers are more sensitive to analyst upgrades than analyst downgrades. And there will be intensified short-sales positions when a stock is upgraded by an analyst, which is inconsistent with our previous expectation.

We propose that short sellers take stock analyst recommendations as one source of their information to make their final investment decisions. And we expect a decline occurs in the

level of short-selling activity after an analyst upgrade, since an analyst upgrade will exert a positive impact on the future trend of the stock prices. However, our regression results seem to be opposite to our hypothesis. This might because of the quality of analyst reporting varies widely in the current A-share market. Compared to well-regulated format in analyst ratings in the developed markets, the scaling systems in analyst ratings in China are extremely confusing. Rather than a uniformed scaling system in the developed markets, we have literally collected 17 different versions of scales in the current A-share market during our data collection process. Although some of these scales are sharing the same meaning, analysts from different financial institutes and companies use different wordings. Besides, avoiding negative sense in stock analyst ratings is normal in China. The academic literature suggests that this force causes bias predictions by analysts that are more optimistic than the facts (McNichols and O'Brien 1997). With data of Nasdaq stocks, Christophe *et al.* (2010) find abnormal levels of short-sales positions prior to the release of analyst downgrades. The increased short positions are significantly related to the subsequent stock prices reacting to the downgrades. Boehmer *et al.* (2012) investigate the sources of short sellers' informational advantage. A heavier level of short positions is observed the week before analyst downgrades, and the predictability of short-selling activity remains after controlling for analyst ratings. Findings of these two studies signify that short sellers know more than stock analysts about firm fundamentals. And this could be a reason why we find a positive relationship between short selling and analyst upgrades.

As the last firm-specific factor, we add block trades as a potential determinant of short-selling activity. First, a significantly positive coefficient is found for the general factor block trades in Table 5.2.A. This indicates that there is a relationship between block trading events and short-sales positions. Then in Table 5.2.B and Table 5.2.C, a significantly positive relationship is observed between plus-tick orders and short-selling activity, while an insignificant negative one is observed for minus-tick orders. The result of minus-tick orders is consistent with our expectation. As the finding by Kraus and Stoll (1972), minus-tick blocks only have distribution effect but not make changes in the underlying value of the stock.

However, we obtain an inconsistent result with our expectation in terms of plus-tick blocks. Since the evidence provided by Kraus and Stoll (1972) showing that plus-tick orders influence the underlying value of the stock, we expected short sellers, as advanced traders in the market, can identify this fact and trade according to it. However, short sellers in the Chinese markets are contrarian to plus-tick trading activities. This is possibly because of the unregulated situation in the Chinese market. As we know, traders who can conduct heavy short positions and block trades are mainly institutional traders. And it is notorious in the A-share market, that institutions manipulate stock prices relying on their capital advantage. Thus, one possible explanation of the positive relationship found between plus-tick orders and short-selling activity is that short sellers are advanced traders who can identify the intrinsic impact of block trader activity.

Besides idiosyncratic factors, we extend our model by adding potential factors with market-wide information. The first factor considered is the past stock market performance. We adopt a one-period lagged date dummy for market stock return. As can be seen in Table 5.2.A, a significant and positive coefficient is found for the lagged market return term, which is consistent with the findings of McKenzie and Henry (2012). Asensio (2001) argues that a bullish market is a fertile ground for short sellers. However, short-sales positions may increase as a market approaching its peak. Our result suggests that short sellers employ contrarian trading as the dominant strategy and they rely on price reversals to make profits.

Lastly, we add a group of variables related to investor sentiment to our model. There are several studies documents that investor sentiment affects stock prices (*e.g.*, FisherKenneth 2000; Brown and Cliff 2004). It would be interesting to see whether investment sentiment will be a factor influencing the level of short-selling activity. Three variables including CCI,

Table 5.2.A The determinants of short-selling activity: general regression with short-sales ratio

Dependent variable: Ln(SSR)	Regression in hierarchical approach																
C	-0.0239*** (-5.50)	-0.0209*** (-4.86)	0.1538*** (6.12)	-0.0299*** (-5.42)	0.0989*** (3.50)	0.2085*** (7.76)	0.1636*** (6.48)	0.1534*** (5.28)	0.2085*** (7.76)	0.2080*** (7.76)	0.2077*** (7.76)	0.2048*** (7.62)	0.2110*** (7.84)	0.1949*** (7.25)	2.6897*** (18.61)	0.4971*** (16.16)	0.2252*** (8.35)	2.0039*** (13.29)
Ln(SSR(-1))	0.7443*** (314.08)	0.7492*** (318.13)	0.7481*** (317.11)	0.7492*** (318.14)	0.7476*** (316.55)	0.7474*** (316.46)	0.7478*** (316.84)	0.7462*** (315.17)	0.7474*** (316.45)	0.7474*** (316.45)	0.7474*** (316.45)	0.7473*** (316.36)	0.7476*** (316.42)	0.7483*** (317.46)	0.7413*** (310.64)	0.7403*** (310.35)	0.7462*** (315.88)	0.7367*** (306.94)
R_i(-1)		0.0627*** (36.04)	0.0630*** (36.81)	0.0627*** (36.06)	0.0627*** (36.01)	0.0630*** (36.20)	0.0630*** (36.18)	0.0626*** (35.97)	0.0630*** (36.20)	0.0631*** (36.17)	0.0630*** (36.20)	0.0632*** (36.28)	0.0632*** (36.28)	0.0915*** (41.39)	0.0908*** (41.11)	0.0902*** (40.84)	0.0914*** (41.39)	0.0899*** (40.80)
Historical volatility			-0.4315*** (-7.06)		-0.3906*** (-6.31)	-0.4187*** (-6.85)	-0.4593*** (-7.46)	-0.3808*** (-6.09)	-0.4186*** (-6.85)	-0.4179*** (-6.83)	-0.4175*** (-6.82)	-0.4207*** (-6.88)	-0.4262*** (-6.96)	-0.4053*** (-6.63)	-0.6907*** (-10.94)	-0.8839*** (-13.49)	-0.4321*** (-7.07)	-0.9612*** (-14.54)
Trading range				0.0168*** (2.61)														
Dividend yield					-0.0171*** (-4.24)			-0.0254*** (-6.05)										
EPS						-0.0603*** (-5.74)		-0.0791*** (-7.22)	-0.0634*** (-5.74)	-0.0631*** (-5.74)	-0.0604*** (-5.75)	-0.0603*** (-5.74)	-0.0614*** (-5.82)	-0.0616*** (-5.86)	-0.0519*** (-4.93)	-0.0389*** (-3.69)	-0.0593*** (-5.64)	-0.0371*** (-3.52)
Price-to-book ratio							0.0002*** (3.67)	0.0002*** (3.53)										
DEx-dividend date									0.0100 (0.17)									
DFinancials										0.0495*** (5.23)				0.0493*** (5.20)	0.0462*** (4.88)	0.0456*** (4.82)	0.0491*** (5.19)	0.0447*** (4.73)
DInsider trading											0.0294 (0.71)							
DAnalyst rating												0.0350*** (2.64)		0.0425*** (3.20)	0.0436*** (3.29)	0.0411*** (3.10)	0.0418*** (3.16)	0.0418*** (3.16)
DLagged block order													0.0431* (1.65)	0.0437* (1.65)	0.0749*** (2.83)	0.0709*** (2.68)	0.0523** (1.97)	0.0885*** (3.35)
R_M(-1)														0.0639*** (20.60)	0.0651*** (21.01)	0.0670*** (21.64)	0.0645*** (20.83)	0.0673*** (21.78)
CCI															-0.0230*** (-17.56)			-0.0144*** (-10.22)
Market turnover																-0.0004*** (-16.03)		-0.0003*** (-10.18)
IPO number																	-0.0329*** (-11.57)	-0.0183*** (-6.26)
R-squared	0.5630	0.5699	0.5702	0.5699	0.5703	0.5704	0.5703	0.5706	0.5704	0.5705	0.5704	0.5704	0.5706	0.5728	0.5749	0.5745	0.5735	0.5758
Adjusted R-squared	0.5626	0.5695	0.5697	0.5696	0.5699	0.5700	0.5699	0.5702	0.5699	0.5701	0.5700	0.5700	0.5702	0.5724	0.5745	0.5740	0.5731	0.5754
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ where the independent variable $X_j s$ in each equation are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The *t*-statistics presented in parentheses are the *t*-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Table 5.2.B The determinants of short-selling activity: regression on positive information with short-sales ratio

Dependent variable: Ln(SSR)	Regression in hierarchical approach							
C	0.2091*** (7.78)	0.2050*** (7.62)	0.2107*** (7.83)	0.1949*** (7.25)	2.6773*** (18.54)	0.4968*** (16.15)	0.2252*** (8.35)	1.9905*** (13.22)
Ln(SSR(-1))	0.7474*** (316.44)	0.7473*** (316.34)	0.7475*** (316.41)	0.7483*** (317.42)	0.7412*** (310.56)	0.7402*** (310.27)	0.7461*** (315.83)	0.7366*** (306.86)
R_i(-1)	0.0630*** (36.20)	0.0632*** (36.27)	0.0634*** (36.33)	0.0917*** (41.43)	0.0910*** (41.15)	0.0903*** (40.89)	0.0917*** (41.43)	0.0901*** (40.85)
Historical volatility	-0.4196*** (-6.86)	-0.4210*** (-6.88)	-0.4261*** (-6.96)	-0.4056*** (-6.64)	-0.6910*** (-10.94)	-0.8840*** (-13.50)	-0.4328*** (-7.08)	-0.9610*** (-14.54)
Trading range								
Dividend yield								
EPS	-0.0602*** (-5.73)	-0.0603*** (-5.74)	-0.0610*** (-5.80)	-0.0612*** (-5.83)	-0.0510*** (-4.85)	-0.0382*** (-3.62)	-0.0587*** (-5.60)	-0.0360*** (-3.42)
Price-to-book ratio								
*D*Ex-dividend date								
*D*Financials				0.0492*** (5.20)	0.0466*** (4.93)	0.0459*** (4.86)	0.0492*** (5.20)	0.0453*** (4.79)
*D*Insider purchase	-0.0744 (-1.28)							
*D*Analyst upgrade		0.0349*** (2.60)		0.0427*** (3.18)	0.0435*** (3.25)	0.0405*** (3.03)	0.0421*** (3.14)	0.0412*** (3.09)
*D*Lagged plus-tick order			0.0918** (2.29)	0.0920** (2.30)	0.1165*** (2.92)	0.1176*** (2.95)	0.0977** (2.45)	0.1298*** (3.25)
R_M(-1)				0.0639*** (20.60)	0.0650*** (21.01)	0.0670*** (21.63)	0.0646*** (20.83)	0.0674*** (21.76)
CCI					-0.0229*** (-17.50)			-0.0143*** (-11.14)
Market turnover						-0.0004*** (-16.05)		-0.0003*** (-10.30)
IPO number							-0.0328*** (-11.55)	-0.0182*** (-6.23)
R-squared	0.5704	0.5704	0.5706	0.5728	0.5750	0.5745	0.5736	0.5758
Adjusted R-squared	0.5699	0.5700	0.5702	0.5724	0.5745	0.5740	0.5731	0.5754
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on positive information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The *t*-statistics presented in parentheses are the *t*-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Table 5.2.C The determinants of short-selling activity: regression on negative information with short-sales ratio

Dependent variable: Ln(SSR)	Regression in hierarchical approach							
C	0.2068*** (7.70)	0.2084*** (7.76)	0.2123*** (7.89)	0.1953*** (7.28)	2.6647*** (18.46)	0.4984*** (16.23)	0.2258*** (8.39)	1.9715*** (13.10)
Ln(SSR(-1))	0.7474*** (316.41)	0.7474*** (316.44)	0.7476*** (316.35)	0.7482*** (317.55)	0.7413*** (310.70)	0.7402*** (310.37)	0.7461*** (315.95)	0.7366*** (306.96)
R_i(-1)	0.0631*** (36.23)	0.0630*** (36.20)	0.0631*** (36.24)	0.0912*** (41.26)	0.0904*** (40.97)	0.0898*** (40.72)	0.0911*** (41.27)	0.0895*** (40.67)
Historical volatility	-0.4157*** (-6.80)	-0.4187*** (-6.85)	-0.4292*** (-7.01)	-0.3930*** (-6.644)	-0.6762*** (-10.72)	-0.8739*** (-13.36)	-0.4205*** (-6.89)	-0.9490*** (-14.38)
Trading range								
Dividend yield								
EPS	-0.0605*** (-5.75)	-0.0604*** (-5.74)	-0.0606*** (-5.74)	-0.0606*** (-5.78)	-0.0504*** (-4.81)	-0.0374*** (-3.55)	-0.0582*** (-5.55)	-0.0353*** (-3.36)
Price-to-book ratio								
*D*Ex-dividend date								
*D*Financials				0.0499*** (5.28)	0.0474*** (5.02)	0.0465*** (4.93)	0.0498*** (5.27)	0.0459*** (4.87)
*D*Insider sale	0.0955* (1.67)			0.1043* (1.83)	0.1286** (2.26)	0.1528*** (2.69)	0.1239** (2.18)	0.1671*** (2.94)
*D*Analyst downgrade		-0.0027 (-0.04)						
*D*Lagged minus-tick order			-0.0068 (-0.20)					
R_M(-1)				0.0637*** (20.57)	0.0650*** (21.98)	0.0669*** (21.61)	0.0644*** (20.81)	0.0672*** (21.75)
CCI					-0.0228*** (-17.41)			-0.0141*** (-10.00)
Market turnover						-0.0004*** (-16.08)		-0.0003*** (-9.15)
IPO number							-0.0331*** (-11.63)	-0.0185*** (-6.34)
R-squared	0.5704	0.5704	0.5705	0.5726	0.5747	0.5742	0.5733	0.5756
Adjusted R-squared	0.5700	0.5700	0.5701	0.5722	0.5743	0.5738	0.5729	0.5752
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on negative information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

market turnover and IPO volume are included in the model in turn. From Table 5.2., significantly positive coefficients are found for all three variables. After comparison between the *t*-statistics of the three variables and the adjusted R-squared values of the three regressions, we finally choose CCI as our explanatory variable. Our findings are consistent with what we expect before. Qiu and Welch (2004) provide evidence that investor sentiment plays a role in the trend of stock returns. As such, short selling is expected to be taken when investors believe that the stock market is recessing.

The outcome of this hierarchical procedure generates the model presented in the fourth column on the right of Table 5.2., which bring all the significant factors together from previous analyses. With the sample of 73 stocks in the Chinese A-share market, short-selling activity is finally specified as a function of past short-selling activity, past stock returns, risk measured by the stock's historical volatility, firm fundamentals proxied by EPS, industry type of the stock, insider sales, analyst upgrades, past plus-tick blocks, past market performance, and investment sentiment proxied by CCI. All three final estimated models have explanatory power of 57 percent, with consistent coefficients retaining their significance.

5.5.2 Determinants of Margin-trading Activity

Similar to regressions done for short-selling activity in equation (5.1), the results of the hierarchical pooled regressions for margin-trading activity in equation (5.2) are presented in Table 5.3. Based on event-based factors, three sub-tables under Table 5.3 are displayed in the main body. The results of the general regression, the results of the regression focusing on positive information, and the results of the regression focusing on negative information are reported in Table 5.3.A, Table 5.3.B and Table 5.3.C, respectively. We turn to the latter two tables when we discuss the results of event-based factors, otherwise, we focus on Table 5.3.A.

Table 5.3.A presents the results of the general regression of the determinants of margin-loans ratio. The first model estimates the relationship between the dependent variable and its own one-period lag. As can be seen from the first column, the coefficient of the lagged margin-loans

ratio is significantly positive. This result is consistent with our finding of the significantly positive autocorrelations of margin-trading activity in Appendix 5.2. Compared to the significant result 0.7443 found for short selling, the estimated coefficient of lagged margin-loans activity is slightly lower at 0.7266. This indicates that short selling shows a higher autocorrelation level than margin trading in A-share market, which might because of the difference in the nature of the two mechanisms. Since short selling requires a completely opposite trading strategy to normal stock trading, the domestic investors are possibly more familiar with margin trading than short selling. The statistic of the adjusted R-squared shows that the explanatory power of this model is 58 percent and the p-value of F-test shows strong significance.

Next, a one-period lagged return term is added to our second model. The estimated coefficient of the lagged return term is significantly positive, which is consistent with our expectation. Hirose *et al.* (2009) study the Japanese stock market and find that margin traders are contrarian traders for small-firm stocks but contrarian traders for large-firm stocks. Since the 73 sample stocks adopted in our study are blue-chip stocks with the largest capitalisation among all A-share stocks, we previously predict a negative relationship between the past stock returns and margin-trading activity. However, our results suggest that margin traders in the current Chinese market A-share market are momentum traders even for large-firm stocks.

As the same to short selling, we extend the determinant model of margin trading with two volatility measures. The third column shows a significantly negative coefficient of historical volatility. Since a higher historical volatility suggests an unsteady trend of future stock price, a negative relationship between historical volatility and either of our two mechanisms is anticipated. Compared to the result of short selling, the magnitude of the estimated result of historical volatility is much larger for margin trading. This indicates that margin readers are more sensitive to stock volatility. They understand that investing in margin positions would be too risky and their transaction costs would be high. A significantly negative coefficient is also found for the intraday measure. This result is consistent with our previous expectation that margin-trading activity decreases when the stock becomes riskier. We keep historical volatility for further regressions, as it has a higher *t*-statistic.

Table 5.3.A The determinants of margin-trading activity: general regression with margin-loans ratio

Dependent variable: Ln(MLR)	Regression in hierarchical approach																	
C	0.6847*** (116.35)	0.6821*** (116.00)	1.4780*** (107.62)	0.6797*** (113.87)	1.4677*** (102.51)	1.4551*** (104.78)	1.4759*** (107.45)	1.4547*** (101.40)	1.4556*** (104.81)	1.4546*** (104.72)	1.4558*** (104.80)	1.4578*** (104.87)	1.4533*** (104.61)	1.4684*** (105.39)	0.2631*** (5.53)	1.3966*** (100.75)	1.4683*** (105.30)	0.6579*** (13.29)
Ln(MLR(-1))	0.7266*** (318.74)	0.7276*** (319.47)	0.6520*** (258.45)	0.7274*** (319.30)	0.6519*** (258.38)	0.6499*** (256.93)	0.6514*** (257.97)	0.6492*** (256. 44)	0.6498*** (256.89)	0.6497*** (256.92)	0.6498*** (256.93)	0.6497*** (256.84)	0.6502*** (256.73)	0.6467*** (254.03)	0.6337*** (245.34)	0.6068*** (227.81)	0.6467*** (253.92)	0.6022*** (225.32)
R_i(-1)		0.0092*** (15.49)	0.0077*** (13.35)	0.0092*** (15.47)	0.0078*** (13.42)	0.0078*** (13.37)	0.0077*** (13.36)	0.0077*** (13.35)	0.0078*** (13.37)	0.0077*** (13.37)	0.0078*** (13.40)	0.0078*** (13.52)	0.0077*** (13.30)	0.0023*** (3.14)	0.0017** (2.37)	0.0006 (0.82)	0.0023*** (3.14)	0.0004 (0.50)
Historical volatility			-1.4956*** (-63.82)		-1.4881*** (-63.02)	-1.5160*** (-64.53)	-1.4844*** (-63.14)	-1.5066*** (-63.16)	-1.5161*** (-64.53)	-1.5163*** (-64.54)	-1.5171*** (-64.55)	-1.5157*** (-64.52)	-1.5142*** (-64.42)	-1.5256*** (-64.89)	-1.4464*** (-61.26)	-1.3318*** (-56.38)	-1.5255*** (-64.88)	-1.2995*** (-54.92)
Trading range				−0.0051** (-2.22)														
Dividend yield					0.0035** (2.56)			0.0007 (0.48)										
EPS						0.0386*** (10.79)		0.0391*** (10.46)	0.0386*** (10.80)	0.0387*** (10.81)	0.0387*** (10.81)	0.0386*** (10.79)	0.0382*** (10.65)	0.0384*** (10.74)	0.0345*** (9.67)	0.0235*** (6.59)	0.0385*** (10.74)	0.0226*** (6.36)
Price-to-book ratio							-0.0001*** (-5.83)	-0.0001*** (-5.82)										
DEx-dividend date									-0.0569*** (-2.80)					-0.0548*** (-2.71)	-0.0435** (-2.16)	-0.0607*** (-3.03)	-0.0548*** (-2.70)	-0.0538*** (-2.69)
DFinancials										0.0399*** (12.08)				0.0402*** (12.16)	0.0397*** (12.04)	0.0399*** (12.20)	0.0402*** (12.16)	0.0397*** (12.15)
DInsider trading											0.0273* (1.94)			0.0252* (1.79)	0.0286** (2.05)	0.0480*** (3.46)	0.0252* (1.79)	0.0464*** (3.35)
DAnalyst rating												-0.0189*** (-4.23)		-0.0178*** (-3.97)	-0.0182*** (-4.08)	-0.0166*** (-3.74)	-0.0178*** (-3.97)	-0.0171*** (-3.87)
DLagged block order													0.0271*** (2.98)	0.0280*** (3.09)	0.0129 (1.42)	0.0105 (1.17)	0.0280*** (3.08)	0.0050 (0.56)
R_M(-1)														0.0120*** (11.60)	0.0120*** (11.64)	0.0106*** (10.36)	0.0120*** (11.59)	0.0108*** (10.64)
CCI															0.0116*** (26.49)			0.0072*** (15.58)
Market turnover																0.0003*** (45.80)		0.0003*** (40.61)
IPO number																	0.0002 (0.21)	0.0101*** (10.24)
R-squared	0.5873	0.5884	0.6062	0.5884	0.6062	0.6067	0.6063	0.6069	0.6067	0.6068	0.6067	0.6068	0.6065	0.6072	0.6102	0.6162	0.6072	0.6174
Adjusted R-squared	0.5869	0.5880	0.6059	0.5881	0.6059	0.6064	0.6060	0.6065	0.6064	0.6064	0.6064	0.6064	0.6062	0.6069	0.6099	0.6158	0.6069	0.6171
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ where the independent variable $X_j s$ in each equation are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The *t*-statistics presented in parentheses are the *t*-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level，respectively.

Table 5.3.B The determinants of margin-trading activity: regression on positive information with margin-loans ratio

Dependent variable: Ln(MLR)	Regression in hierarchical approach							
C	1.4557*** (104.81)	1.4580*** (104.88)	1.4531*** (104.59)	1.4683*** (105.39)	0.2622*** (5.52)	1.3962*** (100.72)	1.4681*** (105.30)	0.6578*** (13.30)
Ln(MLR(-1))	0.6498*** (256.92)	0.6496*** (256.81)	0.6503*** (256.84)	0.6468*** (254.12)	0.6337*** (245.34)	0.6068*** (227.83)	0.6467*** (254.00)	0.6022*** (225.33)
R_i(-1)	0.0078*** (13.36)	0.0078*** (13.53)	0.0077*** (13.24)	0.0023*** (3.10)	0.0017** (2.33)	0.0006 (0.77)	0.0023*** (3.10)	0.0003 (0.45)
Historical volatility	-1.5167*** (-64.55)	-1.5157*** (-64.52)	-1.5146*** (-64.43)	-1.5255*** (-64.90)	-1.4458*** (-61.25)	-1.3311*** (-56.36)	-1.5255*** (-64.89)	-1.2987*** (-54.89)
Trading range								
Dividend yield								
EPS	0.0387*** (10.82)	0.0386*** (10.79)	0.0386*** (10.78)	0.0389*** (10.88)	0.0347*** (9.73)	0.0236*** (6.64)	0.0390*** (10.87)	0.0226*** (6.38)
Price-to-book ratio								
$D_{\text{Ex-dividend date}}$				-0.0548*** (-2.70)	-0.0434** (-2.15)	-0.0605*** (-3.02)	-0.0548*** (-2.70)	-0.0536*** (-2.68)
$D_{\text{Financials}}$				0.0401*** (12.14)	0.0398*** (12.11)	0.0401*** (12.29)	0.0401*** (12.14)	0.0400*** (12.26)
$D_{\text{Insider purchase}}$	0.0507** (2.57)			0.0470** (2.38)	0.0437** (2.23)	0.0597*** (3.06)	0.0469** (2.38)	0.0581*** (2.98)
$D_{\text{Analyst upgrade}}$		-0.0202*** (-4.45)		-0.0189*** (-4.17)	-0.0192*** (-4.26)	-0.0173*** (-3.87)	-0.0189*** (-4.17)	-0.0178*** (-3.98)
$D_{\text{Lagged plus-tick order}}$			0.0266* (1.93)	0.0276** (2.00)	0.0157 (1.14)	0.0106 (0.78)	0.0276** (2.00)	0.0061 (0.45)
R_M(-1)				0.0120*** (11.57)	0.0119*** (11.62)	0.0106*** (10.36)	0.0120*** (11.57)	0.0109*** (10.65)
CCI					0.0117*** (26.54)			0.0072*** (15.59)
Market turnover						0.0003*** (45.79)		0.0003*** (40.57)
IPO number							0.0002 (0.23)	0.0102*** (10.29)
R-squared	0.6067	0.6068	0.6065	0.6072	0.6103	0.6162	0.6072	0.6174
Adjusted R-squared	0.6064	0.6065	0.6061	0.6068	0.6099	0.6158	0.6068	0.6171
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on positive information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Table 5.3.C The determinants of margin-trading activity: regression on negative information with margin-loans ratio

Dependent variable: Ln(MLR)	Regression in hierarchical approach							
C	1.4551*** (104.76)	1.4552*** (104.79)	1.4536*** (104.63)	1.4672*** (105.45)	0.2570*** (5.41)	1.3947*** (100.75)	1.4670*** (105.36)	0.6547*** (13.23)
Ln(MLR(-1))	0.6499*** (256.92)	0.6498*** (256.83)	0.6502*** (256.74)	0.6466*** (254.32)	0.6335*** (245.57)	0.6065*** (227.94)	0.6465*** (254.20)	0.6020*** (225.47)
R_i(-1)	0.0077*** (13.37)	0.0078*** (13.37)	0.0078*** (13.40)	0.0022*** (3.00)	0.0016** (2.18)	0.0005 (0.62)	0.0022*** (3.00)	0.0002 (0.28)
Historical volatility	-1.5160*** (-64.51)	-1.5161*** (-64.53)	-1.5150*** (-64.45)	-1.5267*** (-64.98)	-1.4468*** (-61.32)	-1.3311*** (-56.37)	-1.5266*** (-64.97)	-1.2988*** (-54.91)
Trading range								
Dividend yield								
EPS	0.0386*** (10.79)	0.0386*** (10.79)	0.0383*** (10.69)	0.0388*** (10.87)	0.0345*** (9.70)	0.0234*** (6.59)	0.0388*** (10.86)	0.0224*** (6.33)
Price-to-book ratio								
*D*Ex-dividend date				-0.0545*** (-2.69)	-0.0431*** (-2.13)	-0.0604*** (-3.01)	-0.0544*** (-2.68)	-0.0534*** (-2.67)
*D*Financials				0.0400*** (12.12)	0.0399*** (12.13)	0.0402*** (12.33)	0.0400*** (12.12)	0.0401*** (12.31)
*D*Insider sale	-0.0007 (-0.04)							
*D*Analyst downgrade		0.0328 (1.58)						
*D*Lagged minus-tick order			0.0258 (0.23)					
R_M(-1)				0.0121*** (11.69)	0.0121*** (11.74)	0.0107*** (10.49)	0.0121*** (11.69)	0.0109*** (10.77)
CCI					0.0117*** (26.63)			0.0073*** (15.62)
Market turnover						0.0003*** (45.90)		0.0003*** (40.65)
IPO number							0.0003 (0.30)	0.0101*** (10.25)
R-squared	0.6067	0.6067	0.6065	0.6073	0.6104	0.6163	0.6073	0.6176
Adjusted R-squared	0.6064	0.6064	0.6061	0.6070	0.6101	0.6160	0.6070	0.6172
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on positive information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Then the model is augmented with variables of financial ratios. As can be seen from Table 5.3.A, a significantly positive coefficient is found for both DY and EPS, while a significantly negative one is found for the PTBR. All these estimated results are consistent with our expectations. Given the predictive ability of these ratios to the future returns, they become natural information resources for margin traders. Contrast to short-selling activity, our results show that margin-trading activity intensifies when the fundamentals of a stock improve. We keep EPS as the fundamental measure since it has the highest *t*-statistic and adjusted R-squared value.

We next include the ex-dividend date to the main regression. A significant coefficient with a negative sign is found for the ex-dividend date dummy. As mentioned earlier, an investor who holds stocks immediately before the ex-dividend date is entitled to the stock dividend. The negative coefficient found indicates that margin-trading activity decreases at the ex-dividend date since no more advantage can be taken in terms of stock dividends. This finding is consistent with our hypothesis.

Besides the control variables, we then extend the model with firm-specific independent factors. Firstly, we adopt a financial dummy to see whether margin traders pay more attention to stocks belong to the financial industries. As can be seen from the table, a significantly positive coefficient of the financial dummy is found. This indicates that financial stocks tend to have less margin-loans positions than stocks in other industries. As discussed in the literature section, financial firms having the economic function of providing loans for businesses, mortgages to homeowners and insurance to consumers. In this case, financial firms are competent to predict the general market conditions. Also, the financial industries play increasingly more significant role in the recent decade in domestic China. Because of their influence, financial stocks are more attractive to investors on margin, including both short sellers and margin traders.

Next, we investigate the relationship between margin-loans position and insider trading event. As the same to short selling, we conduct three regressions with each event independent factor.

Besides a general regression of the event itself, we run two more regressions focusing on event with positive information and event with negative information separately. From Table 5.3.A, a significantly positive relationship is found between insider trading event and post-event margin-trading activity. By dividing the factor into two sub-variables, we get the regression results in Table 5.3.B and Table 5.3.C. A significantly positive coefficient is found between insider purchase and the dependent variable, while an insignificantly negative one is found for insider sale. These results are generally consistent to our previous expectations. Unlike short sellers, margin traders tend to pay more attention to insider purchases rather than insider sales. With a sample of 446 stocks, Chen *et al.* (2016) find abnormal margin-trading activities before and after insider purchases. But the relationship between margin trading and insider purchases become significantly negative in a further regression. The overall empirical results thus turn to be uninterpretable. Compared to the two-year size data adopted in Chen *et al.*, we apply a longer time range of data and document a higher level of margin-trading activity when insider purchase occurs. However, margin traders show no difference to insider sales events.

Another potential determinant, stock analyst ratings, is then examined. Firstly, a significantly negative coefficient is observed for the general factor in Table 5.3.A. While a significantly negative coefficient is found for analyst upgrade in Table 5.3.B, an insignificant positive coefficient is found for analyst downgrade in Table 5.3.C. Similar to short sellers, margin traders in the A-share market are more sensitive to analyst upgrades than analyst downgrades. Being consistent with our hypothesis, more margin-loans positions will occur when a stock is upgraded by an analyst. It is fully documented in the literature that analyst recommendations predict future returns (*i.e*. Stickel 1995, Womack 1996, Krische and Lee 2000, Barber *et al*. 2001). However, the analyst recommendations in the current Chinese market is not reliable as in the West. Our finding reveals that analyst recommendation, especially analyst upgrade, is a direct information source to margin traders during their investing process.

As the last firm-specific factor, the block trading event is added to our model. Firstly, a significantly positive coefficient is found for the general factor in Table 5.3.A. Further regressions are taken to see this relationship in detail. Table 5.3.B shows a significantly positive coefficient for plus-tick orders, while in Table 5.3.C, an insignificant positive one is observed

for minus-tick orders. These results are consistent with our expectation. Kraus and Stoll (1972) document that plus-tick blocks have the price effect in the underlying value of the stock while minus-tick blocks only have distribution effect. Our finding suggests that margin traders take advantage of this fact by increasing their positions on margin when a plus-tick order occurs.

Besides firm-specific factors, two market-level factors are also considered. The first factor is the past stock market performance. As can be seen in Table 5.2.A, a significantly positive coefficient is found for the lagged market return term. This finding is consistent with the perception that margin traders are momentum traders. Three measures of investor sentiment are added in turn to the model. The significant results for CCI and market turnovers in Table 5.3.A show that investor sentiment is a factor influencing margin-loans positions. After a comparison between the *t*-statistics of the two variables and the adjusted R-squared values of the two regressions, market turnover is chosen as the explanatory variable of investor sentiment. These findings are consistent with our hypothesis that margin-trading activity intensifies when investor sentiment of the market becomes positive.

The outcome of the hierarchical procedure yields the final model presented in the third column on the right of Table 5.3., which includes all the significant factors from previous analyses. With the sample of 73 designated stocks in the A-share market, margin-trading activity is eventually specified as a function of past margin-trading activity, past stock returns, risk measured by historical volatility, firm fundamentals proxied by EPS, the ex-dividend date, industry type of the stock, insider purchases, analyst upgrades, past plus-tick block orders, past market performance, and the investment sentiment proxied by market turnover. All three final regressions in Table 5.3 have explanatory power of 61 percent, with consistent coefficients retaining their significance.

5.5.3 Robustness Tests

Besides the main tests of short-selling and margin-trading activities, we conduct two groups of robustness tests for each of our dependent variables. First, we adopt the original activity data

without being scaled, short-sales value (SSV) and margin-loans value (MLV), to see if there is any difference between the results. Second, with SSR and MLR data from 31/03/2010 to 31/03/2017, we extend the time range of the main tests from five years and three months to seven years. The regression results of robustness tests are in the Appendix. Appendix 5.5 and Appendix 5.6 show the estimated results of robustness test I for short selling and margin trading separately, while Appendix 5.7 and Appendix 5.8 show the results of robustness test II. We summarise the robustness results and compare them with the results of our main tests in Table 5.4.

From the results of short selling presented in Panel A, Table 5.4, we can see that the results of the two robustness tests are generally consistent with our main tests. However, there are still some small differences. Firstly, we can see that for the robustness test I, it finally chooses trading range as the risk measure, while both the other two tests choose the measure of historical volatility. This difference seems not critical since the sign and significance of both risk measures retain for all three tests. There is a significantly negative relationship between historical volatility and short selling while a significantly positive one for intraday volatility. Second, when we use a longer time range in robustness test II, the measure of financial ratios changes to DY, while the other two tests both adopt EPS. Again, this difference is not critical, since all results of the three measures of financial ratios retain consistent sign and significance (except for PTBR in robustness test II, which share the same sign with their counterparts, but no significance shows). For the factor of insider trading events, although slight differences are seen in the results' significance level, we can speak confidently that there is a positive relationship between insider sales and short-sales positions. Similar to insider trading, results of the following two factors also have slight differences in the significance level of their results, which would not change our conclusions over the relationship between the two factors and short-selling activity. For the coefficient of past market returns, the robustness test II has an opposite sign to the results from the previous two tests. It is well known that between June 2015 to June 2016, a severe crash happened in the

Table 5.4 Summary of the results

	Panel A: SS Results		Main test			Robustness test I			Robustness test II			**Panel B: MT Results**		Main test			Robustness test I			Robustness test II		
			SSR, 5 yrs and 3 mths			SSV, 5 yrs and 3 mths			SSR, 7 yrs					MLR, 5 yrs and 3 mths			SSV, 5 yrs and 3 mths			SSR, 7 yrs		
No.	**Expected SS**		**Gen**	**Pos**	**Neg**	**Gen**	**Pos**	**Neg**	**Gen**	**Pos**	**Neg**	**Expected MT**		**Gen**	**Pos**	**Neg**	**Gen**	**Pos**	**Neg**	**Gen**	**Pos**	**Neg**
1	Ln(SS(-1))	+		+***			+***			+***		LN(MT(-1))	+		+***			+***			+***	
2	R_i(-1)	+		+***			+***			+***		R_i(-1)	+		+***			+***			+***	
3	Historical volatility	-		-***			-***			-***		Historical volatility	-		-***			-***			-***	
	Trading range	+		+***			+***			+***		Trading range	-		-***			-**			-***	
4	Dividend yield	-		-***			-***			-***		Dividend yield	+		+***			+**			+***	
	EPS	-		-***			-***			-***		EPS	+		+***			+***			+***	
	Price-to-book ratio	+		+***			+			+***		Price-to-book ratio	-		-***			-***			-**	
5	*D*Ex-dividend date	+		+			+			+		*D*Ex-dividend date	-		-***			-***			-*	
6	*D*Financials	+		+***			+***			+***		*D*Financials	+		+***			+***			+***	
7	*D*Insider trading	***	+			+**			+			*D*Insider trading	***	+*			+			+*		
	*D*Insider purchase	-		-			-			-		*D*Insider purchase	+		+**			+			+	
	*D*Insider sale	+			+*			+***			+**	*D*Insider sale	-			-			-			-
8	*D*Analyst rating	***	+***			+***			+**			*D*Analyst rating	***	-***			-**			-***		
	*D*Analyst upgrade	-		+***			+***			+**		*D*Analyst upgrade	+		-***			-**			-***	
	*D*Analyst downgrade	+			-			-			-	*D*Analyst downgrade	-			+			+*			+*
9	*D*Lagged block order	***	+*			+***			+*			*D*Lagged block order	***	+***			+***			+***		
	*D*Lagged plus-tick order	-		+**			+***			+***		*D*Lagged plus-tick order	+		+*			+***			+*	
	*D*Lagged minus-tick order	+			-			-			-	*D*Lagged minus-tick order	-			+			-			+
10	R_M(-1)	+		+***			+***			-***		R_M(-1)	+		+***			+***			+***	
11	CCI	-		-***			-***			-***		CCI	+		+***			+***			+***	
	Market turnover	-		-***			-***			-***		Market turnover	+		+***			+***			+***	
	IPO No.	-		-***			-***			-***		IPO No.	+		+			+			+*	

Notes: This table summarises the estimated results of three groups of regressions with different data type and time range for the determinants of short-selling and margin-trading activities. Panel A shows the findings of short-selling activities, while panel B shows the findings of margin-trading activates. Notations in shading indicate that corresponding variables are included in the final regression of each test. Three sub-regressions done respectively under each test, categorised as general regression, the regression focusing on positive events and the regression focusing on negative events. A plus sign '+' indicates a positive relationship between the dependent variable and certain independent variable, while a minus sigh '-' indicates a negative one between the two. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

A-share market. As discussed earlier, intensified short selling tend to be seen when the market price reaches its peak. Since robustness test II adopts a longer period with more stable time, it is reasonable for short sellers to adopt momentum trading strategy when market condition settles. Lastly, as the same to the results of stock risks and financial ratios, the difference in the results of investors sentiment is not critical. In terms of the estimated results of margin trading, although several places of difference are found in the significance level of results among the three groups of tests, no critical difference is found.

From the results comparison table, we see that short-selling and margin-trading activities share almost all determinants expect for the factor of the ex-dividend date. Both short sellers and margin traders consider their own past activities and positively follow the previous trend. Short sellers are contrarian traders to both the previous stock returns and the past market returns, while margin traders are always momentum traders. Both short sellers and margin traders pay close attention to changes in EPS of a stock when they take margin positions. However, margin traders consider issues of dividend to make more profits, while short sellers are not concerned much. Financial stocks draw more attention from both short seller and margin traders, due to the pivotal role of financial sector in an economy. Both types of the traders consider the three event factors when they make an investment, while the focuses of them are quite different. Short sellers carry on transactions follow insider sales events, while margin traders buy long after insider purchases. In the Chinese A-share market, both traders trade against analyst recommendations on the market, due to the unreliability of the recommendations. Again, in terms of block trades, short sellers are contrarian traders while margin traders are momentum traders. As for the last factor of investor sentiment, short sellers decrease their positions when the investor sentiment becomes high, while margin traders do the opposite.

5.6 Conclusions

It is well acknowledged that short selling and margin trading contribute to the integrity of an efficient market. However, false perceptions of these two mechanisms still widely exist among financial regulators and common investors. When a financial crisis comes, regulators often turn

to bans and constraints on short selling and margin trading to stabilise the market. To eliminate false perceptions of the two mechanisms, figuring out what motivates short sellers and margin traders to make their investment decisions becomes crucial. The question whether they are motivated by fundamentals-related reasons or they are simply opportunistic traders is important.

To examine the roles of short sellers and margin traders in financial markets, we investigate the determinants of short-selling activity and margin-trading activity separately from both firm and market perspective. Taking together with control variables, the firm-level determinants of short-selling (margin-trading) activity include past short-selling (margin-trading) activities, past stock returns, stock returns volatility, financial ratios, ex-dividend date events, industry classifications, insider trading events, stock analyst recommendations, block trading events, whereas the market-level factors include past market performance and investor sentiment.

With pooled regressions of the hierarchical approach, we find that short-selling activity is significantly related to past short-selling activity, past stock returns, historical volatility, EPS, industry classification, insider sale, analyst upgrade, block plus-tick order, past market performance and CCI. While margin-trading activity is decided by past margin-trading activity, past stock returns, historical volatility, EPS, ex-dividend date event, industry classification, insider purchase, analyst upgrade and downgrade, block plus-tick order, past market performance and market turnover. These findings indicate that the motivations of activities of short sellers and margin trader are tightly fundament-related. Both of them are not simply opportunistic traders. However, compared to short sellers, margin traders are momentum traders at both individual stock level and the market level. This strategy adopted by margin traders may lead more uncertainty to the market.

Our results provide crucial additional insights into the nature of information advantages that lead to abnormal returns earned by short sellers and margin traders. These findings further allow novel inferences about how short sellers and margin traders contribute to price discovery and market efficiency. By identifying information sources of short sellers and margin traders' trading advantages, the study has important implications for financial regulators and

policymakers, particularly for an emerging market like China. Also, our findings could help the public have better understandings of short selling and margin trading. The two mechanisms should not be scapegoats when the market becomes depressed and unsettled.

Our study extends the current literature of the determinants of short selling. And at the first time, we identify the determinants of margin trading. However, there are limitations of our study. It can be easily seen that the question of the determinants of short-selling and margin-trading activity is an open topic. The factors considered in the current study is not only limited by our understanding of the current literature but also the market settings and the data accessibility. As a study of an emerging market, our results may not be perfectly applied to the same issue of the developed market. In domestic China, trades on margin currently only includes the two mechanisms studied in our study, while in more advanced markets, short selling and margin trading activities may also be affected by the trading of futures and options. The data accessibility in the A-share market also leads certain limitations to our study. The determinants of short-selling (margin-trading) activity conducted by different groups can be an interesting research topic.

5.7 Appendices

Appendix 5.1 Descriptive statistics of stock returns, short-selling and margin-trading activities

No.	A: Stock returns					B: Short-selling activities		C: Margin-trading activities	
	Mean	Min	Max	S.D.	JB	Short-sales value	Short interest	Margin-loans value	Margin interest
SH01	0.035	-10.558	9.564	1.518	1234.895***	4,844.750	2,786.192	21,720.668	419,401.793
SH03	0.016	-10.563	9.545	1.455	1614.988***	2,157.672	1,296.248	7,615.244	119,726.819
SH04	0.055	-10.525	9.534	1.505	931.489***	5,256.978	5,669.682	17,576.523	376,763.285
SH06	0.025	-10.578	9.598	0.998	12632.694***	554.446	425.551	4,871.287	71,867.043
SH07	0.032	-10.580	9.563	1.373	777.262***	676.686	665.349	13,449.116	180,608.980
SH09	0.064	-10.549	9.570	1.490	703.174***	10,386.990	4,263.748	56,922.881	753,660.162
SH10	0.047	-10.440	9.554	1.439	1035.434***	4,626.179	4,078.805	13,042.712	267,229.372
SH11	0.022	-10.599	9.565	0.983	477.544***	1,933.145	1,682.136	13,125.551	164,862.765
SH12	0.060	-10.598	9.624	1.362	825.829***	1,005.080	715.610	15,191.570	192,321.829
SH13	-0.004	-10.552	9.571	0.972	360.127***	970.923	594.965	8,092.509	125,393.547
SH14	0.008	-11.086	9.550	0.976	1406.112***	1,024.394	1,619.594	5,291.136	77,140.558
SH16	0.015	-10.567	9.556	0.984	381.620***	1,648.012	817.297	6,564.183	81,904.302
SH17	0.008	-10.575	9.569	0.971	474.334***	934.022	1,031.681	4,574.947	114,866.321
SH18	0.025	-10.586	9.599	0.973	724.493***	448.893	508.225	6,967.329	74,331.403
SH19	0.015	-10.528	9.533	0.988	611.717***	1,254.863	5,185.439	7,421.109	124,815.176
SH20	0.026	-11.045	9.558	0.983	739.715***	423.720	655.932	8,673.722	85,397.388
SH23	0.012	-10.548	9.554	0.984	693.267***	767.644	751.233	9,099.207	179,327.355

SH24	0.037	-13.642	9.637	1.456	3541.942***	4,841.416	632.141	10,084.588	110,599.683
SH25	0.047	-10.553	9.576	1.473	632.877***	11,176.830	4,569.563	28,011.179	376,622.674
SH26	0.033	-11.574	7.522	1.284	366.451***	436.133	843.856	3,556.313	139,389.314
SH27	0.032	-13.965	9.549	1.433	4038.600***	918.784	884.877	6,554.424	121,006.778
SH28	0.015	-10.547	9.548	1.428	2815.870***	884.708	1,204.338	7,635.227	111,876.263
SH29	0.027	-10.572	9.594	0.989	732.226***	287.299	301.882	4,053.098	47,166.750
SH30	0.044	-10.586	9.579	1.448	908.594***	4,544.204	2,974.327	27,039.167	506,434.218
SH31	-0.000	-10.561	9.569	0.997	178.634***	296.630	338.439	4,231.384	67,153.504
SH32	0.165	-10.522	9.574	1.304	1279.994***	1,048.891	1,153.436	8,351.607	129,568.870
SH33	0.031	-10.558	9.569	0.954	1365.181***	1,120.584	946.190	11,670.068	121,922.253
SH34	0.032	-10.539	9.544	1.381	454.625***	6,039.501	4,637.545	48,476.580	910,727.190
SH35	0.019	-10.599	9.624	1.539	2563.371***	2,259.216	892.101	11,345.611	157,996.229
SH36	0.029	-10.575	9.593	0.947	1420.294***	1,478.317	1,225.798	13,014.021	119,636.480
SH37	0.015	-10.513	9.531	1.575	6663.959***	956.537	1,570.000	8,046.209	147,310.601
SH38	0.016	-10.595	9.622	0.979	684.622***	487.078	412.304	7,156.353	80,782.421
SH39	0.010	-10.543	9.525	1.306	255.019***	2,068.103	1,970.664	9,270.151	114,932.461
SH40	0.033	-10.544	9.563	1.351	816.017***	1,206.574	1,226.427	10,392.352	123,073.420
SH41	0.085	-10.569	9.605	1.443	915.618***	2,117.845	964.398	24,130.357	271,364.622
SH43	0.074	-10.575	9.607	1.404	1897.251***	1,218.494	891.464	14,645.273	162,275.679
SH44	0.017	-10.524	9.563	1.424	1812.838***	946.014	632.543	8,331.807	100,293.712
SH45	0.019	-10.763	9.576	1.351	1204.202***	218.670	248.615	3,409.352	39,042.537
SH46	0.062	-10.616	9.646	1.465	5687.619***	563.866	417.660	5,846.247	74,641.216
SH48	-0.012	-10.576	9.566	1.594	12303.423***	728.043	601.932	6,361.558	94,602.076
SH49	-0.002	-10.563	9.608	1.312	708.955***	283.084	352.670	2,915.524	44,641.720
SH50	0.017	-11.628	9.658	1.628	10470.229***	1,163.400	885.398	16,403.361	187,573.997
SZ01	0.042	-10.655	9.588	1.443	816.546***	2,304.460	1,353.166	12,440.834	228,317.613
SZ02	0.046	-10.541	9.549	0.961	351.908***	2,645.565	3,350.837	15,928.184	190,625.548
SZ05	0.009	-10.559	9.558	0.999	2550.810***	427.794	625.877	5,063.118	79,772.858
SZ06	0.014	-10.565	9.580	0.994	1014.588***	538.254	487.416	6,209.065	66,139.434
SZ07	-0.004	-10.599	9.619	0.993	690.869***	1,056.542	1,196.483	12,100.248	167,537.454
SZ08	0.014	-10.755	9.581	0.995	4055.047***	626.710	529.629	5,605.812	93,542.526

SZ09	0.014	-10.595	9.612	0.967	569.776***	764.829	866.591	6,415.308	98,558.946
SZ10	0.008	-10.545	9.575	0.999	195.385***	860.107	1,277.463	5,292.381	89,349.425
SZ11	0.021	-10.547	9.594	1.364	311.625***	458.209	363.778	5,186.792	66,518.626
SZ13	0.035	-10.537	9.536	0.986	732.057***	713.791	2,582.454	3,478.112	67,253.053
SZ15	0.003	-13.607	9.548	0.989	667.287***	521.527	777.131	4,200.347	55,629.109
SZ16	0.007	-10.564	9.554	0.993	1372.336***	987.361	1,425.311	8,807.296	134,260.666
SZ17	0.034	-10.476	9.646	1.302	488.798***	290.445	389.631	3,530.427	46,988.478
SZ18	0.034	-15.746	9.546	0.985	305.935***	1,720.368	3,439.650	11,740.823	178,585.594
SZ20	0.008	-10.651	9.726	1.406	6962.720***	1,331.343	276.727	5,176.528	58,060.365
SZ21	-0.001	-10.563	9.568	0.986	448.066***	143.725	237.088	1,671.728	28,864.742
SZ22	0.008	-10.555	9.576	0.979	251.424***	1,059.166	1,030.804	9,158.053	94,182.024
SZ23	0.020	-10.594	9.619	0.928	679.844***	1,720.674	1,168.855	12,182.250	147,999.176
SZ24	-0.027	-10.555	9.547	0.975	434.005***	266.459	442.898	4,600.108	62,616.675
SZ25	0.010	-10.615	9.581	0.992	807.928***	1,005.080	715.610	15,191.570	192,321.829
SZ27	-0.001	-10.572	9.667	1.289	207.796***	302.098	399.864	10,670.255	127,043.206
SZ28	0.009	-10.554	9.531	0.993	333.201***	1,188.062	1,867.578	8,324.828	121,461.750
SZ29	0.017	-10.573	9.558	0.983	542.485***	196.824	321.330	4,093.708	41,456.743
SZ30	-0.003	-10.547	9.561	1.327	517.665***	641.061	1,603.934	3,408.152	48,875.238
SZ34	-0.001	-10.549	9.594	0.992	113.806***	382.306	304.573	3,029.675	36,546.305
SZ35	0.016	-10.569	9.570	1.226	123.978***	228.456	364.047	5,099.831	60,343.925
SZ36	-0.003	-10.591	9.610	0.993	222.963***	426.979	455.993	4,324.270	52,218.261
SZ37	-0.006	-10.558	9.573	0.992	348.694***	278.706	576.998	3,858.018	57,690.338
SZ38	0.017	-10.563	9.598	1.299	241.987***	1,819.350	1,471.519	23,285.319	266,202.629
SZ39	0.022	-10.543	9.550	1.447	940.848***	458.032	411.536	5,473.777	60,133.698
SZ40	0.007	-10.558	9.614	0.983	465.304***	571.870	524.157	6,056.866	77,057.699

Notes: Summary statistics of daily returns of 73 individual stocks adopted are presented in Panel A; Means of short-selling and margin-trading activity measures are presented separately in Panel B and Panel C. Mean, Min, Max, S.D. and JB are the sample mean, minimum, maximum, standard deviation and Jarque-Bera normality test, respectively. The two measures of short-selling activities are short-sales value and short-sales ratio, while measures of margin trading activities are margin-loans value and margin-loans ratio. The unit of the four activity measures are ten thousand Chinese yuan. *** denotes statistical significance at 1% level.

Appendix 5.2 Autocorrelations of short-selling and margin-trading activities

No.	A: Autocorrelations of short-sales value at lag					B: Autocorrelations of margin-loans value at lag				
	1	2	3	4	5	1	2	3	4	5
SH01	0.659*	0.475*	0.448*	0.418*	0.468*	0.696*	0.492*	0.483*	0.481*	0.480*
SH03	0.662*	0.457*	0.425*	0.452*	0.479*	0.679*	0.472*	0.517*	0.515*	0.471*
SH04	0.654*	0.479*	0.426*	0.420*	0.476*	0.677*	0.457*	0.450*	0.447*	0.448*
SH06	0.685*	0.491*	0.451*	0.453*	0.493*	0.669*	0.464*	0.496*	0.482*	0.461*
SH07	0.644*	0.461*	0.437*	0.380*	0.463*	0.724*	0.511*	0.513*	0.507*	0.505*
SH09	0.754*	0.535*	0.516*	0.514*	0.528*	0.731*	0.508*	0.460*	0.457*	0.500*
SH10	0.696*	0.475*	0.383*	0.368*	0.432*	0.675*	0.470*	0.489*	0.476*	0.473*
SH11	0.686*	0.502*	0.466*	0.578*	0.494*	0.708*	0.495*	0.469*	0.457*	0.464*
SH12	0.731*	0.516*	0.487*	0.499*	0.523*	0.696*	0.474*	0.492*	0.480*	0.463*
SH13	0.642*	0.478*	0.466*	0.454*	0.455*	0.691*	0.505*	0.491*	0.453*	0.479*
SH14	0.617*	0.41*	0.365*	0.386*	0.447*	0.696*	0.493*	0.507*	0.499*	0.481*
SH16	0.667*	0.454*	0.466*	0.463*	0.475*	0.692*	0.477*	0.490*	0.498*	0.447*
SH17	0.643*	0.439	0.412*	0.383*	0.409*	0.636*	0.423*	0.352*	0.342*	0.343*
SH18	0.626*	0.443*	0.371*	0.373*	0.410*	0.682*	0.491*	0.426*	0.413*	0.455*
SH19	0.578*	0.410*	0.413*	0.388*	0.391*	0.570*	0.387*	0.413*	0.387*	0.362*
SH20	0.621*	0.647*	0.384*	0.379*	0.417*	0.684*	0.499*	0.426*	0.415*	0.468*
SH23	0.656*	0.497*	0.399*	0.420*	0.456*	0.691*	0.469*	0.475*	0.455*	0.442*
SH24	0.718*	0.515*	0.526*	0.501*	0.490*	0.713*	0.491*	0.453*	0.427*	0.472*
SH25	0.731*	0.505*	0.427*	0.424*	0.494*	0.726*	0.489*	0.414*	0.421*	0.471*
SH26	0.653*	0.451*	0.475*	0.473*	0.453*	0.663*	0.449*	0.385*	0.371*	0.364*
SH27	0.653*	0.473*	0.477*	0.451*	0.449*	0.713*	0.502*	0.487*	0.457*	0.474*
SH28	0.666*	0.491*	0.441*	0.434*	0.475*	0.748*	0.515*	0.480*	0.461*	0.493*
SH29	0.681*	0.483*	0.433*	0.392*	0.466*	0.602*	0.383*	0.372*	0.379*	0.408*
SH30	0.673*	0.496*	0.483*	0.488*	0.486*	0.703*	0.485*	0.510*	0.522*	0.482*
SH31	0.671*	0.484*	0.468*	0.449*	0.489*	0.688*	0.478*	0.496*	0.491*	0.470*
SH32	0.643*	0.466*	0.456*	0.460*	0.454*	0.670*	0.470*	0.511*	0.506*	0.483*
SH33	0.763*	0.551*	0.514*	0.502*	0.540*	0.666*	0.465*	0.501*	0.459*	0.449*
SH34	0.627*	0.470*	0.473*	0.468*	0.454*	0.713*	0.503*	0.528*	0.523*	0.491*
SH35	0.757*	0.529*	0.388*	0.389*	0.417*	0.733*	0.516*	0.490*	0.487*	0.500*
SH36	0.773*	0.557*	0.507*	0.497*	0.540*	0.674*	0.486*	0.483*	0.462*	0.470*
SH37	0.547*	0.423*	0.405*	0.358*	0.355*	0.694*	0.469*	0.492*	0.485	0.456*
SH38	0.729*	0.519*	0.511*	0.479*	0.496*	0.661*	0.466*	0.528*	0.504*	0.459*
SH39	0.612*	0.444*	0.459*	0.452*	0.445*	0.700*	0.481*	0.471*	0.485*	0.483*
SH40	0.665*	0.486*	0.458*	0.474*	0.470*	0.718*	0.484*	0.465*	0.481*	0.490*
SH41	0.746*	0.537*	0.503*	0.496*	0.530*	0.677*	0.477*	0.500*	0.490*	0.470*

SH43	0.735*	0.506*	0.386*	0.372*	0.469*	0.701*	0.478*	0.468*	0.469*	0.441*
SH44	0.661*	0.439*	0.458*	0.424*	0.456*	0.711*	0.507*	0.519*	0.509*	0.492*
SH45	0.720*	0.516*	0.394*	0.399*	0.488*	0.727*	0.507*	0.420*	0.409*	0.479*
SH46	0.669*	0.448*	0.377*	0.372*	0.415*	0.631*	0.403*	0.383*	0.349*	0.357*
SH48	0.648*	0.481*	0.455*	0.425*	0.409*	0.689*	0.493*	0.520*	0.497*	0.489*
SH49	0.657*	0.474*	0.466*	0.456*	0.455*	0.580*	0.397*	0.424*	0.435*	0.373*
SH50	0.662*	0.506*	0.437*	0.328*	0.349*	0.731*	0.509*	0.473*	0.475*	0.505*
SZ01	0.703*	0.507*	0.465*	0.464*	0.502*	0.687*	0.493*	0.486*	0.483*	0.495*
SZ02	0.644*	0.463*	0.441*	0.446*	0.434*	0.685*	0.469*	0.424*	0.415*	0.432*
SZ05	0.693*	0.490*	0.424*	0.426*	0.470*	0.644*	0.457*	0.454*	0.448*	0.440*
SZ06	0.746*	0.537*	0.476*	0.469*	0.525*	0.717*	0.490*	0.487*	0.480*	0.476*
SZ07	0.688*	0.502*	0.470*	0.466*	0.498*	0.728*	0.491*	0.460*	0.468*	0.501*
SZ08	0.695*	0.494*	0.448*	0.431*	0.469*	0.702*	0.483*	0.480*	0.471*	0.469*
SZ09	0.593*	0.423*	0.383*	0.394*	0.413*	0.667*	0.444*	0.470*	0.424*	0.407*
SZ10	0.679*	0.486*	0.528*	0.472*	0.454*	0.733*	0.516*	0.491*	0.468*	0.506*
SZ11	0.688*	0.499*	0.446*	0.438*	0.467*	0.663*	0.475*	0.453*	0.446*	0.432*
SZ13	0.629*	0.455*	0.469*	0.432*	0.439*	0.684*	0.494*	0.477*	0.461*	0.470*
SZ15	0.563*	0.403*	0.389*	0.350*	0.392*	0.654*	0.454*	0.490*	0.475*	0.457*
SZ16	0.716*	0.530*	0.483*	0.487*	0.507*	0.719*	0.503*	0.477*	0.480*	0.507*
SZ17	0.537*	0.364*	0.387*	0.379*	0.367*	0.608*	0.362*	0.365*	0.358*	0.314*
SZ18	0.708*	0.512*	0.468*	0.455*	0.481*	0.684*	0.442*	0.483*	0.489*	0.449*
SZ20	0.583*	0.402*	0.419*	0.348*	0.392*	0.573*	0.399*	0.444*	0.383*	0.422*
SZ21	0.678*	0.513*	0.455*	0.424*	0.447*	0.718*	0.531*	0.490*	0.485*	0.511*
SZ22	0.734*	0.545*	0.483*	0.478*	0.515*	0.681*	0.485*	0.479*	0.446*	0.466*
SZ23	0.656*	0.415*	0.421*	0.435*	0.465*	0.688*	0.419*	0.391*	0.419*	0.446*
SZ24	0.637*	0.486*	0.429*	0.420*	0.436*	0.685*	0.486*	0.492*	0.456*	0.461*
SZ25	0.637*	0.472*	0.438*	0.437*	0.443*	0.676*	0.465*	0.429*	0.428*	0.451*
SZ27	0.658*	0.472*	0.447*	0.441*	0.468*	0.714*	0.516*	0.485*	0.484*	0.495*
SZ28	0.603*	0.445*	0.420*	0.387*	0.437*	0.708*	0.505*	0.475*	0.463*	0.478*
SZ29	0.602*	0.438*	0.451*	0.420*	0.404*	0.721*	0.501*	0.469*	0.460*	0.448*
SZ30	0.646*	0.475*	0.478*	0.476*	0.452*	0.704*	0.503*	0.496*	0.492*	0.500*
SZ34	0.575*	0.408*	0.416*	0.413*	0.398*	0.632*	0.434*	0.435*	0.422*	0.399*
SZ35	0.662*	0.475*	0.440*	0.423*	0.471*	0.719*	0.516*	0.485*	0.465*	0.473*
SZ36	0.566*	0.398*	0.412*	0.405*	0.399*	0.681*	0.477*	0.469*	0.454*	0.450*
SZ37	0.465*	0.456*	0.438*	0.397*	0.430*	0.655*	0.468*	0.437*	0.421*	0.443*
SZ38	0.737*	0.539*	0.501*	0.491*	0.510*	0.753*	0.543*	0.459*	0.433*	0.449*
SZ39	0.696*	0.498*	0.438*	0.441*	0.498*	0.674*	0.456*	0.470*	0.472*	0.445*
SZ40	0.648*	0.503*	0.445*	0.450*	0.489*	0.734*	0.511*	0.473*	0.459*	0.507*

Notes: * denotes statistical significance at 5% level.

Appendix 5.3 Short-selling (margin-trading) correlations between individual stocks

NO.	SH01	SH03	SH04	SH06	SH07	SH09	SH10	SH11	SH12	SH13	SH14	SH16	SH17
	A: Short sales correlations												
SH01	1.000												
SH03	0.858	1.000											
SH04	0.878	0.880	1.000										
SH06	0.610	0.622	0.635	1.000									
SH07	0.706	0.699	0.716	0.822	1.000								
SH09	0.796	0.787	0.766	0.760	0.783	1.000							
SH10	0.772	0.866	0.862	0.651	0.709	0.733	1.000						
SH11	0.697	0.690	0.740	0.864	0.826	0.808	0.725	1.000					
SH12	0.583	0.607	0.610	0.897	0.847	0.752	0.653	0.840	1.000				
SH13	0.647	0.628	0.661	0.821	0.781	0.753	0.674	0.835	0.829	1.000			
SH14	0.729	0.686	0.757	0.762	0.777	0.791	0.740	0.805	0.770	0.759	1.000		
SH16	0.577	0.658	0.646	0.810	0.740	0.719	0.654	0.787	0.813	0.791	0.672	1.000	
SH17	0.677	0.646	0.697	0.754	0.727	0.728	0.680	0.897	0.731	0.760	0.746	0.672	1.000
	B: Margin loans correlations												
SH01	1.000												
SH03	0.870	1.000											
SH04	0.818	0.880	1.000										
SH06	0.652	0.738	0.684	1.000									
SH07	0.762	0.832	0.779	0.872	1.000								
SH09	0.809	0.851	0.804	0.696	0.809	1.000							
SH10	0.824	0.871	0.864	0.744	0.833	0.790	1.000						
SH11	0.726	0.801	0.718	0.818	0.966	0.779	0.736	1.000					
SH12	0.520	0.635	0.580	0.827	0.802	0.597	0.629	0.754	1.000				
SH13	0.681	0.753	0.677	0.811	0.835	0.739	0.725	0.817	0.730	1.000			
SH14	0.640	0.724	0.695	0.815	0.836	0.654	0.741	0.816	0.761	0.796	1.000		
SH16	0.463	0.576	0.528	0.660	0.653	0.559	0.541	0.614	0.700	0.671	0.661	1.000	
SH17	0.537	0.622	0.540	0.565	0.638	0.576	0.549	0.746	0.500	0.579	0.605	0.409	1.000

Notes: This table presents short sales correlations and margin loans correlations separately in panel A and B. Dur to the limited space, only estimates of 13 out of 73 stocks are shown.

Appendix 5.4 Descriptive statistics of relative short-selling and margin-trading activities

No.	A: Short-selling activities				B: Margin-trading activities			
	Short-sales ratio		Short interest ratio		Margin-loans ratio		Margin interest ratio	
	Mean	Max	Mean	Max	Mean	Max	Mean	Max
SH01	2.108	19.169	0.015	0.092	11.730	46.053	2.261	7.366
SH03	2.164	19.417	0.019	0.131	12.297	40.937	1.637	6.054
SH04	2.811	25.425	0.026	0.163	10.191	74.892	1.729	4.826
SH06	1.364	14.006	0.005	0.033	10.412	56.939	0.733	4.128
SH07	0.736	10.075	0.001	0.014	9.967	37.772	0.336	1.862
SH09	2.597	12.618	0.029	0.161	14.262	37.240	4.088	14.729
SH10	2.852	18.076	0.015	0.098	9.019	50.513	0.961	3.450
SH11	1.832	12.263	0.021	0.104	11.049	39.134	1.864	7.119
SH12	0.806	8.672	0.007	0.027	13.252	39.906	1.802	6.036
SH13	1.410	9.797	0.022	0.112	13.195	43.660	3.873	12.651
SH14	1.657	18.642	0.010	0.040	7.406	31.801	0.399	2.250
SH16	2.659	21.193	0.021	0.085	12.314	36.185	2.201	9.112
SH17	2.335	18.062	0.029	0.114	9.993	71.451	2.458	9.536
SH18	1.103	11.707	0.015	0.054	10.722	32.321	2.080	8.247
SH19	1.666	9.683	0.024	0.075	9.196	46.696	0.571	1.767
SH20	0.800	6.551	0.017	0.059	10.198	38.610	2.203	8.178
SH23	1.455	14.267	0.033	0.153	15.242	50.729	7.440	23.113
SH24	1.956	21.101	0.012	0.136	10.803	51.723	1.677	7.434
SH25	3.040	19.136	0.042	0.433	12.074	34.316	3.033	12.148
SH26	1.322	22.522	0.010	0.061	10.660	63.292	1.462	5.285
SH27	1.189	14.204	0.007	0.046	9.776	35.411	0.968	4.480
SH28	1.658	14.473	0.004	0.019	10.849	35.061	0.380	2.077
SH29	0.935	10.228	0.006	0.031	10.243	38.479	0.751	2.713
SH30	2.209	25.825	0.014	0.089	12.957	39.171	2.264	9.047
SH31	1.345	10.917	0.019	0.078	13.304	46.136	3.499	13.031
SH32	1.333	21.875	0.012	0.095	9.682	66.364	1.365	7.299
SH33	0.907	10.131	0.009	0.044	12.250	45.123	1.172	3.644
SH34	1.959	18.572	0.019	0.088	12.044	57.980	2.991	11.901
SH35	1.369	13.768	0.005	0.051	10.965	46.546	0.822	4.223
SH36	1.243	20.212	0.009	0.048	10.846	48.963	0.928	3.092
SH37	1.768	28.517	0.001	0.017	6.931	43.362	0.121	0.754
SH38	1.199	13.624	0.008	0.029	11.719	44.969	1.548	7.047
SH39	2.041	18.114	0.014	0.075	8.073	38.784	0.727	4.850
SH40	1.707	21.843	0.003	0.013	10.629	44.582	0.243	1.275
SH41	0.943	9.038	0.007	0.033	12.505	38.274	1.602	5.975
SH43	1.707	21.843	0.009	0.050	9.358	40.339	1.238	3.559

SH44	1.335	17.254	0.000	0.003	10.532	39.929	0.068	0.321
SH45	1.070	13.991	0.004	0.020	11.860	54.338	0.677	2.415
SH46	1.251	15.336	0.008	0.039	9.350	32.166	1.321	4.601
SH48	1.707	21.843	0.012	0.083	8.435	40.130	1.808	10.069
SH49	1.636	13.594	0.011	0.053	13.531	46.765	1.509	4.645
SH50	2.117	24.848	0.001	0.019	9.693	44.534	0.226	1.637
SZ01	1.886	12.713	0.017	0.136	11.943	46.876	2.524	8.729
SZ02	2.437	12.166	0.031	0.138	8.791	48.409	1.485	7.903
SZ05	1.454	11.963	0.033	0.103	14.630	41.066	3.802	10.593
SZ06	1.885	19.304	0.026	0.113	14.233	43.400	2.726	12.641
SZ07	1.513	9.671	0.028	0.120	13.181	35.790	3.247	11.761
SZ08	1.487	10.358	0.026	0.113	11.709	63.022	3.718	16.690
SZ09	1.433	12.790	0.020	0.104	11.385	46.065	2.612	8.878
SZ10	1.783	21.283	0.061	0.668	11.826	40.891	3.990	16.002
SZ11	1.106	9.135	0.016	0.074	13.767	41.931	2.709	8.562
SZ13	2.331	17.307	0.043	0.173	8.755	38.096	1.034	5.050
SZ15	1.617	10.860	0.021	0.062	10.605	37.658	1.664	6.166
SZ16	2.058	18.935	0.077	0.350	17.953	45.261	6.753	23.022
SZ17	1.406	15.322	0.018	0.067	9.274	36.411	1.937	4.610
SZ18	2.062	15.458	0.039	0.118	8.572	30.727	1.577	6.981
SZ20	1.980	21.080	0.012	0.066	14.335	55.990	2.469	5.809
SZ21	1.055	11.767	0.013	0.062	10.775	46.233	1.600	6.828
SZ22	1.846	15.145	0.027	0.094	12.253	36.228	2.075	5.719
SZ23	2.158	14.830	0.036	0.231	14.094	57.266	3.479	11.061
SZ24	1.249	11.357	0.029	0.137	14.950	41.096	2.885	6.261
SZ25	0.806	8.672	0.007	0.027	13.252	39.906	1.802	6.036
SZ27	0.996	10.650	0.021	0.061	17.899	44.798	5.208	13.316
SZ28	1.688	13.801	0.019	0.056	9.874	34.279	1.276	4.490
SZ29	1.291	10.493	0.019	0.072	9.816	33.028	2.202	7.322
SZ30	2.447	15.313	0.035	0.122	9.357	37.153	1.165	6.483
SZ34	1.795	18.010	0.014	0.056	11.266	54.503	1.843	4.910
SZ35	1.152	10.191	0.023	0.095	13.015	41.412	3.605	11.649
SZ36	1.960	14.853	0.017	0.066	10.995	36.191	1.977	6.268
SZ37	1.161	7.545	0.033	0.097	13.560	40.126	2.883	8.266
SZ38	1.312	8.173	0.031	0.119	13.646	37.269	4.933	15.531
SZ39	0.998	14.990	0.012	0.065	11.100	35.023	1.576	5.502
SZ40	1.327	9.684	0.027	0.107	11.626	38.698	2.684	8.649

Notes: Summary statistics of short-selling (margin-trading) activities relative to market trading are presented in Panel A and Panel B separately. The two measures of relative short-selling activities are short-sales value/trading value and short interest/market value, while measures of relative margin-trading activities are margin-loans value/trading value and margin interest/market value. The unit of these relative activity measures are ten thousand Chinese yuan.

Appendix 5.5.A The determinants of short-selling activity: general regression with short-sales value

Dependent variable: Ln(SSV)	Regression in hierarchical approach																
C	1.3985*** (98.95)	1.3655*** (96.51)	1.7910*** (55.69)	1.3179*** (93.61)	1.3555*** (76.17)	1.3595*** (75.50)	1.3181*** (93.57)	1.3797*** (69.99)	1.3596*** (75.50)	1.3589*** (75.40)	1.3597*** (75.51)	1.3540*** (75.01)	1.3599*** (75.44)	1.3329*** (74.08)	0.9099*** (6.47)	1.2916*** (71.47)	1.3427*** (74.36)	1.8908*** (12.24)
Ln(SSV(-1))	0.7576*** (328.43)	0.7636*** (330.28)	0.7590*** (325.71)	0.7467*** (319.92)	0.7463*** (319.43)	0.7465*** (319.82)	0.7467*** (319.92)	0.7462*** (319.42)	0.7465*** (319.82)	0.7462*** (319.43)	0.7464*** (319.63)	0.7463*** (319.54)	0.7465*** (319.59)	0.7475*** (321.35)	0.7472*** (321.01)	0.7377*** (310.76)	0.7476*** (321.44)	0.7364*** (309.88)
R_i(-1)		0.0458*** (24.14)	0.0461*** (24.29)	0.0448*** (23.82)	0.0450*** (23.89)	0.0449*** (23.84)	0.0448*** (23.82)	0.0450*** (23.89)	0.0449*** (23.84)	0.0448*** (23.83)	0.0449*** (23.87)	0.0452*** (23.99)	0.4513*** (23.94)	0.0885*** (37.02)	0.0885*** (37.03)	0.0875*** (36.66)	0.0886*** (37.06)	0.0874*** (36.64)
Historical volatility			-0.9845*** (-14.73)															
Trading range				0.2704*** (38.23)	0.2669*** (37.37)	0.2724*** (38.40)	0.2704*** (38.23)	0.2694*** (37.44)	0.2724*** (38.40)	0.2704*** (38.21)	0.2720*** (38.33)	0.2715*** (38.26)	0.2716*** (38.26)	0.2899*** (40.84)	0.2882*** (40.50)	0.2424*** (32.40)	0.2923*** (41.13)	0.2399*** (32.02)
Dividend yield					-0.0150*** (-3.46)			-0.0113** (-2.50)										
EPS						-0.0419*** (-3.70)		-0.0335*** (-2.83)	-0.0419*** (-3.70)	-0.0422*** (-3.74)	-0.0422*** (-3.73)	-0.0418*** (-3.69)	-0.0454*** (-4.00)	-0.0482*** (-4.26)	-0.0497*** (-4.39)	-0.0653*** (-5.77)	-0.0470*** (-4.16)	-0.0645*** (-5.70)
Price-to-book ratio							0.0001 (0.46)	0.0001 (0.45)										
$D_{\text{Ex-dividend date}}$									0.0606 (0.93)									
$D_{\text{Financials}}$										0.2665*** (25.37)				0.2655*** (25.34)	0.2653*** (25.32)	0.2593*** (24.79)	0.2659*** (25.38)	0.2590*** (24.78)
$D_{\text{Insider trading}}$											0.1064** (2.40)			0.1158*** (2.62)	0.1142*** (2.59)	0.0885** (2.01)	0.1199** (2.72)	0.0921** (2.09)
$D_{\text{Analyst rating}}$												0.0616*** (4.30)		0.0713*** (4.99)	0.0715*** (5.01)	0.0805*** (5.65)	0.0706*** (4.94)	0.0807*** (5.67)
$D_{\text{Lagged block order}}$													0.1407*** (4.92))	0.1392*** (4.90)	0.1332*** (4.67)	0.1105*** (3.89)	0.1442*** (5.07)	0.1214*** (4.27)
R_M(-1)														0.0973*** (29.03)	0.0969*** (28.89)	0.0904*** (26.88)	0.0978*** (29.19)	0.0905*** (26.95)
CCI															-0.0041*** (-3.03)			-0.0058*** (-3.83)
Market turnover																-0.0004*** (-19.60)		-0.0005*** (-20.97)
IPO number																	-0.0190*** (-6.21)	-0.0288*** (-9.17)
R-squared	0.6228	0.6256	0.6265	0.6322	0.6322	0.6322	0.6321	0.6323	0.6322	0.6323	0.6323	0.6323	0.6323	0.6362	0.6363	0.6380	0.6364	0.6385
Adjusted R-squared	0.6225	0.6252	0.6262	0.6318	0.6319	0.6319	0.6318	0.6319	0.6319	0.6319	0.6319	0.6320	0.6320	0.6359	0.6359	0.6376	0.6361	0.6381
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ where the independent variable $X_j s$ in each equation are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The *t*-statistics presented in parentheses are the *t*-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.5.B The determinants of short-selling activity: regression on positive information with short-sales value

Dependent variable: Ln(SSV)	Regression in hierarchical approach							
C	1.3596*** (75.50)	1.3543*** (75.04)	1.3597*** (75.43)	1.3328*** (74.09)	0.8813*** (6.28)	1.2913*** (71.46)	1.3424*** (74.35)	1.8734*** (12.14)
Ln(SSV(-1))	0.7466*** (319.82)	0.7462*** (319.53)	0.7464*** (319.52)	0.7476*** (321.46)	0.7473*** (321.11)	0.7377*** (310.76)	0.7477*** (321.56)	0.7364*** (309.89)
R_i(-1)	0.0449*** (23.84)	0.0452*** (23.98)	0.4555*** (24.08)	0.0887*** (37.07)	0.0887*** (37.08)	0.0877*** (36.71)	0.0888*** (37.11)	0.0876*** (36.70)
Historical volatility								
Trading range	0.2725*** (38.40)	0.2716*** (38.28)	0.2720*** (38.32)	0.2908*** (40.99)	0.2889*** (40.62)	0.2427*** (32.44)	0.2932*** (41.27)	0.2403*** (32.07)
Dividend yield								
EPS	-0.0419*** (-3.70)	-0.0418*** (-3.69)	-0.0436*** (-3.84)	-0.0461*** (-4.08)	-0.0478*** (-4.22)	-0.0639*** (-5.65)	-0.0448*** (-3.97)	-0.0629*** (-5.57)
Price-to-book ratio								
$D_{\text{Ex-dividend date}}$								
$D_{\text{Financials}}$				0.2679*** (25.60)	0.2675*** (25.57)	0.2609*** (24.98)	0.2683*** (25.65)	0.2608*** (24.99)
$D_{\text{Insider purchase}}$	-0.0271 (-0.43)							
$D_{\text{Analyst upgrade}}$		0.0590*** (4.07)		0.0692*** (4.81)	0.0696*** (4.83)	0.0796*** (5.53)	0.0686*** (4.76)	0.0799*** (5.56)
$D_{\text{Lagged plus-tick order}}$			0.2081*** (4.82)	0.2053*** (4.78)	0.2003*** (4.66)	0.1804*** (4.21)	0.2083*** (4.85)	0.1872*** (4.37)
R_M(-1)				0.0972*** (29.00)	0.0968*** (28.86)	0.0902*** (26.84)	0.0977*** (29.16)	0.0904*** (26.91)
CCI					-0.0044*** (-3.25)			-0.0056*** (-3.72)
Market turnover						-0.0004*** (-19.80)		-0.0005*** (-21.09)
IPO number							-0.0186*** (-6.08)	-0.0287*** (-9.13)
R-squared	0.6322	0.6323	0.6323	0.6362	0.6363	0.6380	0.6363	0.6385
Adjusted R-squared	0.6319	0.6320	0.6320	0.6358	0.6359	0.6376	0.6360	0.6381
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on positive information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.5.C The determinants of short-selling activity: regression on negative information with short-sales value

Dependent variable: Ln(SSV)	Regression in hierarchical approach							
C	1.3605*** (75.55)	1.3592*** (75.48)	1.3595*** (75.41)	1.3394*** (74.70)	0.8810*** (6.28)	1.2993*** (72.17)	1.3491*** (74.94)	1.8579*** (12.04)
Ln(SSV(-1))	0.7463*** (319.50)	0.7465*** (319.81)	0.7466*** (319.66)	0.7479*** (321.74)	0.7476*** (321.38)	0.7381*** (311.16)	0.7479*** (321.83)	0.7368*** (310.29)
R_i(-1)	0.0450*** (23.90)	0.0450*** (23.85)	0.0449*** (23.79)	0.0878*** (36.77)	0.0879*** (36.79)	0.0867*** (36.39)	0.0879*** (36.82)	0.0867*** (36.38)
Historical volatility								
Trading range	0.2720*** (38.33)	0.2723*** (38.39)	0.2721*** (38.34)	0.2916*** (41.12)	0.2898*** (40.74)	0.2443*** (32.68)	0.2940*** (41.04)	0.2420*** (32.33)
Dividend yield								
EPS	-0.0422*** (-3.72)	-0.0420*** (-3.71)	-0.0439*** (-3.68)	-0.0448*** (-3.97)	-0.0465*** (-4.12)	-0.0626*** (-5.54)	-0.0435*** (-3.85)	-0.0616*** (-5.45)
Price-to-book ratio								
$D_{\text{Ex-dividend date}}$								
$D_{\text{Financials}}$				0.2702*** (25.85)	0.2698*** (25.81)	0.2632*** (25.22)	0.2706*** (25.89)	0.2631*** (25.24)
$D_{\text{Insider sale}}$	0.2036*** (3.31)			0.2099*** (3.43)	0.2048*** (3.35)	0.1692*** (2.77)	0.2204*** (3.60)	0.1845*** (3.02)
$D_{\text{Analyst downgrade}}$		−0.1137 (−1.63)						
$D_{\text{Lagged minus-tick order}}$			-0.0897 (0.45)					
R_M(-1)				0.0969*** (28.91)	0.0964*** (28.77)	0.0900*** (26.77)	0.0974*** (29.08)	0.0901*** (26.84)
CCI					-0.0045*** (-3.30)			-0.0053*** (-3.57)
Market turnover						-0.0004*** (-19.61)		-0.0005*** (-20.86)
IPO number							-0.0188*** (-6.17)	-0.0289*** (-9.20)
R-squared	0.6323	0.6322	0.6322	0.6360	0.6361	0.6376	0.6362	0.6383
Adjusted R-squared	0.6319	0.6319	0.6319	0.6357	0.6357	0.6374	0.6359	0.6379
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on negative information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.6.A The determinants of margin-trading activity: general regression with margin-loans value

Dependent variable: Ln(MLV)	Regression in hierarchical approach																
C	0.8474*** (68.78)	0.8683*** (70.52)	1.2943*** (62.39)	0.6797*** (113.87)	1.4436*** (63.36)	1.2754*** (61.09)	1.2930*** (63.32)	1.4508*** (63.71)	1.2758*** (61.10)	1.2750*** (61.07)	1.2756*** (61.09)	1.2750*** (61.07)	1.2776*** (61.18)	1.2746*** (61.14)	0.4491*** (6.68)	1.9321*** (92.97)	1.2752*** (61.12)	0.9186*** (13.74)
Ln(MLV(-1))	0.8983*** (615.29)	0.8957*** (613.85)	0.8829*** (573.74)	0.7274*** (319.30)	0.8780*** (560.04)	0.8816*** (569.91)	0.8826*** (572.93)	0.8740*** (549. 04)	0.8816*** (569.92)	0.8784*** (542.48)	0.8816*** (569.48)	0.8816*** (569.64)	0.8813*** (568.83)	0.8811*** (569.46)	0.8664*** (530.10)	0.7289*** (347.83)	0.8809*** (565.27)	0.7242*** (342.65)
R_i(-1)		0.0197*** (24.01)	0.0200*** (24.17)	0.0091*** (15.47)	0.0195*** (23.96)	0.0198*** (24.27)	0.0198*** (24.19)	0.0196*** (24.10)	0.0198*** (24.27)	0.0198*** (24.26)	0.0199*** (24.26)	0.0198*** (24.16)	0.0197*** (24.14)	0.0081*** (7.74)	0.0083*** (7.97)	0.0110*** (11.09)	0.0081*** (7.74)	0.0110*** (11.09)
Historical volatility			-0.7865*** (-25.47)		-0.8887*** (-28.20)	-0.8059*** (-26.02)	-0.7770*** (-25.05)	-0.9450*** (-29.54)	-0.8057*** (-26.01)	-0.8059*** (-26.02)	-0.8057*** (-26.01)	-0.8076*** (-26.07)	-0.8060*** (-26.00)	-0.8008*** (-25.87)	-0.6949*** (-22.36)	-0.3174*** (-10.69)	-0.8010*** (-25.88)	-0.2562*** (-8.59)
Trading range				−0.0051** (-2.22)														
Dividend yield					0.0305** (6.74)			0.0303*** (6.23)										
EPS						0.0392*** (7.77)		0.0721*** (13.54)	0.0393*** (7.77)	0.0392*** (7.77)	0.0392*** (7.76)	0.0393*** (7.78)	0.0381*** (7.51)	0.0379*** (7.48)	0.0347*** (6.89)	0.0101** (2.10)	0.0378*** (7.48)	0.0089* (1.85)
Price-to-book ratio							-0.0001*** (-3.25)	-0.0001*** (-3.06)										
DEx-dividend date									-0.0740*** (-2.59)					-0.0679** (-2.38)	-0.0502** (-1.76)	-0.0861*** (-3.18)	-0.0679** (-2.38)	-0.0766*** (-2.84)
DFinancials										0.0395*** (8.64)				0.0383*** (8.39)	0.0475*** (10.39)	0.1048*** (23.41)	0.0383*** (8.37)	0.1074*** (24.00)
DInsider trading											0.0126 (0.64)							
DAnalyst rating												-0.0158** (-2.50)		-0.0185*** (-2.93)	-0.0200*** (-3.18)	-0.0446*** (-7.44)	-0.0185*** (-2.93)	-0.0446*** (-7.46)
DLagged block order													0.0758*** (5.92)	0.0767*** (6.00)	0.0584*** (4.58)	0.0537*** (4.43)	0.0765*** (5.98)	0.0473 (3.90)
R_M(-1)														0.0255*** (17.61)	0.0247*** (17.13)	0.0135*** (9.83)	0.0254*** (17.60)	0.0135*** (9.85)
CCI															0.0174*** (26.94)			0.0101*** (15.95)
Market turnover																0.0013*** (101.52)		0.0013*** (99.42)
IPO number																	0.0010 (0.72)	0.0181*** (13.59)
R-squared	0.8416	0.8426	0.8437	0.8432	0.8437	0.8438	0.8437	0.8445	0.8439	0.8439	0.8438	0.8438	0.8439	0.8444	0.8457	0.8604	0.8444	0.8610
Adjusted R-squared	0.8415	0.8425	0.8435	0.8430	0.8436	0.8437	0.8436	0.8444	0.8437	0.8437	0.8436	0.8437	0.8437	0.8443	0.8455	0.8603	0.8443	0.8609
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ where the independent variable $X_j s$ in each equation are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The *t*-statistics presented in parentheses are the *t*-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.6.B The determinants of margin-trading activity: regression on positive information with margin-loans value

Dependent variable: Ln(MLV)	Regression in hierarchical approach							
C	1.2755*** (61.09)	1.2750*** (61.06)	1.2756*** (61.09)	1.2726*** (61.05)	0.4580*** (6.82)	1.9308*** (92.91)	1.2732*** (61.03)	0.9116*** (13.65)
Ln(MLV(-1))	0.8817*** (569.86)	0.8816*** (569.69)	0.8815*** (569.49)	0.8813*** (570.17)	0.8665*** (530.38)	0.7291*** (347.99)	0.8812*** (565.90)	0.7243*** (342.75)
R_i(-1)	0.0199*** (24.26)	0.0198*** (24.17)	0.0196*** (23.92)	0.0080*** (7.59)	0.0082*** (7.83)	0.0110*** (10.96)	0.0080*** (7.60)	0.0109*** (10.96)
Historical volatility	-0.8060*** (-26.02)	-0.8075*** (-26.07)	-0.8061*** (-26.00)	-0.8008*** (-25.87)	-0.6942*** (-22.33)	-0.3173*** (-10.68)	-0.8010*** (-25.87)	-0.2558*** (-8.57)
Trading range								
Dividend yield								
EPS	0.0393*** (7.77)	0.0393*** (7.78)	0.0389*** (7.70)	0.0388*** (7.68)	0.0354*** (7.03)	0.0107** (2.23)	0.0388*** (7.67)	0.0094** (1.96)
Price-to-book ratio								
$D_{\text{Ex-dividend date}}$				-0.0684** (-2.39)	-0.0505* (-1.78)	-0.0865*** (-3.20)	-0.0683** (-2.39)	-0.0769*** (-2.85)
$D_{\text{Financials}}$				0.0387*** (8.48)	0.0477*** (10.46)	0.1051*** (23.50)	0.0387*** (8.47)	0.1077*** (24.09)
$D_{\text{Insider purchase}}$	0.0124 (0.45)							
$D_{\text{Analyst upgrade}}$		-0.0149** (-2.33)		-0.0176*** (-2.75)	-0.0193*** (-3.03)	-0.0446*** (-7.36)	-0.0176*** (-2.76)	-0.0447*** (-7.40)
$D_{\text{Lagged plus-tick order}}$			0.1069*** (5.49)	0.1076*** (5.53)	0.0935*** (4.83)	0.0812*** (4.41)	0.1074*** (5.53)	0.0755*** (4.11)
R_M(-1)				0.0254*** (17.60)	0.0247*** (17.12)	0.0135*** (9.83)	0.0254*** (17.58)	0.0135*** (9.86)
CCI					0.0175*** (27.09)			0.0101*** (16.06)
Market turnover						0.0013*** (101.55)		0.0013*** (99.42)
IPO number							0.0011 (0.81)	0.0181*** (13.56)
R-squared	0.8438	0.8438	0.8439	0.8444	0.8457	0.8604	0.8444	0.8610
Adjusted R-squared	0.8437	0.8437	0.8437	0.8443	0.8455	0.8603	0.8443	0.8609
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on positive information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.6.C The determinants of margin-trading activity: regression on negative information with margin-loans value

Dependent variable: Ln(MLV)	Regression in hierarchical approach							
C	1.2758*** (61.10)	1.2759*** (61.10)	1.2767*** (61.12)	1.2733*** (61.08)	0.4658*** (6.94)	1.9309*** (92.89)	1.2740*** (61.07)	0.9061*** (13.57)
Ln(MLV(-1))	0.8816*** (569.42)	0.8816*** (569.64)	0.8816*** (569.10)	0.8815*** (570.55)	0.8666*** (530.74)	0.7298*** (348.67)	0.8813*** (566.25)	0.7250*** (343.44)
R_i(-1)	0.0198*** (24.23)	0.0199*** (24.27)	0.0199*** (24.29)	0.0084*** (8.00)	0.0086*** (8022)	0.0114*** (11.51)	0.0084*** (8.01)	0.0114*** (11.50)
Historical volatility	-0.8053*** (-26.00)	-0.8060*** (-26.02)	-0.8079*** (-26.06)	-0.7991*** (-25.84)	-0.6923*** (-22.30)	-0.3143*** (-10.59)	-0.7993*** (-25.85)	-0.2529*** (-8.49)
Trading range								
Dividend yield								
EPS	0.0392*** (7.76)	0.0393*** (7.77)	0.0388*** (7.66)	0.0390*** (7.73)	0.0355*** (7.07)	0.0108** (2.26)	0.0390*** (7.73)	0.0095*** (1.98)
Price-to-book ratio								
*D*Ex-dividend date				-0.0683** (-2.39)	-0.0504* (-1.77)	-0.0870*** (-3.21)	-0.0682** (-2.39)	-0.0773*** (-2.86)
*D*Financials				0.0401*** (8.79)	0.0490*** (10.75)	0.1062*** (23.74)	0.0401*** (8.78)	0.1087*** (24.32)
*D*Insider sale	−0.0435 (-1.57)							
*D*Analyst downgrade		0.0496* (1.69)		0.0441 (1.51)	0.0437 (1.50)	0.0357 (1.29)	0.0441 (1.51)	0.0347 (1.25)
*D*Lagged minus-tick order			-0.0469 (-0.87)					
R_M(-1)				0.0253*** (17.50)	0.0245*** (17.00)	0.0132*** (9.62)	0.0253*** (17.48)	0.0132*** (9.64)
CCI					0.0175*** (27.23)			0.0102*** (16.15)
Market turnover						0.0013*** (101.41)		0.0013*** (99.25)
IPO number							0.0012 (0.85)	0.0181*** (13.56)
R-squared	0.8438	0.8438	0.8438	0.8444	0.8457	0.8603	0.8444	0.8610
Adjusted R-squared	0.8437	0.8437	0.8437	0.8443	0.8455	0.8602	0.8442	0.8609
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on negative information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.7.A The determinants of short-selling activity: general regression with short-sales ratio

Dependent variable: Ln(SSR)	Regression in hierarchical approach																
C	-0.0639*** (-15.30)	-0.0613*** (-14.80)	0.3726*** (17.26)	-0.0691*** (-12.79)	0.2779*** (11.15)	0.3757*** (16.20)	0.3793*** (17.54)	0.2989*** (11.73)	0.2779*** (11.15)	0.2779*** (11.14)	0.2774*** (11.12)	0.2746*** (11.00)	0.2757*** (11.04)	0.6030*** (19.24)	2.8695*** (20.38)	0.6077*** (19.44)	0.2921*** (11.65)	2.6799*** (18.85)
Ln(SSR(-1))	0.7395*** (332.57)	0.7445*** (336.79)	0.7363*** (328.59)	0.7445*** (336.81)	0.7351*** (327.24)	0.7363*** (328.59)	0.7360*** (328.20)	0.7346*** (326.73)	0.7351*** (327.23)	0.7360*** (328.54)	0.7351*** (327.24)	0.7350*** (327.04)	0.7350*** (327. 07)	0.7294*** (321.77)	0.7237*** (316.17)	0.7299*** (322.79)	0.7332*** (326.09)	0.7235*** (316.72)
R_i(-1)		0.0643*** (37.86)	0.0649*** (38.29)	0.0643*** (37.87)	0.0644*** (37.99)	0.0649*** (38.29)	0.0649*** (38.30)	0.0644*** (38.00)	0.0644*** (37.99)	0.0644*** (38.00)	0.0644*** (38.00)	0.0645*** (38.04)	0.0644*** (37.97)	0.0624*** (36.73)	0.0619*** (36.48)	0.0908*** (42.07)	0.0917*** (42.45)	0.0904*** (41.96)
Historical volatility			-1.0286*** (-20.48)		-0.9512*** (-18.57)	-1.0290*** (-20.49)	-1.0487*** (-20.81)	-0.9671*** (-18.80)	-0.9512*** (-18.57)	-0.9507*** (-18.55)	-0.9502*** (-18.54)	-0.9532*** (-18.60)	-0.9476*** (-18.48)	-1.4156*** (-24.52)	-1.5145*** (-26.13)	-1.4098*** (-24.48)	-0.9194*** (-17.97)	-1.4666*** (-25.29)
Trading range				0.0143*** (2.26)														
Dividend yield					-0.0287*** (-7.58)			-0.0315*** (-7.97)	-0.0287*** (-7.58)	-0.0287*** (-7.58)	-0.0287*** (-7.57)	-0.0289*** (-7.62)	-0.0287*** (-7.58)	-0.0162*** (-4.21)	-0.0113*** (-2.93)	-0.0152*** (-3.97)	-0.0251*** (-6.64)	-0.0094** (-2.45)
EPS						-0.0030 (-0.37)		-0.0225*** (-2.66)										
Price-to-book ratio							0.0003*** (4.64)	0.0003*** (4.53)										
DEx-dividend date									0.0139 (0.24)									
DFinancials										0.0275*** (2.96)				0.0276*** (2.97)	0.0285*** (3.07)	0.0291*** (3.12)	0.0293*** (3.15)	0.0303*** (3.26)
DInsider trading											0.0286 (0.71)							
DAnalyst rating												0.0309** (2.47)		0.0289** (2.31)	0.0317** (2.54)	0.0349*** (2.80)	0.0359*** (2.87)	0.0370*** (2.97)
DLagged block order													0.0317* (1.65)	0.0571** (2.20)	0.0773*** (2.98)	0.0591** (2.29)	0.0423 (1.64)	0.0824*** (3.19)
R_M(-1)														−0.0004*** (−17.45)	−0.0002*** (−11.50)	−0.0652*** (−21.25)	−0.0628*** (−20.47)	−0.0655*** (−21.38)
CCI															-0.0217*** (-16.51)			-0.0198*** (-14.96)
Market turnover																-0.0004*** (-16.13)		-0.0003*** (-10.70)
IPO number																	-0.0382*** (-14.02)	-0.0245*** (-8.83)
R-squared	0.5560	0.5627	0.5702	0.5627	0.5650	0.5647	0.5648	0.5651	0.5647	0.5650	0.5647	0.5650	0.5650	0.5662	0.5683	0.5674	0.5676	0.5699
Adjusted R-squared	0.5556	0.5624	0.5697	0.5624	0.5646	0.5643	0.5644	0.5647	0.5643	0.5646	0.5644	0.5646	0.5646	0.5658	0.5679	0.5671	0.5672	0.5695
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ where the independent variable $X_j s$ in each equation are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The *t*-statistics presented in parentheses are the *t*-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.7.B The determinants of short-selling activity: regression on positive information with short-sales ratio

Dependent variable: Ln(SSR)	Regression in hierarchical approach							
C	0.2780*** (11.15)	0.2748*** (11.01)	0.2746*** (11.00)	2.8695*** (20.38)	3.1810*** (23.00)	0.6077*** (19.44)	0.2917*** (11.65)	2.6727*** (18.81)
Ln(SSR(-1))	0.7350*** (327.20)	0.7350*** (327.03)	0.7350*** (327. 06)	0.7237*** (316.17)	0.7266*** (319.10)	0.7299*** (322.71)	0.7331*** (326.04)	0.7234*** (316.63)
R_i(-1)	0.0644*** (37.99)	0.0645*** (38.04)	0.0646*** (38.06)	0.0619*** (36.48)	0.0911*** (42.19)	0.0911*** (42.15)	0.0919*** (42.53)	0.0907*** (42.05)
Historical volatility	-0.9517*** (-18.58)	-0.9536*** (-18.61)	-0.9458*** (-18.45)	-1.5145*** (-26.13)	-1.2141*** (-22.94)	-1.4093*** (-24.47)	-0.9186*** (-17.96)	-1.4661*** (-25.28)
Trading range								
Dividend yield	-0.0290*** (-7.65)	-0.0289*** (-7.62)	-0.0287*** (-7.57)	-0.0287*** (-7.60)	-0.0178*** (-4.68)	-0.0152*** (-3.95)	-0.0251*** (-6.63)	-0.0094** (-2.44)
EPS								
Price-to-book ratio								
*D*Ex-dividend date								
*D*Financials				0.0272*** (2.93)	0.0286*** (3.08)	0.0289*** (3.11)	0.0291*** (3.14)	0.0305*** (3.29)
*D*Insider purchase	−0.0893 (−1.58)							
*D*Analyst upgrade		0.0313** (2.48)		0.0374*** (2.97)	0.0400*** (3.18)	0.0349*** (2.77)	0.0365*** (2.91)	0.0371*** (2.95)
*D*Lagged plus-tick order			0.1156*** (2.91)	0.1156*** (2.91)	0.1439*** (3.63)	0.1424*** (3.59)	0.1228*** (3.10)	0.1589*** (4.01)
R_M(-1)				−0.0621*** (−20.22)	−0.0633*** (−20.66)	−0.0652*** (−21.25)	−0.0628*** (−20.48)	−0.0655*** (−21.39)
CCI					-0.0268*** (-21.51)			-0.0198*** (-14.92)
Market turnover						-0.0004*** (-18.64)		-0.0003*** (-11.68)
IPO number							-0.0382*** (-14.02)	-0.0245*** (-8.81)
R-squared	0.5647	0.5650	0.5650	0.5667	0.5688	0.5683	0.5676	0.5699
Adjusted R-squared	0.5643	0.5646	0.5646	0.5663	0.5685	0.5679	0.5672	0.5695
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on positive information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.7.C The determinants of short-selling activity: regression on negative information with short-sales ratio

Dependent variable: Ln(SSR)	Regression in hierarchical approach							
C	0.2757*** (11.05)	0.2776*** (11.13)	0.2785*** (11.16)	0.2597*** (10.43)	3.1685*** (22.92)	0.6120*** (19.60)	0.2960*** (11.83)	2.6799*** (18.71)
Ln(SSR(-1))	0.7350*** (327.19)	0.7350*** (327.07)	0.7350*** (326. 99)	0.7359*** (328.25)	0.7269*** (319.35)	0.7300*** (322.88)	0.7333*** (326.23)	0.7236*** (316.85)
R_i(-1)	0.0645*** (38.03)	0.0643*** (37.96)	0.0643*** (37.96)	0.0915*** (42.39)	0.0906*** (42.04)	0.0906*** (42.03)	0.0915*** (42.42)	0.0902*** (41.91)
Historical volatility	-0.9480*** (-18.50)	-0.9500*** (-18.54)	-0.9509*** (-18.55)	-0.9123*** (-17.83)	-1.2110*** (-22.89)	-1.4078*** (-24.45)	-0.9168*** (-17.94)	-1.4637*** (-25.25)
Trading range								
Dividend yield	-0.0289*** (-7.61)	-0.0287*** (-7.57)	-0.0287*** (-7.56)	-0.0288*** (-7.61)	-0.0179*** (-4.71)	-0.0153*** (-3.98)	-0.0252*** (-6.64)	-0.0095** (-2.47)
EPS								
Price-to-book ratio								
$D_{\text{Ex-dividend date}}$								
$D_{\text{Financials}}$				0.0281*** (3.03)	0.0297*** (3.20)	0.0298*** (3.21)	0.0300*** (3.24)	0.0315*** (3.40)
$D_{\text{Insider sale}}$	0.1137** (2.03)			0.1219** (2.18)	0.1471*** (2.64)	0.1618** (2.90)	0.1427** (2.56)	0.1219** (2.18)
$D_{\text{Analyst downgrade}}$		−0.0026 (−0.04)						
$D_{\text{Lagged minus-tick order}}$			−0.0235 (−0.71)					
R_M(-1)				−0.0619*** (−20.16)	−0.0631*** (−20.59)	−0.0650*** (−21.20)	−0.0626*** (−20.42)	−0.0653*** (−21.33)
CCI					-0.0266*** (-21.39)			-0.0196*** (-14.97)
Market turnover						-0.0004*** (-18.64)		-0.0003*** (-11.72)
IPO number							-0.0382*** (-14.04)	-0.0247*** (-8.86)
R-squared	0.5650	0.5647	0.5647	0.5669	0.5690	0.5685	0.5678	0.5701
Adjusted R-squared	0.5646	0.5643	0.5643	0.5664	0.5686	0.5681	0.5674	0.5697
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $SS_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on negative information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.8.A The determinants of margin-trading activity: general regression with margin-loans ratio

Dependent variable: Ln(MLR)	Regression in hierarchical approach																
C	0.4962*** (108.37)	0.4949*** (108.20)	1.5506*** (118.29)	0.4994*** (104.65)	1.5042*** (110.75)	1.5224*** (115.21)	1.5502*** (118.25)	1.4940*** (109.89)	1.5226*** (115.22)	1.5228*** (115.21)	1.5231*** (115.21)	1.5212*** (115.02)	1.5186*** (114.91)	1.5299*** (115.47)	0.7652*** (15.89)	1.4221*** (106.60)	1.5362*** (115.82)	1.1306*** (22.71)
Ln(MLR(-1))	0.7842*** (416.84)	0.7848*** (417.65)	0.6703*** (296.93)	0.7847*** (417.59)	0.6678*** (294.92)	0.6664*** (293.82)	0.6702*** (296.84)	0.6652*** (292. 85)	0.6664*** (293.81)	0.6650*** (293.78)	0.6664*** (293.82)	0.6667*** (293.59)	0.6667*** (293.51)	0.6642*** (291.09)	0.6599*** (287.79)	0.6311*** (265.69)	0.6635*** (290.77)	0.6276*** (263.64)
R_i(-1)		0.0110*** (17.16)	0.0085*** (13.65)	0.0111*** (17.19)	0.0087*** (13.98)	0.0085*** (13.69)	0.0085*** (13.65)	0.0087*** (13.92)	0.0085*** (13.69)	0.0084*** (13.68)	0.0085*** (13.71)	0.0088*** (14.08)	0.0086*** (13.88)	0.0035*** (4.30)	0.0032*** (3.99)	0.0018** (2.27)	0.0034*** (4.25)	0.0016** (2.01)
Historical volatility			-1.8554*** (-85.56)		-1.8211*** (-83.42)	-1.8715*** (-86.31)	-1.8532*** (-85.38)	-1.8422*** (-84.04)	-1.8716*** (-86.31)	-1.8718*** (-86.31)	-1.8725*** (-86.32)	-1.8647*** (-86.02)	-1.8647*** (-86.02)	-1.8735*** (-86.37)	-1.8437*** (-84.82)	-1.6718*** (-76.19)	-1.8691*** (-86.18)	-1.6480*** (-75.06)
Trading range				-0.0085*** (-3.42)														
Dividend yield					0.0179*** (12.92)			0.0126*** (8.70)										
EPS						0.0476*** (15.80)		0.0400*** (12.55)	0.0476*** (15.80)	0.0476*** (15.80)	0.0477*** (15.82)	0.0477*** (15.86)	0.0473*** (15.69)	0.0476*** (15.79)	0.0471*** (15.64)	0.0384*** (12.84)	0.0476*** (15.78)	0.0380*** (12.69)
Price-to-book ratio							-0.0001** (-2.36)	-0.0001** (-2.56)										
DEx-dividend date									-0.0350* (-1.67)					-0.0337 (-1.61)	-0.0305 (-1.46)	-0.0378* (-1.82)	-0.0347* (-1.65)	-0.0384* (-1.85)
DFinancials										0.0527*** (15.29)				0.0527*** (15.27)	0.0525*** (15.24)	0.0529*** (15.48)	0.0528*** (15.29)	0.0529*** (15.51)
DInsider trading											0.0248* (1.65)			0.0222 (1.48)	0.0247* (1.65)	0.0445*** (2.99)	0.0205 (1.36)	0.0425*** (2.86)
DAnalyst rating												-0.0181*** (-3.92)		-0.0173*** (-3.74)	-0.0180*** (-3.90)	-0.0162*** (-3.53)	-0.0176*** (-3.80)	-0.0170*** (-3.71)
DLagged block order													0.0310*** (3.17)	0.0317*** (3.25)	0.0227*** (2.32)	0.0123 (1.28)	0.0344*** (3.52)	0.0137 (1.41)
R_M(-1)														0.0117*** (10.34)	0.0115*** (10.21)	0.0097*** (8.67)	0.0119*** (10.54)	0.0100*** (8.99)
CCI															0.0073*** (16.52)			0.0029*** (6.19)
Market turnover																0.0004*** (45.29)		0.0004*** (43.82)
IPO number																	0.0088* (1.91)	0.0172*** (7.14)
R-squared	0.6527	0.6537	0.6758	0.6537	0.6763	0.6765	0.6758	0.6768	0.6765	0.6765	0.6765	0.6765	0.6765	0.6767	0.6775	0.6827	0.6769	0.6836
Adjusted R-squared	0.6525	0.6534	0.6755	0.6535	0.6760	0.6763	0.6756	0.6765	0.6762	0.6764	0.6763	0.6764	0.6763	0.6764	0.6772	0.6825	0.6767	0.6834
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ where the independent variable $X_j s$ in each equation are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The *t*-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.8.B The determinants of margin-trading activity: regression on positive information with margin-loans ratio

Dependent variable: Ln(MLR)	Regression in hierarchical approach							
C	1.5228*** (115.22)	1.5213*** (115.03)	1.5185*** (114.90)	1.5295*** (115.47)	0.7614*** (15.83)	1.4212*** (106.55)	1.5358*** (115.82)	1.1275*** (22.67)
Ln(MLR(-1))	0.6664*** (293.81)	0.6667*** (293.56)	0.6668*** (293.62)	0.6643*** (291.18)	0.6600*** (287.83)	0.6312*** (265.75)	0.6636*** (290.86)	0.6277*** (263.69)
R_i(-1)	0.0085*** (13.69)	0.0088*** (14.09)	0.0086*** (13.83)	0.0034*** (4.25)	0.0032*** (3.94)	0.0018** (2.22)	0.0034*** (4.20)	0.0016** (1.96)
Historical volatility	-1.8721*** (-86.33)	-1.8646*** (-86.02)	-1.8649*** (-86.02)	-1.8727*** (-86.36)	-1.8426*** (-84.79)	-1.6705*** (-76.14)	-1.8685*** (-86.18)	-1.6467*** (-75.01)
Trading range								
Dividend yield								
EPS	0.0477*** (15.82)	0.0478*** (15.87)	0.0477*** (15.82)	0.0480*** (15.92)	0.0473*** (15.73)	0.0385*** (12.87)	0.0479*** (15.92)	0.0380*** (12.73)
Price-to-book ratio								
*D*Ex-dividend date				-0.0337 (-1.61)	-0.0305 (-1.46)	-0.0378* (-1.82)	-0.0347* (-1.65)	-0.0383* (-1.85)
*D*Financials				0.0526*** (15.25)	0.0526*** (15.27)	0.0531*** (15.57)	0.0526*** (15.25)	0.0531*** (15.59)
*D*Insider purchase	0.0346 (1.64)							
*D*Analyst upgrade		-0.0195*** (-4.18)		-0.0186*** (-4.00)	-0.0193*** (-4.15)	-0.0172*** (-3.72)	-0.0189*** (-4.06)	-0.0179*** (-3.89)
*D*Lagged plus-tick order			0.0287* (1.90)	0.0297** (1.97)	0.0227 (1.50)	0.0112 (0.75)	0.0314** (2.08)	0.0116 (0.78)
R_M(-1)				0.0117*** (10.35)	0.0115*** (10.22)	0.0097*** (8.71)	0.0119*** (10.55)	0.0101*** (9.02)
CCI					0.0074*** (16.61)			0.0029*** (6.24)
Market turnover						0.0004*** (45.27)		0.0004*** (43.78)
IPO number							0.0158*** (8.85)	0.0253*** (17.14)
R-squared	0.6764	0.6765	0.6765	0.6766	0.6775	0.6827	0.6769	0.6836
Adjusted R-squared	0.6762	0.6763	0.6763	0.6764	0.6772	0.6825	0.6766	0.6834
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on positive information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Appendix 5.8.C The determinants of margin-trading activity: regression on negative information with margin-loans ratio

Dependent variable: Ln(MLR)	Regression in hierarchical approach							
C	1.5225*** (115.19)	1.5189*** (114.93)	1.5189*** (114.94)	1.5277*** (115.43)	0.7598*** (15.80)	1.4193*** (106.50)	1.5339*** (115.78)	1.1273*** (22.66)
Ln(MLR(-1))	0.6664*** (293.82)	0.6667*** (293.52)	0.6667*** (293.55)	0.6644*** (291.21)	0.6601*** (287.86)	0.6313*** (265.77)	0.6637*** (290.90)	0.6277*** (263.73)
R_i(-1)	0.0085*** (13.70)	0.0087*** (13.94)	0.0087*** (13.98)	0.0034*** (4.18)	0.0031*** (3.84)	0.0017** (2.10)	0.0033*** (4.13)	0.0015* (1.84)
Historical volatility	-1.8718*** (-86.30)	-1.8655*** (-86.06)	-1.8654*** (-86.06)	-1.8743*** (-86.44)	-1.8441*** (-84.86)	-1.6714*** (-76.18)	-1.8701*** (-86.26)	-1.6477*** (-75.06)
Trading range								
Dividend yield								
EPS	0.0476*** (15.80)	0.0479*** (15.88)	0.0474*** (15.74)	0.0480*** (15.94)	0.0473*** (15.73)	0.0384*** (12.85)	0.0480*** (15.94)	0.0380*** (12.71)
Price-to-book ratio								
*D*Ex-dividend date				-0.0333 (-1.58)	-0.0301 (-1.43)	-0.0374* (-1.80)	-0.0342 (-1.63)	-0.0380* (-1.83)
*D*Financials				0.0525*** (15.25)	0.0526*** (15.30)	0.0533*** (15.63)	0.0525*** (15.25)	0.0533*** (15.65)
*D*Insider sale	-0.0116 (0.55)							
*D*Analyst downgrade		0.0450* (1.92)		0.0430* (1.84)	0.0405* (1.73)	0.0235 (1.01)	0.0429* (1.83)	0.0221 (0.95)
*D*Lagged minus-tick order			0.0199 (1.42)					
R_M(-1)				0.0118*** (10.42)	0.0116*** (10.30)	0.0098*** (8.78)	0.0120*** (10.62)	0.0102*** (9.10)
CCI					0.0074*** (16.60)			0.0029*** (6.20)
Market turnover						0.0004*** (45.31)		0.0004*** (43.82)
IPO number							0.0087* (1.88)	0.0172*** (7.11)
R-squared	0.6765	0.6765	0.6764	0.6766	0.6774	0.6827	0.6768	0.6836
Adjusted R-squared	0.6763	0.6764	0.6762	0.6764	0.6772	0.6824	0.6766	0.6833
P-value of F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: This table presents regression estimates of equation $MT_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_{j,i,t} + \varepsilon_{i,t}$ focusing on negative information events. The independent variable $X_j s$ in each equation of our pooled testing are specified in the leftmost column. The statistics of goodness-of-fit measures including R-squared, adjusted R-squared and p-value of F-test are shown at the bottom of the table. The column in shading is the final regression of the test. The t-statistics presented in parentheses are the t-values adjusted for heteroskedasticity consistent standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

Chapter 6: Conclusions

This thesis includes three empirical studies related to short selling and margin trading. Chapter 3 investigates the impact of the dual introduction event on feedback trading behaviour and stock volatility dynamics of the designated stocks. With more precise trading data, Chapter 4 investigates the different impacts of short-selling activity and margin-trading activity on the level of feedback trading and returns volatility separately. Also, in Chapter 4 we analyse the impact differences between the trading activity of retail margin investors and that conducted by their institutional counterparts. To justify the roles of short sellers and margin traders in the financial markets, Chapter 5 adopts the panel regressions to study the determinants of short selling and margin trading.

6.1 Summary of Findings and Policy Implications

With a combination of the heterogeneous trader model and GARCH model, Chapter 3 examines the impact of short selling and margin trading on feedback trading behaviour and stock volatility dynamics. A unanimous conclusion is received from the results of the baseline model and the extended model with Heaviside indicators. The dual introduction of short selling and margin trading leads to a reduction in unconditional positive autocorrelation and a substantially lower level of positive feedback trading. These findings indicate that the introduction event has a stabilising effect on the A-share stock market. In addition to that, we study the different impacts of short selling and margin trading on feedback trading by investigating the coefficient indicators conditional on positive and negative historical returns. The findings are opposite to our hypotheses. The estimated coefficients suggest that the designated stocks eligible for short selling see a rise in both the unconditional autocorrelations and the positive feedback trading conditional on negative historical returns. In terms of margin trading conditional on positive historical returns, a significant drop in both unconditional negative autocorrelation and positive feedback trading are found. We thus conclude that

compared to short selling, margin trading is more favourable to the stabilisation of the stock market.

Concerning the changes in volatility, a substantial reduction in the level of stock returns volatility is observed after the introduction. However, a similar trend displays simultaneously among the treatment and the control stocks. Since factors other than the introduction event may also affect the key coefficients in our model, the control groups are constructed for each individual treatment stocks and indices. The detailed GARCH estimates prove that our considerations are necessary. We find that for both the treatment and control groups, the increase occurs only in the unconditional volatility, rather than the news coefficient and the volatility persistency. As the results of the two-period approach, the designated stocks increase more in the unconditional volatility compared to the control stocks, which indicates no advantages of the two introduced mechanisms. However, the facts that the designated stocks decrease less in the news coefficients and decrease more in the volatility persistency suggest that short selling and margin trading play a supporting role in terms of informational efficiency.

In all, our results of Chapter 3 show that the introduction event of short selling and margin trading contribute to a moderated level of unconditional positive autocorrelation and conditional positive feedback trading behaviour. And no evidence shows that the two mechanisms increase the volatility persistence in stocks returns, which may destabilise the stock markets. Instead, our findings support that the two mechanisms improve the informational efficiency and help stabilise the stock markets. However, the aggravating impact of short selling on conditional positive feedback trading should not be ignored. In fact, the Chinese regulators have already paid close attention to this issue. The rigorous requirements for the qualification of investors who are eligible for short selling and margin trading have been aggressively reiterated by the CSRC after the stock crash happened in 2015. The findings of this study would not only provide important policy implications for Chinese regulators but worldwide regulators who are trapped with the issues of short sales constraints and margin requirements.

Chapter 4 focuses on two research questions. We firstly examine whether a larger amount of short-selling/margin-trading activity is associated with a higher level of positive feedback trading and stock returns volatility. Then, we investigate the impact differences of the margin activities conducted by retail investors and institutional investors on feedback trading behaviour and stock returns volatility. There is no evidence showing that activity of short selling/margin trading increases positive feedback trading. However, we observe an increasing impact of short-selling activity on negative feedback trading. In terms of stock returns volatility, margin-trading activity has a significant increasing impact on it, while short-selling activity seems to have a slightly decreasing impact. After being scaled by margin-trading activity, our results of short-selling activity on feedback trading and volatility remain the same. Although evidence shows that neither activity of short selling nor that of margin trading increase positive feedback trading, an increased level of negative feedback trading by short-selling activity is far from being a good thing to the market. In the final analysis, negative feedback trading is not a fundamental-based strategy, which reflects the intrinsic value of a stock.

The number of margin account separately opened by retail and institutional investors has no significant impact on feedback trading behaviour during the stable and booming periods. When the growth rate of account number held by institutional investors is greater than their retail counterparts, the level of stock returns volatility decreases. This implies that compared to retail margin investors, institutional margin investors are better informed. During the bearish and crash periods, the participation of retail margin investors leads to a higher level of negative feedback trading in the market. Consistent with the analysis above, retail investors who are less financially educated tend to conduct more irrational trades and bring more uncertainty to the market.

The findings of Chapter 4 have obvious policy implications. It is well-known that the Chinese stock markets have long been a retail-dominated market, although things start to change in recent five years. In such an environment, the basic financial education to the public of how to make rational investments would be beneficial to reduce misunderstood strategies like negative feedback trading and help investors keep confident even when they face a declining trend. The recent changes in the policy of the A-share market that simply suppress short selling thus seem

to have an adverse impact on the markets. To promote market stability, margin trading should be paid more attention in terms of volatility control. In an emerging market like China, systematic defects in trading mechanisms and financial regulations are obvious. The illegal transactions like inside information leakage often slip under the CSRC's supervision. The introduction of margin trading itself might be beneficial to the market, but lax-regulated margin trading activity could be a problem. Since short selling and margin trading involve more risks and retail investors are less financially educated, the requirements for the qualification of retail investors to participate margin trades should be more stringent. A market with more professional investors seems an irresistible historical trend.

To figure out what motivates short sellers and margin traders to make their investment decisions, Chapter 5 investigates the determinants of short-selling activity and margin-trading activity separately from both the firm and the market perspectives. Taking together with control variables, the firm-level determinants of short-selling (margin-trading) activity include past short-selling (margin-trading) activities, past stock returns, stock returns volatility, financial ratios, ex-dividend date events, industry classifications, insider trading events, stock analyst recommendations, block trading events, whereas the market-level factors include past market performance and investor sentiment.

With the pooled regressions of a hierarchical approach, we find that short-selling activity is significantly related to past short-selling activity, past stock returns, historical volatility, EPS, industry classification, insider sale, analyst upgrade, block plus-tick order, past market performance and CCI. While margin-trading activity is decided by past margin-trading activity, past stock returns, historical volatility, EPS, ex-dividend date event, industry classification, insider purchase, analyst upgrade and downgrade, block plus-tick order, past market performance and market turnover. These findings suggest that the motivations of short sellers and margin trader are fairly fundament-related. Both of these two types of traders are not simply opportunistic. Also, we notice that unlike short sellers, margin traders are momentum traders at both the individual stock level and the market level. This indicates that activities of margin traders may lead more uncertainty to the market.

In all, the findings of this study provide crucial additional insights into the nature of information advantages that lead to abnormal returns earned by short sellers and margin traders. Our results allow novel inferences about how short sellers and margin traders contribute to price discovery and market efficiency. By identifying information sources of short sellers and margin traders, the study has important implications for policymakers and financial regulators, particularly for an emerging market like China. Our findings would also help the public to have better understandings of short selling and margin trading. The two mechanisms should not be treated as scapegoats when the market becomes depressed and unsettled. It is reasonable to believe that these two types of traders are advanced investors who can efficiently exploit publicly accessible information.

6.2 Limitations and Further Research

This thesis has its limitations. As for Chapter 3, we adopt a sample span of eight years from 31/03/2006 to 31/03/2014. Especially for GARCH-type models, a larger sample size implies a better estimation. If a sample of less than 1000 daily observations is used, the estimation will be very unlikely to give us the real information about the parameters (Ng and Lam 2006). Our sample size is limited to eight years due to the late foundation of the Chinese equity markets. Because of the late foundation of the A-share market, 30 stocks among the designated 90 stocks lack data in an earlier stage of our sample period. This significantly reduces our original sample size. Second, the less annual trading days of the whole market and the more suspension trading dates of individual stocks in the Chinese market setting cause serious data discontinuity. The high frequency of non-trading days leads to non-convergence issue in the GARCH regressions and a further data loss of 15 stocks. Third, to maintain data continuity and model suitability, we only adopt the first batch of 90 stocks during the reform as our research objects. However, until now, six batches and several small changes have been taken in the designated list since its first announcement. This feature of data can be exploited as a real plus for future studies. Nevertheless, we realise that the different impacts of short selling and margin trading on feedback trading, returns volatility and related issues of China's 2010 event can be studied further with stricter analysis by adopting the activities data of each mechanism. Our study also introduces some potential research questions for future studies. In this chapter, we focus on the

impacts of the introduction short selling and margin trading on feedback trading and volatility. The impacts may be extended to many different fields, like earnings management (*e.g*., Fang *et al.* 2016) and stock manipulation (*e.g*., Finnerty 2005).

To answer the question raised from Chapter 3, Chapter 4 adopts the more precise data of each mechanism's activity to investigates the impact of short-selling and margin-trading activity on the level of feedback trading and stock returns volatility. Again, since GARCH-type models have been extensively applied in this study as well, data loss stemming from the nonconvergence issue may cause our results to deviate from the facts. Other volatility measures which can prevent this type of issue should be considered. Besides, we study the different impacts of retail margin investors and institutional margin investors with indirect monthly data of the margin account number opened by these two types of investors. A study with more detailed and higher-frequency activity data of different kinds of short-selling and margin-trading investors in other markets would be an addition to the literature.

Chapter 5 extends the current literature of the determinants of short selling, and at the first time, it identifies the determinants of margin trading. However, it can be easily seen that the question of the determinants of short-selling and margin-trading activity is an open topic. The factors considered in the study is not only limited by our understanding of the extant literature but also the market settings and the data accessibility. As a study of an emerging market, our findings may not be perfectly applied to the same issue of the developed market. In domestic China, trades on margin currently only includes the two mechanisms studied in our study, while in more advanced markets, short selling and margin trading activities may also be affected by the trading of futures and options. The data accessibility in the A-share market also leads certain limitations to our study. The determinants of short-selling/margin-trading activity conducted by different groups can be an interesting research topic.

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