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An Analysys of Short Sale and Speed of Price Adjusmentt: Evidence from the Stock Exchange of Thailand

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Abstract

We examine the short selling activities in the Stock Exchange of Thailand (SET) from 2002 to 2009 in two main aspects. First, we investigate the intraday pattern of the short selling activities (i.e., short sale volume, short sale value, and frequency of short sale transactions). The intraday patterns of short selling activities in the SET are W-shaped, consistent with the theoretical explanation by Brock and Kleidon (1992) and Miller (1989). In the second part, we compare the speed of price adjustment between shortable and non-shortable stocks to new information. We apply the dynamic vector autoregressive method from Hasbrouck (1991a) to measure the speed of price adjustment to firm-specific information. In addition, we employ the Dimson beta regression and DELAY measures from Dimson (1979) and Chordia and Swaminathan (2000) to measure the speed of price adjustment to market-wide information. Our results indicate that the shortability of stocks does not improve the speed of price adjustment to either firm-specific or market-wide information. These results are contrast to those found in a developed market (i.e., Hong Kong Stock Exchange) by Chen and Rhee (2010). The possible explanation offered for our results lie in the relatively high frictions in the short selling transactions in the SET. That is, the relatively high fees and lack of supply for shorting could have a negative impact on the speed of price adjustment of shortable stocks to new information.

Keywords: Short Sale / Speed of Price Adjustment / Equity / Information/ The Stock Exchange of Thailand

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Chapter1: Introduction

A short sale is a transaction in which an investor borrows a security from a brokerage firm and then sells it. The investor, or a short seller, has an obligation to cover her short position at some point in the future by buying back the security from the market and return it to the brokerage firm. Therefore, short sellers profit if the security price decline or make loss if the security price rise. The advantages and disadvantages of allowing short sale are widely argued. During the global financial crisis (i.e. subprime mortgage crisis in US and European sovereign-debt crisis in late 2000s until 2013), many investors accuse short selling of destabilizing the markets. Speculators can use short sale to profit in declining markets and thus causes further negative pressure on the markets. However, some investors and academic researchers argue that short selling have benefits. For example, short selling constraints hinder the price adjustment to negative news and make stock prices overvalued. Our study therefore is aimed to investigate whether the short selling constraint has a negative effect on the price adjustment process.

Both academics and practitioners are interested in short sale activities. Two main issues about short sale activities are usually discussed. First is on the effect of short sale activity on securities price, and second is on the effect of short sale activity on the speed of security price adjustment. The study about the effect of short sale on security price is first introduced by Miller

(1977). Miller argues that when investors have heterogeneous opinions in the securities' value, stocks with high short sale constraint tend to be overpriced and are usually associated with negative abnormal returns. Subsequent papers focus on the informational role of shorts selling activity and the relation between short selling and stock valuation. For example, Diether et al. (2002) provide empirical evidence in the US markets in support with the Miller (1977) prediction. They use variability in analyst's forecast as a proxy for difference in opinions, and find that securities with larger distribution in analysts' earnings forecasts tend to have lower future returns than other similar stocks. Chang et al. (2007) also confirmed the prediction by Miller (1977) in the Hong Kong stock market. Finally, Berkman et al. (2009) studies short-selling around earning announcements. Their results suggest that stocks subject to high variation in security value judgment and with more strict short-sales bans tend to be overpriced before earnings announcement days.

Recent short sale literature extends to examine the second aspect of short sale effect, that is, the speed of price adjustment of shortable stock due to new information. Diamond and Verrecchia (1987) predict that short-sale restrictions cause asymmetric price discovery processes, which hinder the speed of price adjustment to new information, especially bad news. Chen and Rhee (2010) show that short-selling in the Hong Kong stock market causes market to be efficient by increasing speed of price adjustment to both private/public firm-specific information and market-wide information. Fung and Draper (1999) also indicate that mispricing in futures can be reduced by loosening up the restriction in short selling, which will improve the speeds of spot price adjustment.

In summary, previous studies generally focus on the effect of short selling constraint on asymmetric price transmission on two main aspects – namely, asymmetric size of price adjustment (i.e. Miller 1977) and asymmetric speed of price changes (i.e. Diamond and Verrecchia 1987; Chen and Rhee 2010). Relatively little work; however, has been done on the second aspect, due mainly to the unavailability of the necessary data set. For example, most stocks in the US markets and many other developed countries can be sold short; therefore, it is difficult to compare the speed of price adjustment between the same set of shares with and without short selling constraints. The only study by Chen and Rhee (2010) can deal with such difficulty. In their study, only a group of stocks (i.e., called the D-list in their study) can be sold short. Therefore, they can compare the speed of price adjustment to new information between the three-month period before a stock is included into the D-list and the three-month period after the stock joins the D-list. Their results show that ability to short improves the speed of price adjustment to new information. In the SET, only stocks in the SET50 index can be sold short. Since January 2011, however, the 100 stocks in the SET 100 index (which includes 50 stocks in the SET50 index) have been allowed to be sold short. This provides a natural setting for us to investigate whether stocks without short-selling restrictions experience a faster speed of price adjustment than (the same) stocks with short-selling constraints. Therefore, our study contributes to the literature by examining the explicit role of short sale constraints on the speed of price adjustment to new information in the Stock Exchange of Thailand, one of the main emerging markets.

Our study consists of two main parts. The first part provides the explanatory intraday characteristics of short sale in the Stock Exchange of Thailand, and the second part examines the effect of short sale constraints on the speed of price adjustment. There are very few papers that investigate the intraday pattern of short-selling activities. Angel (1997) and Aitken et al. (1998) are the only two papers that examine the intraday pattern of short selling in the US and Australia respectively. However, to the best of our knowledge, the intraday pattern of short-selling in developing markets has not been examined. That leads us to conduct an empirical investigation of an intraday pattern of short-selling activities on the Stock Exchange of Thailand, one of the main emerging markets.

In the second part of this paper, we examine whether the short sale constraint delay the speed of price adjustment to information. Due to the high friction of short-selling in SET, as previously mention, we expect that shortable stocks do not significantly adjust faster to new information than non-shortable stocks. Two types of information are considered here – that are, firm-specific and market-wide information. Following Hasbrouck (1991a) and Chen and Rhee (2010), a dynamic vector autoregressive (dynamic VAR) is used to analyze the speed of stock price adjustment to firm-specific information in each transaction. From the dynamic VAR, trading continuity and quote reversal between shortable and non-shortable stocks are then compared. To examine the speed of price adjustment to market-wide information, the Dimson beta regression (Dimson 1979) and DELAY measure (Chordia and Swaminathan 2000) are used. Lastly, we investigate the speed of price adjustment in different market conditions – that are, up and down markets.

Chapter 2: Objectives and Contributions

There are two main objectives of this paper. First, this paper examines intraday patterns of the short sale activities, including short sale volume, short sale value and the frequency of short selling. We extend the previous studies on the intraday patterns of short selling activities in the developed markets (i.e. Angel, 1997 and Aitken et al., 1998) by exploring the short selling activities in the Stock Exchange of Thailand, an emerging market. Moreover, we look into the detail of short selling pattern of different kind of investors. We investigate whether the result of overall pattern come from an influence of any specific investor type. We also provide some descriptive information of short selling in SET such as the characteristic of volume, trade size and number of transactions of shortable stock since 2002 to 2009.

Second, this paper compares the speed of price adjustment of two groups of stocks, i.e., shortable and non-shortable stocks. Specifically, the paper investigates whether stocks without short sale constraint have a different speed of price adjustment to new information than stocks with short sale constraint. As previously mentioned, there are many frictions in the SET (e.g. high SBL fee and lack of supply) that can potentially reduce the speed of price adjustment to information. As a result, due to those frictions, relaxing the short sale constraint may not have significant impact on the improving speed of price adjustment.

This paper makes several contributions as follows. First, this paper presents the intraday patterns of short selling activities in an emerging market. In addition, the study makes a comparison between the short selling activities by investor types (e.g., individual investors and institutional investors) in the SET. Such comparison has so far never been studies. Second, this paper investigates the effect of short sale constraint on the speed of price adjustment to both private/public firm-specific information and market-wide information. Specifically, the paper examines whether such speed of price adjustment is different between shortable and non-shortable stocks. The speed of price adjustment is measured in terms of trade continuity, quote reversals, and incorporation of information into each trade. Third, since the effect of short selling in up market conditions is not widely examined by previous studies, this paper extends to evaluate the speed of price adjustment in both up and down market conditions. The results of this study should have a policy implication on how to properly and effectively regulate the short selling activities, especially in the Stock Exchange of Thailand.

Table 1: Short Selling Comparison between Developed Market and Thailand

Market	%Short Ratio	SBL Fee/ year	SBL in Practice	% Avg. Supply	Shortable stocks	Regulations
US (NYSE and NASDAQ)	23.89% for NYSE 31.33% for NASDAQ (Diether et al.; 2009a)	Fee_{EW} = 0.68% Fee_{VW} = 0.10%	1920s	23.56%	Most of all stocks	• Up-tick rule (abandoned on 2007) • Naked short is banned since 2008 • 102% to 105% of short-sale value as collateral
Australian (ASX)	1.75%	Fee_{EW} = 1.32% Fee_{VW} = 0.33%	Before 1990	15.62%	Most of all stocks	• Naked short is banned since 2001 • 105-110% of short value as collateral (Bris et al.;2007)
Japan (TSE)	6.76% (Takahashi; 2010)	Fee_{EW} = 1.57% Fee_{VW} = 0.40%	Before 1990	4.49%	Most of all stocks	• Up-tick rule after March 2002 • Naked short is prohibited since 2008 until April 2012
Hong Kong (HKEx)	8.67% (Chen and Rhee; 2010)	Fee_{EW} = 1.54% Fee_{VW} = 0.33%	1994	6.96%	Stocks in D-list	• Up-tick rule after January 1994 • Naked short is not allowed • 105% of short-sale value as collateral
Thailand (SET)	1.29% (Stocks in SET50 index)	Fee_{EW} = 2.51% Fee_{VW} = 1.42%	2004	2.55%	Stocks in SET100 (since 1 Jan 2011)	• Zero plus tick rule • Naked short is not allowed • Initial collateral[1] 150% of short value, maintenance collateral[2] 140% of short value, minimum collateral[3] 120% of short value • Lenders (mutual fund) require 100% collateral (note that these collateral amount can be vary depend on the short seller credit and the service of the brokerage firm)

Note: This table is modified from Sawad (2010). It presents the comparison of some important of market characteristics that relate to short selling. %Short ratio is the percentage of trading volume that is sold short (short volume/trading volume). SBL fee/year is the fee of borrowing and lending stocks. There are two types of fee which are represented here; Fee_{EW} is the equal-weight mean and Fee_{VW} is the size-weight average. %Avg. supply is the average of value of shares supplied relative to total value of shares outstanding. Both of SBL Fee/year and %Avg. Supply are quoted from Saffi and Sigurdsson (2011)

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[1] Initial collateral is the amount required to be collateralized in order to open a position.

[2] Maintenance collateral is the minimum amount which is required to be collateralized in order to keep an open position.

[3] Minimum collateral is the force buy threshold. When the collateral lower than this level, investor need to put more money in their collateral account otherwise brokerage firm possible force to buy the securities back.

Chapter3: Literature Review and Hypothesis Development

There are at least two different features of short selling across markets – namely, (1) regulations and (2) securities borrowing and lending (SBL), as shown in Table 1. According to Jain et al. (2011), the degree of regulation on short selling varies across countries. Developed markets, such as the US, Australia and Japan, fully allow short selling. On the other hand, developing markets tend to partially permit short selling (e.g., Thailand and Indonesia), or prohibit short selling (e.g., Bulgaria and Sri Lanka). During the financial crisis (i.e. Asia financial crisis in 1997, subprime mortgage crisis in US and European sovereign-debt crisis in late 2000s), the regulator tends to blame short sale as the activity destabilizes stock markets. Market participants tend to support the bans on naked short sale during the crises. This prohibition is found not only in developed markets (e.g., Swiss Exchange, Tokyo Stock Exchange, and Hong Kong Stock Exchange) but also emerging markets (e.g., the Stock Exchange of Thailand). Beber and Pagano (2011) demonstrate that, during the financial crisis, a short sale ban is strictly enforced, especially for stocks in financial sectors.

In addition, Securities Borrowing and Lending (SBL) is different across markets. The SBL in developed markets tend to have longer history than those in emerging markets. For example, the SBL in the US markets was established before 1920s, while that in Thailand was introduced only since 1999. As shown in Table 1, the percentage of the average supply is significantly higher in developed markets, such as the US and Hong Kong, than in developing countries, including Thailand (Saffi and Sigurdsson, 2011). Furthermore, fees of borrowing and lending securities tend to be much lower in the developed markets with high supply. This could explain the fact that short ratios tend to be much higher in developed markets than in emerging markets (Table 1). Such differences in short-selling regulations and SBL practices between developed and developing markets cast doubt on the applicability of the studies on short-selling in developed markets to the context of short-selling in developing markets.

Intraday patterns in stock markets have attracted much market microstructure research attention. These include the study of Jain and Joh (1988) that study patterns from NYSE, Chan et al. (1995) that study patterns from NASDAQ. These two papers show that, in US, the intraday pattern of volume result in U-shape pattern. This means that the trading volume tend to be relatively higher during the opening trading period. Then, it significantly reduces to lowest level during the mid-day and after that it continuously increases until the end of trading day. After that, the availability of high frequency data from non-US equity markets increases the exploration in such research area. Abhyankar et al. (1997) exhibit that 8,235 stocks listed in the London Stock Exchange (LSE) have two U-shape (or W-shape) patterns for their trading volume. However, when they separate the stocks into two group - that are high trading volume and low trading volume, they find that the heavy-trade stocks show in U-shape pattern. Hamao and Hasbrouck (1995) is the other paper that investigates the patterns outside the US. Their research show that trading volume in the Tokyo Stock Exchange (TSE) shows in the W-shape pattern. There are some papers that use that investigate the intraday pattern in developing market such as Al-Suhaibani and Kryzanowski (2000). They found that, in the Saudi Stock Market (SSM), the intraday trading volume is shown as W-shape pattern. The detail of these previous studies in overall orders pattern is shown in Table 2.

The latter intraday pattern studies extend the previous studies by focusing on a specific order like short selling. However, there is very few papers in this area due to the lack of tick-by-tick data that can specified the order type (i.e. buy, sell or short sell orders). This data has been available in developed market since the past 20 years[4]. However, for some emerging markets, the data have just been easily accessed within around past 10 years[5]. The study of Angel (1997) is one of the very first papers that investigate the short sale characteristics using intraday data. He used SuperDot orders from the NYSE TORQ database. His database contains 144 NYSE firms during the studying period from the beginning of November 1990 to the end of January 1991. In addition, he claims that his data can identify the investor types who submit the orders. His study reveals that size of short sell orders tend to be larger than regular sell orders. The volume of short orders is about 13 percent of total sell order volume placed through the NYSE SuperDot system. Index arbitrage and program trading are the investor types who sent the highest volume of short sale orders, which are over 30 percent of the overall short volume. For larger stocks, institutions submit more short orders than the individual traders do. In contrast, the individual portion of short selling increases statistically in the four smallest size deciles. Furthermore, institutions tend to send larger size of short order than individuals. He also exposed that short orders have intraday pattern as U-shape.

Aitken et al. (1998) study the intraday trading behavior in Australian Securities Exchange (ASX), in particular, which is associated with short sale orders and their information role. Their results conclude that, in a market condition that short sale information is transparent, short sale is nearly instantly

4 According to the book “Using SAS in Financial Research” by Ekkehart Boehmer, John Paul Broussard and Juha-Pekka Kallunki (2002), intraday data is broadly available in 1988.

5 For example, tick by tick data from SET is obtainable since 1999.

bad news, just after execution. They also present that investors submit limit short order more than market short orders about two times. Furthermore, they separate intraday short orders in to two groups, limit orders and market orders, which were found U-shape patterns in both groups. The details of these intraday short sale patterns are shown in Table 2.

Even though, each markets shows their patterns in two different shapes-that are U-shape and W-shape pattern, all of them are consistent with the study of Brock and Kleidon (1992) and Miller (1989). Brock and Kleidon(1992) explain that open and close of trading periods can be classified as special trading time because they are the linkage between two periods; continuous trading time and time which trading is impossible. Trading demand at the open and close is greater than at other times of the trading day due to the inability to trade when market is closed. This abnormal high demand is reflected in the increasing trading volume. For example, investor cannot trade on the information that occurs during the night, when market is closed. So, they tend to eagerly trade when market is open in the morning resulting in the relatively high trading volume. They also point out that short-term day traders tend to transfer the risk of holding positions overnight to other traders. The other study that explains the U and W-shape patterns is the study of Miller (1989). He claims that short sellers desire to close out their short positions at day end in order to avoid the typical overnight rise in price as settlement is delayed by one day. Furthermore, day traders avoid the overnight exposure by closing their position out at the end of trading day, then re-establishing new positions the following day. Both of these two studies can explain the finding of U and W-shape patterns.

So, we can summarize that, there are two main groups of researches that study in intraday pattern. First group focuses on the studying time-of-the day pattern of overall orders including regular buy, regular sell and short sell orders.

The second group directs their analysis to short selling transaction. The studies in first group have been covered various stock exchange markets including US markets, other developed markets in Europe and Asia, and emerging markets. In contrary, the studies in this second group, short sale pattern, have been done in only developed market. None of them extend their scope to investigate into emerging markets. This academic gap leads to our objective that to investigate whether the results in developing markets are consistent with developed markets. We would like to mention that we cannot precisely apply the result or U-shape that is found in these two developed market (i.e. Angel (1997) and Aitken et al. (1998)) to emerging market such as Thailand because of the difference in some market structure such as the trading hours (have or not have intermission) and trading system (quote-driven market or order-driven market). The first part of this study exhibits whether emerging market also have same pattern of short selling to developed market.

Table 2: Previous Studies in Intraday Pattern of Trading Volume

Previous Researches	Study	Sample	Findings
Jain and Joh(1988)	Overall orders	NYSE	· U-shape pattern
Chan et al.(1995)	Overall orders	NASDAQ	· U-shape pattern
Abhyankar et al. (1997)	Overall orders	London Stock Exchange (LSE)	· two U-shape patterns (W-shape) · When separate the stocks into actively and thinly traded portfolios, they shows U-shaped pattern for the heavily traded stocks.
Hamao and Hasbrouck (1995)	Overall orders	Tokyo Stock Exchange (TSE)	· two U-shape patterns (W-shape)
Al-Suhaibani and Kryzanowski (2000)	Overall orders	Saudi Stock Market (SSM)	· W-shape pattern
Angel (1997)	Short sale order	NYSE	· U-shape pattern
Aitken et al. (1998)	Short sale order	Australian Securities Exchange (ASX)	· U-shape pattern

Note: There are two main groups of previous literature in intraday pattern. First group focuses on the studying time-of-the day pattern of overall orders, including regular buy, regular sell and short sell orders. The second group directs their analysis to short selling transaction. However, none of them uses sample from emerging equity market.

In addition, we investigate the patterns of short sale from the different investor types. As previous mention, the previous study of Angel (1997) show that non-individual investor send the short orders a lots more frequent than individual investors. He report that, in NYSE, individual account have a proportion in total short frequency less than 12 % and about 8% in total short volume. However he does not explore whether the result of U-shape he found come from the influence of any specific investor type that have significant higher short volume comparing to other investor types (i.e. institutional investor). There are some previous papers that analyze intraday variation patterns by trader types. Chiu et al. (2012) explore patterns in the Taiwan Futures Exchange (TAIFEX) from four types of traders; individual day trader, individual non day trader, foreign institutional trader, and future proprietary firm trader. They found that time-of-the day patterns are the same, resulting in U-shape, regardless of the investor types. However, there was no previous paper that compares the pattern of short selling characteristics from different investor types in stock market. This paper is the very first paper that explore in such an area.

Most of the prior papers that focus on studying short sale extend from two main papers: the study of Miller (1977) and Diamond and Verrecchia (1987). In the condition that investors have divergence of opinions, Miller (1977) shows that short-sale restrictions lead to overpricing in stocks. In markets with short-sale constrains, the stock prices are already included the optimistic estimation of traders because traders who have pessimistic view cannot short stocks. In other word, short-sales constraints emphasize that it is pessimists who are willing to submit short sale orders. This lead to his conclusions that when the investors have heterogeneous opinions in the security price, the high short-sale constrained shares tends to be overpriced and give the negative abnormal return.

In contrast with Miller (1977), Diamond and Verrecchia (1987) argue that if short sellers have rational expectation, short-sale restrictions do not lead to the biased prices. These constraints reduce some informative trades, but do not make upward biased prices. They also provide four conclusions which are widely studied in later time as following. First, forbidding traders from shorting decreases the adjustment speed of prices to private information, especially to bad news. Second, on public information announcement days, reducing short sales constraints causes the distribution of abnormal returns less skewed to the left and reduces the excess returns in absolute value. Third, the announcement of unexpected increasing in short-interest can be considered as a bad news. Last, the periods with absence trade are bad news because they increase probability of informed traders with bad information who are restricted from selling short. This refers to that a current period of inactive trade can be classified as a downward bias to measured excess return because the previous trading price is an upward biased measure of security price.

Later researches focus on testing Miller's study and the second to the fourth conclusions of Diamond and Verrecchia (1987) such as Aitken et al. (1998), Hong and Stein (2003), Gao et al. (2006), Chang et al. (2007), Diether et al. (2009a) and Takahashi (2010). However, there are very few studies that investigate the first conclusion of Diamond and Verrecchia (1987). Fung and Draper (1999) use multiple regression analysis to analyze the relation in futures market between the size of mispricing and several economic factors. They provide the evidence that short-sale restrictions increase mispricing in futures. This mispricing can be reduced by loosen up the restriction in short selling which also improve the speeds of adjustment. Diether et al. (2009b) investigate the impact of short-sale regulation on market quality in US stock markets, NYSE and NASDAQ. They find that the relaxing short sale constraints enhance the symmetric price transfer process without much increase in short-term volatility. Incidentally, both papers of Fung and Draper (1999) and Diether et al. (2009b) do not “directly” evaluate the speed of price adjustment of shortable and non-shortable stocks.

The only one paper that precisely studies the speed of price adjustment in equity is the research of Chen and Rhee (2010). By using shortable stock from Hong Kong Stock Exchange (HKEx) which is called D-listed stocks, they study the speed of price adjustment to new information for the stocks three months before and after they join the D-list. They conclude their paper as following. First, short selling increases speed of price transfer process to private/public firm-specific information. Second, shortable stocks adjust quicker to market-wide information than non-shortable stocks. Third, the speed of price adjustment for shortable stocks is higher than non-shortable stocks in both up and down market situations. Last, when control for firm size, trading volume, liquidity, price and option trading, ability to short sale stand out as the significant elements that speed up price adjustment.

Again, we cannot directly apply such result from developed markets to emerging markets because there are some unique features of emerging market such as high fee for SBL and stricter short-sale restrictions. The study of short selling across countries by Bris et al. (2007) found that prices incorporate negative information faster in countries where short sales are allowed and practiced. They also indicate that short selling in Thailand is not clearly practical because SBL is very narrow, especially on the supply side. Saffi and Sigurdsson (2011) study the effect of short-sale constraints on price efficiency and return distributions by using data from 26 countries. There are two main findings in this paper. First, they define the high short sale constrain as the stocks with low lending supply and find that these group of stocks have lower price efficiency. Second, relaxing short sales constraints do not relate to an increase in price instability. They also indicate that although short selling is allowed in a particular country, stocks are still subjected to other frictions such as the availability of shares for lending. They conclude that limited lending supply and high fees affect the price efficiency. Last but not least, Reed (2007) show that stocks that have high cost of short selling tend to have larger price reactions to earnings announcements, especially to bad news. They also conclude that when short selling is costly, the strong reaction to information announcements provides evidence of informational inefficiency for constrained stocks. According to these unique features of emerging market (e.g. the higher fee and less supply as showing in Table 1) and the findings of Chen and Rhee (2010), we come up with the following hypotheses as follows;

Hypothesis1: The speed of price adjustment to new firm-specific information for shortable stock is insignificantly different from non-shortable stocks.

Hypothesis2: The speed of price adjustment to market-wide information for shortable stock is insignificantly different from non-shortable stocks.

Chapter 4: Data Description

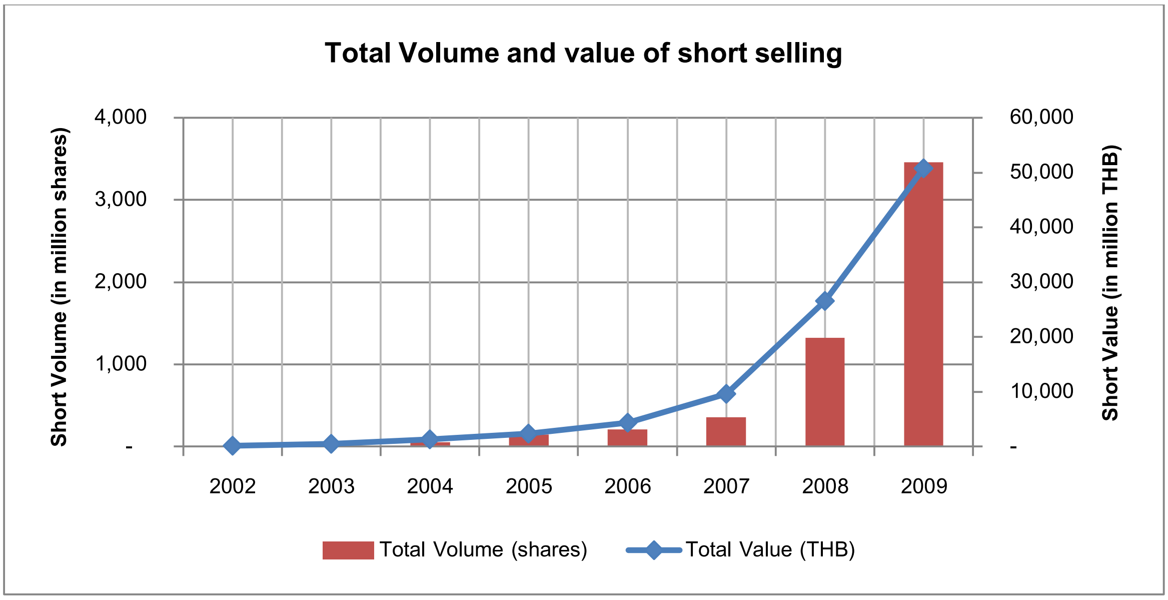
The sample period of this study starts from January 2002 to December 2009. Short sale during this sample period increases dramatically, especially during 2008-2009 as shown in Table 3 and Figure 1.

Table 3: Trading Characteristics in the SET

Year	Overall orders			Short sale		
	Frequency (in thousands)	Volume (in millions shares)	Value (in millions baht)	Frequency (in thousands)	Volume (in millions shares)	Value (in millions baht)
2002	16,301.92	247,661.46	1,651,098.31	0.45	4.15	209.69
2003	30,132.22	522,117.49	4,140,704.68	2.22	38.55	562.82
2004	31,206.84	538,714.91	4,626,925.56	4.12	56.83	1,325.57
2005	27,563.00	625,151.33	3,643,969.22	8.14	144.55	2,380.09
2006	28,139.72	725,056.34	3,397,659.68	13.73	206.26	4,430.65
2007	27,303.10	579,668.93	3,696,915.43	27.39	356.77	9,669.56
2008	30,766.45	818,611.50	3,517,262.06	127.93	1,327.16	26,613.31
2009	34,612.82	877,600.09	4,110,159.97	207.52	3,459.32	50,757.40

Note: The panel “overall order” indicates the whole orders that are executed in the SET (i.e. regular buy, regular sell and short sale). The panel “short sale” show the data descriptive mainly focus on short sale.

Figure 1: Short selling characteristics in the SET



The sample period from January 2002 to December 2009 was chosen because of two main reasons. First, before 2002, short sale in Thailand is rare. Even though the SET has introduced short sale since the beginning of 1997, in practice, the short sale activities had increased slowly. According to Bris et al. (2007), there were only three firms in Thailand during 1999 that provide SBL services. There was only one short sale transaction in the SET from 1997 to 1999. Second, since January 2010, the SET has expanded the universe of stocks that can be sold short from SET50 stocks to SET100 stocks. In order to avoid the impact of the regulation change on our study, we decide to limit our study period to only December 2009.

During our studying period, SET50, which is also shortable stocks, has been revised 16 times accounting for 63 addition stocks (and also 63 deletion stocks). We use these 63 addition stocks to be our sample stocks, as shown in Table 4.

In this paper, we investigate the speed of price adjustment to new information by focusing on the three-month period before and after stocks are included in the SET50 index, which is also the list of shortable stocks. The investigation of the three month before and after the event has at least three main advantages (Chen and Rhee 2010). First, according to the SET selection rule, stocks that can be sold short (i.e. stocks in SET50) must have met regulation from SEC for about 3-12 months of trading period before they can be sold short. This sample design make us sure that any difference in the speed of price adjustment between three months before and after the stock becomes shortable should be mainly come from the change in short sales restrictions rather than the changes in firm fundamentals (e.g. size, P/E). The detail of this SEC regulation shows in appendix. This settings and selection regulation prevent the confounding effect caused by the changes in firm-specific characteristics. Second, the inclusion decision in the shortable list is made by the SET not by the firm, which allows us to limit the self-selection bias. Third, the use of the SET data decrease the clustering effect of an event analysis because the effective days of sample stocks becoming shortable are distributed across the entire 8-year studied period. Event day from each stock are not the same day. Hence, this selection criteria adopted by SET allows us to solely examine the effect of changes in short sales limitation on the speed of price adjustment. The summary statistics of these stocks are shown in Table 5.

Table 4 List of Stocks Under Analyses

Year	**Additions**
2002-1	TPI
	CCET
2002-2	PTT
	AEONTS
	GOLD
	QH
2003-1	BT
	CCET
	MAJOR
	TISCO
	ITD
2003-2	SSI
	ATC
	ITV
	MS
	AP
	LALIN
	SIRI
	AMATA
2004-1	VNG
	TT&T

Year	**Additions**
2004-2	KEST
	TOC
	TPC
	CK
	STECON
	PSL
	TTA
	UCOM
2005-1	SCIB
	ASP
	NPC
	AOT
	NSM
2005-2	CPF
	TUF
	TOP
	CP7-11
	MCOT
	DELTA
	TISCO
2006-1	PTTCH

Year	**Additions**
2006-1	CPN
(cont')	GLOW
	MAKRO
	BGH
	BH
2006-2	CCET
	MINT
	AMATA
2007-1	KSL
	IRPC
2007-2	RRC
2008-1	PS
	MAJOR
2008-2	DTAC
2009-1	TSTH
	QH
	ESSO
	TTW
	BIGC
2009-2	MBK
	BECL
Total Number	**63**

Table 5: Key Statistics Comparision between Non-shortable and Shortable Periods

	Non-shortable	Shortable	p-value of equality-test
Price	20.09	21.35	0.7493
Volume (in million shares)	916.08	1,001.58	0.8002
Value (in million THB)	6,291.37	7,617.67	0.4366
Market Cap (in million THB)	26,346.13	28,357.78	0.6997
P/E	14.76	14.07	0.7353
P/BV	2.65	2.78	0.7082
Book Value per Share (THB)	14.22	14.77	0.8606
Dividend Yield (%)	4.26	4.53	0.6703
Turnover Ratio (%)	34.70	36.55	0.7958
Listed Share (in million shares)	2,119.65	2,156.68	0.9462

Note: The table presents summary statistics of stock in two periods, three-month before join SET50 (in column named non-shortable) and three month after join SET50 (in column named shortable). This summary statistics include all stocks from Table 4. Each variable is calculated from the arithmetic for each stock in the sample period, then compute the mean across stocks. Statistics for each stock is calculated as follows: price is total trading value (in THB) divide by total volume. Volume is total shares amount of every transaction during the studied period. Value is total value of transaction in THB during studied period. Market capitalization is calculated from the product of closing price and total number of registered shares during the studied period. P/E is price-earnings ratio calculated from product of closing price and outstanding number of common stocks divided by last 12-month profit of that firm. P/BV is price per book value ratio computed from product of closing price and outstanding number of common stocks divided by shareholders equity of the firm. Book value per share is common stocks part divided by total number of common stocks. Dividend yield is total last 12-month dividend payment divided by the product of closing price and total number of registered shares. Turnover ratio is total trading volume multiplies by 100 and divides by the average of number of listed stocks during studied period. Listed share is total number of stock that registers with SET. The null hypothesis of equality test is average value of shortable stock is equal to average value of non-shortable stocks.

Chapter 5: Empirical Results

5.1. Short Sales and Short Seller Types

In this part, we examine the statistical description of short sale transaction. We look into three characteristics which are frequency of short sale, short selling volume (in shares) and short selling value (in THB). The summary is shown in Figure 2.

The average of frequency of short transactions, since 2002 to 2009, comes mainly from individual investors (about 70.46%). The proprietary short sale accounts for about 29.15%. Only less than 1.00% comes from foreign account and institution account. For short selling volume (in shares), we find quite the same result as number of short transactions. Sorting from the highest volume to lowest volume, the short volume (in shares) is highest at about 67.49% for individual investor account, secondly high for the proprietary account at 31.36%, significantly lower for foreign account around 1.13% and lowest for institution.

Figure 2: Average Percentage of Overall Order and Short Selling Characteristic

Note: These figures exhibit the average of percentage of frequency, volume and value of overall orders (left figures) and short sale (right figures).

Finally, for the short value (in THB), the rank is also consistent with the rank of short sale volume. The rank, sorting from the highest THB amount to the lowest THB amount, is as follows: individual investor account, proprietary account, foreign account and institution account. The THB volume of short selling activities by individual investors account for about 53.51% of all account types while the remaining 46.03% of comes from proprietary accounts. Less than 1.00% comes from the other two account types, foreign accounts and institution accounts.

Note that, generally, the main investor in the Stock Exchange of Thailand is also individual investor. Individual investor are account for more than 64 % of overall trading value (including regular buy, regular sell and short sale), around 83 % of trading frequency and 87% for trading volume. We find that when compare with the overall orders, short sale still mainly come from the individual investor. However, the proportion of short sale that comes from proprietary investor is significantly high; especially if we take into account the size of overall order that comes from proprietary investor (e.g. approximately 6.35% of overall trading value is come from proprietary investor but around 46.03% of short sale value is come from this investor type)

When we look into each short transaction, we found that, on average, different type of short sellers tend to send short orders in different value (measuring in THB). We notice that proprietary, foreign and institution account which are generally classified as agency or non-individual investors tend to send lager size in THB amount of orders than individual account. This result is consistent with the empirical finding in NYSE by Angel (1997). He found that agency account including proprietary and institution account tend to send larger value of short orders comparing to the individual traders. In addition, when looking into the data across time, we found that the frequency of shorting, short order volume (in shares) and short order value (in THB) drastically increase. Since year 2006 to 2009, short selling approximately doubles its size every year. For example, the total volume of the short selling in year 2009 is approximately THB 50.8 billion, drastically increasing from the year 2008 volume of THB 26.6 billion, or about 90.72% percent increase.

5.2. Short Sale Intraday Pattern

In this section, we examine the short selling patterns in intraday time period. We start by investigate the time-of-the day pattern of short selling from every account type and then, we divide our sample into two groups-which are individual and non-individual investors. We compare the intraday pattern of these two investor groups. Note that since the short selling activities from foreign and institution investors are relatively lower than any other investor type, we include these two investor types with proprietary trader and define them as non-individual investors.

The intraday for all investor types combined are shown in Table 6 and Figure 3. We compute the statistics measurement of short volume, frequency of short and short selling value for every 15 minute-trading periods, starting on 10.00 AM to 12.30 PM and 2.30 PM to 4.30 PM. Then, we scale down such variables into percentage of total amount of each variable in a trading day. The intraday pattern of short selling volume looks W-shaped. That is, the volume is relatively high at the first 15 minute of trading and then decreases over time. The volume increases again at the opening period of the afternoon, decreases over time, and finally slightly increases at the end of the day. The short selling volume at open in the morning trading session is about four times higher than the mid-day trading volume (before morning trading session is closed). The first two trading hours during each opening period-one hour in the morning session and one hour in the afternoon session-accounts for most of all trading volume, about 56.79% of the total volume trading in each day. The result of intraday pattern for number of short sale transaction and value of short selling are quite the same as short selling volume pattern. They show the same W-shape patterns. In addition, when we separate our sample in to individual and non-individual investor, we found that both groups of investor show the same results, W-shape pattern. The result of patterns for individual investors and non-individual are not reported here.

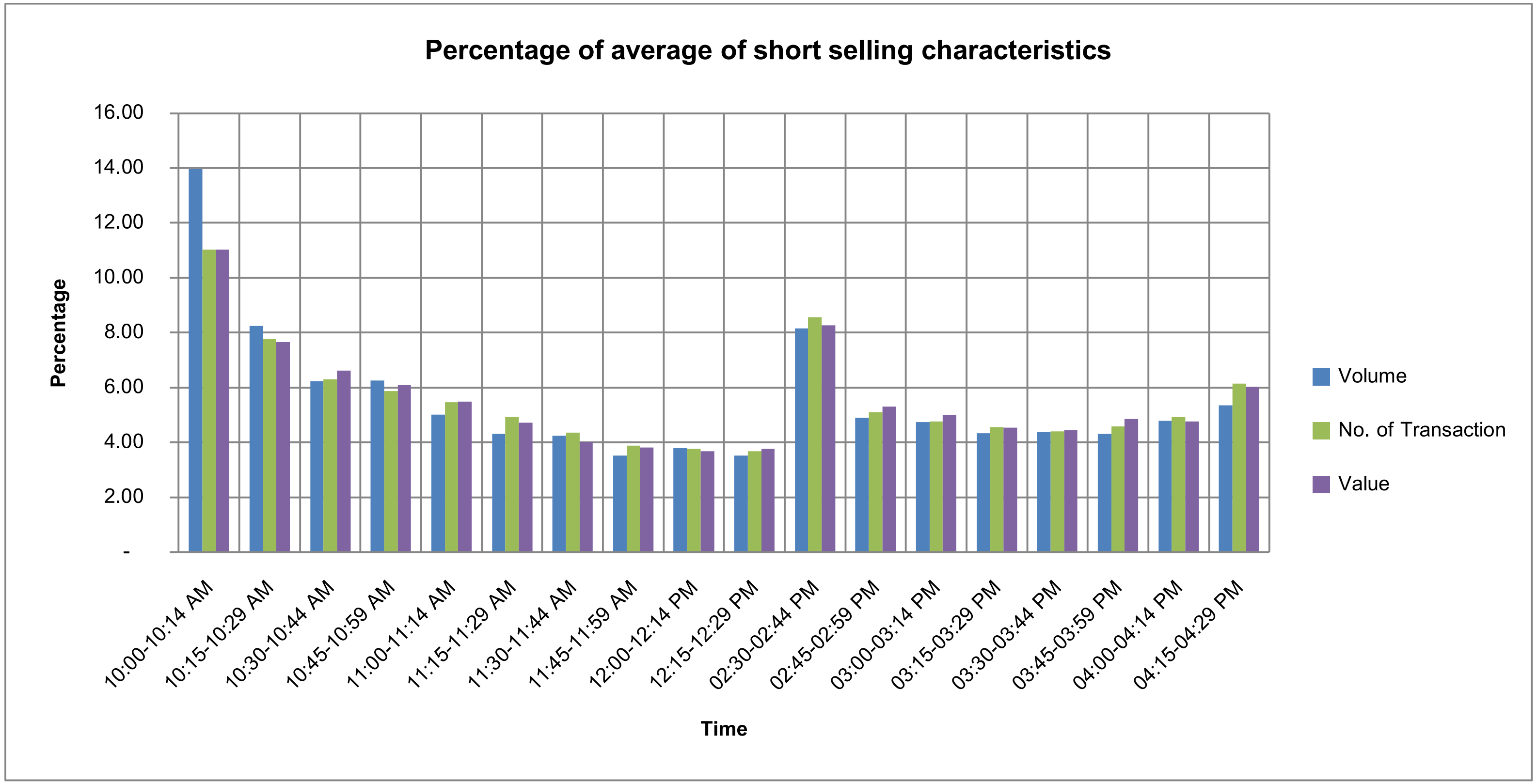
This SET's short sale empirical evidence is different from a U-shape pattern that is found in the NYSE (Angel, 1997) and Australian Securities Exchange (ASX) (Aitken et al., 1998), due mainly to the absence of mid-day intermissions in the NYSE and ASX. However, both U-shape and W-shape are consistent with the explanation of Brock and Kleidon (1992) and Miller (1989). Brock and Kleidon (1992) show that, during opening and closing of each trading session, trading demand tend to be greater than at other times of the trading day due to the inability to trade when market is closed. This unusually high demand is reflected in the high trading volume, trading value and frequency of trading. Moreover, Miller (1989) claims that short sellers and short-term day traders want to close out their positions at the end of each trading day in order to prevent the risk that occurs overnight. This causes the trading volume to be relatively high during the opening and closing trading time. So, these results of U-shape appear in any exchanges that have no lunch break and W- shape pattern shows in any exchanges that have midday trading intermission.

Table 6 Percentage of Average of Intraday Patterns for Short Selling

Year	Percentage of average 2002 to 2009		
Time	**Volume**	**No. of Transaction**	**Value**
10:00-10:14 AM	13.96	11.01	11.02
10:15-10:29 AM	8.25	7.76	7.65
10:30-10:44 AM	6.23	6.30	6.61
10:45-10:59 AM	6.26	5.86	6.09
11:00-11:14 AM	5.01	5.45	5.49
11:15-11:29 AM	4.31	4.91	4.71
11:30-11:44 AM	4.24	4.36	4.01
11:45-11:59 AM	3.52	3.88	3.80
12:00-12:14 PM	3.78	3.77	3.67
12:15-12:29 PM	3.52	3.67	3.77
Trading Break			
02:30-02:44 PM	8.15	8.56	8.28
02:45-02:59 PM	4.88	5.09	5.30
03:00-03:14 PM	4.73	4.76	4.99
03:15-03:29 PM	4.32	4.56	4.54
03:30-03:44 PM	4.38	4.40	4.43
03:45-03:59 PM	4.32	4.58	4.85
04:00-04:14 PM	4.78	4.92	4.75
04:15-04:29 PM	5.35	6.13	6.02
Total (%)	100.00	100.00	100.00

Note: This table presents the percentage of shortable stocks' characteristics which include the following information; total volume of short trading (in thousands shares), total number of transactions, and total value of short selling (in thousands THB), which each 15-minute trading interval.

Figure 3 Percentage of Average Intraday Patterns for Short Selling



Note: This figure shows the intraday patterns of short selling in SET. These patterns include W-shape of short volume, frequency of shorting and short value. The results are presented in the percentage form of the average of eight-year short selling transactions.

5.3. Comparing Speed of Price Adjustment to Information

In this part, we investigate the speed of price discovery process due to the firm-specific information and market-wide information. Then, we compare the speed of price adjustment before and after the stock become shortable. We state two hypotheses as follows:

Hypothesis1: The speed of price adjustment to new firm-specific information for shortable stock is not different from non-shortable stocks.

Hypothesis2: The speed of price adjustment to market-wide information is faster for shortable stock is not different from non-shortable stocks.

Testing Hypothesis 1:

We apply dynamic vector autoregressive model (dynamic VAR model) from (1991a) to test our Hypothesis 1. Hasbrouck (1991a) suggests that the interactions of security trades and quotes changes can be modeled as vector autoregressive model system. Trades pass on the information and make a continuing impact on the stock price. By using VAR model, information effect in trade can be determined as the ultimate price impact of the trade innovations. Note that since price impacts can be either permanent or transitory, the immediate price effect is measured by b_0 in the following equation 1. Additionally, Hasbrouck (1991b) suggests the impulse response function be used to measure permanent price effects. Therefore, to test Hypothesis 1, we estimate the following dynamic VAR model:

Equation 1 Dynamic vector autoregressive model

$$r_t = \sum_{i=1}^{5} a_i \, r_{t-i} + \sum_{i=0}^{5} b_i \, Q_{t-i} + v_{1,t}$$

$$Q_t = \sum_{i=1}^{5} c_i\, r_{t-i} + \sum_{i=1}^{5} d_i\, Q_{t-i} + v_{2,t}$$

Where

m_t is the log midpoint of the quote when transaction occurs at time t

$r_t = m_t - m_{t-1}$ is the log quote-mid-point change due to transaction t

Q_t is the buy-sell indicator equal to +1 if trade is buyer initiator. If the trade is initiated by the seller, then the variable Q_t is equal to -1.

This dynamic VAR model is estimated using ordinary least square estimates of the multiple-equation system. The coefficient a_i indicates the autocorrelation in the quote revision. The coefficients b_0 captures the contemporaneous correlation between order flows and quote midpoint return. The coefficients b_i indicates the quote adjustment subsequent to each trade. The coefficients c_i indicates the Granger causality running from quote revision to trades. The coefficients d_i implies the autocorrelation in trade.

The model is estimated using five lags following Chen and Rhee (2010). The lag terms beyond five lags tend to be statistically insignificant and/or less in their magnitudes. This model is estimated twice; first, for three-month-period before stocks become shortable and second, three-month-period after the stocks become shortable. We delete the data in the call auction period and use only data during the continuous trading periods – that is, during 10.00 AM to 12.30 PM and during 2.00 PM to 4.30 PM, due to the following two reasons; first is to avoid the effect of overnight returns; secondly, the opening transaction is under call auction mechanism, which is different from the continuous matching during the normal trading hours. Table 7 presents the result from the dynamic VAR model.

Table 7 Estimation of Dynamic VAR Model

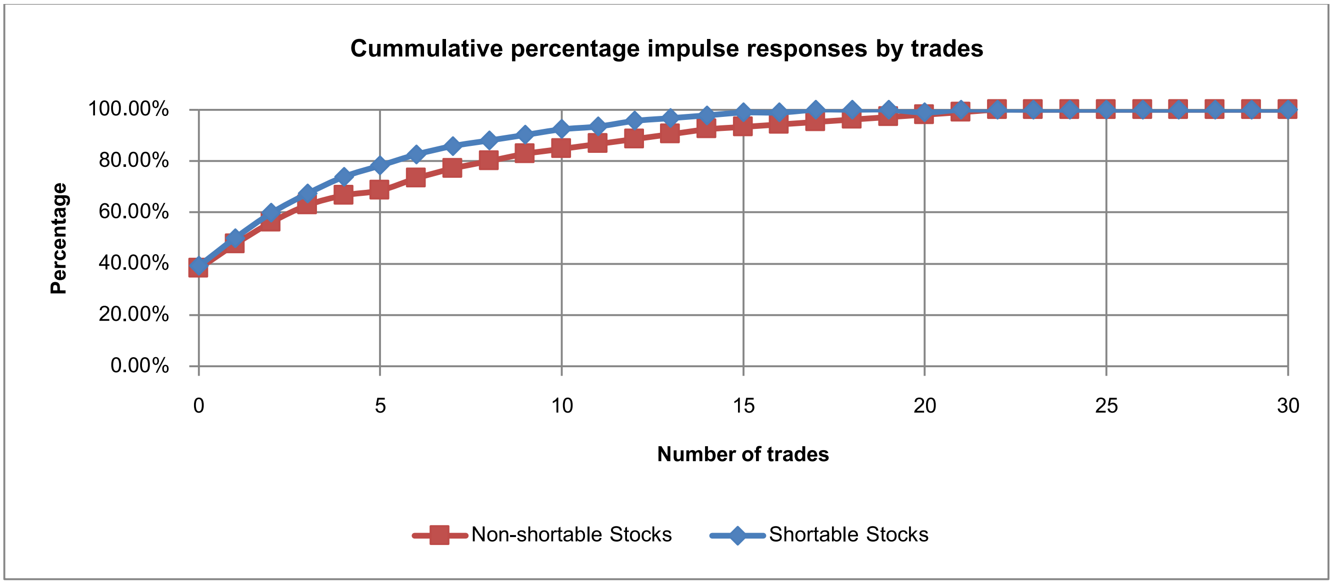
Variable	Non-shortable stocks		Shortable stocks		Variable	Non-shortable stocks		Shortable stocks	
	Coeff.	Stat. Sig	Coeff.	Stat. Sig		Coeff.	Stat. Sig	Coeff.	Stat. Sig
a1	-0.20624	***	-0.21872	***	c1	-200.845	***	-203.8764	***
a2	-0.05733		-0.06202	*	c2	-72.32266	***	-74.10666	**
a3	-0.01402		-0.01676		c3	-28.17791	*	-30.36226	*
a4	0.00280		-0.00231		c4	-11.77618		-14.00268	
a5	0.00731		0.00247		c5	-5.18232		-5.64199	
Sum a	-0.26747		-0.29735		Sum c	-318.304		-327.9899	
p-value of equality-test	0.1675				p-value of equality-test	0.6641			
b0	0.00088	***	0.00081	***					
b1	0.00008		0.0001		d1	0.47109	***	0.46406	***
b2	0.00000		-0.00001		d2	0.19783	***	0.19395	***
b3	-0.00004		-0.00004		d3	0.08623	**	0.08794	**
b4	-0.00006		-0.00005		d4	0.04721	*	0.05491	*
b5	-0.00008		-0.00007		d5	0.04046	*	0.04069	
Sum b	0.00077		0.00075		Sum d	0.84282		0.84156	
p-value of equality-test	0.7685				p-value of equality-test	0.9235			

Note: This table presents the result from estimation of dynamic VAR model:

$$r_t = \sum_{i=1}^{5} a_i\, r_{t-i} + \sum_{i=0}^{5} b_i\, Q_{t-i} + v_{1,t} \text{ and } Q_t = \sum_{i=1}^{5} c_i\, r_{t-i} + \sum_{i=1}^{5} d_i\, Q_{t-i} + v_{2,t}$$

Where m_t is the log midpoint of the quote when transaction occurs at time t, $r_t = m_t - m_{t-1}$is the log quote-mid-point change due to transaction t, $Q_t$is the buy-sell indicator equal to [1,-1] if the trade is [buy, sell]. The call auction period is eliminated from our study to avoid the effect of overnight return and abnormal trading activity during the morning opening and afternoon closing periods. The model is estimated for 3-month period before and after stocks become shortable. The p-value of equality-test is p-value from testing the null hypothesis that the summations of coefficients between shortable and non-shortable stocks are the same. All regressions are estimated with the White heteroskedasticity correction for standard error. Note that the row Stat. Sig is indicated the statistical significant of the variables. * indicates a 10% significance level; ** indicates a 5% significance level; *** indicates a 1% significance level

Figure 4 Cumulative Percentage Impulse Responses by Trades



The estimation of b_0 is 8.8 and 8.1 basis points before and after the stocks join the SET50, indicating that the quote-midpoint on average increases/decreases by 0.088% (0.081%) immediately after a purchase/sale order when a stock is shortable (non-shortable). The coefficients of longer lags b_i are decreasing. The positive autocorrelation in the trades reflected by the coefficients $\sum_{i=1}^{5} d_i$ suggests trading continuity, which implies that a buy (sale) transaction tends to follow by another buy (sale) transaction. The negative autocorrelation in the quote adjustment reflected by the coefficients $\sum_{i=1}^{5} a_i$ indicates quote reversals. Hasbrouck (1991a) and Chen and Rhee (2010) suggest that stronger trade continuity (high positive value of $\sum_{i=1}^{5} d_i$) and weaker quote reversals (less negative value of $\sum_{i=1}^{5} a_i$) imply slower speed of price adjustment to new information. Strong (weak) trade continuity leads to lagged (fast) adjustment to new information. Madhavan et al. (1997) found that stronger trade continuity leads to weaker quote reversal. The fundamental intuition is that, the greater the autocorrelation in order flow, the less the revision in beliefs, and the slower the price adjust to new information. If trade is positively correlated, successive transactions at the bid or the ask are more likely to continue than reversal; this will delay the price adjustment. Therefore, stronger trade continuity and weaker quote reversals lead to a slower speed of price adjustment to new information. In contrast, weaker trade continuity and stronger quote reversals lead to a faster speed of price adjustment.

From Table 7, comparing the shortable and non-shortable stocks, the magnitude of $\sum_{i=1}^{5} d_i$ for shortable stocks is quite the same as non-shortable counterparts, which implies that shortable stocks have quite the same trade continuity as non-shortable stocks. The estimated $\sum_{i=1}^{5} a_i$ are also not much different for both types of stocks, which imply that quote reversal is quite the same for shortable and non-shortable. Therefore, the results from Table 7 indicate that short sales do not reduce the trade continuity and do not increase the quote reversals; thus a stock that becomes shortable is not associated with the higher speed of price adjustment.

Finally, the summations $\sum_{i=0}^{5} b_i$ are the same for before and after stocks become shortable. This implies the quote adjustment subsequent to each trade is the same for both shortable and non-shortable stocks. The amounts of $\sum_{i=1}^{5} c_i$ which indicates the Granger causality running from quote revision to trades are negative for both shortable and non-shortable stocks. This means that knowledge of past quote revision and past trade leads to better predictions of trade than would result from knowledge of past trade alone for both shortable and non-shortable stocks.

We also measure the long-run impact of the trade on price from the cumulative quote-midpoint response to a unit innovation in trade. The results are shown in Figure 4. We find that the eventual price impacts following a unit shock to Q_t are 0.00092 (0.00105) for shortable stocks (non-shortable stocks). The immediate quote adjustment is 39.13% of the total adjustment for shortable stocks, while it is 38.10% for non-shortable stocks. The second quote adjustment reaches half of total adjustment for shortable stocks and 47.62% for non-shortable stocks. It takes about 21 trades to accomplish the total price adjustment for shortable stocks and around 22 trades to accomplish the same percentage level of price adjustment for non-shortable stocks. The shortable stocks have slightly reverse adjustment. In summary, our results suggest that both shortable and non-shortable stocks provide roughly the same speed of price adjustment, and therefore the shortability of a stock does not enhance its speed to price adjustment.

Testing Hypothesis 2:

To measure the speed of price movement that reflects the new *market-wide* information, we use the stock price adjustment DELAY measure, which is estimated by Dimson beta regression. This model is introduced by Dimson (1979) and developed by Chordia and Swaminathan (2000). In this model, the market return is employed as a proxy for new information to which individual stock prices respond. Specifically, we estimate Equation 2 as shown below.

First, we use the regression model of return of stock *i* on the return of the market index and their lag market index returns up to five lags. The number of lags is applied from method of Chen and Rhee (2010). All is estimated using daily data.

Equation 2 Dimson beta regression

$$r_{i,t} = \alpha_0 + \sum_{k=0}^{5} \beta_{i,k} r_{m,t-k} + \mu_{i,t}{}^{k}$$

Where

$p_{i,t}$ is the natural logarithm of total return index for stock i on day t

$p_{m,t}$ is the natural logarithm of total return index for market on day t. Note that we use SET total return index as a proxy for the market.

$r_{i,t} = p_{i,t} - p_{i,t-1}$ is the return of stock i on day t

$r_{m,t} = p_{m,t} - p_{m,t-1}$ is the return of market on day t

The Dimson beta regression is estimated daily for each individual stock. We use GMM to control for and correct heteroskedasticity. Coefficient $\beta_{i,0}$ is the contemporaneous adjustment of market return. The summation of the lagged coefficient $\sum_{k=1}^{5} \beta_{i,k}$ is the lagged adjustment to market return in time 0. If shortable stocks adjust faster to market-wide information, its contemporaneous beta $\beta_{i,0}$ should be greater than non-shortable stocks. In addition, if the market-wide news is reflected slower for non-shortable stocks, their lagged coefficient size $\sum_{k=1}^{5} \beta_{i,k}$ should be larger than those of shortable stocks. This implies that non-shortable stocks adjust lag to market information more than shortable stocks. Then, following Chordia and Swaminathan (2000), we compute the DELAY measure as follows;

Equation 3: DELAY measures

$$X = \sum_{k=1}^{5} \beta_{i,k} / \beta_{i,0}$$

$$DELAY_i = 1/(1 + e^{-x})$$

The possible value of DALAY is ranged between zero and one. The value of DELAY close to zero indicates a less delay in adjustment or the price can instantly reflect the new market-wide information. The high value of DELAY, when approaching to one, indicates the slow speed of price adjustment.

Table 8 shows the result of Dimson beta regression and DELAY measure. The contemporaneous beta is 1.00982 for shortable stocks and 0.99182 for non-shortable stocks. They are quite the same, indicating that their price adjustment to the market-wide news is quite the same. The lagged coefficients tend to be statistically insignificant. Then, when we transform to DELAY measure, they show that the DELAY for shortable stocks is 0.51885 and 0.51822 for non-shortable stocks. In addition, the p-value for equality-test between the DELAY values of shortable and non-shortable stocks indicates that such difference is not statistically significant. Therefore, our empirical results here suggest that shortability of stocks does not improve the speed of price adjustment to market-wide information.

We provide two possible reasons for our empirical results that the shortability of stocks in the SET does not improve the speed of price adjustment to information; the relatively high cost of short selling in the SET and the relatively limited supply of stocks to be lent in the SET, as shown in Table 1.

Table 8 Dimson Beta Regression and DELAY Measure

Coefficient	Non-shortable stocks	Pr > |t|	Shortable stocks	Pr > |t|
α_0	0.00002	0.5243	0.00056	0.4605
β_0	0.99182	0.0559	1.00982	0.0378
β_1	-0.10311	0.4810	0.00936	0.4605
β_2	0.02021	0.4775	0.01516	0.4863
β_3	0.03847	0.4544	0.05090	0.4597
β_4	0.03485	0.5055	-0.02306	0.4976
β_5	0.01345	0.4600	0.03280	0.4589
DELAY	**0.51822**		**0.51885**	
P-value of equality test	0.98320			

Note: This table presents the result from estimation of Dimson beta regression and DELAY measure:

$$X = \sum_{k=1}^{5} \beta_{i,k}/\beta_{i,0} \text{ and } DELAY_i = 1/(1+e^{-x})$$

Where $p_{i,t}$ is the natural logarithm of total return index for stock i on day t, $p_{m,t}$ is the natural logarithm of total return index for market on day t, $r_{i,t} = p_{i,t} - p_{i,t-1}$ is the return of stock i on day t, $r_{m,t} = p_{m,t} - p_{m,t-1}$ is the return of market on day t and $X = \sum_{k=1}^{5} \beta_{i,k}/\beta_{i,0}$. We estimate this Dimson beta regression and DELAY measure 3-month period before and after a stock joins the shotable list for individual stocks. All regressions are estimated using GMM to correct standard errors. The coefficients and DELAY show in this table is the arithmetic mean of coefficient estimate from individual stocks. The p-value in the last row indicates equality-test of DELAY between shortable and non-shortable stocks. H_0: $DELAY_{\text{Non-shortable stocks}} = DELAY_{\text{Shortable stocks}}$ (For more detail of this equality-test, please see Chiang et al., 2008)

The study of short selling across countries by Bris et al. (2007) found that prices incorporate negative information faster in countries where short sales are allowed and practiced. They also indicate that short selling in Thailand is not clearly practical because security borrowing and lending stock (SBL) is very narrow, especially on the supply side. Saffi and Sigurdsson (2011) study the price efficiency and short selling in 26 countries. They point out that high equity lending supply and low fees are related with an improvement in speed of price adjustment. They also indicate that although short selling is allowed in a particular country, stocks are still subjected to other frictions such as the availability of shares for lending. They conclude that limited lending supply and high fees could lead to slower price adjustment to market-wide information. Further, Reed (2007) studied the price adjustment during quarterly announcement. His results show that stocks realize 32% less of the total post earnings announcement drift on the announcement day when short sale is limited. He suggests that when short sale is costly, stocks price incorporate private information slowly even after the information become public knowledge. Therefore, according to these three studies (Bris et al, 2007, Saffi and Sigurdsson, 2011 and Reed, 2007), the constraints, such as high fees and the insufficient stock supply to lend in the SET could slow down the speed of price movement the new information.

Chapter 6: Robustness Tests

6.1 Robustness Tests: Impact of Market Conditions

We also further investigate whether the speed of price adjustment to both firm-specific and market-wide information for shortable stocks versus non-shortable stocks is different in up and down market conditions. Specifically, we separate our sample period into two market conditions: up days and down days.

Following Chen and Rhee (2010), we define up (down) day as the day a stock has positive (negative) open-to-close return. Then, we use dynamic VAR model to test whether the speed of price adjustment to firm-specific information is different for shortable and non-shortable stocks in each market condition; up and down days. For testing speed of price movement to market-wide information, we classify up (down) market day as the day the SET index has positive (negative) open-to-close return. We then apply the Dimson beta regression and DELAY measure to estimate whether the different market conditions affect the speed of price movement of shortable and non-shortable stocks.

Testing Hypothesis 1:

The result of dynamic VAR and impulse response are shown in Table 9 and Figure 5. Regardless of market conditions, the results show that the speed of price adjustment between shortable stocks and non-shortable stocks is not different. Comparing the shortable and non-shortable stocks, the magnitude of $\sum_{i=1}^{5} d_i$ for shortable stocks is quite the same as non-shortable counterparts in both up and down days. This implies that shortable stocks have quite the same trade continuity as non-shortable stocks regardless of condition in the market. The estimated $\sum_{i=1}^{5} a_i$ are also not much different for shortable and non-shortable stocks in these two market conditions, which imply that quote reversal is quite the same for shortable and non-shortable. The summations $\sum_{i=0}^{5} b_i$ are the same for before and after stocks become shortable in both market conditions. This implies the quote adjustment subsequent to each trade is the same for both shortable and non-shortable stocks in both market situations. The amounts of $\sum_{i=1}^{5} c_i$ which indicates the Granger causality running from quote revision to trades are negative for both shortable and non-shortable stocks. These means that, in both bull and bear circumstance, knowledge of past quote revision and past trade leads to better predictions of trade than would result from knowledge of past trade alone for both shortable and non-shortable stocks. None of the summations of coefficients between shortable and non-shortable stocks are statistically significant different in both up and down market conditions.

For impulse response, we found that, in up days (down days), the eventual price impacts following a unit shock to Q_t are 0.00095 (0.00104) for shortable stocks and 0.00105 (0.00110) for non-shortable stocks. In up days (down days), the immediate quote adjustment is 40.00% (32.69%) of the total adjustment for shortable stocks, while it is 37.14% (36.36%) for non-shortable stocks. For up days (down days), the second quote adjustment reaches 51.58% (42.31%) of total adjustment for shortable stocks and 47.62% (45.45%) for non-shortable stocks. For up market conditions (down market condition), it takes about 21(27) trades to accomplish the total price adjustment for shortable stocks and around 22 (23) trades to accomplish the same percentage level of price adjustment for non-shortable stocks. Overall, our empirical evidence suggests that both shortable and non-shortable stocks provide quite the same speed of price adjustment regardless of the market conditions. Our results in emerging market do not consistent with the study of Chen and Rhee (2010) in developed market that ability to short improves the speed with which both private and firm-specific information are reflected in prices in both up and down days.

Table 9 Estimation of Dynamic VAR Model: Up and Down Days

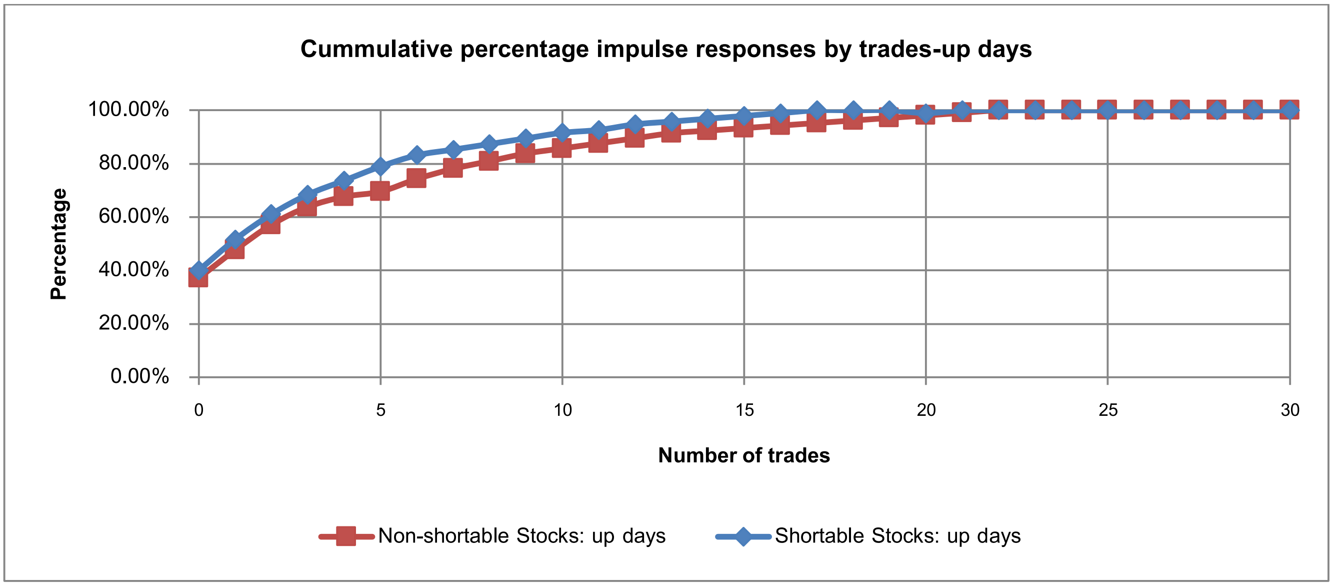
Coefficient	Up days		Down days	
	Non-shortable stocks	Shortable stocks	Non-shortable stocks	Shortable stocks
Sum a	-0.24716	-0.27839	-0.27634	-0.3078
p-value of equality-test	0.1544		0.3305	
Sum b	0.00074	0.00072	0.00085	0.00081
p-value of equality-test	0.7287		0.6718	
Sum c	-317.92566	-329.91586	-312.83246	-327.53574
p-value of equality-test	0.6063		0.5295	
Sum d	0.84294	0.84122	0.83787	0.83621
p-value of equality-test	0.8992		0.9107	

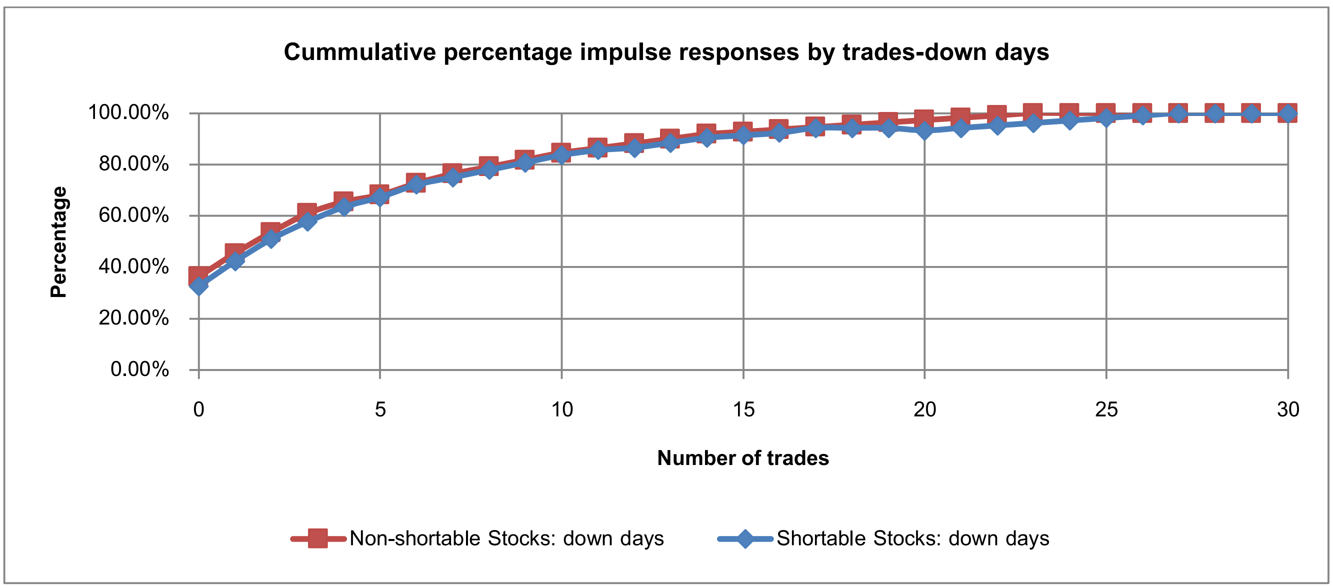
Note: This table presents the result from estimation of dynamic VAR model:

$$r_t = \sum_{i=1}^{5} a_i r_{t-i} + \sum_{i=0}^{5} b_i Q_{t-i} + v_{1,t} \text{ and } Q_t = \sum_{i=1}^{5} c_i r_{t-i} + \sum_{i=1}^{5} d_i Q_{t-i} + v_{2,t}$$

Where m_t is the log midpoint of the quote when transaction occurs at time t, $r_t = m_t - m_{t-1}$ is the log quote-mid-point change due to transaction t, Q_t is the buy-sell indicator equal to [1,-1] if the trade is [buy, sell]. The call auction period is eliminated from our study to avoid the effect of overnight return and abnormal trading activity during the morning opening and afternoon closing periods. The model is estimated for 3-month period before and after stocks become shortable. The p-value of equality-test is p-value from testing the null hypothesis that the summations of coefficients between shortable and non-shortable stocks are the same. All regressions are estimated with the White heteroskedasticity correction for standard error. We define up (down) market days as a day with positive (negative) open-to-close return of particular stocks.

Figure 5 Cumulative Percentage Impulse Response by Trades: Up and Down Days





Testing Hypothesis 2:

To measure the speed of price adjustment between shortable and non-shortable stock to market-wide news in up and down market condition, we use the Dimson beta regression and DELAY measure. The results present in Table 10. We found that, in up days (down days), the contemporaneous beta is approximately 0.98400 (1.06882) for shortable stocks and 0.97712

(0.98776) for non-shortable stocks. They are quite the same for up days. However, they are higher for shortable stocks than non-shortable stocks in the down market condition. This indicates that, during down days, shortable stocks seem to adjust to contemporaneous market-wide information faster than those of non-shortable stocks. However, when take into account the adjustment to lag market-wide information-that is $\sum_{k=1}^{5}\beta_{i,k}$ and transfer to DELAY measure, we found no difference in the speed of price adjustment between shortable and non-shortable stocks in down days. The summations of lagged coefficients are not statistically significant. The DELAY measures show that, in up days (down days), the DELAY for shortable stocks is 0.49760 (0.53761) and 0.53430 (0.52860) for non-shortable stocks. Moreover, the p-value of equality-test suggests that they are not statistically different in both up and down market conditions. In conclusion, regardless of market conditions, short-sale ability does not improve the speed of price adjustment to new market-wide information.

Table 10 Dimson Beta Regression and DELAY Measure: Up and Down Days

Coefficient	Up days		Down days	
	Non-shortable Stocks	Shortable Stocks	Non-shortable Stocks	Shortable Stocks
DELAY	0.5343	0.4976	0.5286	0.53761
P-value of equality test	0.3845		0.8199	

Note: This table presents the result from estimation of Dimson beta regression and DELAY measure:

$$X = \sum_{k=1}^{5}\beta_{i,k}/\beta_{i,0} \text{ and } DELAY_i = 1/(1+e^{-x})$$

Where $p_{i,t}$ is the natural logarithm of total return index for stock i on day t, $p_{m,t}$ is the natural logarithm of total return index for market on day t, $r_{i,t} = p_{i,t} - p_{i,t-1}$ is the return of stock i on day t, $r_{m,t} = p_{m,t} - p_{m,t-1}$ is the return of market on day t and $X = \sum_{k=1}^{5}\beta_{i,k}/\beta_{i,0}$. We estimate this Dimson beta regression and DELAY measure 3-month period before and after a stock joins the shotable list for individual stocks. All regressions are estimated using GMM to correct standard errors. The coefficients and DELAY show in this table is the arithmetic mean of coefficient estimate from individual stocks. The p-value in the last row indicates equality-test of DELAY between shortable and non-shortable stocks. H_0: $DELAY_{\text{Non-shortable stocks}} = DELAY_{\text{Shortable stocks.}}$ We define up (down) market days as a day with positive (negative) market return.

6.2 Robustness Tests: Using 2009 data

As previously shown in Table 3 and Figure 1, short sale activity in 2009 is relatively much higher than the other years' activity. Therefore, it is possible that our main results are driven by, for example, year 2002-2008, during which short selling is not active and therefore does not contribute to the higher speed of price adjustment to information. We therefore redo the whole analyses by using year 2009 data alone. The results are shown in Table 11 and Table 12.

Testing Hypothesis 1:

Comparing the shortable and non-shortable stocks, the magnitude of $\sum_{i=1}^{5} d_i$ for shortable stocks is quite the same as non-shortable counterparts, which implies that shortable stocks have quite the same trade continuity as non-shortable stocks. The estimated $\sum_{i=1}^{5} a_i$ are also not statistically significant different for both types of stocks, which imply that quote reversal is quite the same for shortable and non-shortable. The summations $\sum_{i=0}^{5} b_i$ are not statistically significant different before and after stocks become shortable, as well. This implies the quote adjustment subsequent to each trade is the same for both shortable and non-shortable stocks. The amounts of $\sum_{i=1}^{5} c_i$ which indicates the Granger causality running from quote revision to trades are negative for both shortable and non-shortable stocks. This means that knowledge of past quote revision and past trade leads to better predictions of trade than would result from knowledge of past trade alone for both shortable and non-shortable stocks.

Table 11 indicates that short sales in 2009-which have higher short-selling activity, compare to other previous year, do not reduce the trade continuity and do not increase the quote reversals; thus the short ability of a stock does not enhance the speed of stock price adjustment process.

Table 11 Estimation of Dynamic VAR Model Using Data from 2009

Variable	Non-shortable Stocks		Shortable Stocks		Variable	Non-shortable Stocks		Shortable Stocks	
	Coeff.	Stat. Sig	Coeff.	Stat. Sig		Coeff.	Stat. Sig	Coeff.	Stat. Sig
a1	-0.17003	***	-0.21924	***	c1	-155.19510	***	-196.42039	***
a2	-0.03155		-0.04381	**	c2	-55.03045	***	-64.28652	
a3	-0.00009		-0.00572		c3	-23.87791	**	-25.41008	
a4	0.00089		-0.01188		c4	-10.46742		-17.14369	*
a5	0.01473		-0.01397		c5	-4.59971		-11.74839	
Sum a	-0.18604		-0.29461		Sum c	-249.17059		-315.00907	
p-value of equality-test	0.1057				p-value of equality-test	0.3397			
b0	0.00120	***	0.00084	***					
b1	0.00006	*	0.00009		d1	0.41535	***	0.44192	***
b2	-0.00002		-0.00004		d2	0.18963	***	0.18245	***
b3	-0.00008		-0.00008		d3	0.08906	***	0.07927	*
b4	-0.00006		-0.00003		d4	0.05260	**	0.05343	*
b5	-0.00010		-0.00002		d5	0.04568	***	0.05843	**
Sum b	0.00100		0.00075		Sum d	0.79232		0.81550	
p-value of equality-test	0.3258				p-value of equality-test	0.6024			

Note: This table presents the result from estimation of dynamic VAR model:

$$r_t = \sum_{i=1}^{5} a_i r_{t-i} + \sum_{i=0}^{5} b_i Q_{t-i} + v_{1,t} \text{ and } Q_t = \sum_{i=1}^{5} c_i r_{t-i} + \sum_{i=1}^{5} d_i Q_{t-i} + v_{2,t}$$

Where m_t is the log midpoint of the quote when transaction occurs at time t, $r_t = m_t - m_{t-1}$ is the log quote-mid-point change due to transaction t, Q_t is the buy-sell indicator equal to [1,-1] if the trade is [buy, sell]. The call auction period is eliminated from our study to avoid the effect of overnight return and abnormal trading activity during the morning opening and afternoon closing periods. The model is estimated for 3-month period before and after stocks become shortable. The p-value of equality-test is p-value from testing the null hypothesis that the summations of coefficients between shortable and non-shortable stocks are the same. All regressions are estimated with the White heteroskedasticity correction for standard error. Note that the row Stat. Sig is indicated the statistical significant of the variables. * indicates a 10% significance level; ** indicates a 5% significance level; *** indicates a 1% significance level

Testing Hypothesis 2:

Table 12 shows the result of Dimson beta regression and DELAY measure using data from 2009 alone. The contemporaneous beta is 0.79639 (0.78805) for shortable stocks (non-shortable stocks). They are quite the same, indicating that their price adjustment to the market-wide news is quite the same. The lagged coefficients tend to be statistically insignificant. Then, when we transform to DELAY measure, they show that the DELAY for shortable stocks (non-shortable stocks) is 0.57332 (0.57030). In addition, the p-value for equality-test between the DELAY values of shortable and non-shortable stocks indicates that such difference is not statistically significant. Therefore, our empirical show that short-ability of stocks alone cannot improve the speed of price adjustment to market-wide information.

Table 12 Dimson Beta Regression and DELAY Measure Using Data from 2009

Coefficient	Non-shortable stocks	Pr > |t|	Shortable stocks	Pr > |t|
α_0	0.00182	0.5107	-0.00090	0.2046
β_0	0.78805	0.0046	0.79639	0.0495
β_1	0.08304	0.3721	-0.02701	0.5301
β_2	0.03544	0.5219	0.01441	0.6267
β_3	-0.03405	0.3694	0.02294	0.3203
β_4	0.05974	0.2901	-0.07554	0.4510
β_5	0.04467	0.3793	0.04143	0.2694
DELAY	0.57332		0.57030	
P-value of equality test	0.9786			

Note: This table presents the result from estimation of Dimson beta regression and DELAY measure:

$$X = \sum_{k=1}^{5} \beta_{i,k}/\beta_{i,0} \text{ and } DELAY_i = 1/(1+e^{-X})$$

Where $p_{i,t}$ is the natural logarithm of total return index for stock i on day t, $p_{m,t}$ is the natural logarithm of total return index for market on day t, $r_{i,t} = p_{i,t} - p_{i,t-1}$ is the return of stock i on day t, $r_{m,t} = p_{m,t} - p_{m,t-1}$ is the return of market on day t and $X = \sum_{k=1}^{5} \beta_{i,k}/\beta_{i,0}$. We estimate this Dimson beta regression and DELAY measure 3-month period before and after a stock joins the shotable list for individual stocks. All regressions are estimated using GMM to correct standard errors. The coefficients and DELAY show in this table is the arithmetic mean of coefficient estimate from individual stocks. The p-value in the last row indicates equality-test of DELAY between shortable and non-shortable stocks. H_0: $DELAY_{\text{Non-shortable stocks}} = DELAY_{\text{Shortable stocks}}$ (For more detail of this equality-test, please see Chiang et al., 2008)

Chapter 7: Conclusion

This study examines the short selling transactions from the Stock Exchange of Thailand (SET), one of the leading emerging markets. There are two parts in this study. The first part is the investigation of the characteristics of short selling transactions and their intraday patterns. Previous studies (Angel 1997; Aitken et al. 1998) found that the intraday patterns of short sale volume in developed markets are U-shaped. Such pattern indicates that short orders are highly concentrated during the first trading hour, and then decrease during mid-day, with a little upward before the market closes. However, short sale data (i.e., short volume in shares, short value in THB, and number of short transactions from the SET reveals the W-shaped pattern. The difference between the SET's W-shape pattern and the developed markets' U-shape patterns is due mainly to the midday trading intermission. The U-shape patterns (NYSE from Angel 1997 and the Australian Securities Exchange from Aitken et al. 1998) appear in the markets that have no trading break during the midday. By contrast, W-shape is exhibited in the exchanges that have intermission during the midday, including W-shape in the Tokyo Stock Exchange from study of Hamao and Hasbrouck (1995) and W-shape from the SET. However, both U-shaped and W-shaped patterns are consistent with the explanation of Brock and Kleidon (1992) and Miller (1989). Their studies suggest that much of trading at the open and close is due to the inability to trade when market is closed.

In addition, our study reveals that most of all of short sale in SET, approximately 70 percent, is by individual investor. The second most significant player is proprietary trader. Foreign investors and domestic institutional investors rarely short sell stocks. Furthermore, the analysis of short selling shows that agency account, which includes proprietary trader, institutional investor and foreign investor, has a tendency to send relatively larger value (in THB) of short orders comparing to individual account.

For the second part, we compare the speed of price adjustment between shortable and non-shortable stocks to new information. We investigate two types of information; firm-specific information and market-wide information. We hypothesize that shortable stocks have the same speed of price adjustment to both firm-specific and market-wide information as do non-shortable stocks. We apply the dynamic VAR model of Hasbrouck (1991a) to test the speed of price adjustment to firm-specific information. Our results indicate that shortable stocks are not associated with higher speed of price adjustment to firm-specific information, compared with non-shortable stocks. We then employ the Dimson beta regression and DELAY measure from Chordia and Swaminathan (2000) to measure the speed of price adjustment to market-wide information. Again, our findings suggest that there is no improvement in such speed when stocks become shortable. Our findings are roughly unchanged in both up and down market conditions. Shortability of stocks does not enhance the speed of price adjustment to firm-specific and market-wide information in both up and down market conditions. In addition, when we further investigate by using only year 2009 data set, which have significant higher short-selling activity, our results are again roughly unchanged. Overall, our results are different from the empirical evidence from the developed market (e.g., Hong Kong stock exchange) by Chen and

Rhee (2010). We suggest that the possible explanation of our results lie in the short-sale constraints in the SET – that is, the high fees and the scarcity of supply in SBL in the SET (Bris et al 2007; Saffi and Sigurdsson 2011; Reed 2007). Finally, even in 2009 – which is active short selling year and thus the lack of supply may not be a problem, the results are still unchanged.

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APPENDICES

SET50 Selection Criteria

The followings are the detail about the criteria that SET use to decide qualified stocks to be adding to SET50 which is also become be able to short sell. All the followings are quoted from the recent version announcement of SET in March 2012 quoted from the following link

http://www.set.or.th/en/products/index/files/2013-01-SET50-100-IndexRule-EN.pdf

Selection criteria for companies to be included in the SET50

The methodology for choosing eligible stocks is comprised of (1) the Selection Criteria for periodic review (semi-annual) and (2) the Rule of the Changing to Constituent Companies which is the ongoing index maintenance between the periodic reviews.

Periodic Review

1. Eligible stocks must be listed and traded on the SET for a minimum of 6 (six) months. The criteria shall not be applied for stocks from the Changing of Constituent Companies

2. The eligible stocks must be in the top 200 stocks on the SET's main board in terms of average daily market capitalization for the past 3 (three) months. For the stock(s) included from the Changing to Constituent Companies and listed for less than 3 (three) months, average daily market capitalization shall be based on its (their) available trading days.
3. Eligible stocks must maintain their share distributions or free-float qualifications (Aggregation of ordinary shareholders) of at least 20 percent of the paid-up capital of the listed company in question.
4. Eligible stocks must meet the following liquidity criteria (Active trading):
   4.1. For securities on the SET's main board, the monthly turnover value of the eligible stocks must be more than 50.00% of the total average monthly turnover value per stock in the same month and;
   4.2. The criteria 4.1 should be met for at least 9 (nine) out of the 12 (twelve) months during the evaluation period (or 3/4 (three fourths) of the trading period but not less than 6 (six) months). Stock(s) recently entered from the Changing of Constituent Companies shall meet a minimum 3 of 4 of the available trading period.
5. If the number of eligible stocks is less than 105, SET index committee shall gradually alter until a minimum of 105 stocks is fulfilled, as follows:
   5.1. Step 1 The percentage used in Step 4.1, above, will be reduced in steps of 5.00% each, for example, instead of the monthly turnover value of the stock in question having to be more than 50.00% of the total average monthly turnover value per stock for that month, it

need be only more than 45.00%. If that level does not yield 105 stocks, then the limit will be reduced to 40.00%, etc. However, the limit must not be less than 20.00% in any one month.

5.2. Step 2 The number of months that are required as stipulated in criteria 4.2 will be reduced by 1 month at a time, i.e., to 8 or 7 months but not less than 6 months. This step is not applied to the stocks recently entered from the Changing of Constituent Companies.

5.3. Step 3 If the number of eligible stocks still does not reach the target of 105 securities, the percentage of the average monthly turnover per stock used for screening actively traded stocks will be reduced until a minimum of 105 stocks is reached.

6. Eligible stocks must not:

6.1. Be in the process of being delisted by the SET or having been declared by the SET as being in danger of being delisted.

6.2. Being voluntarily delisted

6.3. Be still suspended from trading for a period of time.

6.4. Its trading might be suspended for an extended period of time in the near future.

7. The top 50 stocks ranked by average daily market capitalization will be chosen for calculating the SET50 Index (the 51st – 55th stocks will be treated as replacements for the SET50 Index). The top 100 stocks, which include all those in the SET50 index together with the next 50 stocks will be used in calculating the SET100 Index (the 101st – 105th stocks will be treated as replacements for the SET100 Index)

8. Periodic Review and Adjustments

The revisions are conducted every December and June. Periodic adjustments and the new list of stocks will be announced as soon as the lists become available. The new stock lists will be used for the SET50 and the SET100 Indices calculations starting with the first trading day of January and July of each year.

Changing to Constituent Companies

Ongoing event-related changes to the indices that are the result of newly-listed securities and other corporate events are reflected in changes to the components of the SET50 or SET100 Indices at the time of the event. These events can affect many aspects of an index and its constituents, as shown below.

1. New Issue
    1.1. If there a large company is listed on the SET (i.e., its market capitalization calculated using its IPO price is greater than 1.00% of SET's market capitalization or is expected to be as large as one of the top 20 of the SET50 or SET100 constituents). The SET will include the new company as a SET50 and SET100 constituent in order to maintain the efficiency of SET50 and SET100 Indices as market indicators.
    1.2. For the purpose of Rule 1, a new company which is restructured, renamed or has resulted from a merger or complex restructuring with/from an existing constituent as shown in Rule 2 is not considered as a new issue.
    1.3. The new company will be included in SET50 Index at the end of its first trading day (Day T). The smallest stock ranked by market capitalization on the close of the announced date (Day T-3) will be removed and placed in the replacement list at the end of Day T.

2. Mergers & acquisitions, takeovers and complex restructurings

   2.1. If the above corporate events involve only index constituents.

      2.1.1. The company resulting from the events in 2.1 will remain a constituent in the original index.

      2.1.2. If a constituent is absorbed by another constituent, the resulting vacancy will be filled subject to Rule 5.

   2.2. If the above corporate events involve both an index constituent(s) and non-constituents

      2.2.1. If the constituent(s) survives, the above corporate actions and its (their) equity can still be listed, it (they) will remain in the original index.

      2.2.2. If an index constituent is absorbed by a non-constituent, the original constituent will be removed and replaced by the resulting company, if it is in listed company status.

   2.3. If an index constituent splits or spins off a portion of its business to form one or more new companies, the constituent involved in the spinoff is still included in its original index on condition that the company has survived and its securities is listed.

   2.4. The Index Committee shall be responsible for considering corporate events not identified above, as well as the interpretation or possible exceptions to the rules above.

3. Timing of deletion as an index constituent

If a stock is to be deleted as a SET50 or SET100 constituent (e.g. inclusion of early entry company), the constituent with the smallest market capitalization on Day T-3 before first trading day (T) of inclusion stock will be removed and placed in replacement list at the end of Day T.

4. Timing of replacing as an index constituent

When a vacancy is created, the company on the replacement list with the largest market capitalization on closing of 3 Days before any sock is deleted from the constituents (Day T-3) will be replaced in the constituents at the end of Day T.

5. Trading suspension for long periods

When a constituent of the SET50 or SET100 Index is suspended from trading for longer than 20 trading days, the SET will exclude that company from the SET50 or SET100 Indices, as the case may be.