THE EFFECT OF SHORT-SALE CONSTRAINTS ON VOLATILITY, SKEWNESS, AND KURTOSIS OF INTRADAY RETURN

Mister Wiwat Suriyaworakul

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ผลกระทบของข้อจำกัดการยืมหุ้นขายชอร์ตต่อความผันผวน, ความเบ้, และความโด่งของผลตอบแทนในระหว่างวัน

นายวิวัฒน์ สุริยาวรกุล

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตร์มหาบัณฑิต
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Accepted by the Faculty of Commerce and Accountancy, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

.....Dean of the Faculty of Commerce and Accountancy
(Associate Professor Pasu Decharin, Ph.D.)

THESIS COMMITTEE

.....Chairman
(Anant Chiarawongse, Ph.D.)

.....Thesis Advisor
(Tanakorn Likitapiwat, Ph.D.)

.....Examiner
(Ruttachai Seelajareon, Ph.D.)

.....External Examiner
(Charnwut Roongsangmanoon, Ph.D.)

วิวัฒน์ สุริยาวรกุล : ผลกระทบของข้อจำกัดการยืมหุ้นขายชอร์ตต่อความผันผวน, ความเบ้, และความโด่งของผลตอบแทนในระหว่างวัน (THE EFFECT OF SHORT-SALE CONSTRAINTS ON VOLATILITY, SKEWNESS, AND KURTOSIS OF INTRADAY RETURN) อ.ที่ปรึกษาวิทยานิพนธ์หลัก : อ.ดร. ธนากร ลิขิตาภิวัฒน์, 76 หน้า.

วิทยานิพนธ์ฉบับนี้ตรวจสอบผลกระทบของข้อจำกัดการยืมหุ้นขายชอร์ตต่อความผันผวน ความเบ้ และความโด่ง (เรียกรวมกันว่าคุณลักษณะของการกระจาย) ของผลตอบแทนในระหว่างวัน การศึกษานี้มีจุดประสงค์เพื่อนำเสนอหลักฐานในการพิจารณาว่าควรมีการอนุญาตให้มีการยืมหุ้นขายชอร์ตในตลาดการเงินหรือไม่ การศึกษานี้ทำการทดสอบในช่วงเหตุการณ์ที่มีหุ้นเข้าหรือออกจากดัชนี SET50 เนื่องจากสมาชิกของดัชนี SET50 เท่านั้นที่ได้รับการอนุญาตให้ยืมหุ้นขายชอร์ตได้ในช่วงปี ค.ศ. 2002-2010 เหตุการณ์เข้าออกจากดัชนีดังกล่าวจึงเป็นตัวแทนของข้อจำกัดในการยืมหุ้นขายชอร์ตได้อย่างดี นอกจากนั้นการศึกษานี้ยังดูผลกระทบของข้อจำกัดการยืมหุ้นขายชอร์ตต่อคุณลักษณะของการกระจายในช่วงก่อนและหลังการประกาศผลการดำเนินงาน ผลจาการศึกษาแสดงให้เห็นว่าเมื่อไม่มีเงื่อนไขของการประกาศผลการดำเนินงาน ข้อจำกัดการยืมหุ้นขายชอร์ตไม่มีความสัมพันธ์เชิงระบบต่อความผันผวน ความเบ้ และความโด่งของผลตอบแทนในระหว่างวัน อย่างไรก็ตามเมื่อทดสอบบนเงื่อนไขของการประกาศผลการดำเนินงาน ข้อจำกัดในการยืมหุ้นขายชอร์ตทำให้ความผันผวน ความเบ้ และความโด่งสูงขึ้น ผลการทดสอบเป็นไปในแบบเดียวกันทั้งก่อนและหลังการประกาศผลการดำเนินงาน เนื่องจากความเบ้ลดลงคู่กับความโด่งเมื่ออนุญาตให้ยืมหุ้นขายชอร์ต เราสามารถสรุปเชื่อมโยงผลลัพธ์ได้ว่าการลดลงของความเบ้เกิดจากการลดลงของผลตอบแทนสุดโต่งทางด้านบวกมากกว่าที่จะเกิดจากการเพิ่มความถี่ของการเกิดผลตอบแทนสุดโต่งด้านลบ ซึ่งสอดคล้องกับแนวคิดที่ว่าการอนุญาตให้ยืมหุ้นขายชอร์ตจะทำให้ผู้ทำอาบิทาร์จมีความสามารถมากขึ้นในการทำให้ราคาสะท้อนข้อมูลได้อย่างถูกต้อง นัยยะของการศึกษานี้คือผู้ควบคุมกฎสามารถออกกฎในการห้ามยืมหุ้นขายชอร์ตในเหตุการณ์ที่มีข้อมูลสำคัญถ้าผู้คุมกฎเห็นความจำเป็นในการบิดเบือนการกระจายของผลตอบแทนในระหว่างวันให้เบ้ไปในทางบวก (ทางขวา) มากขึ้น โดยแลกกับความผันผวนและความโด่งที่มากขึ้นของผลตอบแทนในระหว่างวัน

ภาควิชา การธนาคารและการเงิน ลายมือชื่อนิสิต .....

สาขาวิชา การเงิน ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก .....

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WIWAT SURIYAWORAKUL: THE EFFECT OF SHORT-SALE CONSTRAINTS ON VOLATILITY, SKEWNESS, AND KURTOSIS OF INTRADAY RETURN. ADVISOR: TANAKORN LIKITAPIWAT, Ph.D.,

This study examines the effect of short-sale constraints on volatility, skewness, and kurtosis (collectively, the distributional characteristics) of intraday return distribution. The purpose is to provide marginal evidence to address whether short-sales should be allowed to practice in financial markets. The study conducts tests during SET50 index addition and removal events. Since only SET50 index members were allowed to be sold short during 2002-2010, this constitutes a direct proxy for short-sale constraints. Furthermore, this study examines the effect of short-sale constraints on the distributional characteristics before and after earning announcement. The results show that when unconditional on earning announcement, short-sale constraints do not systematically associated with volatility, skewness, or kurtosis of intraday return. However, when the tests are conditional on earning announcement, short-sale constraints actually increase volatility, skewness, and kurtosis of intraday return. The results are similar in both before and after earning announcement. As skewness decreases along with kurtosis when short-sales are allowed, we can reconcile the results and conclude that reduction in skewness is due to fewer occurrence of extreme positive return, rather than higher frequency of extreme negative return. This is in line with the view that allowing short-sales increases arbitrageurs' ability to correct mispricing. The implication is that regulators can prohibit short-sales during an information event if they see the need to distort intraday return distribution to be more right (positive) skewed at a price of higher volatility and kurtosis of intraday return.

Department : Banking and Finance Student's Signature .....
Field of Study : Finance Advisor's Signature .....
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CONTENTS

page

LIST OF TABLES

page

page

LIST OF FIGURES

page

CHAPTER I

INTRODUCTION

1.1 Background and Problem Review

A long-standing controversy whether short-selling activities should be allowed to practice has lasted as long as the inception of financial markets (Chang et al., 2007). This controversy takes place among regulators versus academics, investors versus traders, risk managers versus speculators, and etc. Given the age of short-sales though, little is actually known about the effect of short-sale constraints on distributional characteristics of return, especially on intraday basis, to address the question objectively (Bris et al., 2007).

Regulatory bodies and market participants often hold short-selling activities responsible for volatility surge, market crashes, and extreme events (Bris et al., 2007). On the other hand, academics have quite a harmonic conviction that short-sales are indeed crucial for well-functioning financial markets[1]. The dilemma motivates this study because it is interesting to see whether what regulators and other market participants believe holds true empirically. If the belief is not supported by evidence, then we should allow financial markets to

[1] There are many studies that indicate overvaluation in markets where short-sales are constrained. Furthermore, evidence suggests that allowing short-sale improve price efficiency, fasten price discovery process, moisture liquidity. See also Miller (1977), Saffi, and Sigurdsson (2011), Chang, Cheng, Yu (2007), Boehme, Danielsen, Sorescu (2006), Bris, Goetzmann, and Zhu (2007), Diamond, and Verrecchia (1987), and Beber, and Pagano (2011).

enjoy the benefit short-sales provide. In contrast, if it holds true, then regulatory bodies should treat regulation design process with careful consideration on the implication on the financial markets.

This study examines changes in distributional characteristics of 30-minute return distribution, namely volatility, skewness, and kurtosis, as a result of short-sale constraint removal. The main purpose of this study is to provide empirical evidence to which extent short-sale constraints affect the magnitude of extreme negative return for which skewness proxies. Besides, to investigate the claim that removal of short-sale constraints causes return to be more volatile, volatility are also examined. Lastly to see how extreme events are associated with the removal of short-sale constraints, kurtosis is involved and scrutinized in this study.

The essence of this study centers around intraday analysis. The intuition is that regulators usually employ short-sale ban at the aim of mitigating sudden and extreme price decline, thus immediate outcome. The authorities need to know short-interval effect in order to get a more complete picture and design appropriate regulations. However, previous works have been focusing on monthly and weekly, return distribution. The study will fill this gap in existing literatures.

The three distributional characteristics are tested in three different settings, which result in the total of nine hypotheses. In the first setting, those distributional characteristics are examined during the periods when short-sale constraints are binding and when those constraints are lifted. The tested hypotheses are “whether the removal of short-sale constraints affects the distributional characteristics of intraday return, which comprise of volatility, skewness, and kurtosis”.

The second and third settings examine the effect of short-sale constraints conditional on an information event, namely earning announcement. In the second setting, the tested hypotheses are whether the distributional characteristics of shortable stocks are different from those of non-shortable stocks in the period before earning announcement. Lastly, in the third setting, the tested hypotheses are as same as in the second setting, but in the period after earning announcement.

The conditional tests provide marginal evidence to regulators in regards to the effect of short-sale constraints conditional on earning announcement. The conditional tests are motivated by many well-known theories whose settings have information events as a catalyst for the effect of short-sale constraints. For skewness, the two most prominent theories that predict the effect of short-sale constraints on this distributional characteristic have been proposed by Hong and Stein (2003) and Lamont and Thaler (2003). Hong and Stein (2003) predict that short-sale constraints will make return more left skewed (rather than right skewed as commonly believed) due to accumulated hidden information. On the other hand, Lamont and Thaler (2003) predict that short-sale constraints will make return more right skewed because of the difficulty in correction of mispricing.

Though seem conflicting at first, these two models can be considered as similar models in different period of time. It may be the case that both models' predictions hold true. For non-shortable stocks, in consistence with Lamont and Thaler (2003), it may be harder to correct mispricing and some fractions of information accumulate, thus more right skewed. After information has been released, hidden accumulated information may cause extreme negative return which results in more

left skewed distribution as predicted by Hong and Stein (2003). To test this possibility, therefore, earning announcement is chosen as a reference information event. This study compares skewness of shortable stocks and non-shortable stocks in the period before and after earning announcement. The purpose is to see if the skewness of the two groups is different from each other in different settings. If the prediction of Lamont and Thaler (2003) is the case, then before earning announcement, non-shortable stocks should exhibit more positive skewness than shortable stocks since it is more difficult to correct mispricing. If Hong and Stein's (2003) prediction holds in the later period, then after earning announcement, non-shortable stocks should be more negative skewed than shortable stocks because it is harder for non-shortable stocks to incorporate information.

From volatility aspect, Bai et al. (2006) propose a theory predicting that short-sale constraints can actually increase volatility rather than reducing it. This is because when short-sales are constrained, relatively more informed pessimistic investors cannot participate in price setting mechanism. Relatively less informed investors take the fraction of information that belongs to the former group of investors as risk. Therefore, the latter group demands higher risk premium which leads to larger price adjustment to information, and ultimately higher volatility. The compatible hypothesis is that "before earning announcement, price is less informative thus non-shortable stocks should exhibit higher-level of volatility".

From resell-option value argument, Scheinkman and Xiong (2003) predict that price is more sensitive to information when short-sales are constrained. This can be translated in to another hypothesis: "after earning announcement, due to resell-

option component in price, non-shortable stocks should exhibit higher-level of volatility".

Lastly, for kurtosis, there is no formal theoretical prediction regarding the effect of short-sale constraints on this moment of distribution. However, as a proxy for "tails" of return distribution in which both extreme positive and negative returns are reflected, it is important to the regulatory design perspective. The common regulatory concern is that short-sales exacerbate extreme returns around the event of information release. Therefore, to address this concern, the hypotheses to be tested are whether kurtosis of shortable stocks are higher than that of non-shortable stocks both before and after earning announcement.

This study employs high frequency data set from Stock Exchange of Thailand. The sample involves only stocks that have ever been added or removed from SET50 index. The addition and removal from SET50 index constitute a direct short-sale constraint as a regulation in Thailand allows short-sales to practice only with the members of SET50 index. The sample period covers year 2002-2010. This thesis will contribute to the understanding of the effect of short-sale constraints on distributional characteristics on intraday basis.

1.2 Research Questions

As mentioned in the previous section, the common concern posed by market participants is that short-sales may exacerbate extreme negative return, induce higher volatility, and increase the probability of extreme return. This concern raises the questions about the empirical effect of short-sale constraints on distributional characteristics of return distribution. The research questions, therefore, are 1)

whether allowing short-sales makes return distribution more negatively skewed, induces higher volatility, and causes kurtosis to be more positive (or thicker tails distribution) as implied by regulators, and 2) whether the effect of short-sales constraints on these distributional characteristics is the same in the period before and after earning announcement.

1.3 Objectives

This thesis aims to fill two gaps in the literature. First, this study will provide understanding of the effect of short-sale constraints on distributional characteristics, namely skewness, volatility, and kurtosis, on intraday basis. Previous works have been focusing on monthly and weekly, return distribution. However, regulators' measure to ban short-selling normally aims at mitigating sudden and extreme price decline, and this implies the need of immediate outcomes. Regulators need to know short-interval effect in order to get a more complete picture and design appropriate regulations. Furthermore, this study will test the possibility that the effect of short-selling constraints on distributional characteristics differs in the period before and after earning announcement.

CHAPTER II

LITERATURE REVIEW

Short-sales were the usual victim of market downturn. Authorities often claim that restricting short-selling activities has calming and stabilizing effect to maintain fair and orderly financial market. For instance, U.S. Securities and Exchange Commission (2008) stated that "….This emergency action should prevent short selling from being used to drive down the share prices of issuers even where there is no fundamental basis for a price decline other than general market conditions". The fall of Lehman Brother in 2008, for example, was the official beginning of the so-call "Hamberger crisis" (Saffi, and Sigurdsson, 2011). Many regulators in prominent exchanges (eg. United State, France, Italy, Japan, Hong Kong, and etc.) promulgated short-sale ban, either for all stocks, or specific segments of securities such as financial industry (Frino et al., 2011). The condition of the ban varied across countries. In the case of United State, SEC Emergency Order, Release No. 34-58592, September 18, 2008 stated that

"all persons are prohibited from short selling any publicly traded securities of any Included Financial Firm".

This means all forms of short-sale in all industries were prohibited, while in Japan, only "naked short-sale" was banned.

The most recent example comes from Europe continent. Many European authorities decree short-sale bans in response to Euro-Zone debt crisis in late 2011. Started with Greece, major economies in Europe continent such as Spain, Italy, French, and Belgium jumped on the ban wagon by banning short-sale in financial industry (Battalio et al., 2011). These examples illustrate common belief in the marketplace that short-sales are used to cause turmoil. The logical choice if one subscribes to this belief appears to be short-sales restrictions.

The opposite view to regulators comes from academic house. The majority of academics agrees upon the premise that short-selling restriction has inverse effect on market qualities (Beber, and Pagano, 2011). Miller (1977) theorizes that security prices in an exchange where pessimistic investors are prevented from short-selling activities will be positively biased[2]. The reason is that adverse information or opinion cannot be impounded into stock prices. The size of bias depends on divergence of opinions.

In addition, many empirical evidences confirm that removal of short-sale constraints facilitate price efficiency. Since short-sale limitation prevents short-sellers to engage in the market, it prevents stock prices to impound bad news. Saffi and Sigurdsson (2011) find that higher stock lending supply, a proxy for less short-sale

[2] Recent evidences widely confirm this prediction. Frino, Lecce, and Lepone (2011) study fourteen equity markets and conclude that "restriction on short-selling lead to artificially inflated prices". Chang, Cheng, and Yu (2007) study securities shuffled in and out the allow-for-shorting list in Hong Kong market. They find association between short-sale constraint and stock overvaluation. Other supportive studies include Jones, and Lamont (2002), Boulton and Braga-Alves (2010), Boehmer, Huszar, and Jordan (2010), Chen and Rhee (2010), Boehmer and Wu (2010), Tseng (2010), Saffi and Sigurdsson (2011). Partial supportive evidence is provided by the study of Boehme, Danielsen, and Sorescu (2006). They find the overvaluation effect only when both necessary condition, namely, short-sale constraint and divergence of opinions, interact.

constraint, is associated with better price discovery. In consistence with Saffi and Sigurdsson (2011), Chen, and Rhee (2010) find that stock that is allowed for selling short has faster price discovery process in case of bad news. Not only short-sales facilitate better price discovery with respect to firm-specific news, but also market-wide information.

In regards to volatility, Scheinkman and Xiong (2003) argue against the regulators' conjecture that short-sales are the cause of more volatile stock returns. They argue that when short-sales are constrained, only buyers of an asset have the right to sell that particular asset. This constitutes re-sell option to the buyers only. This option value results in the higher valuation of asset over the fundamental value of future dividend. The premium above fundamental value comes from the belief that the buyers of the asset will be able to exercise the re-sell option to other more optimistic traders. The option value fluctuates with difference of market participants' opinion which results in excess volatility in stock return. According to their model, the short-sale constraints will lead to premium in stock price (above fundamental value), excessive trading volume and higher volatility.

Empirical evidence on relation between short-sale constraints and volatility, however, is inconclusive. Along with price discovery, Saffi and Sigurdsson (2011) find that less short-sale constraints are associated with lower volatility, which disbelieves the claim that short-sales cause return to be more volatile. On the other hand, Chang et al. (2007) use event study to investigate stocks before and after they were added to allowed-for-short-sale list. They find that when stocks were added into

the list, volatility increases on average. The result, in contrast to Saffi and Sigurdsson (2011), supports the belief that short-sales cause return to be more volatile.

Most empirical researches focus on the first two moments of return distribution, however. Only handful theories related to skewness have been proposed. A well-known theory has been pushed forward by Hong and Stein (2003). They argue that when some segments of investors are constrained from selling short[3] and there are differences of opinion, return distribution will be more negatively skewed. Suppose there are risk-neutral arbitrageur A and B. Both are constrained from short-selling. At time 1, B gets a negative signal but A gets positive one so B's valuation of stock price is below A's. In this case, only A's signal will be reflected into price and B's signal will be hidden. Later on at time 2, if A gets positive signal again, it will also be impounded into price while B's negative signal remains hidden. However if A gets negative signal which may belong to B at time 1, A will sell the stock. This time, more information about B's signal will be learnt. If B starts to buy after stock price drops just by a little, then A and other arbitrageurs know that B's negative signal at time 1 is not that bad. However, if price drops by large (eg. 20%) and B has not yet acted as marginal buyer, then A and other arbitrageurs know that B's negative signal at time 1 is worse than they could have thought. A and other arbitrageurs then continue to sell, thus make return distribution more negatively skewed to the left.

Bai et al. (2006) argue that Hong and Stein (2003) rely too much on risk-neutral assumption, although their prediction is consistent with that of Hong and Stein (2003). They bring risk-averse (yet fully rational) agents into picture. With asymmetric

[3] Fund managers, for example, are subjected to regulations regarding constructing short-position in their managed funds.

information and short-sale constraints, less informed investors take the part of negative information that is not initially compounded into price as risk. When market begins to decline as A in the previous example gets the leak of B's signal, the degree of uncertainty increases, rather than decreases as suggested in Hong and Stein's model. Bai et al. (2006) argue that "This is also consistent with the fact that stock price crashes appear to involve more confusion and uncertainty rather than transparency and clarity, while explanations based on the revelation-of-news or burst of bubbles imply the opposite". A and other investors then demand higher risk premium and then sell the securities. This leads to a big crash in stock price which is associated with more negatively-skewed distribution and excessive volatility.

From information-impounded speed perspective, Diamond and Verrecchia (1987) hypothesize that prohibiting short-selling reduces the speed of price adjustment to private bad news. Bad news accumulates before it is incorporated into price. Thus large price change is more likely negative. This implies that short-sale constraints cause return distribution to be more negatively skewed, consistent with Hong and Stein (2003) and Bai, et al. (2006).

Direct opposite view is proposed by Lamont and Thaler (2003). Their argument bases on the technology bubble in 2000. They argue that short-sale constraints limit arbitrageurs' ability to correct mispricing when stocks are overvalued. According to Fama (1991), definition of securities price in an efficient market is "deviations from the extreme version of the efficiency hypothesis are within information and trading costs". Lamont and Thaler (2003) argue that short-sale restriction imposes infinite trading cost to construct short position. Therefore stocks can be severely overpriced

(e.g. technology stocks) relative to their fundamental value due to the infinite trading cost. This implies more frequencies of extreme positive return and positively-skewed distribution to the right side.

Consistent with the view that skewness increases with short-sale constraints rather than decreases, Xu (2007) proposes a model that takes into account investors' view about precision of public signals. He argues that in a market where short-selling is not possible, if there are heterogeneous beliefs about the precision of public signals (e.g. earning announcement), reaction to positive signals will be stronger than reaction to negative signals. He explains, for example, that those who believe the signal is precise will rely their valuation on the signal more than those who do not believe that the signal is precise. When the signal is positive, the former group will adjust their valuation of the stock more than the latter group. Due to the increase in valuation, the former group will buy more shares. The valuation of the former group pushes price far-above fundamental value of the latter group. The latter group wishes they could sell short the stock, but is prohibited by short-sale constraints. Thus "market reacts through the reaction of higher precision investors" (Xu, 2007). In contrast, when the signal is negative, the high precision group adjust their valuation well-below the low precision group. Due to decrease in valuation, the high precision group wishes they could sell short the stock, but is prohibited. The market will react through the action of lower precision investors, which do not lower their valuation much since they don't believe in reliability of the signal. Thus Xu (2007) concludes that reaction to good news is stronger than bad news. Stronger price reaction to good news leads to higher positive skewness.

Besides conflicting theories regarding the effect of short-sales on skewness, existing empirical evidences offer mixed and indecisive views. Xu (2007) uses data from NYSE from 1962 to 2003. He finds evidence in favor of his own theoretical prediction. The result shows that larger-size firms, which Xu (2007) argues that they proxy for less short-sale constraints, tend to have more negative skewness.

Saffi and Sigurdsson (2011) extend Xu's study by using stock lending supply as a proxy for short-sale constraints. They argue that higher lending supply implies that stocks are easier or cheaper to sell short. The dataset is derived from 26 countries. They examine stocks on individual basis and find negative relation between skewness and lending supply. The result also shows that higher lending supply reduces frequency of extreme return (Kurtosis). Relation between lending supply and skewness, and frequency of extreme return are reconciled. They conclude that positive relation between short-sale constraints and skewness results from less frequency of extreme positive return, rather than more frequency of negative return. These results support Lamont and Thaler's (2003) conjecture that relaxing short-sale constraints makes it easier for arbitrageurs to correct mispricing, hence less positive skewness. The result also supports Xu's (2007) prediction that "skewness should decrease with fewer short-sale constraints" (Siffi and Sigurdsson, 2011).

Bris, et al. (2007) employ data from 46 equity markets. They do not rely on proxies but directly investigate availability of short-sale. Their result is partially consistent with Xu (2007), and Siffi and Sigurdsson (2011). They find evidence that return distribution of market indices exhibits less negative skewness in markets where short-sales are prohibited. But on individual stock basis, they find no relation between

short-sales and skewness. The result on individual stocks contradicts to that of Saffi and Sigurdsson (2011).

Charoenrook and Daouk (2005), however, focus only on skewness on market level. They use data from 111 countries and directly examine availability of short-selling as same as Bris et al. (2007). They find no evidence that short-selling restriction neither increases or decreases skewness of market return, which in turn contradicts to Bris et al. (2007).

For kurtosis, a proxy for extreme value of both positive and negative sides of return distribution, there is no formal theoretical prediction as to how short-sale constraints will affect kurtosis. Empirical evidence suggests that putting short-sale restrictions in place actually increases the likelihood of extreme returns. Saffi and Sigurdsson (2011) find that lower lending supply and higher loan fees (which proxy for higher short-sale constraints) tend to make the tails of return distribution thicker (i.e. higher value of kurtosis).

The existing literatures rely on various types of proxies for short-sale constraints. Those include share lending supply and loan fee (Saffi and Sigurdsson, 2011), firm size (Xu, 2007), or prohibition period (Bris et al., 2007, Charoenrook and Daouk, 2005). Usually, short-sale prohibition is imposed when there is a major crisis which may affect skewness of the distribution. Using data in the crisis period when short-sale restriction is binding to study the impact on skewness may be problematic.

Moreover, “a common conjecture by regulators is that short sales restrictions can reduce the severity of price declines” (Bris et al., 2007). This implies regulators

impose short-sale restriction to mitigate immediate effect. Lack of intraday analysis is another gap in the literatures. This thesis aims to fulfill this gab. Microstructure data from Stock Exchange of Thailand enables me to investigate the direct effect of short-sale constraints on distribution of intraday return.

CHAPTER III

INSTITUTIONAL SETTING IN THAILAND: SECURITIES BORROWING AND LENDING (SBL)[4]

3.1 Overview

Securities Borrowing and Lending (SBL) refers to a transaction of two parties in which one party (Securities Lender) agrees to lend securities to the other party (Securities Borrower) and the latter party agrees to return the securities back to the former party along with lending fees at a predetermined date. As a guarantee to honor the arrangement in the future, the latter party must agree to pledge an asset as collateral to the former party. This collateral will be returned along with interest when the securities borrower returns the securities to the securities lender.

Given the definition, SBL lies in a crucial part of short-selling transactions. Short-selling transactions involve two separate parts. 1) Short-sellers need to borrow securities in which they would like to sell short. 2) The borrowed securities are sold short in the marketplace. The first part is essentially the SBL transaction. The second part is just ordinary course of selling securities.

[4] The information in this section is mainly derived from Thailand Securities Depository Co., Ltd. official website. Visit http://www.tsd.co.th/en/service/sbl.html for more information.

Since the nature of SBL involves future obligation of both parties to the transaction, there is a good chance that some party may not be able to perform the contractual duty(ies) required. To alleviate this counterparty risk, in Thailand, Thailand Securities Depository Co.,Ltd (TSD). are instated as a clearing house and act as a median of SBL transactions to ensure that both parties to the transaction are still willing and able to honor their arrangement as time passed. The following section shall describe institutional bodies involving in SBL in details.

3.2 Institutional Organizations Involved in SBL

Started as early as 1997, Securities and Exchange Commission (SEC) initiated registration and valuation process to grant business licenses to those who wish to expand their business to SBL area. Eligible candidates include variety of financial institutions, such as commercial banks, brokerage firms, venture capitals. Nowadays, it turns out that the majority of incumbent is brokerage firm.

Since initiated, there are two key players involving in SBL transactions. 1) As mentioned earlier, Thailand Securities Depository Co.,Ltd. (TSD) whose role is to alleviate counterparty risk and to support SBL operations, 2) Eligible members entitled by TSD, usually are brokerage firms whose facilities are outstanding in place and can effectively serve clients' need.

As to alleviate counterparty risk, TSD requires securities borrowers to pledge assets as collateral the value of which is as worth. TSD acts as a custodian for the collateral. TSD manages mark-to-market process on daily basis and also monitors variation margin of its members. Should the variation margin falls below the

maintenance margin, TSD will call its members to put more collateral to satisfy the minimum margin level (140% of the value of the borrowed securities).

The scope of responsibility of TSD expands beyond managing settlement risk. It involves the operational aspect as well. Those services include the following lists:

- determine the eligibility of securities for SBL transaction
- determine suitable types of assets for collateral
- process, edit, terminate, extend an SBL contact
- calculate transaction fees, interests, and related taxes
- manage the rights and benefits of collateral pledged
- maintain database regarding members' information, marketing officers, system users, and SBL clients' account of each members
- prepare documents and reports regarding SBL transactions to the SEC and Revenue Department

Lastly, TSD also acts as a "Lender of Last Resort", meaning that TSD will lend securities to its members in the case that there is reasonable doubt in performance of obligations. TSD will act as a sole principal in an SBL transaction. The purpose is to promote growth in this area of business in its infancy period.

The second parties involved are TSD registered members. As of October 15, 2012, there are 16 financial institutions[5] that are registered with TSD. The lists consist of the following members:

- Country Group Securities Public Company Limited,

[5] The source of the information is: http://www.tsd.co.th/th/service/sbl/SBL_Member_15102012.pdf. The url is a link to download a pdf-formatted file containing full lists and details of the eligible members. Please visit the site for further information.

- Phatra Securities Public Company Limited,
- ASIA PLUS Securities Public Company Limited,
- KGI Securities (Thailand) Public Company Limited,
- Capital Nomura Securities Public Company Limited,
- Tanachart Securities Public Company Limited,
- Finansa Securities Limited,
- United Securities Public Company Limited,
- Maybank KIM ENG Securities (Thailand) Public Company Limited,
- Bualuang Securities Public Company Limited,
- Globlex Securities Company Limited,
- CITIBANK N.A. Bangkok Branch,
- TSFC Securities Limited-Custodian,
- CIMB Thai Bank Public Company Limited For Treasury Operations Department,
- Government Pension Fund,
- Finansia Syrus Securities Public Company Limited.

The members act as a point of contact to retail (or institutional) clients. Eligible members are awarded with an SBL license. Eligible members can act either as a principal or an agent. When a member acts as a counterpart to an SBL contact, the member is acting as a principal. On the contrary, if the member acts as a median for a securities lender and a securities borrower, the member is acting as an agent.

In case the pledged collateral value falls below maintenance margin, the securities borrower will need to put more collateral into SBL margin account. The

registered members have responsibility to operate the margin-call process. First, they will inform the securities borrower about their margin status. Second, they will deposit the collateral to client's SBL account at TSD.

Besides, the members are required by law[6] to have working system to process, report, and analyze data in regards to risk exposure related to SBL transactions. They need to adjust their risk management system according to volume, and the level of sophistication of securities borrowed and lent. As a control for risk of the members' own financial status, the law prohibits the members to lend securities to a single non-institutional client more than twenty-five percent of their capital. Also, the total amount of outstanding securities lending to non-institutional clients must not exceed five time of the capital. However, these conditions are not applicable in the case that the borrowed securities increase in value or reduction in members' capital.

3.3 Type of SBL Transactions and Fees

There are two types of SBL transactions. 1) Put-through transactions and 2) Settlement Coverage transactions. For put-through transactions, securities borrowers and lenders negotiate the terms of contract on their own and they are counterparties to each other. In this case, TSD acts as an agent and a custodian to the transaction. The transaction fee is 5% of negotiated lending fee and the minimum of 100 Baht per transaction for put-through transactions. Both securities borrowers and lenders are required to pay the fee.

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[6] Notification of the Office of the Securities and Exchange Commission, No. SorThor. 25/2551 Re: Provisions relating to Working System, Securities Borrowing and Lending Contract and Collateral for Securites Borrowing and Lending Transactions (Thai version), Chapter 1

For settlement coverage transactions, TSD acts as a counterparty to the transaction. This type of transaction is used in the case when a securities lender is skeptical about securities borrower's ability to fulfill their obligations in the future. TSD will borrow securities from the securities lender. In this case, TSD is the securities borrower. Then TSD will lend the borrowed securities to another person. This entitles TSD as a securities lender in another SBL contract. The condition of the contract will be determined by the clearing house. The safety from default comes at the expense of higher transaction cost. For settlement coverage, the transaction fee is 10% of lending fee and is paid by both securities lender and securities borrower.

3.4 Elements in SBL contract

A general SBL contract must at least contain four material elements[7] to have legal enforcement in Thai jurisdiction. They consist of 1) the borrowed securities and the deposited collateral, 2) agreement on how the adjustment of the value of collateral and borrowed securities will be done, 3) compensation of the benefit foregone by lending securities and pledging collateral, and 4) terms in case of default.

First, the contract shall specify the securities to be lent, the collateral to be deposited. The contract shall specify that the transferred assets must be free from any preferential right and obligations. Moreover, the securities and collateral

[7] Notification of the Office of the Securities and Exchange Commission, No. SorThor. 25/2551 Re: Provisions relating to Working System, Securities Borrowing and Lending Contract and Collateral for Securites Borrowing and Lending Transactions (Thai version), Chapter 2, Clause 8

returned should have the same characteristics as the borrowed securities and pledged collateral in terms of issuer, type of securities, and amount.

Second, securities lenders and borrowers should agree upon how the adjustment of the amount of the returned securities and collateral will be made. It should cover diverse scenarios that affect wealth of either lenders or borrowers if they were to hold the lent securities and deposited collateral by themselves. The scenarios should include corporate right actions, securities redemption, shares repurchase, tender offer, merger and acquisition, stock dividend, and etc.

Third, the contract shall specify how to compensate the benefits that securities lenders and collateral depositors forego to enter into the SBL transaction. Those benefits include dividend, interest, and etc. Otherwise specify, the compensation cannot be less than the benefits forego by the lenders and depositors.

And lastly, the agreement should contain right and responsibility of both parties in case either party defaults. This should include practical procedures in the situation that forces debt to become due prior the due date specified in the contract.

3.5 Types of Acceptable Collateral

There are 10 types of assets that are eligible to pledge as collateral. The lists[8] are as followed;

- Cash
- Listed securities

[8] The lists of information are derived from Notification of the Office of the Securities and Exchange Commission, No. SorThor. 25/2551 Re: Provisions relating to Working System, Securities Borrowing and Lending Contract and Collateral for Securites Borrowing and Lending Transactions (Thai version), Chapter 3, Clause 10

- Investment units of an open-ended fund with daily redemption feature
- Treasury bills
- Thai government bonds
- Bank of Thailand bonds
- Bonds or debts guaranteed in full by Ministry of Finance or by Financial Institutions Development Fund
- Bonds or debts that are rated above BBB rate
- Certificates of deposit
- Letter of guarantee

The TSD registered members must call for initial margin of 150% of the value of the borrowed securities. In case the value of the collateral falls below 140%, the members shall call the borrower to deposit more collateral so that the total value of collateral is not less than 140%.

3.6 Structure of SBL Business

The structure of SBL business can be decomposed into 4 types of structure. The first structure is the case that TSD acts as an intermediary agent between its members. It can be shown by the following diagram;

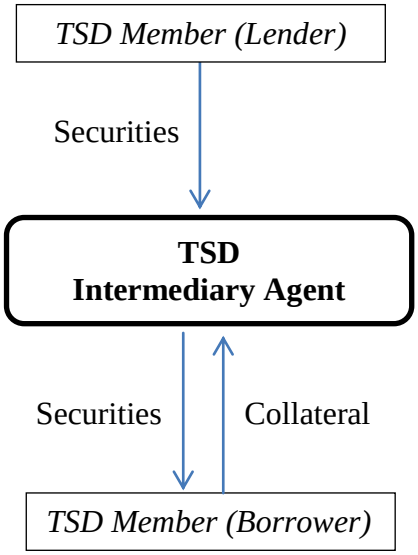

Figure 1: SBL Structure where TSD Acts as an Intermediary Agent

In the figure, TSD acts as intermediary between two of its members who would like to lend and borrow securities. The securities lender gives the lent securities to TSD and TSD passes the securities to the securities borrower to sell short. For guarantee of performance of obligations, the securities borrower deposits collateral to TSD and TSD acts as a custodian to secure the collateral for the securities lender.

The second structure has similar feature as the first one but TSD's role changes from intermediary to principal. It can be shown by the following diagram;

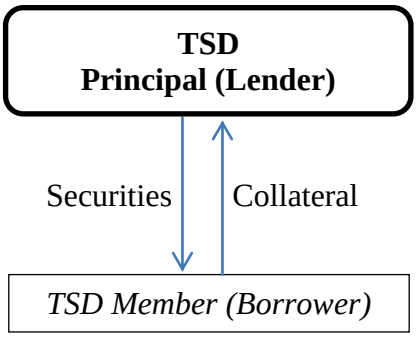

Figure 2: SBL Structure where TSD Acts as a Principal

In this structure, TSD acts as a sole principal to the transaction. TSD gives the lent securities to the securities borrower to sell short. The securities borrower pledges collateral to TSD in return. TSD manages the collateral for itself.

The third structure involves retail clients. It can be shown by the following diagram;

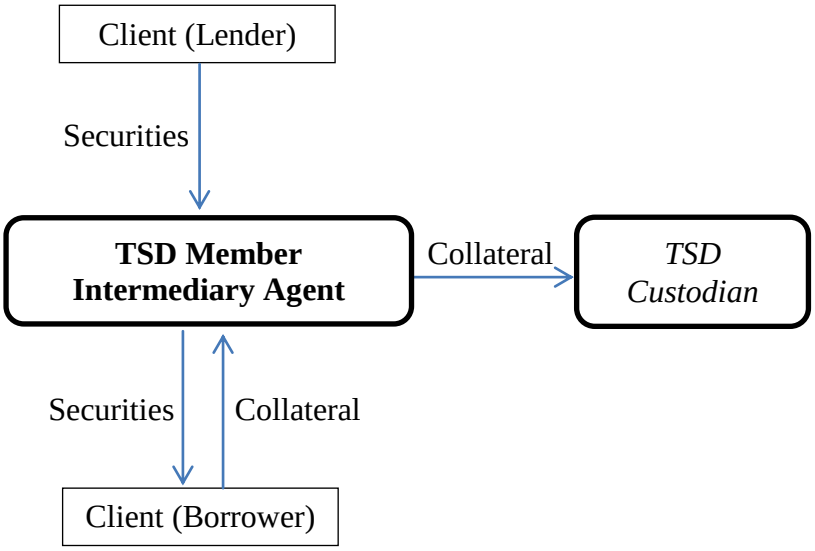

Figure 3: SBL Structure where a TSD Member Acts as an Intermediary Agent and TSD as a Custodian

In this structure, the TSD member acts as an intermediary agent between its own clients. The lending client lends the borrowed securities to the borrowing client by TSD member. The borrowing client then deposits collateral to the TSD member. The TSD member will transfer the collateral to client's account at TSD who acts as a custodian in this case.

The forth structure also involves retail client. However, the role of the TSD member changes from an agent to a principal. This can be shown by the following diagram;

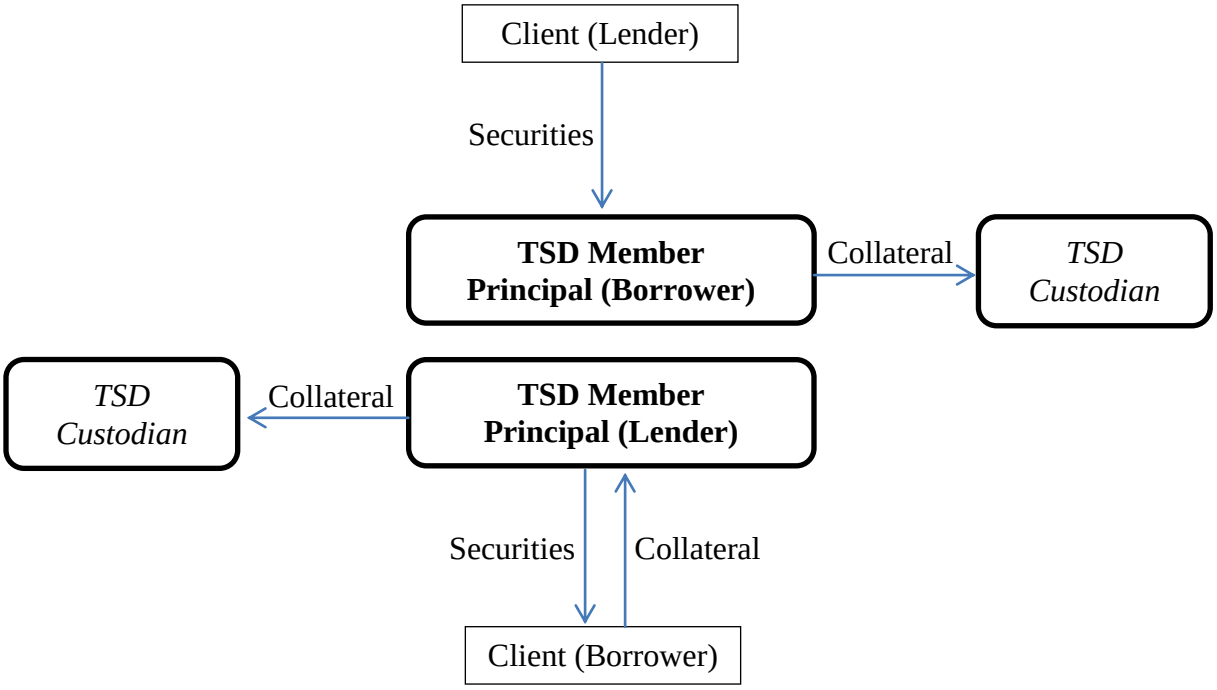

Figure 4: SBL Structure where a TSD Member Acts as a Principal and TSD as a Custodian

This structure calls for TSD members to act as a principal. On one side, a lending client lends securities to a TSD member. The TSD member then deposits collateral to TSD who in this case acts as a custodian for its member. On the other side, TSD member lends securities to a borrowing client. In this case the TSD member is the principal lender. The borrowing client needs to deposit collateral to the TSD member who will then passes along the collateral to TSD to manage.

3.7 Eligible Securities for Short-Selling

According to the Stock Exchange of Thailand's circular, Kor Tor.(Wor) 53/2540, from January 1st 1998, the stock that is eligible for short-selling practice must be a member of SET50 index. This rule has been revised and the eligible stocks changes to members of SET100 index from January 1st 2011. In this study,

the focus shall be allocated to SET50 index only as the sample period covers 2002-2010 due to data scarcity.

Stock Exchange of Thailand instates a set of index committees to decide the composition of the SET50 index. The index committees are also responsible for evaluating and choosing the selection criteria, lists of stock candidates, and calculation methodology[9]. The revision and selection processes are repeated every 6 months. The stocks that no longer meet the selection criteria are replaced with more appropriate stocks.

The selection rules consist of three major criteria[10]. The first criterion is market capitalization. The second criterion is trading volume. The third criterion is the appropriateness of share distribution to minority shareholders (free-float shares). SET50 index members shall meet all of these criteria to maintain their eligibility.

In term of market capitalization, the 200 largest market-capitalization stocks on SET main market have eligible candidacy for inclusion in SET50 index. The statistic is based on average daily market capitalization for the past three months. For change in constituents out of the periodic revision period, average actual trading-day market capitalization shall be applied.

Active trading is another characteristic of eligible stocks for SET50 index. Turnover is the statistic employed in this context. It can be calculated as number of share traded divided by average number of share outstanding. The eligible stocks

[9] The SET50 and SET100 Indices Rule, July 2012, The Stock Exchange of Thailand

[10] The summary of the index and selection criteria can be found at http://www.set.or.th/en/products /index/setindex_p3.html.

must have the average monthly turnover more than 50% above the monthly average of all stocks in the main market. This criterion shall be met at least 9 months out of 12 (or three forth). Stocks that are replaced as a substitute for changing in constituent are required to meet this criterion at least three forth of available trading days.

The last characteristic of SET50 selection criteria is share distribution among minority shareholders. The eligible stocks for SET50 inclusion shall maintain free-float share distribution at least 20% of the paid-up capital to ordinary shareholders.

Furthermore, apart from the three selection criteria, there are several rules that eligible stocks must comply to enter into SET50 index. The first rule is that the eligible stocks must be listed for at least six months. The second rule regards to the possibility of being delisted. The eligible stocks must not be in process, or highly likely in near future, of being delisted from the exchange. The third rule is the compliance with regulation. The eligible stocks must not be, or probably in foreseeable future, suspended from trading for a lengthy period of time.

These selection criteria have implication on this study later on. Since this study uses the event of addition and removal from SET50 index to study the effect of decrease and increase, respectively, in short-sale constraints. These selection criteria will be tested as a robustness check to make sure that the result of this study is the pure effect of change in short-sale constraints and robust from these characteristics.

3.8 Trading Rules and Procedures for Short-Selling Transactions

According to a Stock Exchange of Thailand's regulation, Bor.Sor./Khor. 01-00, short-selling transactions shall be conducted at a price that is at or above last trading price. The short-selling price cannot be lower than last-traded price. This rule is universally known as the "up-tick" rule.

For recording purpose, if stocks are sold short by a member of stock exchange who engages in market-making activities or stabilizing liquidity, the trade shall be denoted by "K". In contrast, if stocks are sold short without those purposes, the trade shall be denoted by "S".

3.9 Statistics of Stock Exchange of Thailand: SBL and Short-Selling

The following section assembles several statistics relating to short-sales characteristics in the Stock Exchange of Thailand. Started with volume, Figure 5 illustrates total volume of short-sell transactions from 2002 to 2010. Figure 6 shows the total value of short-sell transactions in the same period. The bar charts in the figures are classified by statistics in 1) the SET50 index and 2) the sample of stocks this study uses for experiment. The trend in short volume drastically increased in 2008 and doubled by 2009. Short-sell values shows similar trend.

Figure 7 and Figure 8 separate short-sale volume and value, respectively, by the type of transactions. As mentioned in section 3.8, short-sell transactions related to market-making activities shall be flagged by letter "K". Those short-sell transactions sold under normal course shall be flagged by "S". The K-flagged short-sales did not show up in the dataset until 2007. The size of K-flagged short-sales is minimal relative to S-flagged short-sales.

For comparison, Figure 9 and 10 show trading volume and value, respectively, classified by membership of stocks (the sample or SET50 index). As shown, trading volume and trading value have increased over the decade and peaked around 2009-2010. Figure 11 shows the percentages of short-sales value relative to trading value. It has increasing trend over the period, yet the highest value peaked in 2009 at 1.67% which is relatively low compared to developed markets.

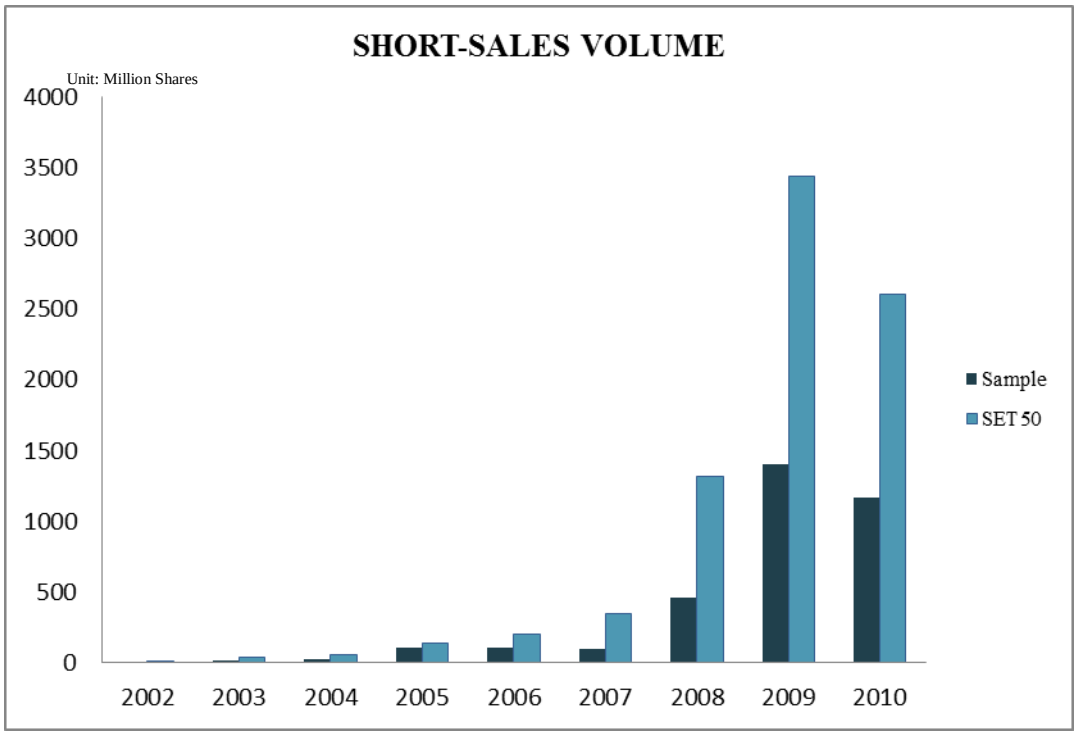

Figure 5: Short-Sales Volume Belongs to Sample and SET50 Index

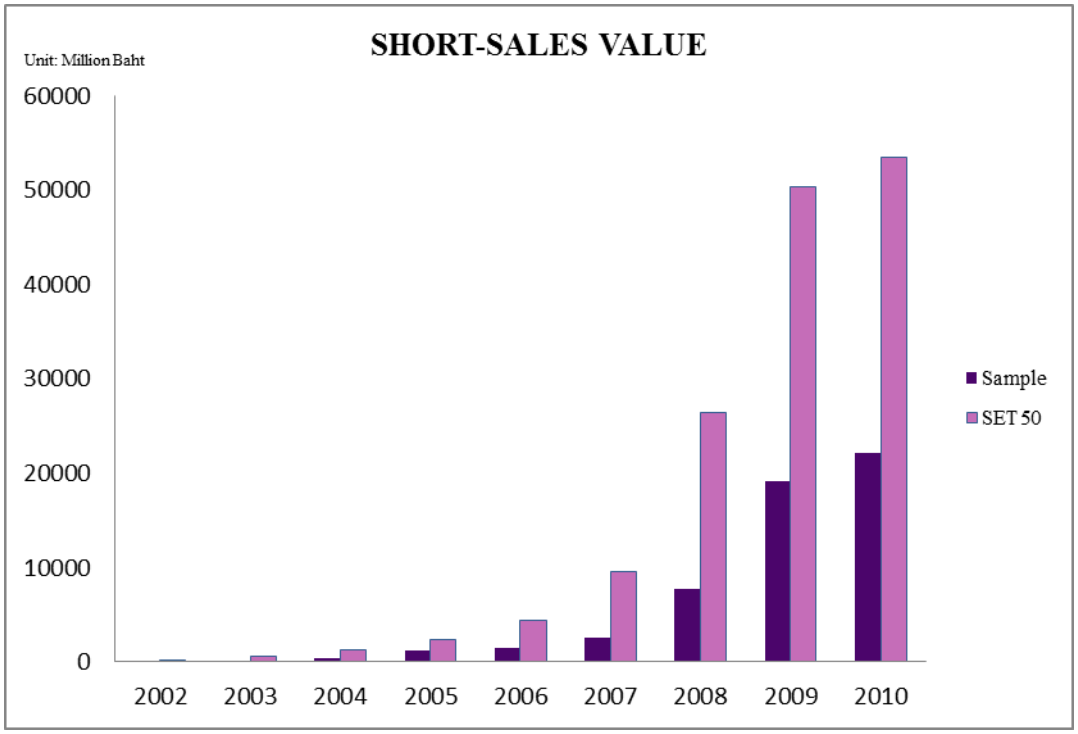

Figure 6: Short-Sales Value Belongs to Sample and SET50 Index

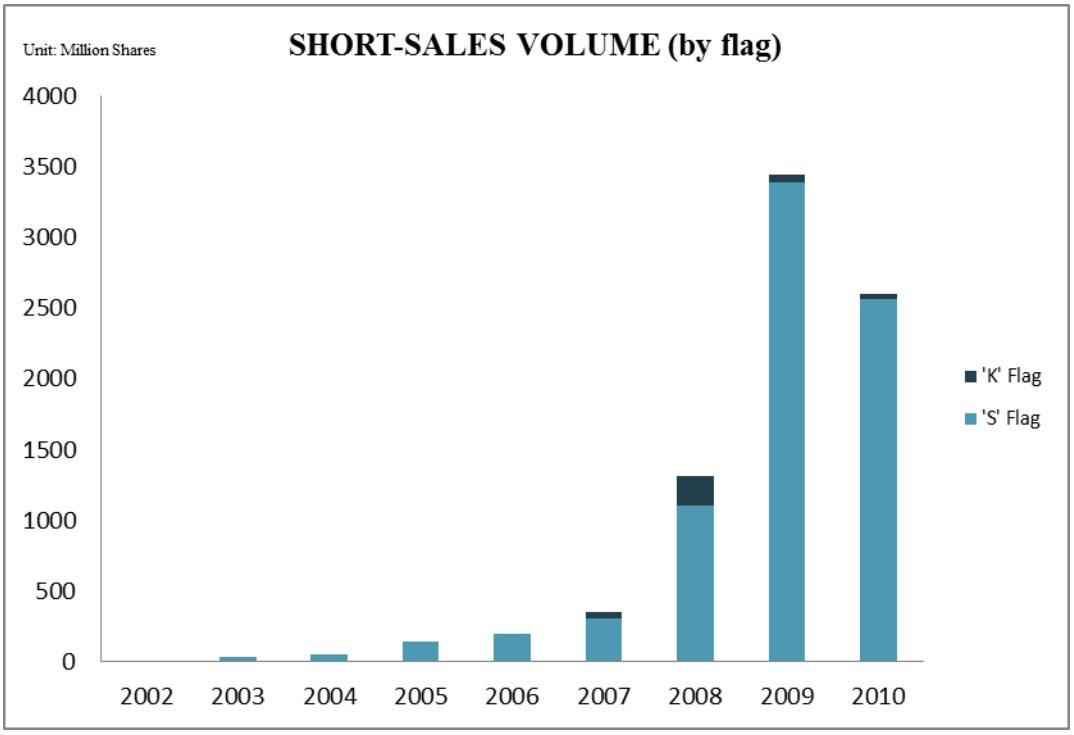

Figure 7: Short-Sales Volume Separated by Short-Sale Flags

Figure 8: Short-Sales Value Separated by Short-Sale Flags

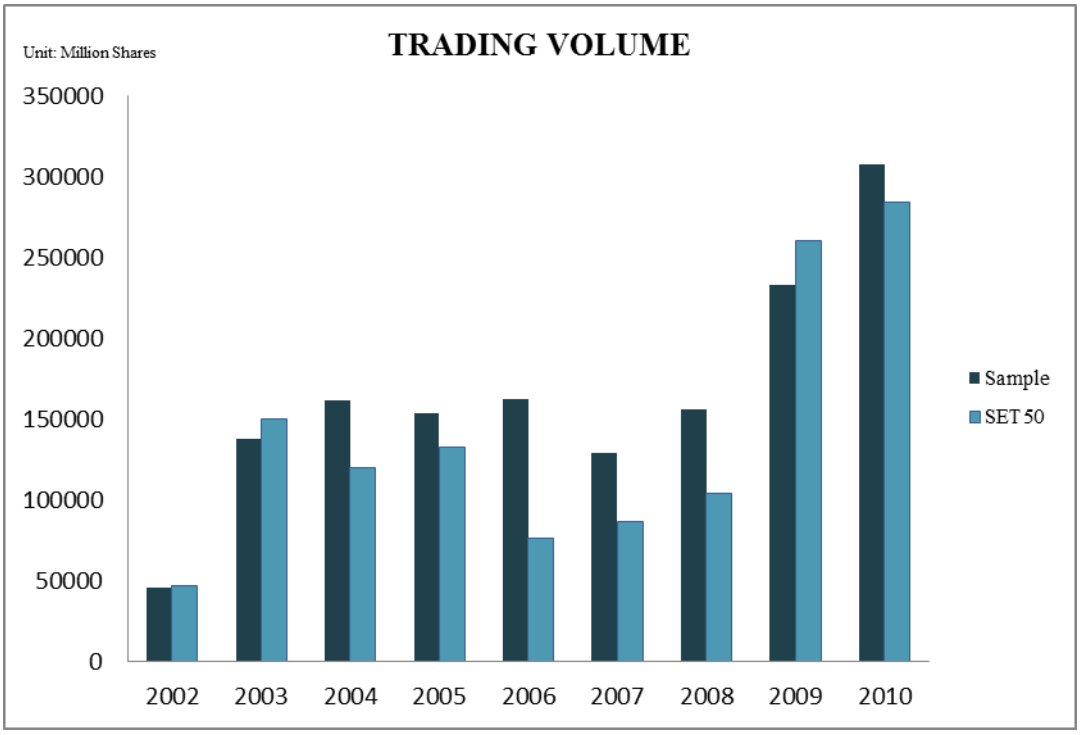

Figure 9: Trading Volume Belongs to Sample and SET50 Index

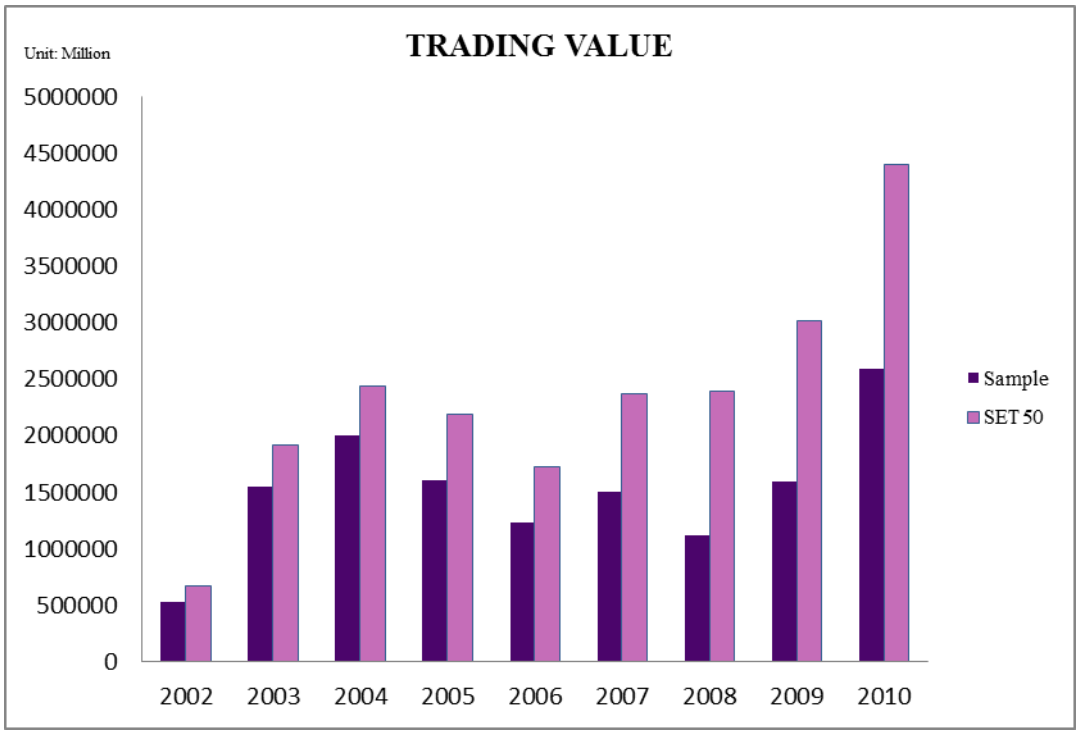

Figure 10: Trading Volume Belongs to Sample and SET50 Index

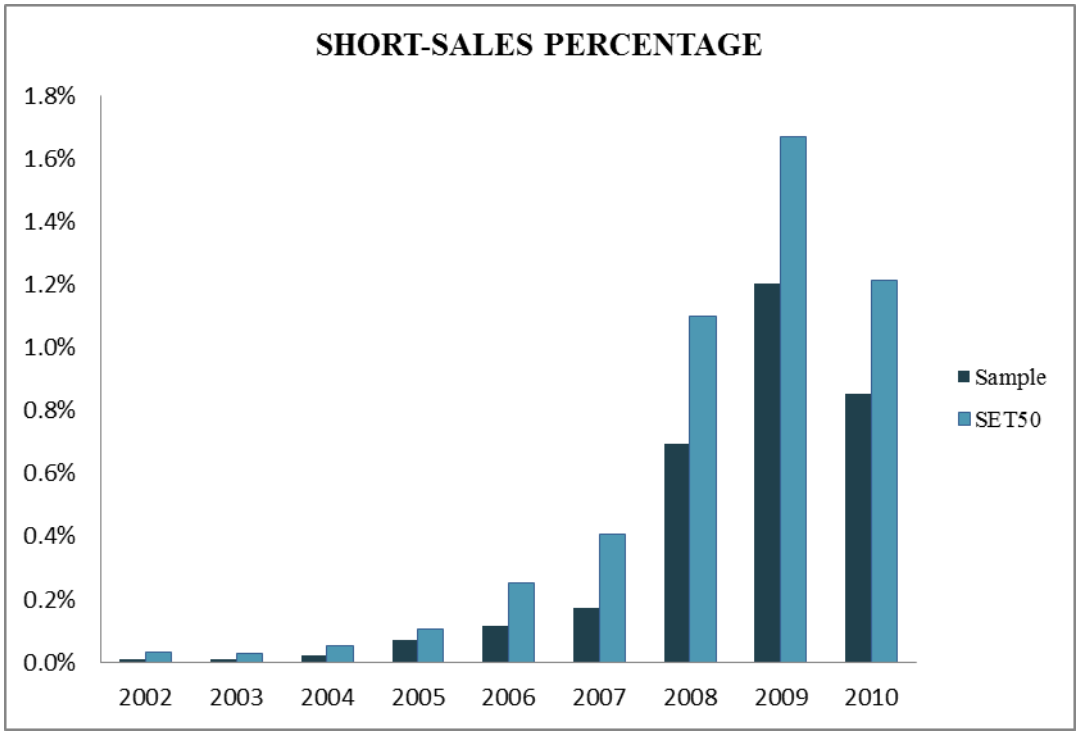

Figure 11: Short-Sale Value as Percentages of Trading Value Belongs to Sample and SET50

CHAPTER IV

SCOPE OF THE EXPERIMENT AND DATA

The data to be used in this study is high frequency data from Stock Exchange of Thailand (SET). Event-study technique is employed where the events of interest are stock addition and removal from SET50 index. The selection of the events is due to a regulation regarding the eligibility of stocks to be sold short in the Stock Exchange of Thailand (SET). From 2002 to 2010, securities companies are allowed to practice Securities Borrowing and Lending (SBL) business only with members of SET50 index. Thus only stocks in SET50 index are shortable at the time. Moreover, Index Committees instated by Stock Exchange of Thailand revise the composition of SET50 index every six months based on certain criteria[11] (e.g. market capitalization, liquidity, share distribution, and etc.) Stocks that fail to those criteria will be removed from the index and others that comply will replace.

As this study focuses on the effect of short-sale constraints (not short-sale volumes), the addition and removal events from SET50 index are used as a direct proxy for short-sale constraints. This is a sound method because it is a regulation that,

[11] There are five selection criteria. First, eligible stocks must be listed in the Stock Exchange of Thailand for at least six months. Second, the stocks must be within the highest 200 ranks in term of market capitalization. Third, the share distribution or free-float shares must be at least 20 percent of paid-up capital. Forth, monthly turnover value of the stocks must be at least 50 percent of monthly turnover value per common stock and this criterion should be met nine out of twelve months within the evaluation period. And last, the stocks must not, or are highly likely, be in the process of delisted from the Exchange.

in the Stock Exchange of Thailand, only members of SET50 index can be sold short. A period before an addition to SET50 index represents a period where the stock is non-shortable. A period after an addition to the index represents a shortable period. The same applies to removal events except that shortable period switches to the period before the event and non-shortable period switches to the period after.

To test the effect of short-sale constraints unconditional on information events, this study examines distributional characteristics 60 trading days before and after the events (addition and removal from SET50). 30-minutes return is used to calculate distributional characteristics of individual stocks. The sample period covers 2002-2010.

The following table shows the sample used and the period in which a sample is added or removed from the SET50 index. There are total of 140 observations. Normally the number of added stocks should be equal to the number of removed stocks. However, in some period, there are some companies that have been delisted or merged together so that the numbers do not comply[12].

Period	Addition	Removal
2002H1	CCET, TPI	COCO, ITD
2002H2	PTT, AEONTS, GOLD, QH	CCET, B-LAND, PPPC, EFS
2003H1	BT, CCET, MAJOR, TISCO, ITD	NPC, BIGC, MAKRO, AEONTS, SUC

[12] DTDS was delisted In July, 2004. NPC and TOC were delisted in December, 2005. ATC and RRC were merged together and became PTTAR in January, 2008.

2003H2	SSI, ATC, ITV, MS, AP, LALIN, SIRI, AMATA	IFCT, TT&T, UCOM, JASMIN, TPI, CCET, AST, CNS
2004H1	VNG, TT&T	ASL, LALIN
2004H2	KEST, TOC, TPC, CK, STECON, PSL, TTA, UCOM	TUF, BT, SPL, GOLD, SIRI, GRAMMY, MAJOR
2005H1	SCIB, ASP, NPC, AOT, NSM	CPF, BOA, AMATA, QH, DELTA
2005H2	CPF, TUF, TOP, CP7-11, MCOT, DELTA, TISCO, TT&T	KGI, VNT, MS, VNG, AP, STEC
2006H1	PTTCH, CPN, GLOW, MAKRO, BGH, BH	ASP, CK, NSM, UBC, TT&T, TPI
2006H2	CCET, MINT, AMATA	UCOM, ITV, SHIN
2007H1	KSL, IRPC	KEST, SATTEL
2007H2	RRC	TISCO
2008H1	PS, MAJOR	SSI
2008H2	DTAC	KK
2009H1	TSTH, QH, ESSO, TTW, BIGC	TPIPL, AMATA, MAJOR, BECL, RCL
2009H2	MBK, BECL	QH, TRUE
2010H1	QH, BCP, TRUE	ITD, MBK, CCET
2010H2	TISCO, BLA, IVL, TPIPL, HMPRO	SCIB, TPC, TSTH, MCOT, BECL

Table 1 Stock Addition and Removal from SET50 Index

Furthermore, to test the effect of short-sale constraints conditional on information events, this study examines distributional characteristics 30 trading days before and after earning announcements. The samples are categorized into two groups. The first group is shortable group. The second is non-shortable group. Distributional characteristics are examined to see whether there is any difference between these two groups both before and after earning announcement periods. The source of earning announcement date is from SETSMART website. 30-minites return is also used in this setting. The sample also covers the same period.

It is crucial to note the scope of this study. This study uses addition and removal events from SET50 as a proxy for short-sale constraints. It does not examine actual short-selling transactions. This is a reasonable method because this study aims to answer the effect of relaxing short-sale constraints on distributional characteristics, not the effect of short-selling transactions themselves.

Additional data, namely market capitalization, number of shares outstanding, daily trading volume, free-float shares, alpha, beta, dividend yield, PE ratio, and PB ratio, are retrieved from Bloomberg. These data are used to test for robustness that the results are sore effect from short-sale constraints, not SET50 selection criteria nor other factors.

CHAPTER V

HYPOTHESIS DEVELOPMENT AND METHODOLOGY

This section shall explain the experiments. It includes hypothesis development and methodology. The experiments are divided into two broad tests. The first is the test unconditional on an information event. The second is the conditional one.

5.1 The Test Unconditional on an Information Event

As a common concern of regulators around the world, allowing short-sales will cause volatility surge, extreme negative return, and eventually market crash (Bris et al., 2007). The usual argument is that short-sales are often used to drive down the price of securities without a sound and reasonable fundamental basis (Saffi, and Sigurdsson, 2011). This eventually leads to more left skewed return distribution. Many academics do not agree on regulators' premise, though.

Hong and Stein (2003) argue that short-sale constraints make it harder for information to incorporate into securities price. They argue that when there are short-sale constraints, some party cannot express their pessimistic opinion by short-selling. A fraction of negative information, therefore, accumulated. Afterward, other parties realize that there is some hidden bad information in the market. They start to sell the securities. The accumulated information tends to cause extreme negative return and hence cause skewness to be more negative (or more left

skewed). Thus, in contrast with regulators' view, Hong and Stein (2003) predict that alleviation of short-sale constraints makes return distribution more right skewed (more positive skewness).

To test these conflicting premises, this study tests whether short-sell constraints cause return distribution to be more right skewed (more positive skewed). In other words, to test whether relaxing short-sale constraints exacerbates extreme negative return and make return distribution more left skewed. This is common believe that regulators around the world hold and claim when they promulgate short-sale bans.

Hypothesis 1: When stocks are shortable, their intraday return distribution will exhibit more negative skewness.

Many regulatory bodies have also expressed considerable amount of anxiety that relaxing short-sale constraints will create excess volatility in stock return. The usual argument often goes with panic selling resulting in instability in price. Ultimately, they are afraid of incremental risk posed by allowing short-sales. In contrast, few academics disagree on this premise, and argue that it is short-sale restriction itself that cause return to be more volatile. Among the most prominent are Scheinkman and Xiong (2003) and Bai et al. (2006).

Scheinkman and Xiong (2003) argue that short-sale restriction[13] constitutes resell option exclusively to securities buyers. With the resell option, securities price incorporates option value element along with fundamental value (commonly

[13] In their work, they mention, for simplicity, that in their setting, short-sale constraints shall be absolute. That means no market participant has the ability to sell short securities. They also mention, however, that the result obtains from their model shall survive in the presence of limited short-sale constraints which is more likely in reality.

estimated as stream of future dividend). The belief that securities holders have the privileged to sell the securities to more optimistic traders drives the option-value component. Therefore, when there is disagreement on fundamental value or change in relative opinion, option value will fluctuate. This creates price premium, excessive trading volume, and ultimately excess volatility above otherwise shortable stocks.

From information asymmetry perspective, Bai et al. (2006) argue that short-sale constraints make securities price less informative. This results from the fact that relatively more pessimistic investors are expelled from price setting mechanism when short-sale constraints are binding. Without relatively more pessimistic investors, a portion of negative information is not impounded into securities price. Perceiving less informative price as risk, relatively less informed investors demand higher risk premium to hold the securities. This leads to stronger price adjustment to information and thus higher volatility in stock return.

The controversy leads to the second hypothesis to be tested. To see whether short-sale constraints cause excess volatility, as regulators have expressed their anxiety, the volatility of intraday return is measured in the period where short-sales become practical.

Hypothesis 2: When stocks are shortable, their intraday return will be more volatile.

From kurtosis point of view, there is no formal theoretical prediction as to the effect of short-sale constraints on this moment of return distribution. Nevertheless,

kurtosis, by its definition, represents the likelihood of extreme events of return. The higher kurtosis than otherwise shortable stocks will pose additional risk to market participants. Therefore, regulators need to exercise considerable amount of discretion on how short-sale constraints will affect kurtosis.

Hypothesis 3: When stocks are shortable, their intraday return distribution will exhibit larger kurtosis.

As aforementioned, it is a rule that only members of SET50 stocks are allowed[14] to sell short. Thus to test the first set of hypotheses, the distributional characteristics 60 trading days before and after stocks are added or removed from SET50 are examined. This can be shown by the following diagram.

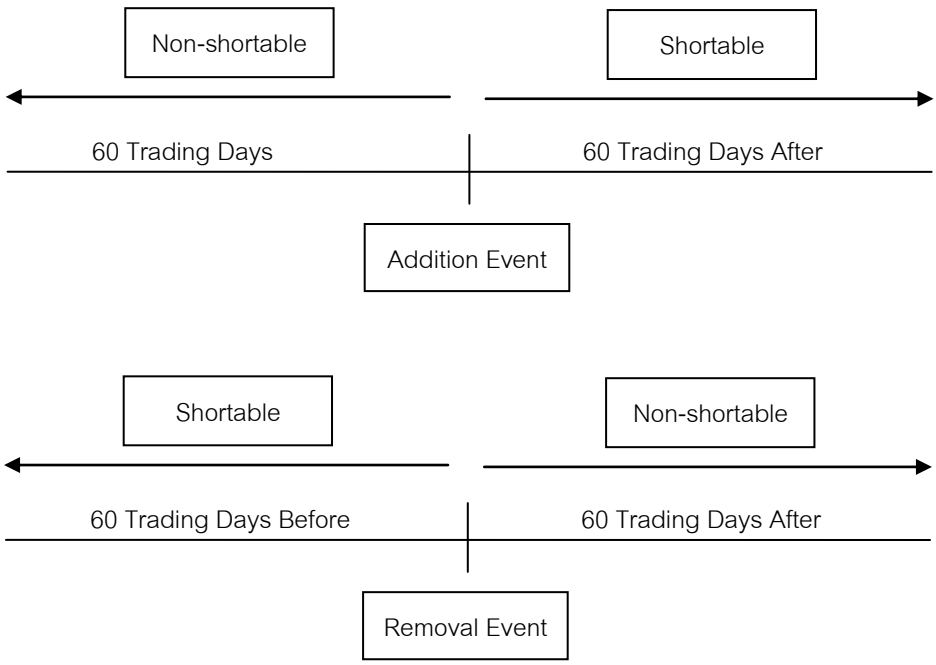

Figure 12: Addition and Removal Events from SET50 Index

[14] This rule has been revised so that from 2011 afterward, the universe of shortable stocks expands to SET100 index.

To address the hypotheses, the test procedure is to compare the distributional characteristics between the period when short-sales are implementable and when they are not. If short-sale constraints have effect on the distributional characteristics as hypothesized, they should have significant difference between these two periods (Chang et al., 2007). Paired sample t-test is the statistics used in this context.

Firstly, individual skewness can be computed as followed:

$$SK_i = \frac{[n(n-1)^{3/2} \sum R_{it}^3]}{[(n-1)(n-2)(\sum R_{it}^2)^{3/2}]}$$

Secondly, individual volatility can be computed as followed:

$$Vol_i = \sqrt{\frac{\sum R_{it}^2}{n-1}}$$

Lastly individual kurtosis can be computed as followed:

$$Kurt_i = \frac{n(n+1)}{(n-1)(n-2)(n-3)} \cdot \frac{\sum R_{it}^4}{((n-1)^{-1} \cdot \sum R_{it}^2)^2} - 3\frac{(n-1)^2}{(n-2)(n-3)}$$

where R_{it} represents series of demeaned 30-minute return of stock *i* during time *t*. *n* is number of observations of 30-minute return used in calculation within 60 trading days period. Under the formulas, standardized normal distribution has expected skewness, volatility, and kurtosis equal to 0, 1, and 0 respectively.

After individual distributional characteristics have been calculated, average difference of the statistics between the two periods when stocks are shortable and non-shortable can be computed by the following formulas.

Firstly, for skewness, the calculation proceeds as followed:

$$\overline{SK}_d = \frac{\sum SK_{i,shortable} - SK_{i,non-shortable}}{n}$$

Secondly, for volatility, the calculation proceeds as followed:

$$\overline{Vol}_d = \frac{\sum Vol_{i,shortable} - Vol_{i,non-shortable}}{n}$$

Lastly, for kurtosis, the calculation proceeds as followed:

$$\overline{Kurt}_d = \frac{\sum Kurt_{i,shortable} - Kurt_{i,non-shortable}}{n}$$

where n is number of paired-samples. In this study, the number of paired-observations is 140.

Furthermore, standard deviations of the difference are computed by the following formula:

$$\hat{\sigma}_d = \sqrt{\frac{\sum (DC_d - \overline{DC}_d)^2}{n-1}}$$

and

$$\hat{\sigma}_{\bar{d}} = \frac{\hat{\sigma}_d}{\sqrt{n}}$$

where DC is a variable for a distributional characteristic of interest. Subscript d represents difference between shortable and non-shortable group, n is number of paired-observations.

The t-test statistic is as follow:

$$t_{\alpha,df} = \frac{\overline{DC}_d}{\hat{\sigma}_{\bar{d}}}$$

The t-statistics then are tested against student-t distribution and empirical distribution[15].

Moreover, apart from the distributional characteristics, SET50 selection criteria along with other variables are tested in the same manner. The variables include market capitalization, trading volume, free-float shares, number of shares outstanding, dividend yield, PE ratio, PB ratio, alpha, and beta. This is to ensure that the results are purely based on the change in short-sale constraints, not from other variables.

5.2 The Test Conditional on an Information Event

The second part of the experiment tests the effect of short-sale constraints conditional on an information event, namely earning announcement. There are two separated setting. The first setting tests whether the distributional characteristics, before earning announcement, between shortable and non-shortable groups of stocks are statistically different. The second setting also tests the difference

[15] The empirical distribution is obtained by bootstrap method.

between those distributional characteristics, but in the period after earning announcement.

The tests conditional on the information event are motivated by the facts that many well-known theories have information event as a catalyst. Besides, regulators also need to know the effect of short-sale constraints on this aspect in order to design appropriate regulations. Conditional tests will give them an edge in designing most effective measure to achieve the desired outcomes, especially in the time of crisis where short-sale restriction is most tempting.

For skewness, the two most prominent theories are proposed by Hong and Stein (2003) and Lamont and Thaler (2003). Hong and Stein (2003) argue that short-sale constraints should make return more left (negative) skewed due to accumulated hidden information. Lamont and Thaler (2003), on the other hand, predict that short-sale constraint will make return distribution more right (positive) skewed because of increased difficulty in the ability to correct mispricing.

Though these two theories are opposite in their prediction, it is interesting to test whether it is that case that both prediction holds but in different periods. When stocks are not shortable, as Lamont and Thaler (2003) predict, the arbitrageurs' ability to correct mispricing decreases. This allows some fractions of information to accumulate which results in more right (positive) skewed distribution. Then, after a proper information catalyst presents itself, hidden information exacerbates return so that the distribution is more left (negative) skewed as predicted by Hong and Stein (2003).

Therefore, in the period before earning announcement, according to Lamont and Thaler (2003), non-shortable stocks should exhibit more positive skewness because it is harder to correct mispricing. Thereafter, in the period after earning announcement, according to Hong and Stein (2003), non-shortable stock should exhibit more negative skewness due to hidden accumulated information.

Hypothesis 4: Before earning announcement, skewness of non-shortable stocks is more positive skewed (to the right) than that of shortable stocks.

Hypothesis 5: After earning announcement, skewness of non-shortable stocks is more negative skewed (to the left) than that of shortable stocks.

For volatility, Bai et al. (2006) argue that short-sale constraints can actually cause volatility surge rather than stabilizing it. Their argument is based on the fact that short-sale constraints make price less informative. Relatively more informed pessimistic investors are restricted from the market and their information is not incorporated into price. Perceiving information belonged to the former group as risk, relatively less informed investors demand higher risk premium which leads to large price adjustment to information, and ultimately volatility surge. Since price is less informative in the period before earning announcement, non-shortable stocks should exhibit higher-level of volatility.

In the period after earning announcement, according to Scheinkman and Xiong (2003), volatility of non-shortable stocks should also be higher than that of shortable stocks. This is because short-sale constraints constitute resell option exclusively to securities buyer. This resell-option value is more responsive to

information. Therefore, the option value component leads to higher volatility in the period after information release.

Hypothesis 6: Before earning announcement, volatility of non-shortable stocks is higher than that of shortable stocks.

Hypothesis 7: After earning announcement, volatility of non-shortable stocks is higher than that of shortable stocks.

Lastly, kurtosis is a proxy for "tails" of return distribution which represents both extreme positive and negative returns. This highlights the need for regulators to consider how kurtosis is affected by short-sale constraints when it is conditional on an information event. However, due to lack of theoretical predictions, the understanding of the effect on kurtosis is far from clear. The common concern is that allowing short-sales may exacerbate extreme returns around the event of information release. Therefore, to address this concern, the hypotheses to be tested are whether kurtosis of shortable stocks are higher than that of non-shortable stocks both before and after earning announcement.

Hypothesis 8: Before earning announcement, kurtosis of shortable stocks is higher than that of non-shortable stocks.

Hypothesis 9: After earning announcement, kurtosis of shortable stocks is higher than that of non-shortable stocks.

To test these hypotheses, earning announcement is used as a proxy for information release. In the conditional tests, the sample consists of stocks that have ever been added or removed from SET50 from 2002 to 2010. The sample will be

separated into two groups. Those are shortable and non-shortable stocks. Skewness of each group will be examined before and after period of earning announcement. This can be shown by the following diagram.

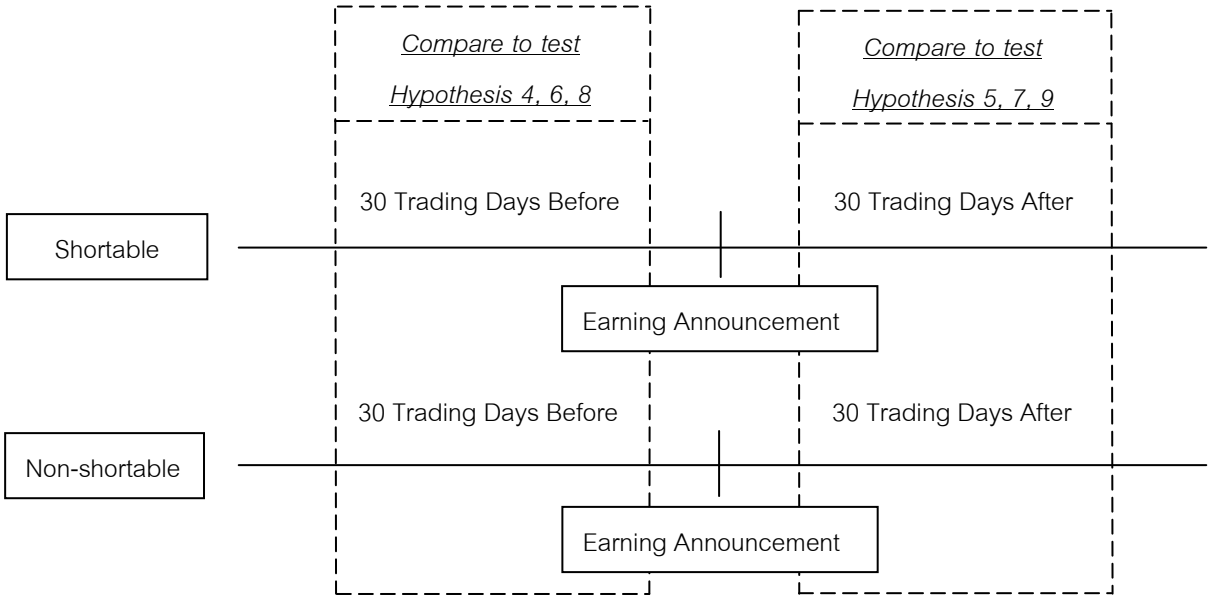

Figure 13: Conditional Tests before and after Earning Announcement

The distributional characteristics of shortable and non-shortable groups of stocks will be compared to test hypotheses 4 to 9. To test hypothesis 4, 6, and 8, the distributional characteristics of 30 trading days before earning announcement will be tested to see the difference between shortable and non-shortable groups. Similarly, the distributional characteristics of 30 trading days after earning announcement will be used to test hypotheses 5, 7, and 9. The test statistics are pooled sample t-tests. The formulas for the distributional characteristics are similar to those of section 5.1. Other statistics proceed as followed.

After individual statistics of each stock have been computed, the distributional characteristics of shortable and non-shortable group will be averaged by:

$$\overline{DC}_g = \frac{\sum DC_i}{n_g}$$

where subscript g represents shortable or non-shortable group.

To compare the mean between these two groups, t-statistic can be computed by:

$$t = \frac{\overline{DC}_{shortable} - \overline{DC}_{non-shortable}}{\hat{\sigma}_{\overline{DC}_{shortable} - \overline{DC}_{non-shortable}}}$$

If equal variance is not assumed, the formula for pooled standard error is as followed:

$$\hat{\sigma}_{\overline{DC}_{shortable} - \overline{DC}_{non-shortable}} = \sqrt{\frac{\sigma^2_{\overline{DC}_{shortable}}}{n_{shortable}} + \frac{\sigma^2_{\overline{DC}_{non-shortable}}}{n_{non-shortable}}}$$

If equal variance is assumed, the formula for pooled standard error is as followed:

$$\hat{\sigma}_{\overline{DC}_{shortable} - \overline{DC}_{non-shortable}}$$

$$= \sqrt{\frac{(n_{shortable} - 1) \cdot \sigma^2_{\overline{DC}_{shortable}} + (n_{non-shortable} - 1) \cdot \sigma^2_{\overline{DC}_{non-shortable}}}{n_{shortable} + n_{non-shortable} - 2}}$$

$$\times \sqrt{\frac{1}{n_{shortable}} + \frac{1}{n_{non-shortable}}}$$

Furthermore, to ensure the quality of the results, SET50 selection criteria along with other variables are tested in the same manner. The variables also include the same variables[16] as in section 5.1.

[16] The variables include market capitalization, trading volume, free-float shares, number of shares outstanding, dividend yield, PE ratio, PB ratio, alpha, and beta.

CHAPTER VI

EMPIRICAL RESULTS

Overall, the evidence is in support of the academics. In the unconditional tests, this study finds that with less short-sale constraints (i.e. when stocks were added in SET50 index or before they were removed from the index), all the distributional characteristics including volatility, skewness, and kurtosis of intraday return decrease. However, the reductions are not statistically significant.

In the conditional tests, this study finds that volatility, skewness, and kurtosis of shortable group are less than those of non-shortable group. This is true to both before and after earning announcement. The difference in mean in those two groups is statistically significant at 1% significance level. Section 6.1 and 6.2 shall describe the empirical results in full detail.

6.1 The Effect of Short-Sale Constraints Unconditional on the Information Event

This section allocates to the results in respect of hypotheses 1-3. The distributional characteristics of intraday return distribution are tested in the period before and after stocks become shortable or non-shortable. The addition and removal from SET50 index constitute the proxy for the short-sale constraints.

Statistics		Shortable	Mean	Std. Deviation	Std. Error Mean	Correlation	Sig. (Corr)
Pair 1	MEAN	NO	-.0172	.0446	.0038	.2221	.0086
		YES	-.0207	.0474	.0040		
Pair 2	VOLATILITY	NO	1.2836	2.3476	.1991	.0421	.6230
		YES	1.1687	.7496	.0636		
Pair 3	SKEWNESS	NO	.3521	1.4840	.1259	-.0016	.9852
		YES	.1763	1.1876	.1007		
Pair 4	KURTOSIS	NO	34.7678	54.7366	4.6427	.1197	.1606
		YES	29.7904	44.6997	3.7914		

Table 2 Paired Samples Statistics: The number of observations is 140. The second column (Shortable) indicates shortablility. If it is yes, the statistics belong to the shortable period, and vice versa.

Statistics		Paired Differences			p-value (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	
Pair 1	MEAN	-.0034	.0574	.0049	.4836
Pair 2	VOLATILITY	-.1149	2.4342	.2065	.5788
Pair 3	SKEWNESS	-.1758	1.9021	.1613	.2777
Pair 4	KURTOSIS	-4.9774	66.3971	5.6317	.3783

Table 3 Paired Samples Test: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations is 140.

Statistics			Bootstrap		
		Mean	Bias	Std. Error	p-value (2-tailed)
Pair 1	MEAN	-.0034	.0000	.0049	.4844
Pair 2	VOLATILITY	-.1149	.0003	.2069	.6092
Pair 3	SKEWNESS	-.1758	.0000	.1612	.2850
Pair 4	KURTOSIS	-4.9774	-.0244	5.6252	.3797

Table 4 Bootstrap for Paired Samples Test: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations is 140. The column "Bias" indicates the degree to which the standardized distribution and the empirical distribution disagree. The bootstrap results are based on 10,000 bootstrap samples.

Table 2 shows the descriptive statistics. Table 3 shows the empirical results of the test. Table 4 shows the results from bootstrap method.

From table 3, the means of intraday return between the two groups are not significantly different as expected. When stocks become shortable, volatility of intraday return slightly decreases by 11.49 basis points. This is consistent with what Scheinkman and Xiong (2003) and Bai, Chang, and Wang (2006) predict. The difference is not statistically significant, though.

As concerned by regulators, skewness of intraday return decreases with fewer short-sale constraints. The difference between shortable and non-shortable groups is 0.1758. With fewer short-sale constraints, kurtosis of intraday return also decreases by 4.9774. Neither the difference in skewness nor kurtosis is statistically significant in the unconditional test.

According to the evidence, this study fails to reject the null hypotheses that volatility, skewness, and kurtosis of intraday return are statistically significantly different from zero. This means the rejection of hypotheses 1-3. The evidence leads to the conclusion that unconditional on information events, short-sale constraints do not systematically and significantly affect the distributional characteristics. The direction of changes, however, tends to support the academics' predictions. As short-sale constraints are fewer, volatility and kurtosis of intraday return decrease, rather than increase as afraid by regulators. In contrast, skewness slightly decreases with fewer short-sale constraints as regulators might concern.

6.2 The Effect of Short-Sale Constraints Conditional on the Information Event

This section focuses how short-sale constraints affect the distributional characteristic when conditional on earning announcement. The distributional characteristics between shortable and non-shortable stocks are compared. The tests are conducted in the period before and after earning announcement, isolatedly.

Statistics	Shortable	Mean	Std. Deviation	Std. Error Mean
MEAN	NO	-.0076	.1605	.0051
	YES	-.0126	.0554	.0018
VOLATILITY	NO	.8492	.4606	.0146
	YES	.7178	.2708	.0087
SKEWNESS	NO	.3295	1.1557	.0367
	YES	.1980	.8144	.0261
KURTOSIS	NO	5.3813	6.9919	.2219
	YES	4.0095	5.3925	.1728

Table 5 Group Statistics Before Earning Announcement: The second column "Shortable" indicates the shortability of the group. If it is yes, the statistics belong to shortable group, and vice versa. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

Statistics		t-test for Equality of Means			
		t	Mean	Std. Error Difference	p-value (2-tailed)
MEAN	Equal variances assumed	-.9144	-.0050	.0054	.3606
	Equal variances not assumed	-.9214	-.0050	.0054	.3570
VOLATILITY	Equal variances assumed	-7.6937	-.1314	.0171	.0000
	Equal variances not assumed	-7.7300	-.1314	.0170	.0000
SKEWNESS	Equal variances assumed	-2.9123	-.1315	.0452	.0036
	Equal variances not assumed	-2.9217	-.1315	.0450	.0035
KURTOSIS	Equal variances assumed	-4.8658	-1.3717	.2819	.0000
	Equal variances not assumed	-4.8778	-1.3717	.2812	.0000

Table 6 Independent Samples Test Before Earning Announcement: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

Statistics		Mean	Bootstrap		
			Bias	Std. Error	p-value (2-tailed)
MEAN	Equal variances assumed	-.0050	.0000	.0054	.1488
	Equal variances not assumed	-.0050	.0000	.0054	.1492
VOLATILITY	Equal variances assumed	-.1314	-.0003	.0170	.0001
	Equal variances not assumed	-.1314	-.0003	.0170	.0001
SKEWNESS	Equal variances assumed	-.1315	.0003	.0451	.0041
	Equal variances not assumed	-.1315	.0003	.0451	.0040
KURTOSIS	Equal variances assumed	-1.3717	.0022	.2839	.0001
	Equal variances not assumed	-1.3717	.0022	.2839	.0001

Table 7 Bootstrap for Independent Samples Test Before Earning Announcement: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974. The column "Bias" indicates the degree to which the standardized distribution and the empirical distribution disagree. The bootstrap results are based on 10,000 bootstrap samples.

Table 5 shows the descriptive statistics of the conditional test before earning announcement. Table 6 shows the empirical results before earning announcement. Table 7 shows the bootstrap results before earning announcement based on 10,000 bootstrap samples.

In the period before earning announcement, from table 6, the means of intraday return between the two groups are not statistically significantly different. Volatility of intraday return in the shortable group is less than that of non-shortable group by 13.14 basis points. The difference is statistically significant at 1% significant level. This is consistent with Bai et al. (2006)'s prediction that short-sale constraints induce higher volatility in the period before information release. This is because short-sale constraints make price less informative. Relatively less informed investors demand higher risk premium from non-shortable stocks which ultimately leads to volatility surge. The result fails to reject hypothesis 6 that volatility of

intraday return of non-shortable stocks is higher than that of shortable stocks in the period before earning announcement.

For skewness of intraday return, from table 6, non-shortable group exhibits higher positive skewness by .1315 before earning announcement. The difference is statistically significant at 1% significant level. This is in line with Lamont and Thaler (2003)'s prediction that short-sale constraints make it difficult for arbitrageurs to correct mispricing. Therefore, non-shortable stocks should exhibit more positively skewed distribution. The result fails to reject hypothesis 4 that skewness of intraday return of non-shortable stocks is higher than that of shortable stocks in the period before earning announcement.

For kurtosis of intraday return, from table 6, shortable stocks exhibit less kurtosis than non-shortable stocks by 1.3717 before earning announcement. The difference is statistically significant at 1% significant level. This provides comforting evidence that allowing short-sales reduces the probability of extreme events before information release. The null of hypothesis 8 that before earning announcement, kurtosis of intraday return of shortable stocks is higher than that of non-shortable stocks is rejected.

In the period after earning announcement, from table 9, the difference in means intraday return is not statistically significant at 1% significance level. Volatility of intraday return of non-shortable stocks is higher than that of shortable stocks by 16.31 basis points. The difference is statistically significant at 1% significance level. This is in line with Scheinkman and Xiong (2003)'s prediction that in the period after information release, short-sale constraints make non-shortable stocks

more volatile due to sensitivity in option-value component. The result fails to reject the null of hypothesis 7 that volatility of intraday return of non-shortable stocks is higher than that of shortable stocks after earning announcement.

Statistics	Shortable	Mean	Std. Deviation	Std. Error Mean
MEAN	NO	-.0067	.2409	.0076
	YES	-.0171	.0528	.0017
VOLATILITY	NO	.8687	.6052	.0192
	YES	.7056	.2377	.0076
SKEWNESS	NO	.3512	1.1437	.0363
	YES	.1392	.9494	.0304
KURTOSIS	NO	5.6735	7.8966	.2506
	YES	4.5317	7.3961	.2370

Table 8 Group Statistics After Earning Announcement: The second column "Shortable" indicates the shortability of the group. If it is yes, the statistics belong to shortable group, and vice versa. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

Statistics		t-test for Equality of Means			
		t	Mean	Std. Error Difference	p-value (2-tailed)
MEAN	Equal variances assumed	-1.3230	-.0104	.0079	.1860
	Equal variances not assumed	-1.3347	-.0104	.0078	.1823
VOLATILITY	Equal variances assumed	-7.8377	-.1631	.0208	.0000
	Equal variances not assumed	-7.8934	-.1631	.0207	.0000
SKEWNESS	Equal variances assumed	-4.4690	-.2120	.0474	.0000
	Equal variances not assumed	-4.4769	-.2120	.0474	.0000
KURTOSIS	Equal variances assumed	-3.3082	-1.1417	.3451	.0010
	Equal variances not assumed	-3.3103	-1.1417	.3449	.0009

Table 9 Independent Samples Test After Earning Announcement: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

Statistics		Bootstrap		
	Mean	Bias	Std. Error	p-value (2-tailed)

MEAN	Equal variances assumed	-.0104	.0000	.0078	.0928
	Equal variances not assumed	-.0104	.0000	.0078	.0916
VOLATILITY	Equal variances assumed	-.1631	-.0004	.0209	.0001
	Equal variances not assumed	-.1631	-.0004	.0209	.0001
SKEWNESS	Equal variances assumed	-.2120	.0003	.0470	.0001
	Equal variances not assumed	-.2120	.0003	.0470	.0001
KURTOSIS	Equal variances assumed	-1.1417	.0057	.3428	.0008
	Equal variances not assumed	-1.1417	.0057	.3428	.0009

Table 10 Bootstrap for Independent Samples Test After Earning Announcement: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974. The column "Bias" indicates the degree to which the standardized distribution and the empirical distribution disagree. The bootstrap results are based on 10,000 bootstrap samples.

Also from table 9, skewness of intraday return of shortable stocks is statistically significantly lower than non-shortable stocks by .2120. This result is against Hong and Stein (2003)'s prediction that after the event of information release, short-sale constraints should make return more left (negative) skewed due to accumulated hidden information. The result successfully rejects the null of hypothesis 5 that after earning announcement, skewness of intraday return of non-shortable stocks is lower than that of shortable stocks.

Kurtosis of intraday return, from table 9, of shortable group is also significantly lower than non-shortable group by 1.1417 after earning announcement. The significance level is 1%. This means short-sale constraints actually increase the frequency of extreme event, rather than reducing. The result is somewhat opposite to regulators' concern. Hypothesis 9 that kurtosis of intraday return of shortable stocks should be higher is rejected by the result.

The results in this section tend to confirm the academics' premise, except for skewness of intraday return. Conditioning on information release, higher short-sale

constraints are associated with higher volatility, and higher kurtosis (fatter tails of distribution) of intraday return. From volatility and kurtosis aspects, the results contradict to what regulators might believe. Allowing short-sales actually lessens volatility of intraday return and reduces the probability of extreme events. This is true to both before and after earning announcement.

From skewness point of view, the results might be disturbing to market participants. The fact that short-sale constraints (conditional information release) are associated with more left (negative) skewed intraday return answers to pessimistic concerns about short-sales directly.

According to Saffi and Sigurdsson (2011), however, we may reconcile the results together and arrive at a more comprehensive conclusion. First, from table 8, the average skewness is positive to both shortable and non-shortable stocks. Second, from table 9, skewness decreases along with lower kurtosis when short-sales constraints lessen. These mean there are less extreme events (implied by reduction in kurtosis), and less extreme positive return (implied by less positive skewness). The cause for reduction in skewness is due to less frequency of extreme positive return, rather than higher frequency of extreme negative return. The conclusion is that decrease in short-sale constraints is associated with higher arbitrageurs' ability to correct mispricing.

6.3 Robustness Test

In this section, further tests are conducted to ensure the integrity of the results. First, to the extent that the differences of the distributional characteristics may not

compile with student-t distribution, non-parametric tests[17] are performed. Those tests include Wilcoxon Signed Ranks Test and Sign Test[18] for unconditional tests, and Mann-Whitney Test, and Wald-Wolfowitz Test for conditional tests. Second, the unconditional test is separated into addition and removal from SET50 events. The results are presented along with their bootstrap counterparts. Third, in conditional test, the raw returns to compute distributional characteristics are altered from 30 to 20 trading days. Forth, SET50 index selection criteria along with other variables are tested in the same manner as the distributional characteristics, both conditional and unconditional on information event. This is to ensure that the results are from change in short-sale constraints, not from the effect of SET50 membership.

The non-parametric tests confirm the result of parametric tests in section 6.1 and 6.2. For the unconditional tests, from table 11, the differences in volatility, skewness, and kurtosis of intraday return are not statistically significant. This is true to both Wilcoxon Signed Ranks Test and Sign Test. In contrast, for the conditional tests from table 12 and table 13, the differences in the distributional characteristics are statistically significant at 1% significance level both before and after earning announcement. The results are the same for both Mann-Whitney Test and Wald-Wolfowitz Test. The results of non-parametric tests are similar to those of parametric tests except that, for conditional test, the mean becomes statistically significant at 1% both before and after earning announcement.

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[17] Non-parametric test is an inferential statistically technique that does not assume particular type of distribution to the data of interest.

[18] According to Chang, Cheng, and Yu (2007), Wilcoxon Signed Ranks Test, and Sign Test are the appropriate non-parametric techniques for studying the property of distributional characteristics. Other statistical techniques can also be used.

The separated unconditional tests show similar results to those in section 6.1. From table 14, the difference in the distributional characteristics is not statistically significant after the stocks were added to the SET50 index. From table 15, the test of SET50 removal event shows the same results.

Furthermore, the results are robust to empirical distribution. From table 4 in section 6.1, the bootstrap results are similar to those in table 3. The bootstrap results in table 15 and table 17 in this section are also consistent with those in table 14 and table 16.

Table 18 and table 19 show the results of conditional test that alter trading days from 30 to 20 days. Table 18 is the test before earning announcement. Table 19 is the test after earning announcement. Overall, the results from changing trading days in the calculation remain intact. Exception is for skewness of intraday return before earning announcement. Although the sign remains unchanged, it becomes less statistically insignificant. Bootstrap results, from table 7 and table 10 in section 6.2, are also consistent with the results in table 6 and table 9, respectively.

To ensure that the results are based on change in short-sale constraints, not from SET50 membership, SET50 index selection criteria are tested. Those variables include market capitalization, trading volume, and free-float shares. Besides, other variables those are potentially associated with the change in the distributional characteristics are also included. Those consist of dividend yield, PE ratio, PB ratio, shares outstanding, alpha, and beta. Table 21 shows the result for unconditional test. Table 23 and table 25 show the conditional tests before and after earning announcement, respectively

From table 21, the SET50 selection criteria are not statistically significantly different when stocks are in and out of SET50 index. The difference in market capitalization, trading volume, and free-float percentage is not statistically significant when stocks are added into or removed from SET50 index. The results for other variables are similar to the selection criteria.

From table 23 and table 25, in the period before and after earning announcement, the difference of mean in SET50 selection criteria is also not statistically significant at 1% significance level. The results of other variables are basically similar to the selection criteria. The exception is for number of shares outstanding whose difference is marginally significant at 10%, before earning announcement.

Statistics		Wilcoxon Signed Ranks Test		Sign Test	
		Z	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)
Pair 1	MEAN	-1.2699	.2041	-.6786	.4974
Pair 2	VOLATILITY	-.2502	.8024	-.8482	.3963
Pair 3	SKEWNESS	-.0147	.9883	.0000	1.0000
Pair 4	KURTOSIS	-.3532	.7239	-.3393	.7344

Table 11 Non-Parametric Paired Sample Test Unconditional on Earning Announcement: This table shows the non-parametric Z-statistics for the differences in distributional characteristics between shortable and non-shortable groups. Negative value of the Z-statistics indicates that the absolute value of shortable stock is less than the absolute of non-shortable stocks

Statistics	Mann-Whitney Test		Wald-Wolfowitz Test	
	Z	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)
MEAN	-0.4107	0.6813	-3.3115	0.0005
VOLATILITY	-7.4799	0.0000	-2.8604	0.0021
SKEWNESS	-3.9819	0.0001	-4.1235	0.0000
KURTOSIS	-5.9922	0.0000	-3.3115	0.0005

Table 12 Non-Parametric Independent Sample Test Before Earning Announcement: This table shows the non-parametric Z-statistics for the differences in distributional characteristics between shortable and non-shortable groups in the period before earning announcement. Negative value of the Z-statistics indicates that the absolute value of shortable stock is less than the absolute of non-shortable stocks

Statistics	Mann-Whitney Test		Wald-Wolfowitz Test	
	Z	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)
MEAN	-1.3668	0.1717	-2.5897	0.0048
VOLATILITY	-7.3758	0.0000	-2.9657	0.0017
SKEWNESS	-5.2796	0.0000	-2.9206	0.0018
KURTOSIS	-5.2747	0.0000	-2.7251	0.0032

Table 13 Non-Parametric Independent Sample Test After Earning Announcement: This table shows the non-parametric Z-statistics for the differences in distributional characteristics between shortable and non-shortable groups in the period after earning announcement. Negative value of the Z-statistics indicates that the absolute value of shortable stock is less than the absolute of non-shortable stocks

Statistics		Paired Differences			p-value (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	
Pair 1	MEAN	.0012	.0442	.0052	.8128
Pair 2	VOLATILITY	.0890	.5919	.0698	.2061
Pair 3	SKEWNESS	-.0529	1.2792	.1507	.7269
Pair 4	KURTOSIS	4.9093	55.6086	6.5535	.4563

Table 14 Paired Samples Test of SET50 Addition Event: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations is 72.

Statistics		Mean	Bootstrap		
			Bias	Std. Error	p-value (2-tailed)
Pair 1	MEAN	.0012	.0001	.0051	.8157
Pair 2	VOLATILITY	.0890	.0002	.0688	.2095
Pair 3	SKEWNESS	-.0529	.0011	.1492	.7217
Pair 4	KURTOSIS	4.9093	-.0177	6.5295	.4616

Table 15 Bootstrap for Paired Samples Test of SET50 Addition Event: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations is 72. The column "Bias" indicates the degree to which the standardized distribution and the empirical distribution disagree. The bootstrap results are based on 10,000 bootstrap samples.

Statistics	Paired Differences			p-value (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	

Pair 1	MEAN	-.0084	.0689	.0084	.3199
Pair 2	VOLATILITY	-.3340	3.4523	.4218	.4312
Pair 3	SKEWNESS	-.3079	2.4022	.2935	.2979
Pair 4	KURTOSIS	-15.6019	75.3002	9.1994	.0946

Table 16 Paired Samples Test of SET50 Removal Event: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations is 68.

Statistics		Mean	Bootstrap		
			Bias	Std. Error	p-value (2-tailed)
Pair 1	MEAN	-.0084	.0000	.0083	.3152
Pair 2	VOLATILITY	-.3340	-.0043	.4171	.5019
Pair 3	SKEWNESS	-.3079	.0038	.2888	.3065
Pair 4	KURTOSIS	-15.6019	.0998	9.2157	.0981

Table 17 Bootstrap for Paired Samples Test of SET50 Removal Event: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations is 68. The column "Bias" indicates the degree to which the standardized distribution and the empirical distribution disagree. The bootstrap results are based on 10,000 bootstrap samples.

Statistics		t-test for Equality of Means			
		t	Mean	Std. Error Difference	p-value (2-tailed)
MEAN	Equal variances assumed	-.2456	-.0020	.0080	.8060
	Equal variances not assumed	-.2472	-.0020	.0080	.8048
VOLATILITY	Equal variances assumed	-6.9225	-.1226	.0177	.0000
	Equal variances not assumed	-6.9421	-.1226	.0177	.0000
SKEWNESS	Equal variances assumed	-1.3339	-.0591	.0443	.1824
	Equal variances not assumed	-1.3353	-.0591	.0443	.1820
KURTOSIS	Equal variances assumed	-3.4782	-.7851	.2257	.0005
	Equal variances not assumed	-3.4792	-.7851	.2257	.0005

Table 18 Independent Samples Test Before Earning Announcement (20 Trading days): The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

Statistics		t-test for Equality of Means			
		t	Mean	Std. Error Difference	p-value (2-tailed)
MEAN	Equal variances assumed	-1.2113	-.0126	.0104	.2259
	Equal variances not assumed	-1.2182	-.0126	.0103	.2234
VOLATILITY	Equal variances assumed	-7.2213	-.1585	.0219	.0000
	Equal variances not assumed	-7.2548	-.1585	.0218	.0000
SKEWNESS	Equal variances assumed	-2.966	-.1279	.0431	.0031
	Equal variances not assumed	-2.972	-.1279	.0431	.0030
KURTOSIS	Equal variances assumed	-4.6618	-1.1266	.2417	.0000
	Equal variances not assumed	-4.6756	-1.1266	.2409	.0000

Table 19 Independent Samples Test After Earning Announcement (20 Trading days): The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

	Statistics	Shortable	Mean	Std. Deviation	Std. Error Mean
Pair 1	ALPHA	NO	.0787	.2507	.0213
		YES	.0768	.1628	.0138
Pair 2	BETA	NO	.9675	.5515	.0468
		YES	.9689	.5334	.0452
Pair 3	DIVIDEND_YIELD	NO	1.6473	9.8225	.8331
		YES	2.0092	12.3263	1.0455
Pair 4	FREE_FLOAT_PCT	NO	44.3383	38.3623	3.2538
		YES	45.0300	39.1543	3.3210
Pair 5	MK_CAP	NO	19039	28702	2434.5396
		YES	19990	29354	2489.8312
Pair 6	PB_RATIO	NO	2.1936	2.1992	.1865
		YES	2.2617	2.0996	.1781
Pair 7	PE_RATIO	NO	15.0161	19.8258	1.6816
		YES	14.7436	18.5767	1.5757
Pair 8	SH_OUTSTANDING	NO	2796.1309	4051.3746	343.6331
		YES	2808.9704	4084.2012	346.4174
Pair 9	VOLUME	NO	16807817	45422565	3852691.6978
		YES	16429422	43603849	3698430.2036

Table 20 Paired Samples Statistics of Additional Variables (Unconditional Test): The number of observations is 140. The second column (Shortable) indicates shortablility. If it is yes, the statistics belong to the shortable period, and vice versa.

Statistics		Paired Differences			p-value (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	
Pair 1	ALPHA	-.0019	.0795	.0082	.8182
Pair 2	BETA	.0014	.0724	.0075	.8558
Pair 3	DIVIDEND_YIELD	.4223	.7355	.3003	.2186
Pair 4	FREE_FLOAT_PCT	-.0059	3.6135	.6597	.9929
Pair 5	MK_CAP	951	33761	3482	.8100
Pair 6	PB_RATIO	.0681	.6572	.0681	.3201
Pair 7	PE_RATIO	-.1678	4.3082	.4817	.7284
Pair 8	SH_OUTSTANDING	12.8395	104.7187	10.8009	.2376
Pair 9	VOLUME	-378394	23379613	2411423	.8757

Table 21 Paired Samples Unconditional Test of Additional Variables: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group, and vice versa. The number of observations is 140.

Statistics	SHORTABLE	Mean	Std. Deviation	Std. Error Mean
ALPHA	NO	.0879	.5234	.0166
	YES	.0649	.1214	.0039
BETA	NO	.9614	1.2560	.0399
	YES	.9782	.4426	.0142
DIVIDEND_YIELD	NO	3.4630	2.1892	.0695
	YES	3.3840	3.0559	.0979
FREE_FLOAT_PCT	NO	44.0935	17.5723	.5576
	YES	42.4862	18.7482	.6007
MK_CAP	NO	47531	123244	3911
	YES	52769	123428	3955
PB_RATIO	NO	1.9786	3.3982	.1078
	YES	2.1206	1.5013	.0481
PE_RATIO	NO	15.8328	44.8025	1.4218
	YES	16.3563	27.7531	.8893
SH_OUTSTANDING	NO	2556	2977	94.4718
	YES	2833	3609	115.6534
VOLUME	NO	14649804	44154067	1401187
	YES	16477464	23704895	759554

Table 22 Group Statistics of Additional Variables Before Earning Announcement: The second column "Shortable" indicates the shortability of the group. If it is yes, the statistics belong to shortable group, and vice versa. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

Statistics		t-test for Equality of Means			
		t	Mean	Std. Error Difference	p-value (2-tailed)
ALPHA	Equal variances assumed	-1.1908	-.0229	.0192	.2339
	Equal variances not assumed	-1.2253	-.0229	.0187	.2208
BETA	Equal variances assumed	.3523	.0168	.0476	.7246
	Equal variances not assumed	.3612	.0168	.0464	.7181
DIVIDEND_YIELD	Equal variances assumed	-1.3639	-.0790	.0579	.1728
	Equal variances not assumed	-1.5070	-.0790	.0524	.1321
FREE_FLOAT_PCT	Equal variances assumed	-1.0046	-1.6074	1.6000	.3156
	Equal variances not assumed	-1.0080	-1.6074	1.5946	.3139
MK_CAP	Equal variances assumed	1.2066	5238	4341	.2278
	Equal variances not assumed	1.1675	5238	4486	.2434
PB_RATIO	Equal variances assumed	1.0594	.1420	.1341	.2896
	Equal variances not assumed	1.0828	.1420	.1312	.2791
PE_RATIO	Equal variances assumed	.2623	.5236	1.9960	.7931
	Equal variances not assumed	.2589	.5236	2.0227	.7958
SH_OUTSTANDING	Equal variances assumed	1.6728	276	165	.0946
	Equal variances not assumed	1.6597	276	167	.0972
VOLUME	Equal variances assumed	1.0240	1827660	1784765	.3060
	Equal variances not assumed	1.0432	1827660	1751931	.2970

Table 23 Independent Samples Test of Additional Variables Before Earning Announcement: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

	SHORTABLE	Mean	Std. Deviation	Std. Error Mean
ALPHA	NO	.0700	.2396	.0076
	YES	.0606	.1178	.0038
BETA	NO	.9653	.5142	.0163
	YES	.9801	.4416	.0141
DIVIDEND_YIELD	NO	3.3823	.6183	.0196
	YES	3.3193	.9983	.0320
FREE_FLOAT_PCT	NO	13.9020	22.8118	.7239
	YES	15.5998	23.5304	.7540
MK_CAP	NO	47686	122386	3884
	YES	51873	122479	3924
PB_RATIO	NO	1.9931	4.1331	.1312
	YES	2.0779	1.5074	.0483
PE_RATIO	NO	13.0405	38.7203	1.2288
	YES	15.0917	31.9425	1.0235

SH_OUT	NO	2564	2978	94.4894
	YES	2777	3598	115.3008
VOLUME	NO	14751059	45226446	1435218
	YES	16320478	27282626	874192

Table 24 Group Statistics of Additional Variables After Earning Announcement: The second column "Shortable" indicates the shortability of the group. If it is yes, the statistics belong to shortable group, and vice versa. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

		t-test for Equality of Means			
		t	Mean	Std. Error Difference	p-value (2-tailed)
ALPHA	Equal variances assumed	-.9862	-.0094	.0095	.3242
	Equal variances not assumed	-1.0078	-.0094	.0093	.3138
BETA	Equal variances assumed	.6178	.0148	.0240	.5368
	Equal variances not assumed	.6212	.0148	.0239	.5346
DIVIDEND_YIELD	Equal variances assumed	-1.5314	-.0630	.0412	.1259
	Equal variances not assumed	-1.5074	-.0630	.0418	.1320
FREE_FLOAT_PCT	Equal variances assumed	1.4675	1.6978	1.1570	.1424
	Equal variances not assumed	1.4659	1.6978	1.1583	.1429
MK_CAP	Equal variances assumed	.9797	4187	4274	.3274
	Equal variances not assumed	.9463	4187	4425	.3443
PB_RATIO	Equal variances assumed	.5386	.0848	.1575	.5902
	Equal variances not assumed	.5534	.0848	.1533	.5801
PE_RATIO	Equal variances assumed	1.1530	2.0512	1.7790	.2491
	Equal variances not assumed	1.1608	2.0512	1.7670	.2459
SH_OUT	Equal variances assumed	1.2967	213	164	.1949
	Equal variances not assumed	1.2881	213	166	.1979
VOLUME	Equal variances assumed	.8343	1569419	1881081	.4042
	Equal variances not assumed	.8483	1569419	1850160	.3964

Table 25 Independent Samples Test of Additional Variables After Earning Announcement: The column "Mean" is the difference of statistics between shortable and non-shortable stocks. The minus sign means the statistic of shortable group is less than non-shortable group. The number of observations of non-shortable group is 993. The number of observations of shortable group is 974.

CHAPTER VII

CONCLUSIONS

The purpose of this study is to provide empirical evidence in regards to the effect of short-sale constraints on volatility, skewness, and kurtosis (collectively, the distributional characteristics) of intraday return. Inconclusive evidence, lack of intraday analysis, and the test conditional on information events are the gaps in the literature filled by this study.

The thesis that motivates this study is that regulators and market participants often hold short-sale responsible for volatility surge, market crash, and extreme events. This melts down to the question whether short-sales should be allowed. Regulators commonly concern that short-sales may pose additional risk to financial markets (Bris et al., 2007). The academics have a harmonic view in support for short-sales that they are essential to well-functioning financial markets[19].

In general, the empirical results in this study tend to support short-sales. This study finds that, in SET50 addition and removal events, the effect of short-sale constraints on volatility, skewness, and kurtosis of intraday return is minimal. The difference in the distributional characteristics is not statistically significant at 1% significance level.

[19] See also Miller (1977), Saffi, and Sigurdsson (2011), Chang, Cheng, Yu (2007), Boehme, Danielsen, Sorescu (2006), Bris, Goetzmann, and Zhu (2007), Diamond, and Verrecchia (1987), and Beber, and Pagano (2011).

When the tests are conducted conditionally on earning announcement, the effect of short-sale constraints on the distributional characteristics is statistically significant at 1% significance level. Before earning announcement, lower short-sale constraints are associated with lower volatility, skewness and kurtosis of intraday return. The results are similar in the period after earning announcement.

With fewer short-sale constraints, reduction in volatility and kurtosis is in favor of short-sales. This means allowing short-sales actually helps stocks become less volatile and reduces the fat tails of intraday return distribution. More negative skewness is consistent with regulators' premise. However, Saffi and Sigurdsson (2011) reconcile the facts that 1) return distribution is positively skewed on average, and 2) skewness reduces along with kurtosis. They conclude that the cause of reduction in skewness is due to fewer occurrence of extreme positive return, rather than more frequency of extreme negative return. This conclusion supports the explanation that short-sale constraints lessen arbitrageurs' ability to correct mispricing.

The results of this study speak directly to existing literatures. During earning announcement, the fact that imposing short-sale constraints actually makes stocks more volatile is consistent with Saffi and Sigurdsson (2011)'s empirical evidence (on monthly and weekly return basis). In the opposite, the results disagree with Chang et al. (2007)'s result of which positive association between short-sale restriction and daily volatility has been found.

Regarding to Scheinkman and Xiong (2003), the empirical evidence found in this study tends to support their theoretical prediction. From the resell-option value argument, they predict positive association between short-sale constraints and

volatility. This is because short-sale constraints constitute resell option to the buyers of securities, hence the resell-option value. The resell-option value is the integral part of the securities price. This effectively makes the securities price more sensitive to information. This study finds that, during earning announcement, non-shortable stocks exhibit higher volatility of intraday return. The results stand to both before and after earning announcement. This is consistent with what Scheinkman and Xiong (2003) theorize.

In regard to skewness, this study finds that, when conditional on earning announcement, relaxing short-sale constraints is associated with reduction in skewness of intraday return. This is consistent with the findings of Xu (2007), and Saffi and Sigurdsson (2011). The result is, however, against Bris et al. (2007) as they find no systematic effect of short-sale constraints on individual stock basis. The finding that kurtosis of intraday return decreases when short-sale constraints are relaxed is also in line with Saffi and Sigurdsson (2011)'s evidence.

From the theoretical standpoint, in addition to Saffi and Sigurdsson (2011), the evidence based on intraday analysis also supports Lamont and Thaler (2003)'s theory that relaxing short-sale constraints actually increases arbitrageurs' ability to correct mispricing, specifically when securities are overvalued. The empirical results in this study find that during earning announcement period, when short-sale constraints are relaxed, we observe less skewness in absolute term (or more negative skewed distribution) which is exactly what Lamont and Thaler (2003) predict. The results also support Xu (2007)'s prediction that short-sale constraints cause the reaction to positive news to be stronger (than to negative news), hence higher skewness (or more

positive skewed distribution). When the results are reconciled with the finding that kurtosis also decreases with fewer short-sale constraints, however, the argument proposed by Lamont and Thaler (2003) is more likely to hold.

This study raises the possibility that Hong and Stein (2003)'s and Lamont and Thaler (2003)'s models are actually similar, but try to explain the effect of short-sale constraints in different period. Because they propose theories that predict opposite relation between short-sale constraints and skewness, it may be the case that Lamont and Thaler (2003)'s prediction holds in the period before, and Hong and Stein (2003)'s prediction holds in the period after the information event.

If the results showed that before earning announcement shortable stocks exhibited more positive skewness, and after earning announcement shortable stocks exhibited more negative skewness, the possibility that both theories are actually the same model would be confirmed. Nevertheless, the empirical results reject this possibility. The results are similar in both before and after earning announcement that shortable stocks constantly exhibit more positive skewness. This tends to support Lamont and Thaler (2003)'s hypothesis that short-sale constraints make it harder to arbitrageurs to correct mispricing. And this explanation is more likely to hold to both before and after the information event.

Despite the implication on existing literatures, this study has its own uniqueness. Thanks to the availability of high frequency data from the Stock Exchange of Thailand, intraday analysis of the effect of short-sale constraints on the distributional characteristics can be performed. This is important to the regulation design process because the purpose of imposing short-sale restriction is to mitigate short-term effect,

and it aims for immediate outcome. The lack of intraday study is the gap in the literature. Besides, the intraday analysis performed is conditional on earning announcement. The analysis provides understanding to the effect of short-sale constraints when they are conditional on the information event.

The implication of this study is that, in a normal course, regulators may allow short-sales to provide benefits to a financial market. Nevertheless, when there is an appropriate information event, should the regulators need intraday return to be more positive skewed, they can do so by putting short-sale constraints in place at a price of higher volatility and ticker-tailed intraday return distribution.

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BIOGRAPHY

Mister Wiwat Suriyaworakul was born on December, 1988. He received his bachelor degree in business and administration from Faculty of Commerce and Accountancy, Thammasat University. He had been working to earn his master degree since 2011 in Master of Science in Finance from Faculty of Commerce and Accountancy, Chulalongkorn University.