Short-sales and Foreign Investors' Behavior in the Korean Stock Market during the Global Financial Crisis*

Sang Buhm Hahn (Kyonggi University)**

Yeongseop Rhee (Seoul National University)***

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ABSTRACT

This paper examines the behavior of short selling activity on event days of non-normal times on an intra-day basis in the Korean stock market, investigates whether foreign investors destabilize the market, and also intends to identify channels through which short-selling activity affects stock prices during non-normal times. After identifying event days, we examine whether short selling affects market quality in terms of market destabilization and market efficiency, based on abnormality of short selling, order imbalance, and market liquidity. We found that there is little evidence of abnormal and abusive short-selling, that non-short selling is much more aggressive than short selling, and that the influence of short-sellers on market liquidity is very limited. The regression analysis of the multivariate structural model shows that for short-sellers, pure selling channel may not be important, while both pure selling and other channels are important for non-short-sellers. Regarding the role of foreign investors, it seems that as foreigners are more actively involved in short selling trading, downward pressure is added and price declines further. Also, after the list of short sale ban, foreigners more utilize non-short-selling trading and their influence on price changes comes more though non-short-selling than short-selling compared to the past.

Keywords: short selling, price reversals, order imbalance, market liquidity

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** Corresponding author: Professor at department of economics, Kyonggi University, Korea; sbhahn@kgu.ac.kr

*** Professor at GSIS, Seoul National University, Korea; ysrhee@snu.ac.kr

I. Introduction

When stock prices sharply fell to the bottom during the period of global financial crisis, it triggered an intense debate on the role of short-sellers in financial markets. Some financial companies severely hit by the turmoil and media strongly blamed short-sellers for that extreme volatility. For example, "a number of banks, most notably Bear Stearns, Lehman Brothers, and Morgan Stanley, blamed short sellers for their woes."[1] Also in mass media, "Almost everyone condemns naked short selling."[2]

Financial regulators seemed to take these arguments, and imposed temporary restrictions on short-selling. On September 18th 2008, the Financial Services Authority (FSA) of the U.K. enacted a ban of short-selling on 32 stocks of financial services companies. On September 19th, the Securities and Exchange Commission (SEC) of the U.S. restricted short-selling of all financial stocks. The Canadian securities administrators also banned short-selling of 13 shares of financial sector issuers which were inter-listed with the U.S. market on September 19th. On September 21st, Australia temporarily banned all forms of short selling, and more European countries also banned short selling of financial stocks. Korea banned short-selling of all stocks on October 1st 2008, and lifted the rule from June 1st 2009 while keeping the ban for financial stocks.

This kind of widespread criticism is at odds with the view of the financial sector and most academic researchers. They argue, "The consensus view among economists is that nothing is wrong with short selling",[3] and that short-sale ban would lead to the opposite result to the intention of regulators, causing substantial deterioration of market quality.[4] Most economists believe that short selling is a valuable market activity, and that short sellers help facilitate more efficient price discovery, mitigate price bubbles, increase market liquidity, and promote risk management activities. "Simply put, short-selling is a vital investment strategy that responds to market fundamentals and contributes to the integrity of stock prices."[5]

Given the wide difference between regulators and academic researchers, it is important to look at empirical evidence. Extant empirical evidence is mostly in favor of short selling, and studies that provide favorable evidence are relatively rare.[6] What's missing in the debate over

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[1] Brunnermeier and Oehmke (2014), p.2153.
[2] George Monbiot, The Guardian, February 15th 2011.
[3] Brunnermeier and Oehmke (2014), p.2154.
[4] Beber and Pagano (2013); Boulton and Braga-Alves (2010).
[5] Requoted from "Are short-sellers really to blame?" New York Times, September 23rd 2008. Also see ISLA (2009) for a position of an interest group.
[6] For positive evidence, see Bechmann (2004); Henry and Koski (2010); Mitchell et al. (2004); Shkilko

the benefits and costs of short-selling, however, is whether short-selling is abusive and disorderly not in normal but in non-normal times. When regulators put restrictions on short-selling, it was clearly stated that they introduced those restrictions "on an emergency basis" and "at a time of extreme market turbulence, manifested in the forms of high and prolonged price volatility and downward pressure on the prices of financial stocks in particular".[7] Thus to discuss whether short-selling ban is justified, we need to focus on those non-normal days and show whether short-selling is really abusive and predatory at "times of stress" and at times of "occasional excesses" rather than during "normal times". If we use all the observations including both normal and non-normal days, the observations of normal days are much larger than the other. Then the influence of the first will be predominant and empirical evidence may not be informative of the real behavior of short selling.

There is little literature that has analyzed short-selling behavior during those non-normal days with occasional excesses. Brunnermeier and Pederson (2005) and Brunnermeier and Oehmke (2014) theoretically show that "even though short-selling activity is beneficial during normal times, at times of stress short sellers can destabilize a financial institution." Shkilko et al. (2007; 2009; 2012) empirically identify days with large intraday price reversals (event days), and show that short sellers are abnormally aggressive and put substantially further pressure on price decline on those event days, even though short-selling enhances market efficiency during normal times. Still we have not found yet a study to analyze short-selling activity in an emerging market, in particular, on an intra-day basis during non-normal times. To our knowledge, Hahn and Rhee (2015) is the first paper that investigated sort-selling activity in Korea on an intra-day basis during non-normal times.[8] But they have not covered the period of global financial crisis, and this paper extends Hahn and Rhee (2015) with more extended data.

When we investigate the behavior of stock prices in an emerging market like Korea, we additionally need to consider the effect of foreign investors. When Asian countries were hit by financial crises in 1997 and 2008, foreign investors were often blamed for the collapse of their financial and foreign exchange markets. For example, during the Asian crisis Stiglitz (1998) argued that "developing countries are more vulnerable to vacillations in international capital flows than ever before". "The experience of crises has led many East Asian countries to conclude that … to prevent a future crisis and to ensure a resilient financial system in emerging

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et al. (2012).

[7] U.K. FSA (2009), p.3.

[8] There are many studies on short-selling in the Korean stock market. But none of them is focused on short-selling behavior during non-normal cases on an intra-day basis. See Binh (2009), Choe and Lee (2010), Eom (2010), Kim (2010), Ko and Ahn (2006), Lee and Wang (2012), Park (2011), Yi and Jang (2009), Yi et al. (2010) among others.

and developing economies, a reduction of capital flow volatility should take priority" (Bark and Rhee 2011). Politicians and journalists further this blame. Mahathir, the former prime minister of Malaysia, said that "currency trading is unnecessary, unproductive and immoral", and "They should be shot." Even 20 years after the crisis, he still blasts "currency traders as unscrupulous profiteers in an immoral line of work."[9] In contrast to the arguments that foreign investors exert a destabilizing influence on financial markets in emerging and developing countries, empirical studies find little evidence of destabilizing effect of foreign investors' activity on stock and currency prices.[10] To clearly understand underlying causes of price volatility in emerging and developing markets, it is therefore very important to additionally consider the role of foreign investors in the markets.

This paper has the following purposes. First, it examines the behavior of short selling activity on event days of non-normal times on an intra-day basis in the Korean stock market. Second, the paper also aims to investigate whether foreign investors indeed destabilize the market. Third, since the data period covers from 2007 to 2010, it includes the period during which short sale ban was imposed. Thus, we additionally analyze the effect of short selling restrictions during the global financial crisis period in the Korean stock market. Finally, this paper intends to identify channels through which short-selling activity affects stock prices during non-normal times.

The remainder of the paper is structured as follows. Section II briefly explains the data used in the paper and shows an overview of short sale trading in the market. In Section III, very detailed explanation on the methodology to identify event days will be provided, following Shkilko et al. (2007; 2009; 2012). After identifying the event days, the section summarizes interesting features in the trend of event days. Section IV examines the behavior of short selling activity and that of foreign investors in terms of abnormality measured by current short-selling volume off the past normal trend, aggressiveness measured by order imbalance, and market liquidity measured by quoted spread. In Section V, we estimate a multivariate model to examine the interplay of different factors in shaping intraday price patterns and to identify various channels through short-selling affects stock price. The conclusion is drawn in Section VI with a brief summary of main findings.

II. Data and Overview

[9] https://www.bloomberg.com/news/articles/2017-07-05/mahathir-still-hates-currency-traders-20-years-after-asia-crisis

[10] For the analysis on the Korean market, see Choe et al. (1999) and Lee and Wang (2012) among others.

For the analysis in the paper, we use all intraday trades and quotes (TAQ) data of stocks that are listed on the Korea Exchange (KRX) and involve short sale from January 3rd of 2007 to December 28th of 2010. TAQ and short-selling data are collected from the Korea Capital Market Institute and the KRX. The data include total 144 million transactions.

Figure 1 shows the basic trend of short sale trading during the period between 2007 and 2010. In the Korean stock market, short sale trading volume steadily increased until the break of the global financial crisis. Since October 1st 2008 when short-selling was banned on all stocks, almost no trading of short sale was observed until the rule was lifted on June 1st 2009. After the lift of ban, there was some recovery of short sale trading but still the volume is smaller than before the ban of short sale trading.

(***Figure 1 here***)

Figure 2 shows that during the period, the volume of short sale trading in the Korean stock market is less than 3% relative to the total volume of daily trading. The share of short sale plunged to almost 0% during the period of restriction; but even after the lift of ban, the share is still lower than before. Figure 3 shows that the short sale trading by foreigners is dominant in the Korean stock market. The mean of foreigners' share in short sale trading is 87% over the sample period. Their share was lowered down to below 40% during the period of ban, but almost fully recovered after the lift of ban.

(***Figure 2 and Figure 3 here***)

III. Identification of Event Days

1. Methodology to identify event days[11]

An event day of non-normal times is defined as a day with large price reversal. The identification procedure of an event day follows two steps. The first step to identify a trading day *d* as an event day with large price reversal is to set a historical intraday volatility ($\sigma_{\bar{u}}$) of stock *i*'s five minute cumulative returns. Following Shkilko et al. (2007; 2009; 2012), we

[11] This part is borrowed from Hahn and Rhee (2015).

calculate $\sigma_{i\bar{d}}$ as the average of daily standard deviations of stock *i*'s five minute cumulative returns during twenty trading days preceding day *d*.

The second step is to set the range of price reversal within a day. A price reversal consists of two stages: the pre-rebound stage with big price decline and the post-rebound stage with price recovery. If a day *d* is to be an event day with large price reversal, it requires two conditions: the price decline should be large enough so that the decrease of stock *i*'s cumulative intraday return is equal to or more than $2 \times \sigma_{i\bar{d}}$ and at the same time the price should rebound so that the return recovers up to the range of 90% to 110% of the initial level by the end of the day. Figure 4 shows the identification procedure of an event day. Suppose the price is 100 at A and $\sigma_{i\bar{d}} = 1\%$. The first condition of large price decline requires that the daily minimum price at B should be equal to or lower than 98 (=100-2 x 1%). The second condition of price rebound implies that the price should recover so as for the closing price to stay between 99.8 (=100-(1.0-0.9) x 2%) at the level of p_1 and 100.2 (=100+(1.1-1.0) x 2%) at the level of p_2.[12]

(***Figure 4 here***)

This identification procedure can differentiate an event day from a non-event day. The first requirement of price decline can differentiate an event day with predatory short-selling from a day without short-selling or news. Without short-selling or news, the price can still fluctuate. However, it would not fluctuate a lot but a little bit around the initial price all day long. If there is predatory short-selling or bad new information instead, then the price decline will be large. Also the second requirement of the 90% to 110% recovery range can differentiate an event day influenced by predatory short-selling from a day influenced by new information. "New information is likely to result in a new price level at the end of the day" (Shkilko et al. 2012, p.350): higher level with good news and lower level with bad news. But if the price influenced only by predatory short-selling, it is likely end up with a similar level to the initial level of price. Thus this requirement can further eliminate the possibility of information influence.

After identifying event days, we filter the results to select the cases of non-normal times that fit our purpose of analysis. We first excluded the data whose prices are lower than 1,000 KRW at the beginning of year, and whose price changes are missing on a given trading day. Since our goal is to identify information-free reversals, we seek to further eliminate information effects by searching DART disclosure system of FSS and KIND system of KRX for corporate

[12] This example assumes $|\Delta r| = 2\%$.

announcements and other news on and around price reversal days. We excluded reversals that occur within a [–5; +5]-day window surrounding an earning or a dividend announcement as reported to FSS and KRX, and reversals that occur within a [–10; +10]-day window surrounding other corporate news events transmitted by almost major business news outlets as reported like SEO (seasoned equity offerings), embezzlement, M&A, and so on.

For the analysis on an intra-day basis, we divided each trading day (regular trading hours: 9:00 am – 3:00 pm) into 72 intervals with each interval of 5 minute length (*j = 1 to 72*). For each interval *j*, 5 minute returns (r_{ij}) of stock i are calculated, and those stocks with less than 50 traded intervals on a given trading day are excluded. Before filtering, the data included 623 stocks and 7,362 event day observations. After all filtering procedures, the number of stocks is reduced to 564 and the number of event days to 5,777 in our final sample.

We further divided pre-rebound and post-rebound stages into 10 sub-periods each. A benefit of this additional procedure is that we can detect the influence of short-selling over long time span: Some short-selling may affect price within a very short run while others may affect a little longer. But a cost is that it reduces the number of observations. In addition, we made four groups of the sample. Price decline may be larger as short-selling grows more aggressive. To examine this possibility and get more information on price fluctuations, the whole sample is divided into four groups according to the magnitude of the pre-rebound price decline: $2 \times \sigma_{it} \leq |\Delta r| < 3 \times \sigma_{it}$; $3 \times \sigma_{it} \leq |\Delta r| < 4 \times \sigma_{it}$; $4 \times \sigma_{it} \leq |\Delta r| < 5 \times \sigma_{it}$; and $5 \times \sigma_{it} \leq |\Delta r|$.

2. Trend and features of event days

Figure 5 and Figure 6 show a basic trend of event days. Out of 5,777 event day observations after the filtering, 1,922 event days were observed with short sale trading, while on the other 3,855 event days, short selling was not observed at all. On average, event days without short sale are more than those with short sale. Also both event days with short sale and without short sale declined during the period of short sale ban, and recovered after the lift of ban. One thing interesting is that ratio of event days with short sale to those without short sale is much smaller after the ban than before. This finding together with the finding that most of short sale trading is carried out by foreigners suggests that there might be some change in foreigners' behavior after the short sale ban. This one will be discussed later.

(***Figure 5 and Figure 6 here***)

Table 1-A and Table 1-B show large intraday price reversals on event days with short sale and those without short sale respectively. The numbers in the table represent cumulative intraday returns. In each table, Panel A shows the total pre-rebound and post-rebound cumulative returns, and Panel B shows period-by-period cumulative returns. The tables clearly show that price declines in the pre-rebound stage and rebounds in the post-rebound stage. Also it is confirmed that as price decline gets larger, the rebound grows larger. For example, in the case of event days with short sale in Table 1-A, the first group shows the smallest price reversal of 1.89% from -1.56% to 0.33%, while the last group the biggest reversal of 4.38% from -4.04% to 0.34%. This observation is also similar in the case of event days without short sale in Table 1-B. If we compare price reversals between Table 1-A and Table 1-B, it is observed that price reversals with short sale are larger than those without short sale, as shown in Figure 7.

(***Table 1-A and Table 1-B here***)
(***Figure 7 here***)

IV. Behaviors of Short-selling activity

The literature on the effect of short sale trading on market quality mostly focuses two issues: whether short sale destabilizes the market; and whether short sale worsens or enhances market efficiency.[13] Before specifically examining these issues, as a starting point we first look at whether short sale trading shows abnormal behavior on event days. However, the existence of abnormal short sale itself cannot be an evidence that short sale deteriorates the market quality. Therefore additional investigation of two issues will be followed. One of them is aggressiveness of short sale related with destabilization of the market, and the other is liquidity related with market efficiency.

1. Abnormality of short sale

To examine the basic relation between short sale and price reversals, we first check whether short sale is more active than usual on event days. Instead of using the magnitude of

[13] Beber and Pagano (2013) said that the literature on the effect on the market quality of short sale bans around the world can be categorized into three classes, focusing on liquidity, price discovery, and overpricing.

short sale trading volume itself, we use the following measure of standardized short sale.

$$av_{ijd} = \frac{v_{ijd} - \mu_v}{\sigma_v} \quad (1)$$

In the above equation (1), v_{ijd} is short sale trading volume of stock *i* during interval *j*, and μ_v and σ_v are respectively the mean and the standard deviation of short sale trading volume during twenty trading days preceding event day *d*. We will call this measure 'abnormal short sale' (av) because it shows whether the current short sale is off the past normal trend or not. If short sale is more active on event days, av on event days is expected to be significantly larger than on non-event days.

Table 2 and Figure 8 show the relation between short sale and price reversals on event days. We can first find that av is increasing both in the pre-rebound stage and in the post-rebound stage, which suggests that there is little evidence of abusive short sale in the Korean stock market. Second, the short selling activity increases as price decline in the pre-rebound stage becomes larger. This is also confirmed in Table 3, which provides more detailed information on price decline and abnormal short sale volume. In all groups, most short sale estimates are statistically significant not only in the pre-rebound stage but also in the post-rebound stage.

This result is different from Shikilko et al. (2009). From the analysis of short selling activities in the U.S. market, they found that "Overall, *abnormal short-selling* gradually increases early in the pre-rebound stage and then begins to decline mid-stage" (Shikilko et al. 2009, p.13), but that it is still significantly different from zero in the post-rebound stage. Intense short sale in the pre-rebound stage implies predatory activities while intense short sale in the post-rebound stage implies contrarian activities. Thus they conclude that in the case of the U.S., "whereas aggressive activities may cease by the time prices reach a reversal point, a contrarian activity may replace it" (Shikilko et al. 2009, p.14). However, in Korea we couldn't find predatory short sale in the pre-rebound stage but only contrarian short sale in the post-rebound stage.

(***Figure 8 here***)
(***Table 2 here***)

2. Aggressiveness of short sale

Although the above short sale volume may hint short-seller's abusiveness, we need a

separate measure to differentiate pure aggressiveness of short sale from others. If short-sellers are speculative, they will aggressively place sell-orders when price declines. Thus in the pre-rebound stage of price decline, the seller-initiated trading volume will be much larger than the buyer-initiated one. In contrast, when price rebounds, buy-orders will consume all sell-orders and the seller-initiated trading volume will be smaller than the other.[14] Thus as a measure of short sale aggressiveness, we use the following order imbalance (iv).

$$iv_{ijd} = \frac{buyer\ initiated\ volume - seller\ initiated\ volume}{total\ trading\ volume} \quad (2)$$

Table 3-A shows order imbalances in the pre-rebound and the post-rebound stages for the four groups on event days. According to the table, sellers do not dominate in the pre-rebound stage of price decline unlike our expectation. Estimates of order imbalances are positive in many cases and are not statistically significant. In contrast, in the post-rebound stage of price reversals, buyers are dominant and order imbalance becomes positive and statistically significant as expected. This implies that in the Korean stock market, short sale is not predominantly seller-initiated and short-sellers are not so aggressive when price declines.

Order imbalances may be caused not only by short sale but also by non-short-sale (Brunnermeier and Pederson 2005). To compare aggressiveness between short sale and non-short sale, we also show the estimates of order imbalances for non-short sale in Table 3-B. The table clearly shows that as price declines, sellers dominate and order imbalances are largely negative. This dominance remains very strong until price begins to rebound. Once price reveals start in the post-rebound stage, order imbalances become positive. In the case of non-short sale, order imbalances both in the pre-rebound and in the post-rebound stages are consistent with our expectation. This result shows that non-short sale is much more aggressive than short sale in the Korean stock market.

(***Table 3-A and Table 3-B here***)

3. Short sale and market liquidity

Short sale may also affect the efficiency of the stock market through its influence on market liquidity. If short sale increases potential sellers in the market, market liquidity can be

[14] Sifat and Mohamad (2015), p.8; Shkilko et al. (2009), pp.15-16.

increased and market efficiency can also be improved through increased trading volumes and reduced transaction costs (FSA 2009, p.10). Conversely, if short sale reduces market liquidity as Madrigal (1996) and Cai et al. (2006) posit, it will discourage potential sellers, increase transaction costs and worsen market efficiency. In particular, when short sellers are intentionally putting excessive pressure on prices, they "may be actively promoting withdrawals of liquidity on the bid side or inducing additional short selling by contacting other traders" (Shkilko et al. 2009, p.23) and amplify price decline in the pre-rebound stage.

A widely used measure of liquidity is that of Amihud (2002), which is the daily ratio of absolute stock return to its trading volume, averaged over time. But it has some limit to apply to our data, and we use the percentage quoted spreads as a proxy measure of market liquidity, following Shikilko et al. (2009).

$$sp = \frac{best\ ask\ quote - best\ bid\ quote}{0.5 \times (best\ ask\ quote + best\ bid\ quote)} \qquad (3)$$

Table 4 shows that quoted spreads don't show much difference between two stages but are a little wider in the pre-rebound stage of price decline than in the post-rebound stage of price reversals. This would imply that market liquidity may be a little limited during price decline stages while it slightly improves during price reversal stages. As price decline becomes larger in the pre-rebound stage, quoted spreads also become larger. It implies that more active short selling limits market liquidity a little more than less active one.

(***Table 4 here***)

V. Channels of Intraday Price Changes

In the previous section, we examined behaviors of short sale, i.e., abnormality of short sale, order imbalance, and liquidity, which are believed to affect intraday price change on event days with large price reversals. Even though we have investigated the effects of those variables separately, it would be naïve to believe that their influences on market price are separate and independent. To identify channels that short sale affects intraday piece changes, it is needed to examine not only separate effects but also the interplay of different variables in shaping intraday price patterns.

1. The model

To investigate the influences of various factors on intraday price changes, we specify a multivariate structural model including those variables considered above. In addition, we include non-short sale volume (av^n) and order imbalance of non-short sale volume (iv^n) because the results in the previous section suggest they strongly affect price declines in the pre-rebound phase. In particular, to investigate the role of foreign investors, the foreigners' share in short sale trading volume is added in the model. We also include lags of all variables.

$$r_{ij} = \beta_0 + \beta_1 av_{ij} + \beta_2 av_{ij-1} + \beta_3 av_{ij}^n + \beta_4 av_{ij-1}^n + \beta_5 iv_{ij} + \beta_6 iv_{ij-1} + \beta_7 iv_{ij}^n + \beta_8 iv_{ij-1}^n + \beta_9 sp_{ij} + \beta_{10} sp_{ij-1} + \beta_{11} r_{ij-1} + \beta_{12} r_{ij-1} + \varepsilon_i \quad (4)$$

where r_{ij} is the 5-minute return for stock *i* during interval *j* used to identify price reversals in Section II. av and av^n are abnormal volumes of short sale and non-short sale respectively calculated using equation (1). They are expected to have a negative effect on prices because sell orders will put downward pressure on prices. iv and iv^n are order imbalances of short sale and non-short sale respectively based on equation (2). They are also expected to have a negative effect on prices because aggressive sell orders further move prices down. sp is quoted spreads from equation (3), and is expected to have a negative sign because as short sale is more aggressive, predatory short sellers will actively promote withdrawals of liquidity on the bid side and price will decline further. fs is the share of foreign investors in short sale trading, and is expected to have a negative sign. As foreigners are more active in short sale, it will further downward pressure on prices. The lag of the dependent variable r_{ij-1} is included to get the consistent estimates. We estimate this dynamic panel model using system GMM estimation method by Blundell and Bond (1998).

2. Results

Table 5 reports the empirical results with price changes in the pre-rebound stage as the dependent variables. We ran regressions of equation (4) with three different specifications: Model (1), Model (2) and Model (3).

Model (1) includes only abnormality trading variables on event days (av and av^n) with excluding order imbalance variables. Since order imbalance variables are not included, av variables reflect the compound effect of short sale on stock price not only through selling

(buying) pressure of market trading on event days but also through other complicated channels such as market sentiment change. The regression result of Model (1) shows that the sum of coefficients for av variables is positive[15] while that of av^n is negative and larger than that of av in absolute terms. This indicates that selling of stocks moves prices down but short sellers behave as a contrarian trader rather than a momentum trader in the Korean stock market. This is consistent with Lee and Wang (2012) who found that short-sellers are contrarian traders in Korea. Also the coefficients of quoted spread variable (sp) are not significant, which implies that the influence of short-sellers on market liquidity is very limited.[16]

(***Table 5 here***)

Model (2) additionally includes order imbalance variables only of short sale (iv), still excluding those of non-short sale (iv^n). This is to analyze a separate effect of short sale on price changes through pure selling (buying) pressure from that through other channels. If the effect of short sale is purely through selling (buying) pressure, then the addition of order imbalances of short sale significantly reduces the effect of av. Otherwise, some part of av's influence on stock price should still remain even after the addition of iv. The regression result of Model (2) is basically the same as that of Model (1). But one thing to note is that the effect of additional variable iv on stock price is not significant and that av is still significant. This implies that the pure selling (buying) channel of short sale is not noticeable in influencing stock price and that seller-initiated aggressive short sale does not lead to negative order imbalance and price decline. The result suggests that there are other channels than pure selling (buying) of short sale through which prices are affected on event days.

Model (3) adds order imbalances of both short sale and non-short sale (iv and iv^n) to Model (1). This is to identify various channels not only for short sale but also for non-short sale. As we saw in the previous section, non-short sale is more aggressive than short sale in the Korean stock market. Thus this examination of whether order imbalances of non-short sale as well as short sale affect price changes through pure selling (buying) channel is very important. The regression result of Model (3) again looks similar to that of Model (2). An important additional result is that the coefficient of order imbalances of short sale becomes significantly negative and that of non-short sale is positive and very significant. But the latter is much larger,

[15] The coefficients for lagged ones are negative but mostly insignificant.
[16] Lee and Wang (2012) found that liquidity provision by investors is not supported through their short-selling activity in the Korean stock market.

indicating that aggressive seller-initiated trading of non-short sellers leads to negative order imbalances and further decline of prices. Even though the effect of order imbalances of non-short sale is very strong, av^n is still statistically significant. This implies that both pure selling and other channels are important for non-short sellers. Finally, the sum of coefficient for foreign investors is negative. This suggests that as foreigners are more actively involved in short sale trading, downward pressure is added and price declines further.

In Table 6, we divide the whole period into two sub periods, before and after adopting the short sale ban on October 1st 2008. This is to analyze the difference in the channels between two sub periods and the effect of the ban. The results in the pre-ban and the post-ban periods look similar to each other. But a few things are noteworthy. First, the coefficients of *av* variables become smaller while those of *iv* variables become larger in the post-ban period. This implies that the influence of pure selling channel is increasing in the post-ban period. Second, in the pre-ban period *fs* is not significant, but it becomes significantly negative in the post-ban period. Considering previous findings all together that event days increase with non-short sale in the post-ban period, that most of short sale is carried out by foreigners, and that the effect of order imbalances of non-short sale is much stronger than that of short sale, this finding indicates that foreigners more utilize non-short sale trading in the post-ban period than before. Thus the ban may have some effect in changing foreigners' behavior in short market even after the lift of ban in that foreigners' influence on price changes comes more though non-short sale than short sale compared to the past.

(***Table 6 here***)

VI. Conclusion

In this paper, we examined short sale activity focusing on its behaviors not during normal times but during non-normal times of occasional excesses in the Korean stock market. To our knowledge, this paper is the first to investigate the behavior of short sale activity during non-normal times on an intra-day basis in the Korean stock market.

Using the methodology explained by Brunnermeier and Pederson (2005) and Shkilko et al. (2009; 2012), we first identified event days of large price reversals. It was observed that the the short sale trading by foreigners is dominant in the Korean stock market. It was also found that event days without short sale are more than those with short sale, that the ratio of event days

with short sale to those without short sale is decreased in the post-ban period, and that price reversals with short sale are larger than those without short sale.

After identifying event days, we examined whether short sale affects market quality in terms of market destabilization and market efficiency, based on abnormality of short sale, order imbalances, and market liquidity. First, there was little evidence that short sale abnormally behaves and is abusive on event days, but that short sellers look like a contrarian rather than momentum trader. When we compared aggressiveness between short sale and non-short sale using order imbalance variables, we found that non-short sale is much more aggressive than short sale in the Korean stock market. From the observation of market liquidity measured by quoted spreads, we could find that market liquidity may be a little bit limited during the price decline stage while it slightly improves during the price reversal stage.

Also, using a multivariate structural model, we tried to identify channels through which short-selling activity affects stock prices during non-normal times, (disaggregating the compound effect of short sale into differentiated ones not only through pure trading channel of short selling but also through other complicated channels such as non-short selling channel and market sentiment changes). Overall, the regression analysis of the multivariate structural model shows similar results to those findings in the previous section. In the Korean stock market, short sellers seem to behave as a contrarian trader rather than a momentum trader. Also, seller-initiated aggressive trading of non-short sale rather than that of short sale leads to negative order imbalances and further price decline. For short-sellers, pure selling channel may not be important, while both pure selling and other channels are important for non-short-sellers. Regarding the role of foreign investors, it seems that as foreigners are more actively involved in short sale trading, downward pressure is added and price declines further. Finally, quoted spreads are not significant, which implies that the influence of short sale on market liquidity is very limited.

We also compared between the pre-ban period and the post-ban period. Two things are noteworthy. First, the influence of pure selling channel is increasing in the post-ban period. Second, foreigners more utilize non-short sale trading in the post-ban period than before. This implies that the ban has some effect in changing foreigners' behavior in short market even after the lift of ban: i.e., in the post-ban period, foreigners' influence on price changes comes more though non-short sale than short sale compared to the past.

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<Table 1-A> Price changes on event days with short sale

Group		1	2	3	4
Range		[2; 3)	[3; 4)	[4; 5)	[5; ∞)
Panel A: Pre- and post-rebound aggregate statistics					
Pre		-1.56	-2.29	-2.91	-4.04
Post		0.33	0.27	0.28	0.34
Panel B: Pre- and post-rebound statistics, by period					
PRE PERIOD	-10	0.02	-0.17	-0.38	-0.40
	-9	-0.30	-0.54	-0.82	-0.97
	-8	-0.47	-0.80	-1.05	-1.33
	-7	-0.64	-1.02	-1.29	-1.68
	-6	-0.75	-1.17	-1.55	-1.98
	-5	-0.87	-1.34	-1.68	-2.22
	-4	-1.00	-1.49	-1.94	-2.56
	-3	-1.16	-1.72	-2.20	-2.96
	-2	-1.34	-1.94	-2.46	-3.37
	-1	-1.56	-2.29	-2.91	-4.04
POST PERIOD	1	-1.53	-2.21	-2.84	-4.02
	2	-1.35	-2.00	-2.57	-3.63
	3	-1.23	-1.83	-2.33	-3.35
	4	-1.16	-1.71	-2.20	-3.09
	5	-1.07	-1.60	-2.10	-2.86
	6	-0.98	-1.48	-1.86	-2.59
	7	-0.86	-1.29	-1.69	-2.31
	8	-0.71	-1.04	-1.38	-1.91
	9	-0.48	-0.73	-0.99	-1.43
	10	0.33	0.27	0.28	0.34
Panel C: Number of events					
	1922	988	543	291	172

<Table 1-B> Price changes on event days without short sale

Group		1	2	3	4
Range		[2; 3)	[3; 4)	[4; 5)	[5; ∞)
Panel A: Pre- and post-rebound aggregate statistics					
Pre		-1.51	-2.15	-2.67	-3.52
Post		0.37	0.38	0.25	0.21
Panel B: Pre- and post-rebound statistics, by period					
PRE PERIOD	-10	0.04	-0.15	-0.10	-0.09
	-9	-0.28	-0.48	-0.57	-0.59
	-8	-0.47	-0.67	-0.84	-0.81
	-7	-0.59	-0.87	-0.97	-1.07
	-6	-0.73	-1.07	-1.19	-1.30
	-5	-0.85	-1.24	-1.42	-1.63
	-4	-0.95	-1.42	-1.67	-1.93
	-3	-1.09	-1.63	-1.84	-2.19
	-2	-1.27	-1.80	-2.14	-2.59
	-1	-1.51	-2.15	-2.68	-3.52
POST PERIOD	1	-1.53	-2.20	-2.65	-3.69
	2	-1.33	-1.93	-2.40	-3.35
	3	-1.22	-1.75	-2.07	-3.15
	4	-1.13	-1.60	-1.95	-2.91
	5	-1.06	-1.48	-1.78	-2.61
	6	-0.97	-1.39	-1.57	-2.39
	7	-0.88	-1.23	-1.37	-2.12
	8	-0.75	-1.06	-1.14	-1.73
	9	-0.53	-0.76	-0.87	-1.34
	10	0.38	0.38	0.25	0.21
Panel C: Number of events					
	3855	1973	1056	467	359

<Table 2> Short sale during large price reversals: *av*

Group		1	2	3	4
Range		[2; 3)	[3; 4)	[4; 5)	[5; ∞)
Panel A: Pre- and post-rebound aggregate statistics					
Pre		0.17***	0.18***	0.29***	0.43***
Post		0.26***	0.34***	0.46***	0.55***
Panel B: Pre- and post-rebound statistics, by period					
PRE PERIOD	-10	0.14	0.14	0.17	0.28
	-9	0.08	0.13	0.18	0.38
	-8	0.12	0.15	0.29	0.25
	-7	0.12	0.14	0.21	0.24
	-6	0.12	0.16	0.25	0.37
	-5	0.15	0.16	0.25	0.25
	-4	0.12	0.17	0.23	0.46
	-3	0.12	0.12	0.25	0.30
	-2	0.14	0.12	0.27	0.38
	-1	0.09	0.09	0.31	0.40
POST PERIOD	1	0.36	0.33	0.52	0.57
	2	0.20	0.26	0.39	0.60
	3	0.19	0.25	0.54	0.26
	4	0.17	0.29	0.32	0.11
	5	0.16	0.25	0.27	0.24
	6	0.13	0.25	0.43	0.40
	7	0.17	0.27	0.40	0.41
	8	0.13	0.19	0.32	0.47
	9	0.15	0.18	0.38	0.38
	10	0.28	0.37	0.51	0.50

<Table 3-A> Order imbalance with short sale: *iv*

Group		1	2	3	4
Range		[2; 3)	[3; 4)	[4; 5)	[5; ∞)
Panel A: Pre- and post-rebound aggregate statistics					
Pre		0.476***	0.472***	0.460***	0.317***
Post		0.496***	0.507***	0.455***	0.312***
Panel B: Pre- and post-rebound statistics, by period					
PRE PERIOD	-10	0.522	0.489	0.608	0.480
	-9	0.507	0.501	0.509	0.385
	-8	0.464	0.485	0.423	0.351
	-7	0.457	0.456	0.432	0.386
	-6	0.401	0.426	0.437	0.253
	-5	0.433	0.378	0.482	0.248
	-4	0.470	0.476	0.466	0.258
	-3	0.496	0.481	0.501	0.306
	-2	0.510	0.362	0.471	0.211
	-1	0.452	0.494	0.328	0.216
POST PERIOD	1	0.451	0.457	0.477	0.286
	2	0.459	0.448	0.417	0.347
	3	0.438	0.481	0.438	0.216
	4	0.446	0.507	0.361	0.244
	5	0.474	0.487	0.387	0.239
	6	0.486	0.460	0.441	0.275
	7	0.511	0.461	0.395	0.323
	8	0.520	0.491	0.602	0.299
	9	0.555	0.564	0.552	0.207
	10	0.641	0.647	0.699	0.428

<Table 3-B> Order imbalance with non-short sale: iv^n

Group		1	2	3	4
Range		[2; 3)	[3; 4)	[4; 5)	[5; ∞)
Panel A: Pre- and post-rebound aggregate statistics					
Pre		-0.238***	-0.259***	-0.235***	-0.251***
Post		0.035***	0.053***	0.104***	0.078***
Panel B: Pre- and post-rebound statistics, by period					
PRE PERIOD	-10	-0.078	-0.080	-0.122	-0.161
	-9	-0.224	-0.268	-0.233	-0.207
	-8	-0.234	-0.231	-0.221	-0.296
	-7	-0.251	-0.253	-0.276	-0.258
	-6	-0.266	-0.293	-0.240	-0.295
	-5	-0.236	-0.270	-0.236	-0.345
	-4	-0.272	-0.312	-0.292	-0.282
	-3	-0.283	-0.324	-0.305	-0.284
	-2	-0.326	-0.364	-0.307	-0.299
	-1	-0.365	-0.400	-0.389	-0.376
POST PERIOD	1	-0.021	-0.035	0.038	-0.011
	2	-0.023	-0.042	0.010	-0.025
	3	-0.033	-0.002	0.001	-0.046
	4	-0.016	-0.019	0.041	-0.052
	5	-0.035	-0.024	0.060	0.071
	6	0.009	0.012	0.099	0.084
	7	0.037	0.084	0.121	0.109
	8	0.078	0.092	0.157	0.172
	9	0.145	0.187	0.230	0.211
	10	0.379	0.382	0.450	0.452

<Table 4> Liquidity: *quoted spreads (qs)*

Group	1	2	3	4
Range	[2; 3)	[3; 4)	[4; 5)	[5; ∞)
Quoted spreads (% qsp, bps)				
Pre	0.2633***	0.2834***	0.2872***	0.3004***
Post	0.2582***	0.2643***	0.2720***	0.2908***

<Table 5> Determinants of intraday returns

	pre-rebound		
Model	(1)	(2)	(3)
av_t	0.0508***	0.0478***	0.0371***
	(0.0018)	(0.0037)	(0.0036)
av_{t-1}	-0.0046**	-0.0025	-0.0045
	(0.0018)	(0.0036)	(0.0035)
av^n_t	-0.1053*** (0.0022)	-0.1016*** (0.0055)	-0.0920*** (0.0053)
av^n_{t-1}	0.0242*** (0.0022)	0.0278*** (0.0055)	0.0271*** (0.0053)
sp_t	-0.0387 (0.0306)	0.0464 (0.1081)	-0.0233 (0.1041)
sp_{t-1}	0.0052 (0.0300)	-0.0816 (0.1040)	-0.0745 (0.1001)
r_{t-1}	-0.1015*** (0.0026)	-0.0907*** (0.0062)	-0.0924*** (0.0061)
iv_t		-0.0018 (0.0163)	-0.0400* (0.0158)
iv_{t-1}		-0.0081 (0.0165)	-0.0175 (0.0160)
iv^n_t			0.3953*** (0.0188)
iv^n_{t-1}			-0.0094 (0.0192)
fs_t			0.0356 (0.0250)
fs_{t-1}			-0.0439* (0.0251)
Constant	-0.0603*** (0.0019)	-0.0600*** (0.0082)	-0.0335 (0.0229)
R-squared	0.1141	0.1038	0.1710
N	35,017	6,509	6,509

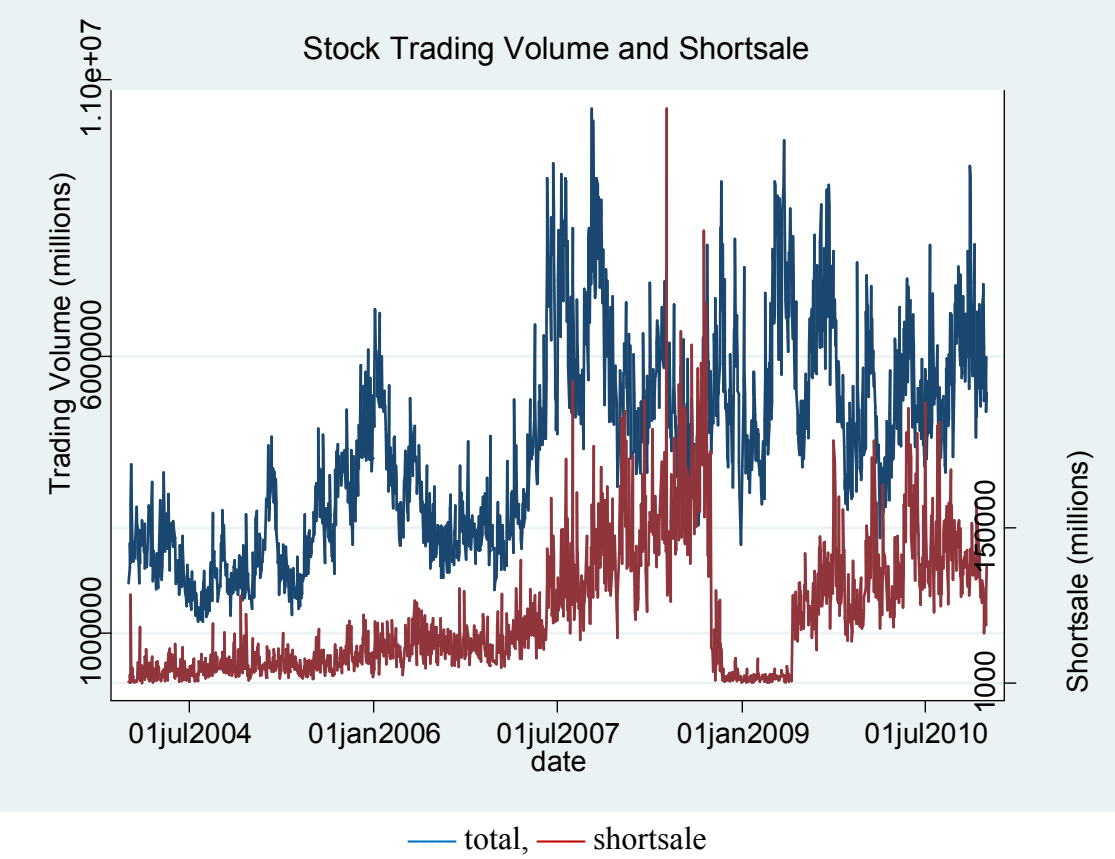
Note: 1. *av* and av^n are abnormal short sale and non-short sale respectively. *iv* and iv^n are order imbalances of short sale and non-short sale. *sp* is quoted spreads. *fs* is foreigners' share in short sale trading.
2. Standard errors are reported in parentheses.
3. ***, ** and * denote significance at 1%, 5%, and 10% level, respectively.

<Table 6> Determinants of intraday returns: by group

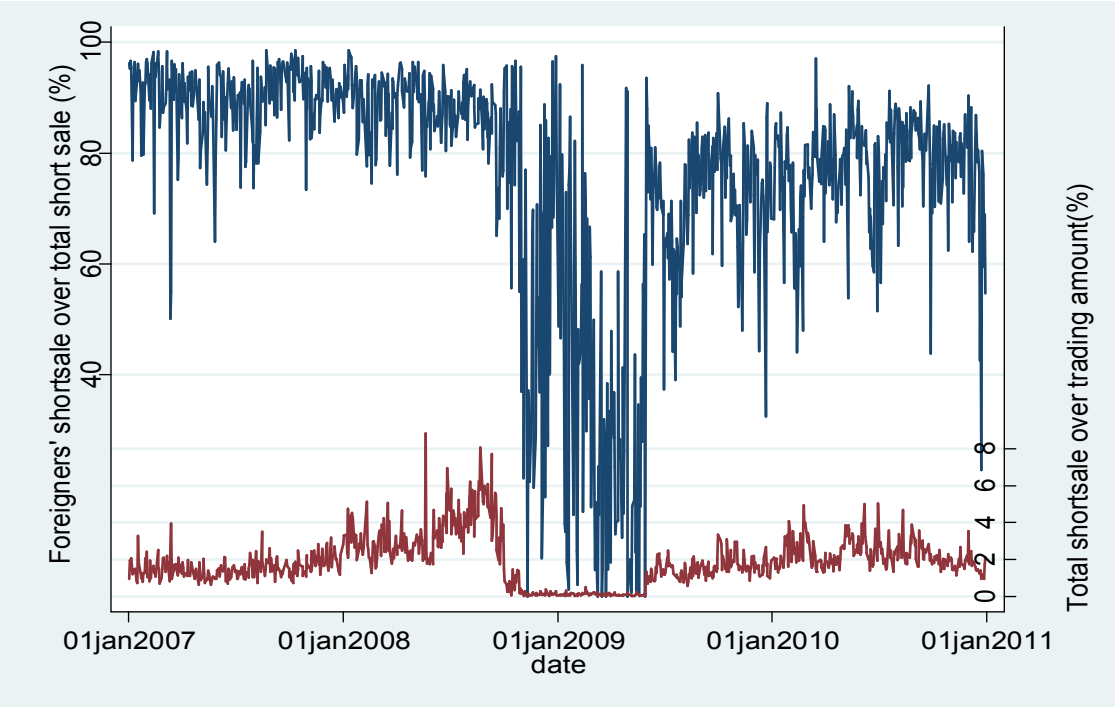
	pre-rebound	
	Before Crisis	After Crisis
av_t	0.0350*** (0.0070)	0.0221*** (0.0045)
av_{t-1}	-0.0008 (0.0068)	-0.0031 (0.0044)
av^n_t	-0.0892*** (0.0104)	-0.0884*** (0.0068)
av^n_{t-1}	0.0112 (0.0104)	0.0284*** (0.0069)
sp_t	-0.0614 (0.1773)	0.2605 (0.1351)
sp_{t-1}	0.0143 (0.1685)	-0.1537 (0.1361)
r_{t-1}	-0.0726*** (0.0122)	-0.1059*** (0.0084)
iv_t	-0.0374 (0.0306)	-0.0624** (0.0218)
iv_{t-1}	-0.0289 (0.0309)	0.0022 (0.0224)
iv^n_t	0.4405*** (0.0315)	0.4626*** (0.0242)
iv^n_{t-1}	-0.0367 (0.0326)	-0.0298 (0.0249)
fs_t	0.0092 (0.0516)	-0.0090 (0.0269)
fs_{t-1}	-0.0443 (0.0547)	-0.0498* (0.0265)
Constant	0.0025 (0.0702)	0.0386 (0.0299)
R-squared	0.2233	0.2323

Note: 1. *av* and av^n are abnormal short sale and non-short sale respectively. *iv* and iv^n are order imbalances of short sale and non-short sale. *sp* is quoted spreads. *fs* is foreigners' share in short sale trading.
2. Standard errors are reported in parentheses.
3. ***, ** and * denote significance at 1%, 5%, and 10% level, respectively.

<Figure 1> Stock trading volume and short sales

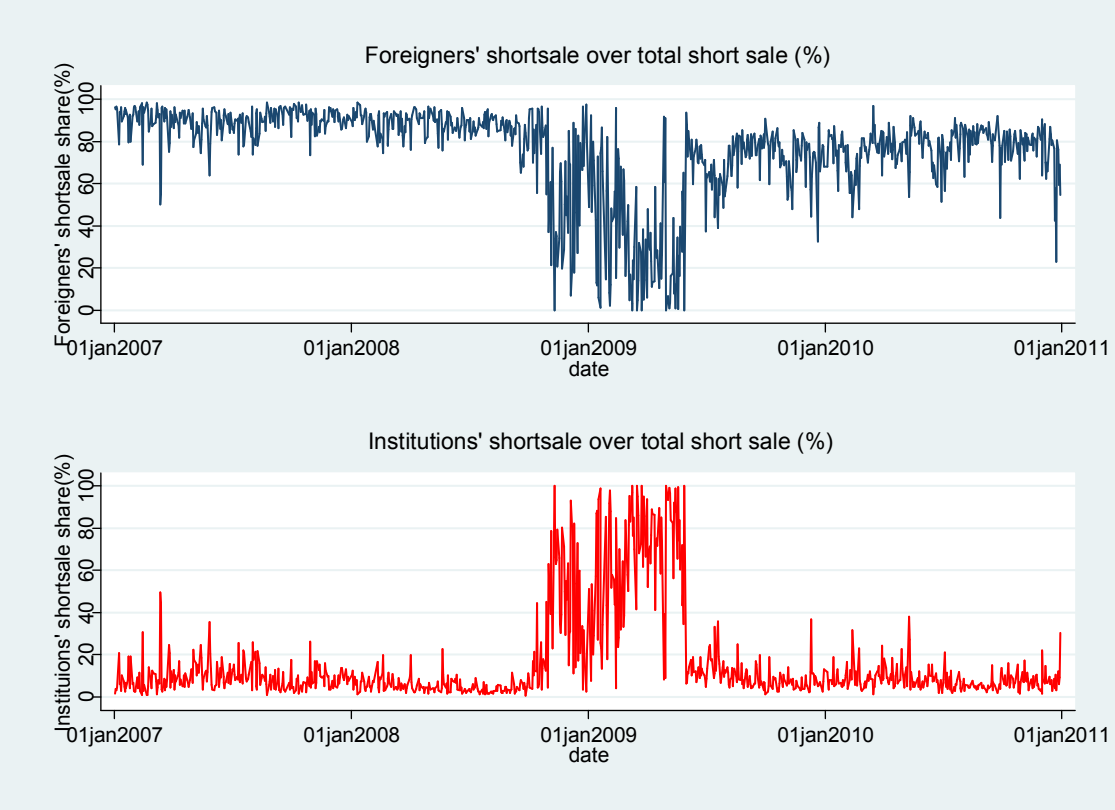


<Figure 2> Share of short sales



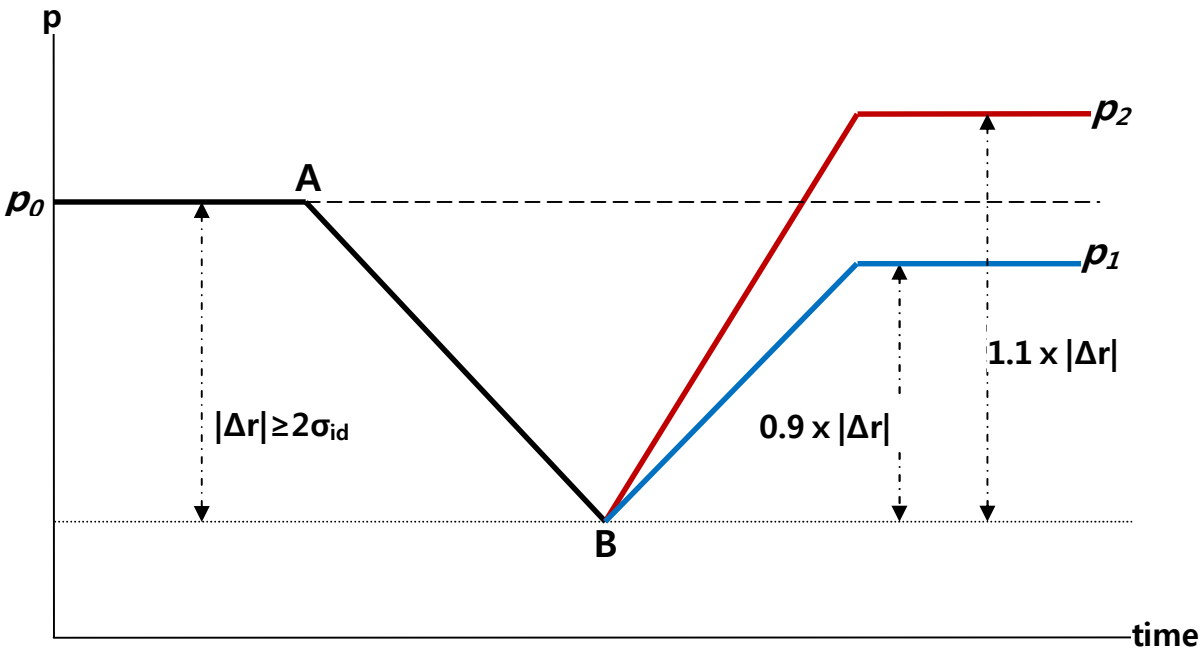
foreigners' share in shortsale, shortsale/total volume

<Figure 3> Share of short sales: foreigners vs. institutions

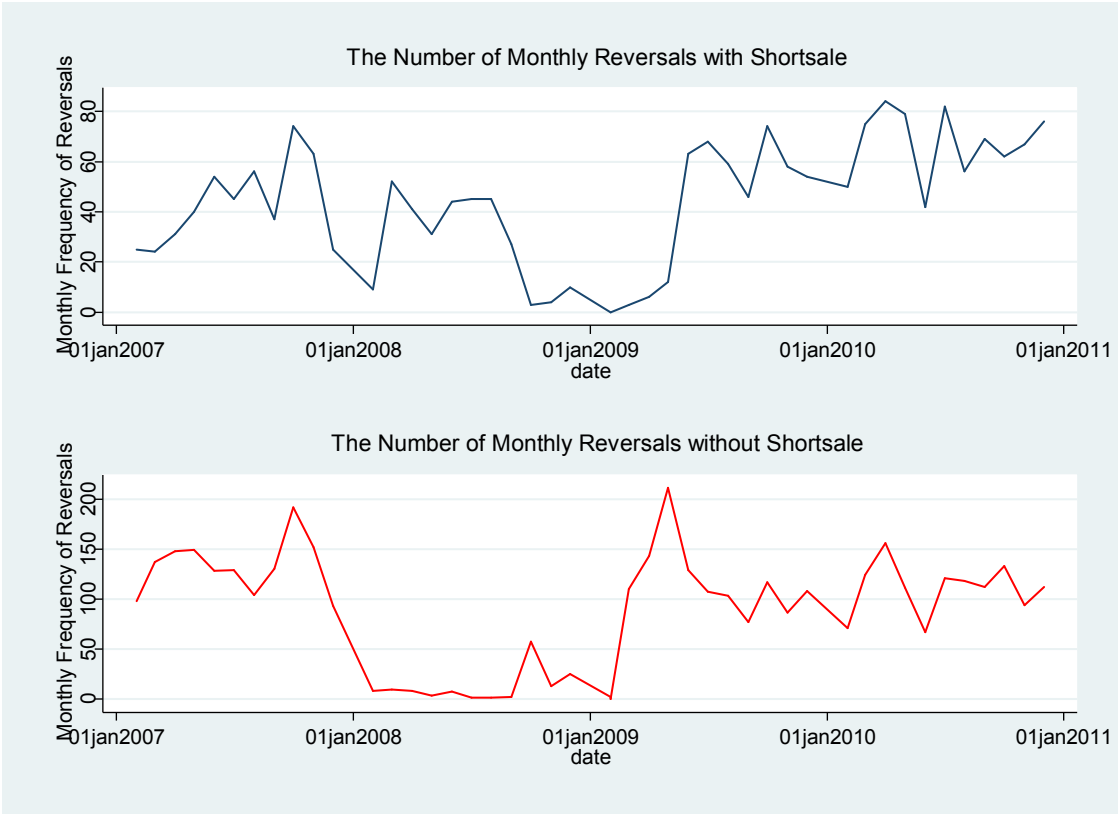


foreigners' share in short sale, institutions' share in short sale

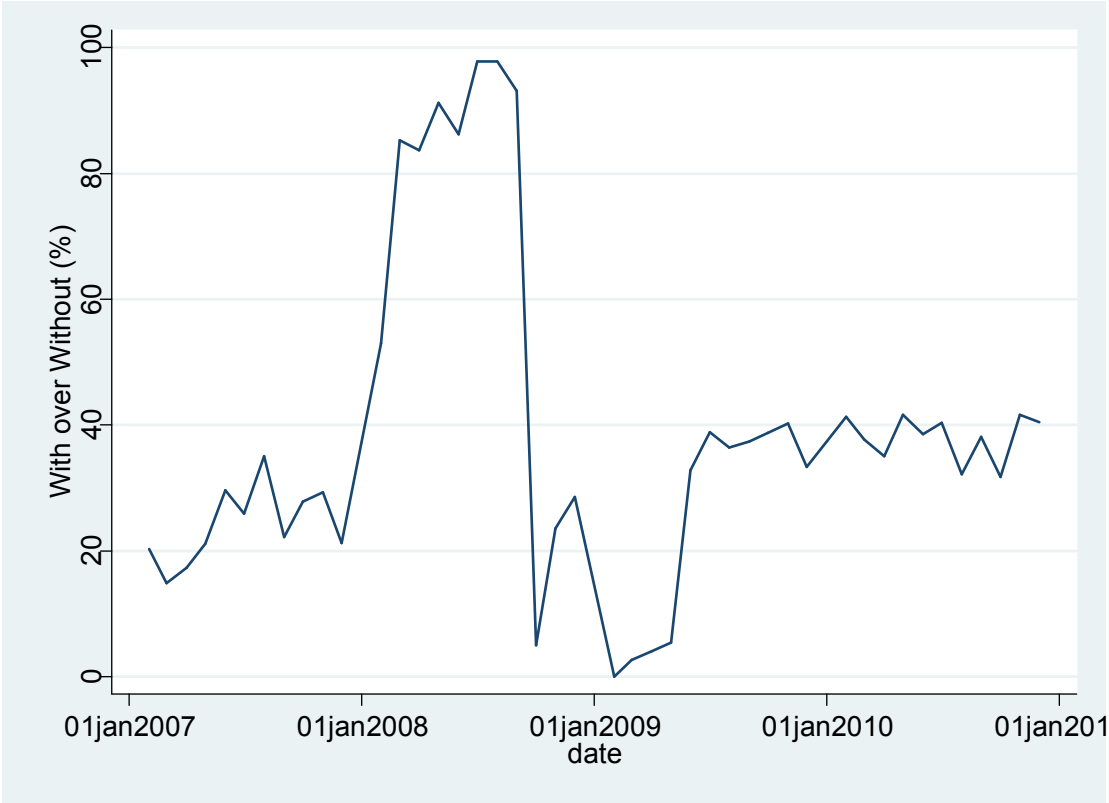
<Figure 4> Identification of large price reversals



<Figure 5> Number of event days

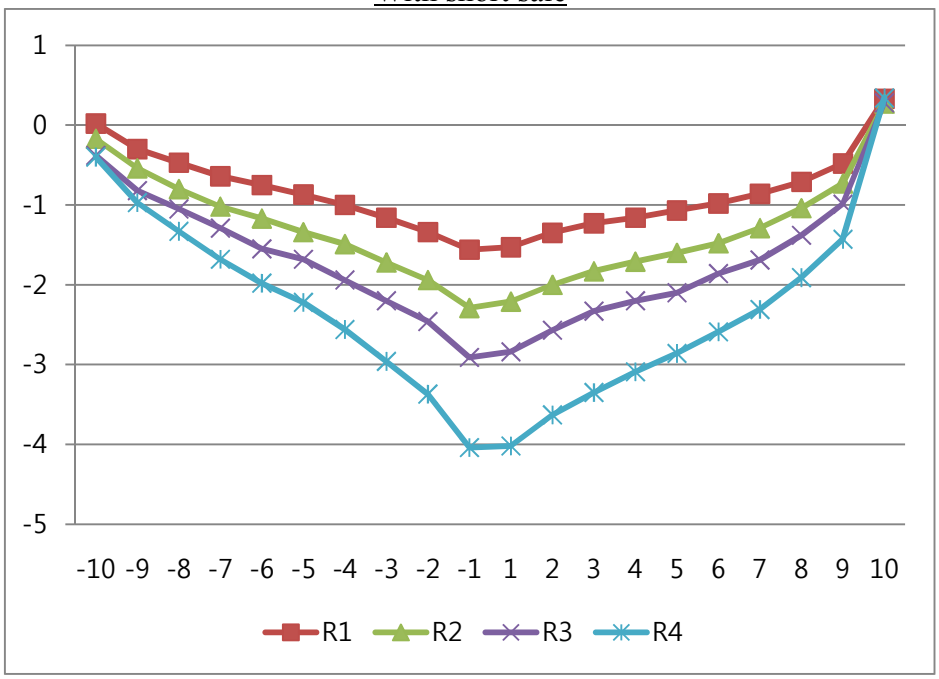


<Figure 6> Ratio of two type event days
(short sale / non-short sale)

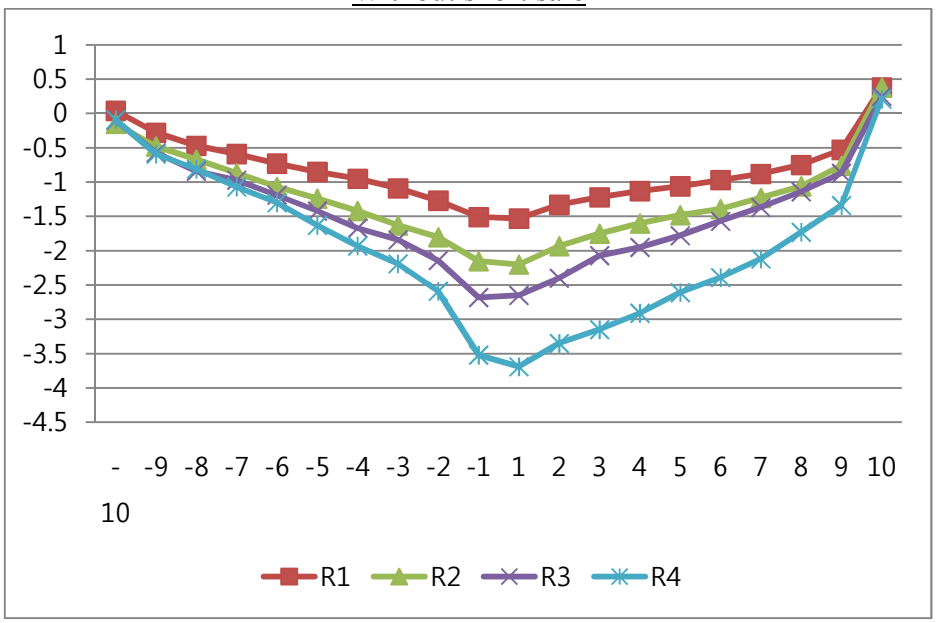


<Figure 7> Price reversals on event days

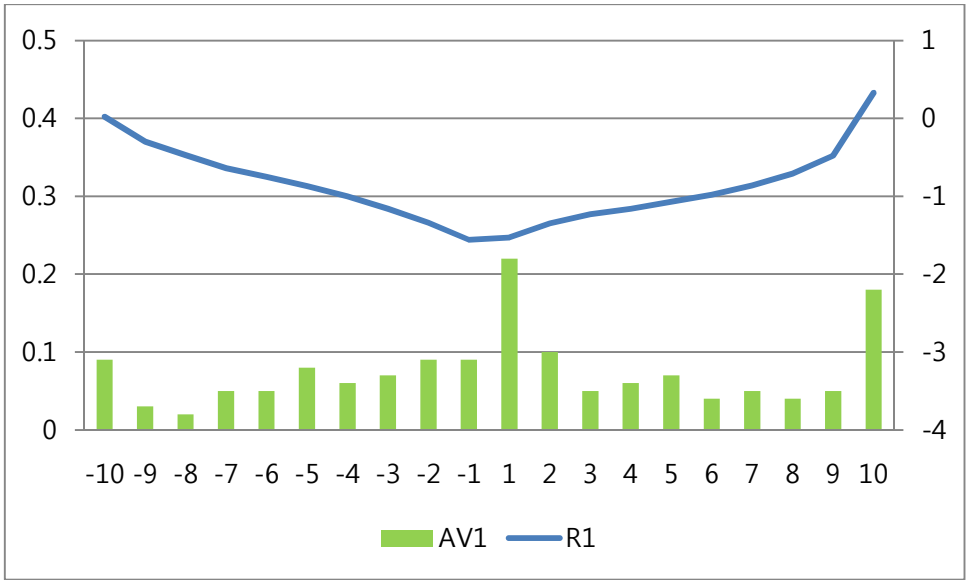
With short sale

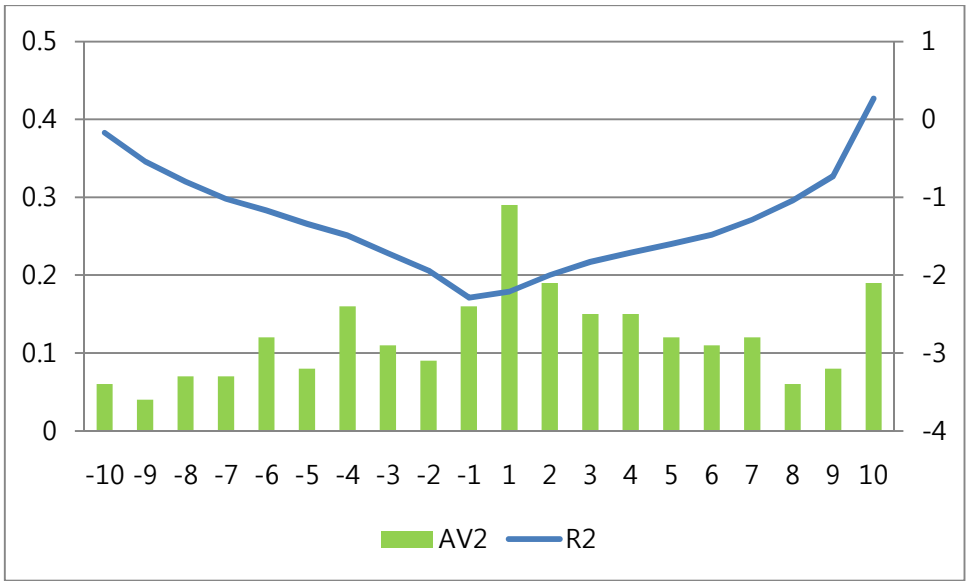


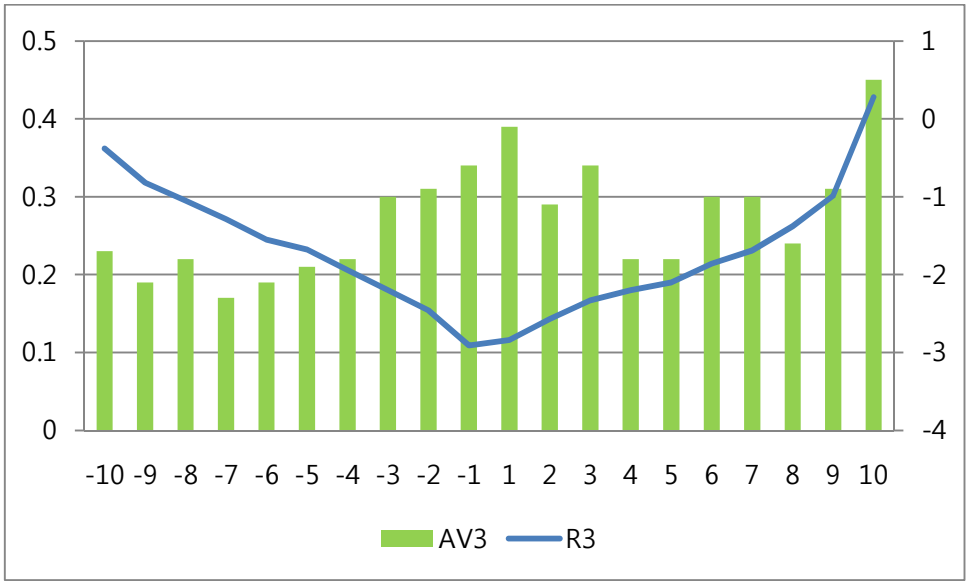
Without short sale



<Figure 8> Short sale and price reversals



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0.4
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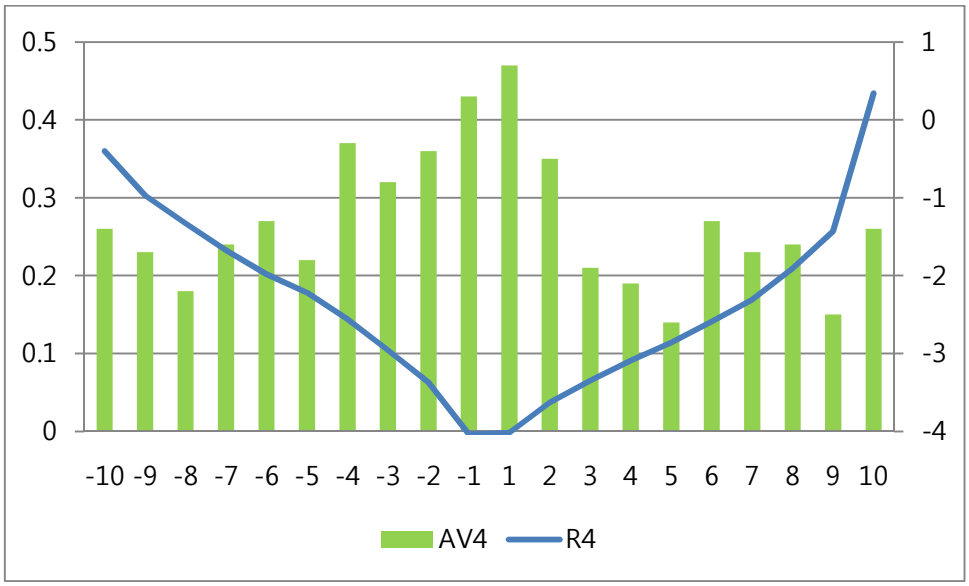
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9 10
AV3
R3


0.5
0.4
0.3
0.2
0.1
0
1
0
-1
-2
-3
-4
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9 10
AV4
R4