

Short Interest, Insider Trading, and Stock Returns

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Abstract

In this paper, we examine the effects of short selling on stock price movement in the Hong Kong stock market over the period 1996 to 2000. One characteristic of short selling in Hong Kong is the high frequency of transactions. We observe that short selling transactions have information content to signal future decrease in share price. The combined effects of two different forms of informed trading, short-selling and insider trading are also examined in this study. We find that insider purchases help mitigate the negative impacts of short sold transactions. Our regression results show that the magnitude of abnormal loss is related to the size of short sold value, the presence of insider purchases and whether the securities is also an optioned stock.

1. Introduction

Short-selling involves borrowing and selling a stock that is not owned. The short-sellers create a short position by selling the borrowed stock when the share price is expected to decrease and close the short position by buying the lower valued stock later. Therefore, short-selling presumably conveys unfavorable information to the market, suggesting a negative relation between short interest and market movement. Many markets around the world, including the U.S. market, impose short-selling restrictions with the aim to prevent excessive market volatility induced by short-selling activities. In this paper, we examine the effects of short sale constraints and insider trading activity on stock price movements in the Hong Kong stock market.

The regulatory framework and disclosure procedure for short-selling in Hong Kong provide us a quite unique setting for the study. Short-selling is prohibited in Hong Kong until January 3, 1994 when the Hong Kong Exchanges launched a pilot scheme allowing 17 designated securities for short-selling. In 1996, the number of designated securities extends to more than 100 securities. From then on, the Hong Kong stock market moves from a prohibited short-selling regime to a regulated short-selling system. Under this regulated short-selling system, the stock brokers are required to identify and report the short-selling activities to the Hong Kong Exchanges in a daily basis. The Hong Kong Exchanges aggregates the total daily trading shares and market value of short sales transactions of individual designated stocks. The information of all short-selling transactions is disclosed to the public the next day on-line through the web-site of the Hong Kong Exchanges and newspapers. These reporting and disclosure requirements on short-selling activity in Hong Kong are unique as the trading activities of short-sellers can be identified on a daily basis. Such reporting and disclosure practices for short-selling activities in Hong Kong are more timely, more frequently, and more available than those in other more mature financial markets such as the US. In the US, the short interest data for each stock

(common and preferred) and warrant is collected by the two stock exchanges, New York Stock Exchange and American Stock Exchange, on the 15th of each month. After compilation, the aggregate short interest data is published monthly in the Wall Street Journal, Barron's and the New York Times. The daily reporting and disclosure practice in Hong Kong and the high frequency trading data allow us to examine the informational role of short interest and the market-timing ability of short-sellers using daily data. The disclosure of short-selling data on a daily basis is only available recently in the US (Christophe, Ferri and Angel 2004; Daske, Richardson and Tuna 2005).

The regulatory framework on insider dealing and disclosure is developed in Hong Kong since 1991. Under the regulations governing insider trading activities, insiders (including directors, chief executives and substantial shareholders (owning more than 5% of the shares of the listed firms) are allowed to deal in their firms' shares in the market. However, the reporting and disclosure rules require the insiders to notify the Hong Kong Exchanges and their firms within five business days (within three days from 2003 onwards) from the day the securities transactions are made.

Specifically, our paper examines the relation between the level of short interest, insider trading, and stock returns in the Hong Kong market between May 1996 and December 2000. We find that short-selling activity is a bearish signal. The abnormal returns are significantly negative after controlling for the market factors, firm size factor, book-to-market factor and momentum factors. Our findings provide evidence that short selling transactions have negative impacts on the firm and the market. When we examine the combined effects of short selling and insider trading activities, we find that insider purchases help reduce the magnitude of abnormal losses brought by short sold transactions.

The rest of the paper is organized as follows. Section 2 provides a brief summary of related research. Section 3 introduces the data and methodology. Section 4 provides the empirical results. Section 5 concludes the paper.

2. Literature Review

Short-selling restrictions are imposed to prevent volatility due to excessive speculation. Most of the early studies in the finance literature on short-selling mainly focus on the impacts of the restrictions and relaxation of short-selling on the market using the US data. Miller (1977) argue that short-selling constraints lead to upward biased stock price as the transmission of negative information can be delayed. Jarrow (1980) proposes a substitution effect for the prices of risky assets due to the short-selling restrictions. Diamond and Verrecchia (1987) find that, by relaxing the short-selling constraints, price discovery or adjustment of private information, particularly the bad news, becomes faster and the abnormal returns around announcement days of public information becomes less skewed to the left. Others examine the relations between short-selling restriction, volatility and leverage effect (French, Schwert and Stambaugh 1987; Schwert 1990; Nelson 1991; Cheung and Ng 1992). Examples of studies in markets other than the US market include Ho (1996) and Poitras (2002) using Singaporean data, Aitken, Frino, McCorry and Swan (1998) using Australian data, and Hoontrakul, Ryan and Perrakis (2002) using Thailand data.

Besides conducting short-selling studies to examine the price effects, many studies investigate if the short-sellers are able to predict the future market movement. The higher the level of short interest, the more negative is the subsequent market reaction (Asquith and Meulbroek, 1996; Dechow, Hutton, Meulbroek and Sloan, 2001; Arnold, Butler, Crack and Zhang, 2005). There are strong relations between short-selling strategies and measures of

fundamental value (cash-flow-to-price, earnings-to-price, book-to-market and value-to-market). Short-sellers short sell when they expect the share price to fall. Therefore, it is hypothesized that aggregate short-selling is motivated by a prediction of future market decline. Lamont and Stein (2004) find that aggregate short interest moves in a countercyclical fashion. There are also studies examining the relation between short-selling activity and corporate announcements such as SEC actions (Dechow, Sloan and Sweeney, 1996), restatement and corrective disclosure (Griffin 2003) and earnings announcement and management forecast announcement (Christophe, Ferri and Angel, 2004; Daske, Richardson and Tuna, 2005).

Henry and McKenzie (2006) examine the impact of short-selling on the price-volume relation using Hong Kong data. Their finding provides evidence showing that short-selling activity has a significant impact on the non-linear and bidirectional relation between volume and volatility. These results suggest that the Hong Kong market demonstrates greater market volatility since the relaxation of the short-selling restrictions. In addition, the short selling transactions also help to exacerbate the asymmetric responses to positive and negative innovations to returns.

3. Data and Methodology

3.1 Characteristics of Hong Kong Regulated Market for Short-selling

The Hong Kong Exchanges introduced a pilot scheme for short-selling activity in January 1994. The rules and regulations governing the short-selling transactions in the market are laid down in the eleventh schedule¹ of the regulatory framework and rules of the Hong Kong Exchanges. Under the regulated pilot scheme for the two years between January 1994 and

¹ The eleventh schedule applies to short selling of securities other than securities market maker short selling, derivative warrant liquidity provider short selling, equity-linked index (ELI) liquidity provider short selling, designated index arbitrage short selling, stock futures hedging short selling, derivative warrant hedging short selling and options hedging short selling.

March 1996, only 17 securities are allowed to be short sold in the market. The eligible stocks for short-selling are termed designated securities. To conduct short-selling transactions, the short-sellers should have the exercisable and unconditional right to vest the stocks. In addition, there is a “tick rule” requiring that all short sale transactions to be conducted at a price above the best current ask price. The regulated short-selling transaction in Hong Kong refers to the sale of designated securities which are not owned by the seller. The short-sold transaction is consummated by the delivery of securities under a securities borrowing and lending agreement by which the short-selling traders execute the short-selling transactions by borrowing or obtaining a confirmation from the counterparty to the agreement that the counterparty has the securities available for lending.

The Hong Kong Exchanges revised the pilot scheme in March 1996. The “tick rule” is abolished temporarily for two and a half years but is re-established on September 7, 1998 due to the changes in market conditions². Since then, as a precaution against “too heavy” short-selling pressure in the future, the “tick rule” applies again to all short-selling transactions except for those of the stock options market makers conducting market making activities for the purpose of hedging portfolio risk. Still, only those securities which have been announced by the Hong Kong Exchanges to be designated short-selling securities are eligible for short-selling. The Hong Kong Exchanges revises and announces the number of designated securities on a quarterly basis. The number of designated short-selling securities increases from 17 in 1993 to 113 in 1996³. From then on, the number of designated securities varies from time to time.

² The 1997 Asian financial crisis created great selling pressure in most financial markets in the Asian regions. In view of the significant loss suffered, the Hong Kong government intervened in the Hong Kong financial market by buying stocks and futures. The reinstatement of the “tick rule” is one of the many precautionary measures to avoid massive speculative short-selling stress.

³ A designated securities is an automatch stock which is chosen by the Hong Kong Exchange from time to time as being eligible for short selling in accordance with several selection criteria. According to the eleventh schedule of the rules of the Hong Kong Exchange, the designated securities are either constituent stocks of indices (for instance, Hang Seng Index, Hang Seng 100 Index, Hang Seng MidCap 50 Index) which are the underlying indices of equity index products traded on the Hong Kong Exchange or the Hong Kong Futures Exchange; underlying stocks of stock

3.2 Sample and Data

The short-selling restrictions are relaxed in January 1994 when the Hong Kong Exchanges allows 17 designated securities to be short sold in a pilot scheme. Since there are few short-selling activities from the 17 designated securities during the pilot study period between 1994 and 1995, our sample starts from 1996. Before 1998, the announcement for the designated short-selling securities is made once a year. Between 1998 and 2000, the announcement for the designed short-selling securities is made three times a year⁴. The short-selling announcement and transaction data are obtained from the Research and Planning Division of and the “Monthly Quotation” issued by the Hong Kong Exchanges respectively. The share price return data and accounting information are extracted from the Company Returns and Financial Statements files of the PACAP database respectively. Our final sample covers a five-year period between 1996 and 2000.

TABLE 1 HERE

Table 1 reports the statistics of the securities eligible (Panel A) and disqualified (Panel B) for short-selling as at the end of the respective year. In Panel A, for the two years of the short-selling pilot scheme from 1994 to 1995, only 17 securities, account for about 3% of the total number of listed firms, are allowed to be short sold. The number increases by 6.65 times to

options traded on the Hong Kong Exchange; underlying stocks of stock futures contracts traded on the Hong Kong Futures Exchange; stocks that meet the minimum liquidity requirement for the issuance of basket derivative warrants; stocks with market capitalization of not less than HK\$1 billion and an annual turnover to market capitalization ratio of not less than 40%; Tracker Fund of Hong Kong and other Exchange Traded Funds; and all stocks traded under the Pilot Program.

⁴ The month for making the designated short-selling securities announcement is not fixed every year. The first announcement is made on January 3, 1994. In 1995, there is no announcement and so the number of designated short-selling securities remains 17. In 1996 and 1997, the announcements are made in March and May respectively. The nine months for making the announcements between 1998 and 2000 are January, March and November of 1998, March, September and November of 1999, and February, May and August of 2000.

113 in 1996 and 2.13 times to 241 in 1997 which is the highest number over the sample period. Over the period between 1994 and 2000, the average percentage of designated short-selling securities to the total number of listed firms is 21%. While there are securities added to the designation list, there are also designated securities being removed from the designation list. In Panel B, in the first four years of the relaxation of short-selling restrictions, the number of disqualified securities is small. However, the numbers of designated and disqualified securities change substantially in 1998, mainly because the securities authorities in Hong Kong tried to stabilize the very volatile equity market after the 1997 Asian financial crisis. The number of designated securities decreases from 241 to 195 and that of disqualified securities increases from 1 to 146, making the percentage of designated number to total listed firms to be 28.34%. Panel C shows the summary statistics of the short-selling transaction sample. Between 1996 and 2000, there are 27,085 short-selling transaction records. The average number (market value) of short-sold shares to total number (market value) of trading volume is 0.22% (2.07%).

In total, there are 3,514 announcements for designation and disqualification between 1994 and 2000 and 27,085 short-selling transaction records between 1996 and 2000. Our sample analysis for the announcement events excludes the finance companies (302 cases), thus reducing our sample size to 3,212. Of the 3,212 events, 11 cases are without valid stock code information.

We use the market model to measure the abnormal returns of the firms becoming designated short-selling securities and being removed from the designation list as well as the firms making short-selling transactions. The sample selection criteria trim down 1,632 events from our announcement sample. Therefore, our final sample for short-selling announcement events is made up of 1,871 cases, of which 1,095 events are of designation announcements and 776 events are of disqualification events. For the 27,085 transaction records, the selection criteria reduces

19,713 records from our transaction sample, leaving 7,372 transaction events in our final sample for the analysis of the share price performance of the short-selling transactions.

3.3 Methodology

Event Study of Abnormal Return

We employ event study to measure the abnormal returns of the designation and disqualification announcements of the short-selling firms and the short-selling transactions. We use the market model to compute the abnormal returns⁵. For the market model, the abnormal return of firm i on day t (AR_{itm}) is the difference between the realized return of sample firm i and that of the market index. We follow the way outlined by Brown and Warner (1985) to compute the test statistics for the significance of the abnormal returns. The length of our estimation period to measure the standard deviation is 200 days between $t = -300$ and $t = -101$. We measure the abnormal returns for the designation announcement of stocks to become designated securities, disqualification announcement of stocks to be “delisted” from designated securities and the short-sold transaction. In addition, we observe that there are directors’ dealings around the time when the stocks are short-sold. Consequently, we also measure the abnormal returns of these different short-selling events with and without insider trading activities (insider purchase and insider sale).

Calendar-time Portfolio Approach of Abnormal Return

Following the methodology framework of Desai, Ramesh, Thiagarajan and Balachandran (2002), we examine the relation between the level of short interest and stock returns. This calendar-time approach advocated by Mitchell and Stafford (2000) can address the problem of

⁵ For robustness purposes, we also use the control firm approach to compute the abnormal returns (Barber and Lyon 1997).

cross-sectional dependence and take into account the cross-sectional correlation among the individual stocks included in the portfolio. Desai, Ramesh, Thiagarajan and Balachandran (2002) employ a calendar-time portfolio approach using monthly short interest data for the period from June 1988 to December 1994. The monthly returns of the stocks that have at least 2.5% short interest (as a percentage of number of outstanding shares) in the previous month are used to form the monthly return of the portfolio. The monthly portfolio returns are then regressed on a four-factor model, of which the first three factors, market factor, size factor and book-to-market ratio, are the risk factors of Fama and French (1992) and the fourth factor is the momentum factors of Carhart (1997).

Since the Hong Kong Exchanges reports the short selling activities on a daily basis, we adopt the calendar-time portfolio approach using daily data. We do not include all firms whose shares are short sold in our daily portfolio. Instead of measuring the level of short interest as a percentage of number of outstanding shares as it is in the study of Desai, Ramesh, Thiagarajan and Balachandran (2002), we assess the intensity of daily short selling activity as a percentage of daily trading volume. The firm is regarded as heavily shorted when the level of short interest as a percentage of daily trading volume is at least 0.0025%. For each day and for each firm, we measure the 0.0025% short interest level. Only if the stock is being short sold with at least 0.0025% of daily trading volume on the previous day, the firm is included in our daily portfolio. If we use 0.0025% as our cut-off point, there are 15,602 daily observations. For robustness purpose, we also use other cut-off percentage points, there are 11,178 daily observations for 0.005%, 7,344 daily observations for 0.0075% and 5,704 daily observations for 0.01%.

Between May 1 1996 and December 29 2000, we form four equally weighted daily portfolios of stocks when the daily percentages of short sold shares reach 0.0025%, 0.005%, 0.0075% and 0.01% on the previous day. We re-balance the equally weighted portfolio on a

daily basis to add in the stocks whose short sold interest level reach our cut-off points and drop out the stocks whose short sold interest level do not reach our cut-off points. Consequently, we have daily returns for our portfolio. The daily portfolio return is regressed on four factors, market factor, size factor, book-to-market ratio and momentum factor, as follows:

$$Portfolio\ Return = \alpha_0 + \beta_1 Market + \beta_2 Size + \beta_3 BM + \beta_4 Momentum \quad (1)$$

Portfolio Return is the average of ten-day returns of the portfolio comprising the stocks whose short interests reach the cut-off point on the previous day. *Market* is the average of ten-day return of the market return. *Size* is the average of the log value of the market value of portfolio which is estimated as the product of the daily price and the number of outstanding shares. *BM* is the ratio of book value to market value of equity. *Momentum* is the difference in return between the average of the two highest returns and the average of the two lowest returns of the size quintile portfolio according to market value of equity⁶. The intercept, α_0 , is the coefficient on short interest, which is the measure for abnormal returns due to short sold transactions. We expect the sign for α_0 to be negative, indicating that short selling activity is a bearish signal.

Short-selling Activity and Aggregate Market Return

Chowdhury, Howe and Lin (1993) examine the short-term relation between insider trading and market return with weekly data using vector autoregressive analysis (VAR)⁷. We adopt the

⁶ To measure the momentum factor, we calculate the average prior return for 300 days of all stock in the industry firm category of the PACAP database. Then we divide all the stocks into five groups according to the market value (price times number of outstanding shares) of the stocks. For all the stocks in each size quintile portfolio, we rank the average prior return from lowest to highest. Momentum factor for all stocks in the same size quintile portfolio is the difference in return between the average of the two highest returns (winners) and the average of the two lowest returns (losers).

⁷ Vector autoregression (VAR) is a time-series model of a set of simultaneous equations in an overfit reduced form to forecast values of more than one variable at a time. Unlike the simultaneous equation model for examining simultaneity among a set of variables, the VAR model employs only past regularities and patterns in historical data as a basis for forecasting. The VAR model requires no *a priori* distinction between endogenous and exogenous variables as it treats all variables as endogenous. Therefore, the vector autoregressive analysis has long been employed for explaining a variable by the past values of the independent variables. This econometric technique is

methodology of Chowdhury, Howe and Lin (1993) and use the vector autoregressive model to examine the causality relation between short-selling activity and aggregate market return with monthly (one lag), weekly (two lags) and daily (five lags) data. Tests of Granger causality are based on a simple F test in the VAR model. The F -statistics test the null hypothesis that the independent variables do not have Granger-causality relations with the dependent variable. We measure the level of short interest as the percentage of the trading volume and trading value. We examine the Granger-causality relation between aggregate short-selling activity (SS) and market return (MR) as follows:

$$MR_t = \alpha_i \sum_{i=1}^T MR_{t-i} + \beta_i \sum_{i=1}^T SS_{t-i} \quad (2)$$

MR_t is the market return at time t . MR_{t-i} is the market return at time $t-i$. We have two measurements of SS_{t-i} . In terms of trading volume, SS is the ratio of total number of short-sold shares to the total number of shares traded. In terms of trading value, SS is the ratio of total market value of short-sold shares to the total market value of shares traded. Time horizon is in terms of monthly, weekly or daily data.

Cross-Sectional Model of the Returns to Short-selling Transactions

Our regression model evaluates the cross-sectional variation in the level of abnormal returns of the firms whose shares being short-sold. Many short-selling empirical studies (e.g., Senchack and Starks 1993) have shown that the magnitudes of the abnormal returns associated with short-selling transactions are related to the characteristics of the firm and the intensity of the transactions. The abnormal returns reflect the stock market's perceptions of the information

useful in both macroeconomics and microeconomics for finding causality and cointegration relations, for analyzing dynamic relations among several time series values, and for forecasting future values.

quality of the short-sellers. Similar to other studies, we construct a cross-sectional model to explain the magnitude of the abnormal returns of the short-selling transactions:

$$CAR = \alpha_0 + \beta_1 SSValue + \beta_2 LnSize + \beta_3 Option + \beta_4 InsBuy + \beta_5 TimeD \quad (3)$$

CAR is the abnormal return over different time periods ($+1 \leq t \leq +10$, $+1 \leq t \leq +60$, $+1 \leq t \leq +120$ and $+1 \leq t \leq +150$).

Diamond and Verrecchia (1987) propose that the negative market reaction of the short-selling transaction is due to the unfavorable information brought by the level of short interest. The results on the relation between short interest and abnormal returns are mixed. The studies by Figlewski (1981) and Woolridge and Dickinson (1994) do not provide evidence of a significant relation between short-selling and abnormal returns. Desai, Ramesh, Thiagarajan and Balachandran (2002) find that firms with large short position experience negatively significant abnormal returns. Therefore, we include a proxy, *SSValue*, for the trade size of the informed short-sellers and we hypothesize that *SSValue* to be positively related to the value of private information. *SSValue* is the measure of the intensity of short-selling activity in terms of log value of the market value of the short-sold shares.

Firm size is a proxy for the information environment of the firm. In general, larger firms are more likely to be followed by analysts and hence more information is publicly available than for smaller firms. Therefore, the information content of short-selling transactions for larger firms should be relatively less than that for smaller firms. We include *LnSize* as a measure of firm size to control for the size effect in our regression model. *LnSize* is measured as the natural log of the market value of firm's equity (which is the product of the price and the number of outstanding shares) on the transaction date.

When short-selling is prohibited, options trading is an alternative for the investors to act on in anticipation of future stock price movement. As short-selling can be costly, investment

strategies making use of options (buying put options and selling call options) can create the same short position but at a relatively lower cost. Informed traders who expect the future share price to decrease may choose to conduct option trading (write a call or buy a put) if option trading is available instead of selling short the shares. Therefore, there should be a difference in the market reaction for short-selling transactions for optioned and nonoptioned short-selling designated stocks (Senchack and Starks 1993). In addition, the availability of option trading also make the information more available to the market, which may reduce the information content of short-selling transactions. The variable, *Option*, which is a dummy variable that takes the value of 1 if the stock is an optioned stock and 0 otherwise, is included in our regression model as a control variable to control for the potential effect of tradable options on the market reaction of short-selling transactions. We expect that there is a less negative reaction to the short-selling transaction of optioned stocks.

Seyhun (1986) finds that directors buy when they expect the share price to increase and sell when they expect the share price to decrease. In this study, we examine if the trading pattern of the directors (buying or selling) may affect the level of abnormal returns of short-sold transactions. Therefore, we include an insider trading variable, *InsBuy*, in the regression model. *InsBuy* is a dummy variable that takes the value of 1 if there is insider purchase around the short-selling transaction and 0 otherwise.

We observe that short-selling transactions are not a single-day event. Many short-selling transactions are followed by subsequent short-selling transactions within the next few days. Of the 7,372 observations, 6,361 events (86.29%) are day-to-day transactions. However, there are some short-selling transactions which are widely spaced in time, 10 days or 15 days apart. Occasional and isolated short-selling transactions may be indicative of non-signaling motivations and insufficient to send unfavorable signal to the market. We have two hypotheses about the

frequency of the short-selling transactions on the impact of market reaction. Informed short-sellers trade frequently (day by day) because they have superior private information about the future decline of stock price. Then, we expect more negative share price response to the series of short-selling transactions. On the contrary, the efficient market hypothesis suggests that the market reaction should be more significant for the initial short-selling transaction. Hence, the market reaction to subsequent short-selling transaction should be smaller as the market should have responded to the unfavorable information brought by short-seller on the first transaction. We test these two hypotheses by including *TimeD* in our regression model. *TimeD* is a dummy variable which takes the value of 1 if the time length between two consecutive short-sold transactions is equal to and greater than 10 days and 0 otherwise.

4. Empirical Results

4.1 Event Study of Abnormal Return

We report the abnormal return results for the short-selling designation and disqualification announcements in Table 2. It appears that the market reacts more negatively to the designation announcement and less negatively to the disqualification announcement.

TABLE 2 HERE

We also plot the CAR path in Figure 1. We observe that there is a great difference in the market reaction between designation announcement and disqualification announcement. Miller (1977) argues that short-sale constraints prevent unfavorable information from being conveyed to the market, and hence short-selling constraints can lead to upward biased stock price. Therefore, there is no surprise to find that announcements of designation lead to downward price pressure

and announcements of disqualification, i.e. the announcement to re-impose the short-selling constraints on the stocks, lead to inflated price.

Figure 1 HERE

The event study results for the short-selling transactions are shown in Table 3 and Figure 2. The short-selling transactions are not a single-day event and we find that many short-sellers trade repeatedly day after day (86.29%) and within five days (6.39%). There are some short-selling transactions conducted infrequently, such as 10 days or 15 days after the previous transaction (7.33%). Therefore, we divide the total observations into four subsamples. “Day-to-day Short-selling Transactions” subsample includes events where the short selling transactions are conducted day after day. “No Prior Transaction for 5 Days” subsample includes events where the two consecutive short selling transactions are apart for more than 5 days but less than 10 days. “No Prior Transactions for 10 Days” subsample includes events where the two consecutive short selling transactions are apart for more than 10 days but less than 15 days. “No Prior Transactions for 15 Days” subsample includes events where the two consecutive short selling transactions are apart for more than 15 days.

TABLE 3 HERE

In Table 3, the cumulative abnormal returns over +10+60, +10+120 and +10+150 time periods for “All” sample and four subsamples are significantly negative, ranging from 2.78% to 12.79%. The cumulative abnormal returns over +1+10 for “All” sample and “Day-to-day Short-selling Transactions” subsample are also negative and significant. Comparing the magnitude of cumulative abnormal returns for “No Prior Transactions for 15 days” and other subsamples, the level of abnormal returns is the most negative. This finding can be shown more

clearly in Figure 2. The subsample of “No Prior Transactions for 15 days” is represented by the line with triangle symbol and the subsample of “Day-to-day Short-selling Transactions” is represented by the line with square symbol. The market reaction to “No Prior Transactions for 15 days” subsample is more pronounced.

FIGURE 2 HERE

We examine the market reaction of the short-selling transaction to measure if the trading of short-sellers conveys unfavorable information. In this study, besides examining the changes in market reaction for short-selling transactions, we also explore the impact of short-selling transactions on the trading strategy of the directors and the changes in the market reaction for the different trading patterns of the informed directors and short-sellers. We report the results in Table 4 and Figure 3.

TABLE 4 HERE

We divide the sample into three exclusive subsamples. “Short-selling Transactions Only” subsample includes events where there are only short selling transactions without insider trading activity during the examination period. “Short-selling Transactions and Insider Purchase” subsample includes events where there are both insider purchases and short selling transactions during the examination period. “Short-selling Transactions and Insider Sale” subsample includes events where there are both insider sales and short selling transactions during the examination period. Figure 3 shows the CAR paths for the three subsample, “Short-selling Transactions Only” (downward sloping with a kink in the middle), “Short-selling Transactions and Insider Purchase” (More on this, especially the changing slope of the curve) and

“Short-selling Transactions and Insider Sale” (almost monotonically decreasing slope). We find that insider purchase helps reduce the negative impact of short-selling transactions.

FIGURE 3 HERE

4.2 Calendar-time Portfolio Approach of Abnormal Return

Table 5 reports our regression results for our four daily portfolios of stocks of 0.0025%, 0.005%, 0.0075% and 0.01% short interest subsamples. t-statistics are adjusted for heteroskedasticity using White’s procedure (1980). We are interested in the coefficient of the intercept. A negative sign for the intercept means that the firms whose shares are being short sold suffer from abnormal loss. For the 0.0025% short interest subsample, the coefficient on the intercept is -0.92%, which is significant at the 0.01 level. The -0.92% for the intercept indicates that the designated short-sold stocks lose a daily abnormal return of 0.92%, supporting the hypothesis that short-sellers have informed information about the firms and the short-selling transactions have information content about future share price decline. We find similar negative and significant results for other short interest subsamples of 0.005%, 0.0075% and 0.01%. These findings suggest that heavily shorted stocks suffer from negative and significant abnormal loss, ranging from 0.83% to 1.02% per day, after controlling for market factor, size factor book-to-market ratio and momentum factor.

TABLE 5 HERE

4.3 Short-selling Activity and Aggregate Market Return

Table 6 shows the test results of the causality relation between the market return and the aggregate measure of short-selling activity. Before we test the causality relation of the time-series variables using vector autoregression (VAR), it is important to make sure that the data series are stationary. For being stationary, it means that the mean, variance and autocorrelation function of the data series do not change over time. We use a unit root test, the augmented Dickey-Fuller (ADF) to assess the stationarity of the variables. Although we do not report the results here, the augmented Dickey-Fuller (ADF) test finds that the variables of causality relation are stationary. Panel A and Panel B show the causality results using aggregate number of short-sold shares (as percentage of total trading volume) and aggregate market value of short-sold shares (as percentage of total trading value) respectively.

We examine the causality relation over three time-horizons, monthly, weekly and daily. When we use the monthly and weekly data, no significant causality relation is found. The causality relation is only significant when we use the daily data. The VAR analysis results show that there is a causality relation between the market return and the lagged short-selling activity over the shorter time horizon on a daily basis, and hence provides evidence that the aggregate short-selling activity can be used to predict subsequent market returns. The stronger predictive power of the lagged aggregate short-selling activity on short horizon returns may be due to the more timely reporting and disclosure procedures for short-sold transactions in Hong Kong.

TABLE 6 HERE

4.4 Cross-Sectional Model of the Returns to Short-selling Transactions

Table 7 reports the results of the regression model. The t-statistics for the coefficients are adjusted for heteroskedasticity using White's procedure (1980). Previous studies find that

firms with large short position experience negatively significant abnormal returns (Diamond and Verrecchia 1987; Desai, Ramesh, Thiagarajan and Balachandran 2002). The higher the level of short interest, the greater the negative market reaction should be. We use *SSValue* as the measure for the level of short interest and expect a negative relation between *SSValue* and abnormal returns. Table 7 shows that the coefficients on *SSValue*⁸ are significantly negative, indicating that short-selling activity has information content of future decline in share price.

LnSize, which is the log value of the market value of equity, is our control variable for size effect in our regression model. We find that *LnSize* is negatively related to the level of abnormal return and is significant for the time periods $+1 \leq t \leq +60$ and $+1 \leq t \leq +150$. The negative relation indicates that the market react more unfavorably to larger firms whose shares are being short sold.

We use *Option*, which is a dummy variable with the value of 1 if the stock is an optioned stock and 0 otherwise, as a control factor in the model to control for the impact that the designated securities is also an optioned stock. The coefficients on *Option* are positively and significantly related to the level of abnormal returns of short-selling transactions in all time periods examined. This result indicates that optioned stocks react less negatively to short-selling activities.

In Table 4, we find that there are directors trading around the time when there are short-selling activities. Therefore, we use *InsBuy* to test whether the abnormal returns for the short-sold transactions would be affected by the trading strategy of the directors who also trade at the same time. For the long-term abnormal return, $+1 \leq t \leq +120$ and $+1 \leq t \leq +150$, the coefficients on *InsBuy* is positively and significantly related to abnormal returns. This result

⁸ In Table 7, we report the results using the measure of log value of the market value of short-sold shares. For robustness purposes, we also employ alternative measures such as log value of number of short-sold shares, proportion of short-sold shares to total trading volume and proportion of short-sold value to total trading value. The results are similar.

suggests that the buying activity of the directors helps reduce the negative impact of the trading activity of the short-sellers.

Figure 3 shows that the market reaction for transactions without prior short-sold transactions for 10 days and 15 days are more pronounced (more positive and more negative) than that for the day-to-day transactions. Therefore, we include *TimeD* in the regression model to examine whether the magnitude of abnormal returns for short sold transactions is affected by the frequency of short-selling activity. *TimeD* is a dummy variable for time length in terms of the number of trading days between two consecutive short-selling transactions of the same firm. In Table 7, the coefficients on *TimeD*⁹ are not significant.

TABLE 7 HERE

5. Conclusion

Short-selling is not very common as many countries impose short-selling constraints. No matter whether short-selling is allowed or prohibited, there has been a substantial body of empirical research investigating issues on the information content of short interest on firm level and market level, information effects of short sales constraints, and profitability of short-selling activity. Prior research has mainly focused on American data although there are some studies based on short-selling activity in other countries. To date, there are few published studies using data from Asian markets.

Using a comprehensive database of short-selling and insider trading transactions in Hong Kong over the period 1996 to 2000, we examine the characteristics of short-selling and insider

⁹ In Table 7, we report the results using a dummy variable as our measure. For robustness purposes, we repeat the regression analysis using an alternative measure of the log value of the number of trading days between two consecutive short-sold transactions. The results are similar.

trading activities and their impact on stock prices. Short sellers make trades very frequently. We find that short selling exerts a significantly negative impact on the firm. The market reacts negatively to the designation announcement and short-sell transactions. The event study identifies large cumulative abnormal loss for short-selling transactions. When we examine the combined effects of short-selling and insider trading activities, we find that insider purchases help reduce the negative impact of short-selling transactions. Our regression results suggest that the magnitude of abnormal loss is related to the intensity of short selling activity, and whether there is insider trading activity and whether the designated securities is also an optioned stock.

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Table 1

Descriptive Statistics of the Short-selling Activity in Hong Kong

Year	Finance	Utilities	Properties	Consolidated Enterprises	Industrials	Hotels	Others	Total	% as Number of Listed Firms
Panel A: Announcement for Securities Eligible for Short-selling									
1994	2	5	5	5	0	0	0	17	3.16%
1995	2	5	5	5	0	0	0	17	3.09%
1996	17	7	27	46	10	6	0	113	19.12%
1997	24	8	43	83	73	8	2	241	36.19%
1998	23	9	37	49	68	5	4	195	28.34%
1999	20	8	34	45	65	5	4	181	25.67%
2000	21	9	28	63	77	6	5	209	28.36%
Panel B: Announcements for Designated Securities Removed from the Designated List									
1994	0	0	0	0	0	0	0	0	0.00%
1995	0	0	0	0	0	0	0	0	0.00%
1996	0	1	0	0	0	0	0	1	0.17%
1997	0	1	0	0	0	0	0	1	0.15%
1998	6	1	23	60	51	4	1	146	21.22%
1999	3	1	5	7	7	1	0	24	3.40%
2000	3	1	9	6	8	1	0	28	3.80%
Panel C: Trading Activity of Short-selling Firms and the Market									
Year	Number of Short-sold Shares	Total Market Trading Shares	% of Short-sold to Total Trading Shares	Market Value of Short-sold Shares	Total Market Trading Value	% of Short-sold to Market Trading Value			
1996	410.79	329,192.69	0.12%	6,902.04	1,286,989.24	0.54%			
1997	1,570.11	1,079,958.51	0.15%	25,895.99	3,508,944.75	0.74%			
1998	2,688.81	539,316.51	0.50%	59,836.52	1,596,716.58	3.75%			
1999	2,461.54	1,048,976.56	0.23%	62,305.37	1,772,494.79	3.52%			
2000	3,421.50	1,903,270.41	0.18%	73,263.56	2,833,396.57	2.59%			
Total	10,552.75	4,900,714.67	0.22%	228,203.48	10,998,541.92	2.07%			

Table 2

Abnormal Return of Designation and Disqualification Announcement

Designation Announcement is the date when the Hong Kong Exchanges makes the announcement for the list of designated securities eligible for short selling transactions. Disqualification Announcement is the date when the Hong Kong Exchanges make the announcement to disqualify the designated securities to be eligible for short selling transactions. As the Hong Kong Exchanges make the designation and disqualification announcements every quarter, we can classify the announcement events into “First” announcement (the first time when the firm becomes designated securities or disqualified securities) and “Other” announcement (events not classified as “First”). The market model is used to compute the abnormal returns.

Panel A: Classification by Type of Announcement

Sample Size	Designation Announcement			Disqualification Announcement
	All 1095	First 236	Other 859	First 86
Event Day	Abnormal Return (t-statistics)			
-1+1	-0.0167 (-2.16)*	-0.0146 (-1.43)	-0.0173 (-2.06)*	0.0287 (1.07)
0	-0.0089 (-2.00)*	-0.0107 (-1.82)	-0.0084 (-1.74)	0.0061 (0.39)
-3+3	-0.0259 (-2.19)*	-0.0088 (-0.56)	-0.0308 (-2.39)*	0.0456 (1.11)
-5+5	-0.0453 (-3.06)**	-0.0218 (-1.12)	-0.0521 (-3.23)**	0.0414 (0.80)
-10+10	-0.0333 (-1.63)	-0.0061 (-0.22)	-0.0411 (-1.85)	0.1032 (1.45)

Panel B: Classification by Year

Sample Size	Designation Announcement					Disqualification Announcement		
	1996 80	1997 142	1998 356	1999 246	2000 258	1998 59	1999 14	2000 13
Event Day	Cumulative Abnormal Return (t-statistics)							
-1+1	-0.0046 (-0.63)	0.0266 (1.08)	-0.0469 (-3.68)**	-0.0035 (-0.20)	-0.0194 (-1.30)	0.0640 (1.71)	-0.0089 (-0.26)	-0.0691 (-1.96)*
0	-0.0005 (-0.12)	0.0120 (0.85)	-0.0240 (-3.27)**	0.0013 (0.13)	-0.0131 (-1.52)	0.0288 (1.33)	-0.0118 (-0.61)	-0.0563 (-2.77)**
-3+3	-0.0020 (-0.18)	0.0712 (1.90)	-0.0688 (-3.54)**	-0.0161 (-0.61)	-0.0422 (-1.85)	0.0861 (1.50)	0.0273 (0.53)	-0.0878 (-1.63)
-5+5	-0.0171 (-1.22)	0.0513 (1.09)	-0.0933 (-3.82)**	-0.0264 (-0.80)	-0.0683 (-2.39)*	0.1019 (1.42)	0.0249 (0.39)	-0.1582 (-2.34)*
-10+10	-0.0148 (-0.77)	0.0739 (1.14)	-0.0507 (-1.50)	-0.0722 (-1.58)	-0.0445 (-1.13)	0.1993 (2.01)*	-0.0429 (-0.48)	-0.1252 (-1.34)

* significant at 5% level

** significant at 1% level

Figure 1
Cumulative Abnormal Return Path

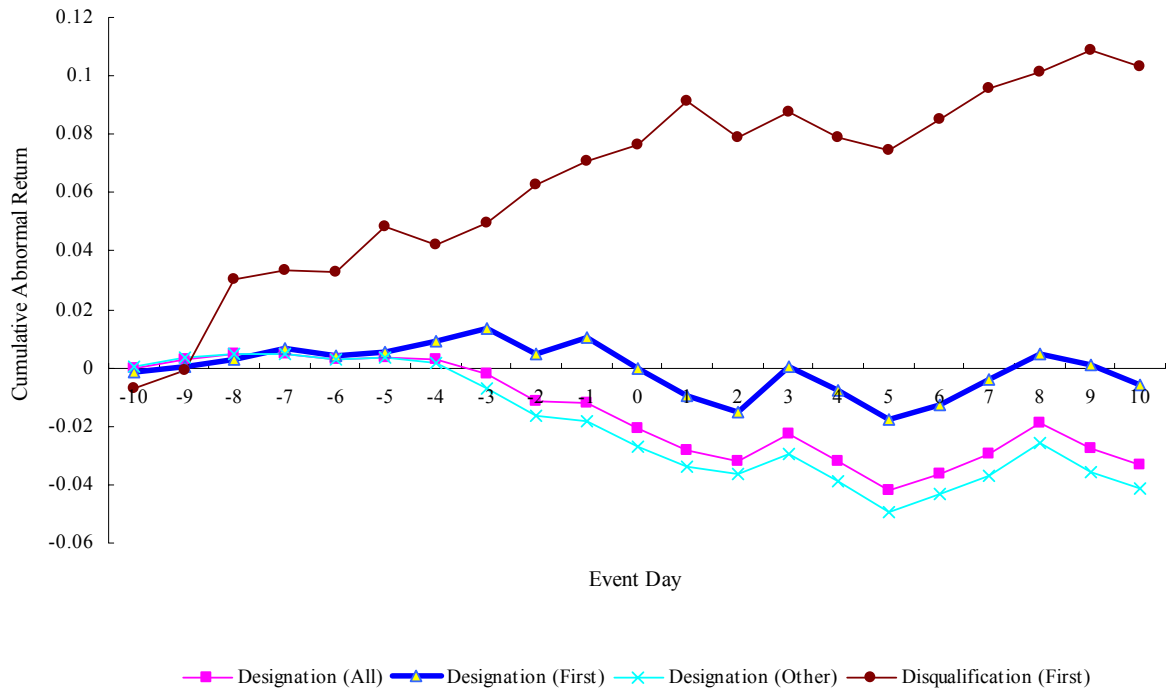


Table 3

Abnormal Return for Short-selling Transaction

The short-selling transactions are not a single-day event. "Day-to-day Short-selling Transactions" subsample includes events where the short selling transactions are conducted day after day. "No Prior Transaction for 5 Days" subsample includes events where the two consecutive short selling transactions are apart for more than 5 days but less than 10 days. "No Prior Transactions for 10 Days" subsample includes events where the two consecutive short selling transactions are apart for more than 10 days but less than 15 days. "No Prior Transactions for 15 Days" subsample includes events where the two consecutive short selling transactions are apart for more than 15 days. The market model is used to measure the abnormal returns.

Cumulative Abnormal Return															
(t-statistics)															
Size	All			Day-to-day Short-selling Transactions			No Prior Transactions for 5 Days			No Prior Transactions for 10 Days			No Prior Transactions for 15 Days		
	Total	1994-1997	1998-2000	Total	1994-1997	1998-2000	Total	1994-1997	1998-2000	Total	1994-1997	1998-2000	Total	1994-1997	1998-2000
	7372	3511	3861	6361	2955	3406	471	283	188	166	92	74	374	181	193
+1+10	-0.0053	-0.0050	-0.0056	-0.0055	-0.0056	-0.0055	-0.0018	-0.0009	-0.0031	0.0052	0.0020	0.0093	-0.0108	-0.0047	-0.0166
	(-5.14)**	(-4.93)**	(-3.12)**	(-4.98)**	(-5.61)**	(-2.87)**	(-0.42)	(-0.25)	(-0.34)	(0.72)	(0.30)	(0.66)	(-1.78)	(-0.89)	(-1.48)
+10+60	-0.0302	-0.0206	-0.0395	-0.0278	-0.0162	-0.0384	-0.0451	-0.0403	-0.0531	-0.0352	-0.0388	-0.0298	-0.0501	-0.0521	-0.0480
	(-12.92)**	(-9.01)**	(-9.71)**	(-11.08)**	(-7.20)**	(-8.97)**	(-4.71)**	(-4.91)**	(-2.59)**	(-2.15)*	(-2.55)*	(-0.94)	(-3.65)**	(-4.34)**	(-1.89)
+10+120	-0.0700	-0.0539	-0.0857	-0.0676	-0.0496	-0.0843	-0.0771	-0.0633	-0.1002	-0.0599	-0.0560	-0.0652	-0.1069	-0.1091	-0.1050
	(-20.32)**	(-16.01)**	(-14.30)**	(-18.28)**	(-14.93)**	(-13.33)**	(-5.46)**	(-5.22)**	(-3.31)**	(-2.48)*	(-2.49)*	(-1.40)	(-5.28)**	(-6.16)**	(-2.81)**
+10+150	-0.0832	-0.0742	-0.0914	-0.0805	-0.0705	-0.0889	-0.0881	-0.0800	-0.1012	-0.0788	-0.0934	-0.0546	-0.1279	-0.1159	-0.1424
	(-21.44)**	(-19.55)**	(-13.53)**	(-19.31)**	(-18.82)**	(-12.48)**	(-5.54)**	(-5.86)**	(-2.97)**	(-2.90)**	(-3.69)**	(-1.04)	(-5.61)**	(-5.81)**	(-3.38)**

* significant at 5% level

** significant at 1% level

Figure 2
Cumulative Abnormal Return Path

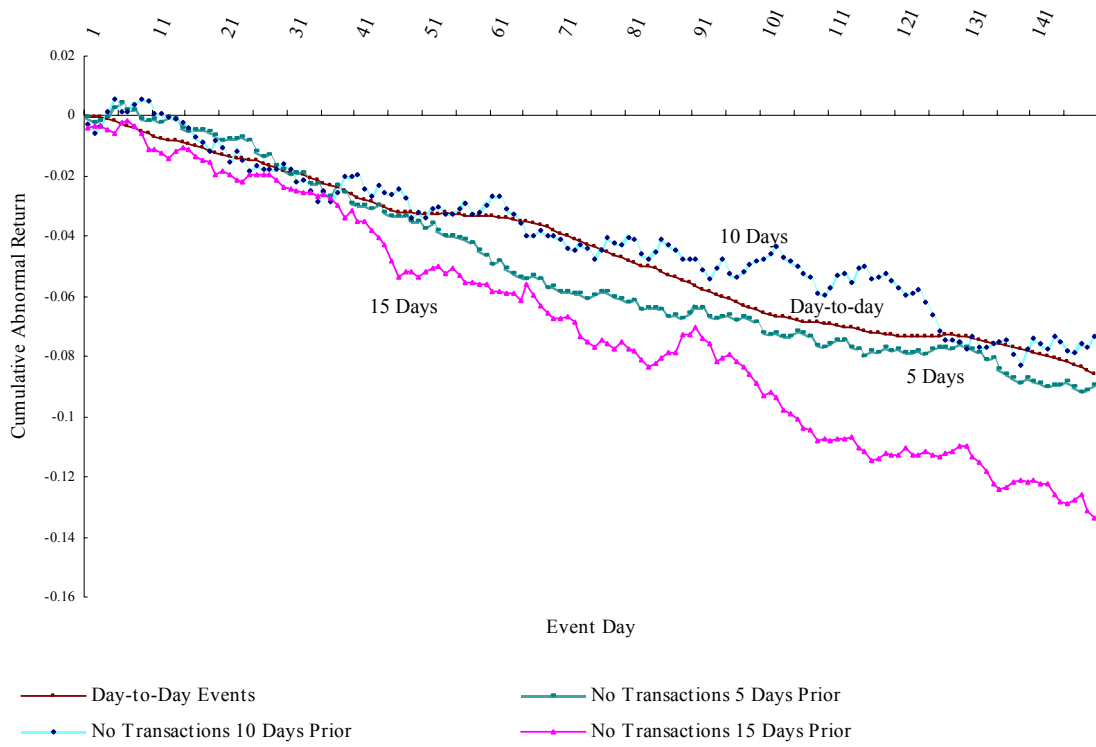


Table 4

Abnormal Return for Short-selling Transaction with Insider Trading

“Short-selling Transactions Only” subsample includes events where there are only short selling transactions without insider trading activity during the examination period. Short-selling Transactions and Insider Purchase (Sale)” subsample includes events where there are both insider purchases (sales) and short selling transactions during the examination period. The market model is used to measure the abnormal return.

Sample Size	Short-selling Transactions Only 2386	Short-selling Transactions and Insider Purchase 3045	Short-Selling Transactions and Insider Sale 1941
Event Day	Cumulative Abnormal Return (t-statistic)		
+1+10	-0.0049 -2.87**	-0.0072 -3.72**	-0.0029 -1.45
+10+60	-0.0290 -7.57**	-0.0398 -9.09**	-0.0165 -3.70**
+10+120	-0.0618 -10.92**	-0.0742 -11.47**	-0.0729 -11.07**
+10+150	-0.0705 -11.06**	-0.0794 -10.89**	-0.1035 -13.96**
+10+200	-0.1354 -18.23**	-0.0702 -8.27**	-0.1355 -15.70**
+10+250	-0.1718 -20.60**	-0.0714 -7.49**	-0.1716 -17.70**
+10+300	-0.1908 -20.82**	-0.0831 -7.93**	-0.1888 -17.72**

* significant at 5% level
 ** significant at 1% level

Figure 3
 Cumulative Abnormal Return Path

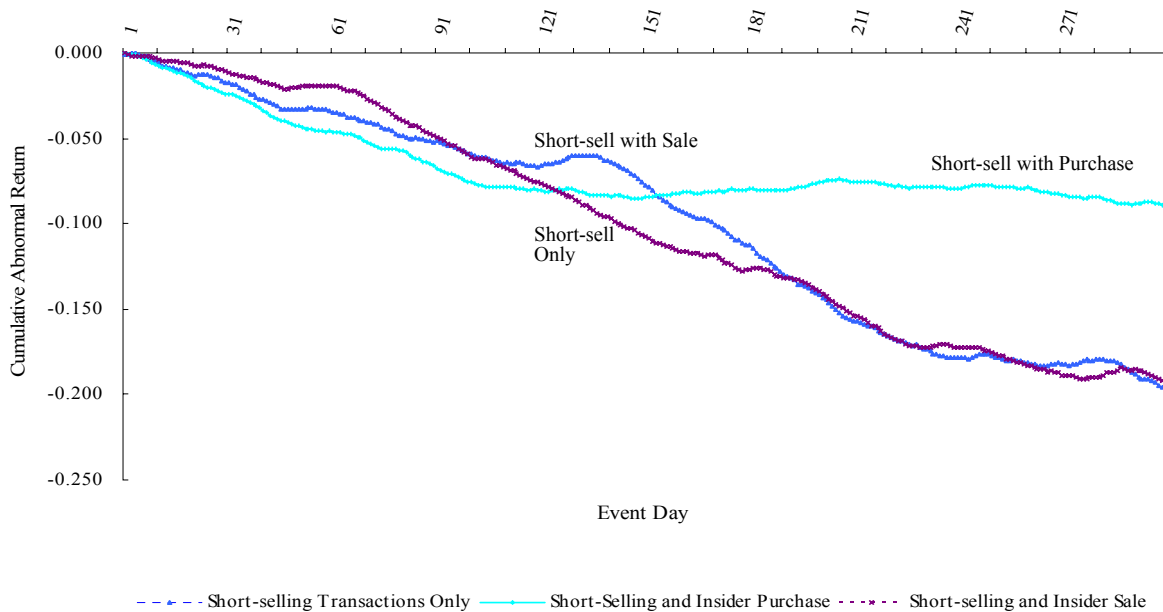


Table 5

Calendar-time Portfolio Abnormal Return

$$\text{Portfolio Return} = \alpha_0 + \beta_1 \text{Market} + \beta_2 \text{Size} + \beta_3 \text{Book-to-Market} + \beta_4 \text{Momentum}$$

Portfolio Return is the average of ten-day returns of the portfolio comprising the stocks whose short interests reach the cut-off point on the previous day. *Market* is the average of ten-day return of the market return. *Size* is the average of the log value of the market value of portfolio. *Book-to-Market* is the ratio of book value to market value of equity. *Momentum* is the difference in return between the average of the two highest returns and the average of the two lowest returns of the size quintile portfolio according to market value of equity. *t*-statistics are adjusted for heteroskedasticity using White's procedure (1980).

Short Interest Percentage	0.0025%	0.005%	0.0075%	0.01%
	Beta Coefficient			
	(t-statistics)			
Intercept	-0.0092 (-2.62)**	-0.0088 (-2.71)**	-0.0083 (-1.99)*	-0.0102 (-2.98)**
Market	0.9645 (43.92)**	0.9115 (34.20)**	0.9103 (27.46)**	0.9103 (32.75)**
Size	0.0006 (2.89)**	0.0006 (3.16)**	0.0006 (2.45)*	0.0007 (3.48)**
Book-to-Market	0.0002 (3.08)**	0.0002 (2.25)*	0.0001 (1.99)*	0.0002 (2.17)*
Momentum	-0.0039 (-6.50)**	-0.0051 (-6.66)**	-0.0057 (-5.26)**	-0.0055 (-6.90)**
Adjusted R ²	0.7866	0.6964	0.5441	0.6759
F statistics	1017.4860	617.3871	303.5883	556.1409
P-value	[0.00]	[0.00]	[0.00]	[0.00]
Number of observations				

* significant at 5% level

** significant at 1% level

Table 6

Tests of Causality Relations between Market Return and Aggregate Short Selling Activity

$$MR_t = \alpha_i \sum_{i=1}^T MR_{t-i} + \beta_i \sum_{i=1}^T SS_{t-i}$$

MR_t is the market return at time t . MR_{t-i} is the market return at time $t-i$. In terms of trading volume, SS is the ratio of total number of short-sold shares to the total number of shares traded. In terms of trading value, SS is the ratio of total market value of short-sold shares to the total market value of shares traded. Time horizon is in terms of monthly, weekly or daily data.

Panel A: Aggregate Short Selling Activity as Percentage of Total Trading Volume

Horizon	Lag	MR ₁	MR ₂	MR ₃	MR ₄	MR ₅ Coefficient [t-statistic]	SS ₁	SS ₂	SS ₃	SS ₄	SS ₅	F
Month	1	-0.0135 [-0.10]					0.1047 [0.65]					0.2289
Week	1	0.0603 [0.94]					0.0179 [0.14]					0.4495
Week	2	0.0555 [0.87]	0.0696 [1.08]				-0.0671 [-0.46]	0.1732 [1.19]				0.8732
Day	1	0.0265 [0.90]					-0.0405 [-0.33]					0.4915
Day	2	0.0274 [0.93]	-0.0570 [-1.95]				-0.0896 [-0.55]	0.0581 [0.36]				1.2483
Day	3	0.0339 [1.16]	-0.0595 [-2.04]	0.1079 [3.70]			-0.0798 [-0.48]	0.0857 [0.47]	-0.0148 [-0.09]			3.1282**
Day	4	0.0422 [1.43]	-0.0635 [-2.17]	0.1110 [3.80]	-0.0753 [-2.56]		-0.0618 [-0.37]	0.0910 [0.49]	0.0102 [0.06]	-0.0840 [-0.50]		3.1882**
Day	5	0.0403 [1.36]	-0.0611 [-2.07]	0.1085 [3.70]	-0.0762 [-2.59]	-0.0235 [-0.80]	-0.0881 [-0.52]	0.0832 [0.45]	-0.0161 [-0.09]	-0.1753 [-0.94]	0.1812 [1.07]	2.7424**

Panel B: Aggregate Short Selling Activity as Percentage of Total Trading Value

Horizon	Lag	MR ₁	MR ₂	MR ₃	MR ₄	MR ₅ Coefficient [t-statistic]	SS ₁	SS ₂	SS ₃	SS ₄	SS ₅	F
Month	1	-0.0156 [-0.11]					0.0335 [1.07]					0.5856
Week	1	0.0629 [0.99]					0.0275 [1.13]					1.0749
Week	2	0.0598 [0.92]	0.0745 [1.16]				0.0278 [0.64]	0.0014 [0.03]				0.8563
Day	1	0.0283 [0.97]					0.0150 [0.66]					0.6529
Day	2	0.0288 [0.98]	-0.0559 [-1.91]				0.0024 [0.07]	0.0139 [0.41]				1.2917
Day	3	0.0347 [1.18]	-0.0594 [-2.03]	0.1098 [3.76]			0.0004 [0.01]	0.0149 [0.40]	0.0085 [0.24]			3.2383**
Day	4	0.0427 [1.45]	-0.0641 [-2.18]	0.1111 [3.79]	-0.0730 [-2.49]		0.0011 [0.03]	0.0099 [0.26]	-0.0009 [-0.02]	0.0116 [0.32]		3.2192**
Day	5	0.0413 [1.40]	-0.0610 [-2.06]	0.1108 [3.76]	-0.0706 [-2.39]	-0.0231 [-0.78]	0.0030 [0.08]	0.0130 [0.33]	0.0029 [0.07]	0.0177 [0.47]	-0.0186 [-0.51]	2.6615**

* significant at 5% level

** significant at 1% level

Table 7

Regression analysis

$$CAR = \alpha_0 + \beta_1 SSValue + \beta_2 LnSize + \beta_3 Option + \beta_4 InsBuy + \beta_5 TimeD$$

CAR is the abnormal return over different time periods (+1 ≤ t ≤ +10, +1 ≤ t ≤ +60, +1 ≤ t ≤ +120 and +1 ≤ t ≤ +150). *SSValue* is the log value of the market value of short-sold shares. *LnSize* is the natural log of the market value of firm's equity. *Option* is a dummy variable which takes the value of 1 if the stock is an optioned stock and 0 otherwise. *InsBuy* is a dummy variable that takes the value of 1 if there is insider purchase around the short-selling transaction and 0 otherwise. *TimeD* is a dummy variable for time length in terms of the number of trading days between two consecutive short-selling transactions of the same firm and takes the value of 1 if the time length is equal to and greater than 10 days and 0 otherwise. t-statistics are adjusted for heteroskedasticity using White's procedure (1980).

	+1 ≤ t ≤ +10	+10 ≤ t ≤ +60	+10 ≤ t ≤ +120	+10 ≤ t ≤ +150
	Beta Coefficient (t-statistics)			
Intercept	-0.0046 (-0.29)	0.1064 (2.59)**	0.1396 (2.45)**	0.1787 (2.85)**
SSValue	-0.0002 (-0.30)	-0.0056 (-3.15)**	-0.0149 (-5.73)**	-0.0162 (-5.35)**
LnSize	-0.0003 (-0.31)	-0.0068 (-2.32)*	-0.0071 (-1.75)	-0.0101 (-2.20)*
Option	0.0152 (5.65)**	0.0910 (11.95)**	0.1969 (19.07)**	0.2238 (18.94)**
InsBuy	-0.0027 (-1.29)	0.0101 (1.89)	0.0261 (3.93)**	0.0343 (4.46)**
TimeD	0.0038 (0.77)	0.0034 (0.29)	0.0246 (1.47)	0.0210 (1.16)
Adjusted R ²	0.0065	0.0295	0.0719	0.0723
F statistics	10.5073	45.4000	114.1821	114.8447
p-value	[0.00]	[0.00]	[0.00]	[0.00]

* significant at 5% level

** significant at 1% level