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Trading Behavior in Volatile Markets: An Exploratory Investigation into Thai Markets

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Abstract

Project Title Trading Behavior in Volatile Markets: An Exploratory Investigation into Thai Markets

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This study is an exploratory investigation into trading behavior within volatile markets. It examines several aspects of trading behavior by various types of market participants (local retail investors, local institutional investors and foreign investors) during volatile markets. Issues investigated in the study include abnormal trading activity, the impact of trading activity, and the causality between prices and volumes of securities on the foreign board compared to that seen on the main board, as well as with warrants and their underlying assets. The quality of the market during volatility as opposed to a 'normal' market is also examined. Using the intraday market data on the Stock Exchange of Thailand (SET) during a period from 1999 to 2003, first, it was found that domestic retail investors seemed to follow contrarian trading strategies, while institutional and foreign participants seemed to be momentum traders. However, institutional and foreign investors were seen more sensitive to market conditions and adjusted their trading activities in a risk adverse manner. Second, abnormal trading activity was observed and found to be more pronounced during extreme 'bull' market surges than during extreme 'bear' markets. Based on a study of related evidence, however, such overreaction was not found to be strong. Retail investors' trading tended to have more of an impact on prices than those of other investor categories. However, the directions they took were opposite to what we would have expected. Third, our results showed that, generally, there were positive contemporaneous associations between the price changes/trading volumes in securities on the main board, and the price changes and trading volumes of corresponding securities on the foreign board, as well as with warrants and their underlying assets, regardless of market conditions. Finally, the results confirmed our expectation that the quality of exchange during normal periods was better than during volatile periods.

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1. Introduction

Who panics during a large change in stock markets? Although there are several studies on the behavior of investors, there is no clear answer to this question. Most extant studies have investigated the effects of herding and feedback on trading by institutional and individual investors (e.g., Lakonishok, Shleifer, and Vishny (1994), Wermers (1999), and Nofsinger and Sias (1999)). Under extreme market conditions, it can be argued that individual investors who may be uninformed and more risk averse are those who exhibit the most heightened response to a large market decline.

On the other hand, institutional investors are inclined to 'herd' during such events. Choe, Kho and Stulz (1998) examined this trading behavior with foreign investors in Korea during the 1997 economic crisis using intraday data. They found strong evidence of positive feedback trading and herding by foreign investors before the crisis. During the crisis, however, the evidence of herding became weaker and there was no evidence found of positive feedback trading.

More recently, Dennis and Strickland (2002) empirically investigated whether individuals or institutions were more sensitive during volatile markets. They found evidence that institutional investors reacted more strongly than individuals in volatile markets. The magnitude of a firm's abnormal returns and turnover were found to be related to the percentage of shares held by institutions and the type of shares held. In particular, investment advisors, as well as ownership by mutual funds, pension funds and endowments were found positively related to turnover on volatile days. The evidence on this is consistent with the conjecture that fund managers are evaluated more frequently than other types of institutional management, so they have more incentive to herd than do other types of institutional investors such as banks.

In emerging markets such as Thailand, there has been no conclusive evidence on the behavior of investors during volatile markets. However, it is conjectured that individual local traders tend to be less informed and are more speculative in nature, so they tend to take pause in a volatile market situation. Whether the evidence found by Dennis and Strickland (2002) on U.S. markets holds true for Thai capital markets is an interesting supposition to investigate, because it provides us insight into the price

dynamics of securities during extreme market conditions. This study thus seeks to add to the limited body of literature on trading behavior in volatile market situations.

Unlike one extant study by Dennis and Strickland (2002), which infers that there is a behavioral relationship between ownership changes and returns, this study uses the direct observed volume of trade by type of investor and intraday data to investigate behavior. The unique structures (foreign vs. main boards) and types of investors (local retail investors, local institutional investors, and foreign investors) in Thai markets certainly provide further insight into this issue.

Furthermore, information on trading behavior profiled by investor type and the quality of the market during extreme conditions would be useful in determining the implications of such policy as whether to promote foreign investors, local institutional investors and/or retail investors.

Using the intraday data on stock listed on the Stock Exchange of Thailand (SET) during 1999 to 2003, the study thoroughly investigates several issues that come to light during volatile markets. First, we analyzed the trading behavior across each type of investor classified by the Stock Exchange of Thailand: foreign investors, local retail investors, and local institutional investors. Abnormal trading volumes sub-classified by type of investor were measured during volatile markets. In addition, the impacts of investors' trading activities were investigated using both intraday and daily returns. We also investigated trading behavior across markets. The causality between the prices and volumes of securities in the main board and foreign board was examined, as well as similar phenomena with warrants and their underlying assets. Finally, the quality of markets during volatile and normal situations was investigated, as well.

Our preliminary investigation shows that retail investors seem to follow contrarian trading strategies, while institutional and foreign investors seem to be momentum traders. Retail investors were net sellers when other investors tended to be net buyers and vice versa. Moreover, institutional and foreign investors tend to buy lower risk stocks during extreme receding markets than during extreme rising markets, and vice versa. The results suggest that institutional and foreign investors are more responsive to market conditions and adjust their trading activity in a more risk averse manner.

Concerning abnormal trading activity during an extreme market, it was found that institutional investors are more sensitive to market conditions. For example, the average value of securities bought was statistically significant at 42 percent higher than during the control period, while the corresponding numbers for retail and foreign investors were 36 percent and 33 percent, respectively. In addition, abnormal trading activities were more pronounced during extreme rising markets than during extreme receding markets. Based on the event study, evidence of overreaction was not strong. Although on the event days most of the abnormal returns were statistically significant, post-event day abnormal returns were, in general, statistically insignificant.

There were price impacts on the largest order imbalance intervals, regardless of the type of investor. These price impacts were negative for net sell imbalances and positive for net buy imbalances. It was observed that retail investors' trades did have a greater impact on prices than those of other investors. Surprisingly, their overall direction was opposite to what we would have expected. In a normal market, the returns after the largest net buy imbalances were all negatives that were statistically significant for five intervals. Moreover, in an extreme rising (bull) market, only net buying positions by retail traders had negative impacts, and vice versa. Furthermore, our regressions show that generally there are positive contemporaneous associations between the price changes and trading volumes of securities on the main and foreign boards, as well as with warrants and their underlying assets, regardless of market conditions. Finally, the results confirm our expectation that the quality of exchange during normal periods is better than during volatile periods.

The study proceeds as follows. Section 2 reviews related studies, while Section 3 discusses the sample. The trading behavior across types of traders during volatile markets is investigated in Section 4. The relationship between movements of stock traded on the main and foreign boards, as well as any seen vis-à-vis warrants and their underlying stock during volatile markets is also examined in Section 5. Then, Section 6 investigates whether or not the quality of a market changes during periods of market volatility. Finally, Section 7 concludes and discusses the main findings.

2. Review of Related Studies

In this section we briefly review related studies in the area of trading behavior of investors in financial markets. Based on their psychological foundations, investors may not behave in a rational manner as presumed by traditional economists. The aspects of their behavior are manifested in the trading strategies of investors in such phenomena as herding, positive feedback, and so on. Recent studies on how investors trade in extreme market conditions are also discussed here.

2.1 Trading Behavior

Previous studies such as Kahneman and Tversky (1979) and Thaler and Shefrin (1981) have sought to provide a theory that explains how decision-makers actually behave in situations of market uncertainty. Subsequent works on this issue suggest that investors in financial markets do herd (flock together) and feedback when they trade securities (e.g., DeLong, Shleifer, Summers, and Waldman (1990), Froot, Scharfstein, and Stein (1992))[1]. Understanding herding and feedback trading behaviors is important since such understanding has the potential to explain several irregularities in financial events such as excess volatility, momentum, and reversals in the pricing of securities.

Herding by institutional investors may differ from herding by individual investors. Individual investors engage in herding as a result of irrational responses to fads or sentiment (Shiller (1980), Shefrin and Statman (1985), as well as Shleifer and Summers (1990)), while institutional investors engage in herding as a result of agency problems (Lakonishok, Shleifer, Thaler, and Vishny (1991) and Lakonishok, Shleifer, Vishny (1994)). A growing number of empirical studies have examined the trading behavior of institutional investors and their impact on stock prices. For example, Lakonishok, Shleifer, and Vishny (1992) documented that pension fund managers engage in either positive-feedback trading or herding, especially on low-priced stock. Wermers (1999) examined the trading activity carried out by mutual funds. That study

[1] Herding refers to a group of investors trading in the same direction. 'Feedback trading' involves trading activities that are based on past returns. See Bikhchandani and Sharma (2000) for a review of the most recent theoretical and empirical research on herd behavior.

found weak evidence to support herding behavior on medium-priced stock. But, herding was found more pronounced in trading on low-priced stock and in trading conducted by growth-oriented funds. Stock that herds bought was seen to outperform stock that mutual funds sold by four percent over a six month period following relevant transactions. These results are consistent with the concept of mutual fund herding as a phenomenon that expedites price adjustments.

Nofsinger and Sias (1999) attempted to postulate on the relative importance of the herding exhibited by institutional and individual investors. They found a strong positive correlation between changes in institutional ownership and returns measured over the same period. These results suggested that either institutional investors conducted more positive-feedback trade than retail investors, or institutional herding impacted prices more than herding by individuals[2]. In addition, they found no evidence of subsequent return reversals.

With respect to the behavior of retail (individual) investors, most empirical studies on individual herding focuses on whether individual investors' herding impacts close-ended fund discounts, since these funds are held primarily by individual investors. Studies on this include Lee, Shleifer, and Thaler (1991), Chopra, Lee, Shleifer, and Thaler (1993), and Chen, Kan, and Miller (1993). Most studies found evidence to support the supposition that individual herding may come from irrational behavior or a 'fad' following. Another thread of literature posits that there is a tendency of investors to hold losing investments too long, and sell winning investments too soon, the so-called 'disposition effect' by Shefrin and Statman (1985). Odean (1998) investigated the disposition effect by analyzing trading records at large discount brokerage houses. Consistent with that hypothesis, it was found that, in general, individual investors realize profitable investments at a much higher rate than unprofitable ones, except in December when tax-motivated selling prevails[3]. Moreover, it was found that individual investors trade stock excessively. Subsequently,

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[2] An increase in institutional ownership arises when either institutional investors herd to a stock, or retail investors herd away from it.

[3] Odean (1999) documents the return patterns before and after purchases and sales made by individual investors. These investors tend to buy stock that has risen or fallen relatively more over the previous six months than the stock they have sold. They sell stock that has risen rapidly in recent weeks, and they sell far more previous winners than losers.

Barber and Odean (2000) also documented that retail investors trade stock too frequently. It was found that, on average, the investments of individual investors (households represented by a large discount broker house) underperformed the value-weighted market index by 1.1 percent annually. This relatively poorer performance can be traced to the costs associated with high frequency in trading transactions. They hypothesize that this high frequency in trading can be partly explained by a behavioral bias: Such people are often overconfident, and overconfidence leads to too much trading.

2.2 Behavior of Investors during Volatile Conditions

Although the question of who trades during large market moves is interesting and helpful in understanding the dynamics of stock pricing and sources of market volatility, but there are not many studies on this matter. Choe, Kho and Stulz (1998) examined trading behavior and the impact of foreign investors in Korea during the 1997 economic crisis using intraday data. They found strong evidence of positive feedback trading and herding by foreign investors before the crisis. During the crisis, however, the evidence of herding became weaker and there was no evidence of positive feedback trading by foreign investors. They concluded that there was no evidence that foreign investors had destabilized Korea's stock market during the sampling period.

A study by Dennis and Strickland (2002) was the first to investigate the behavior of investors under extreme market conditions. They examined the returns on stock on volatile days, defined as when the absolute market return was larger than two percent and they documented certain interesting findings.

First, they found that when there was a large stock market drop, stock that exhibited a greater percentage of institutional ownership typically had lower returns than other stock with lower proportions of institutional ownership.

Similarly, it was found that when there was a large stock market rise, stock that had a greater percentage of institutional ownership exhibited higher returns than stock that had lower such ownership proportions. They argued that this evidence was consistent with the notion that institutions sell more than individuals when there is a large stock market drop and vice versa. In addition, they documented that abnormal

turnover was positively related to the level of institutional ownership on volatile days. Moreover, it was found that different types of institutional ownership do matter.

In other words, different types of ownership have different effects on a firm's abnormal return in volatile markets. Ownership by mutual funds, investment advisors, pension funds, and endowments were seen as positively related to the abnormal return on large market rise (and the other way around), while ownership by banks has an opposite effect. These results are consistent with the fact that the performance of funds is subjected to evaluation more frequently than that of bank managers. Finally, it is documented that abnormal returns subsequent to a large market drop are positive (negative) for stocks that have high (low) levels of institutional ownership (again with the obverse – in parentheses – being true, as well). This evidence suggests that institutional trades do not make the market more efficient, but rather, make the market more volatile.

In summary, the trading behavior of institutional and individual investors has been investigated by a large number of studies. Their behavior under extreme market conditions, however, is just underway. This is consistent with the recent direction in the area of corporate finance, which looks at the behavior of firms under extreme conditions, e.g., Harvey, Lins, and Roper (2001) and Minton and Wruck (2001). With the unique Thai market structure and using intraday investigations, the proposed study will provide further insights on recent topics of interest in this area.

2.3 Quality of an Exchange

One other interesting issue to pursue is whether there is any difference in trading cost between volatile days and normal days. Hasbrouck (1993) provides an appropriate framework. What Hasbrouck calls "quality" of a security market can be viewed as an implicit measure of trading cost. Some other popular measures such as the bid-ask spread represents trading cost only under certain restrictive assumptions. The framework that we employ is general enough to be applied to both order-driven and quote-driven exchanges.

3. Sample

3.1 Definition of Volatile (Extreme) Markets

Volatile (or extreme) markets are defined here as trading days when the absolute value of the SET (Stock Exchange of Thailand) index returns were greater than the 5th percentile rank. These days are referred to as an **'event day'**. From these event days, rising market ('extreme rising market') days are defined as trading days when the SET index returns were positive, while receding market days ('extreme receding market') are defined as trading days when the returns were negative. The normal market is defined as trading days when returns were ±2.5 percent of the median (47.5–52.5 percentile).

The data on trading activities categorized by type of investor ware compiled from the SET intraday database for the period July 2, 1999, through to November 3, 2003. This data set contained all buy and sell transactions on each type of investor during each trading day. The types of investors were the three types identified by the SET: local retail investors, local institutional investors, and foreign investors. During the sampling period, there were 108 event days that were classified as volatile markets, 54 days when the returns were greater than the 95 percentile, and 54 days when returns were lower than the 5th percentile.

Table Set 1 exhibits descriptive statistics of trading activity categorized by type of investor during the event period compared to normal market days. For example, in Panel 1A trading activity discriminated by the value of trade (in millions of Baht), volume of trade (in millions of shares), and by the number of deals (number of buy and sell transactions) by type of investor (retail, institutional, foreign) for the overall extreme event days are shown. In comparison, Panels 1B through 1D report on trading activities for the extreme rising, extreme receding and normal markets, respectively.

In Table Set 1, it is shown that during the sampling period, retail investors were dominant in the trading activity; their activity accounted for more than 70% of the overall market trading. The proportion of foreign investors tended to increase during extreme markets (21.79 percent) compared to that of normal markets (19.74 percent). The proportion traded by institutional investors seems to have been the same (at around 5 percent) during extreme and normal markets.

We also further examine the trading behavior of each type of investor by classifying the extreme market into rising and receding trends. This showed that average trading activity during extreme markets was higher than during normal markets. For example, from Panel 1B, the average total trading activity by value (number of deals) in an extreme market was 524,109 million Baht (4,170,000 transactions), compared to 422,165 million Baht (3,660,000 transactions) during a normal market.

Moreover, it is interesting to note that retail investors were net sellers, while other types of investors (institutional and foreign) tended to be net buyers during extreme rising markets. The pattern reversed itself during extreme receding markets; retail investors became net buyers while the others tended to be net sellers. For example, from Panel 1B, it can be seen that retail investors had a net selling position of -21,695 million Baht (representing 912 million shares), with 69,000 more sell transactions than buy transactions overall on extreme rising market days during the sampling period. Also, from Panel 1C, it can be seen that retail investors had a net buying position of 30,057 million Baht (1,630 million shares), with 242,000 more buy transactions than sell transactions during extreme receding market days over the period. These patterns seem to suggest that retail investors follow contrarian trading strategies, while institutional and foreign investors seem to follow momentum trading strategies.

It is also quite informative to investigate securities traded during extreme market conditions by these investors. Using the intraday data allows us to investigate the characteristics of securities traded by each type of investor. Table Set 2 reports on the characteristics of stock traded by each type of investor during extreme and normal markets. From these tables, it can be concluded that retail investors generally trade in riskier stock than other investors. For example, in a normal market, retail investors buy and sell stock that has an average beta of around 1.3, while institutional and foreign investors trade in stock that has a nominal average beta of around 1.1. It is interesting that in extreme rising or receding markets, the characteristics of stock that retail investors buy or sell seem to have the same beta (around 1.3).

This evidence suggests that regardless of the market conditions, retail investors buy or sell stocks with the same risk characteristics. However, the same conclusion

cannot be reached for the trading behavior of institutional or foreign investors. Institutional investors tend to buy lower risk stock in extreme receding markets than they do during extreme rising markets. In addition, during extreme rising markets, they tend to buy higher beta value stock than they sell. Similarly, the same pattern is observed with foreign investors. The results seem to suggest that institutional and foreign investors are more sensitive during extreme market conditions and adjust their trading activity in a risk averse manner.

When the volume of traded securities is examined, this suggests that retail investors buy and sell securities that have lower market capitalizations than institutional and foreign investors. For example, in a normal market, the average volume of buying transactions conducted by retail investors was around 12,902 million Baht, compared to 32,452 million Baht and 29,660 million Baht, respectively, for those of institutional and foreign investors. Moreover, retail investors tended to buy lower priced securities and sell higher priced securities during extreme rising markets, and vice versa. The opposite pattern was found for foreign investors who tended to buy higher priced securities and sell lower priced shares during extreme rising markets, and vice versa. The pattern is less conclusive for institutional investors since during extreme receding markets, the volumes of securities traded were roughly the same.

4. Trading Behavior by Type of Trader during Volatile Markets

4.1. Who blinks when the SET is volatile?

Unlike Dennis and Strickland (2002)'s study, this question can be answered directly by examining the aggregate trade sub-divided by type of investor that is compiled and reported by the SET. To measure abnormal volumes on an event-day (day 0), we adopted Field and Hanka (2001)'s measure of abnormal volume trade during lock-up periods. Specifically, the abnormal volume (value) is measured relative to the mean volume over days –50 to –6, which is defined as:

$$\text{Abnormal Volume (Value)}_{\,T} = \frac{V_T}{\frac{1}{45}\sum_{t=-50}^{-6} V_t} - 1 ,$$

where V_t is the volume (value) by each type of investors on day t and T is an event day.

The results of abnormal trading activity are reported in Table Set 3. In particular, the abnormal value, volume trade, and the number of deals are reported in Panels 3A, 3B, and 3C, respectively. From the table it can be concluded that there is abnormal trading activity during extreme markets. For example, the average value of securities bought is at 42 percent higher than the control period, while the corresponding numbers for retail and foreign investors were 36 and 33 percent, respectively (all are statistically significant). It is also apparent from Table Set 3 that abnormal trading activity was more pronounced during extreme rising markets. The total values traded during such periods were 74, 61 and 48 percent higher than those during the control period for retail, institutional and foreign investors, respectively (all are statistically significant). On the contrary, during extreme receding and normal markets there seems to be no evidence of abnormal trading activity since the corresponding numbers are relatively small and mostly statistically insignificant.

In addition, when we further investigate the pattern of abnormal buying and selling activities during extreme rising markets (Panel 3B), the evidence seems to be consistent with evidence found in the descriptive statistics discussed in the previous section. With retail investors, the average abnormal value of selling transactions is

higher than the average abnormal value of buying transactions. In particular, the selling transaction value was 80 percent higher than during the control period, while the buy transaction value was 67 percent higher than during the control period. Again, the pattern seems to be reversed with institutional and foreign investors. For example, foreign investors had a sell value only 32 percent higher than during the control period, but their buy value was 48 percent higher than during the control period.

4.2. Days after: Overreaction?

What happens after event days? If investors overreacted, we would expect price reversals after volatile market days. This supposition was investigated using the standard event study approach. The daily abnormal returns of securities classified by the net position of each type of investor around the event-days were calculated and examined. In particular, the following standard event-study procedure (Brown and Warner (1985)) was used to calculate abnormal returns.

Specifically, abnormal returns were defined as deviations from the market model using intraday stock returns. With the event day defined as day 0, the estimation period for market model coefficients runs from day – 120 through to day -31. Abnormal returns (AR) were calculated from day – 20 through to day +20, and then averaged across firms. Specifically, averaged abnormal returns were found using:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it},$$

where

AR_{it} = $R_{it} - E(R_{it})$.

R_{it} = the actual return on security i at day t,

$E(R_{it})$ = the expected return on security i for day t from the market model,

A test statistic is then constructed to determine whether the mean abnormal return is significantly different from zero. The t-value is calculated as:

$$t = \frac{AAR_t}{S(AAR_t)},$$

where $S(AAR_t)$ is the standard deviation of average residual returns calculated as:

$$S(AAR_t) = \left[\frac{\sum_{t=-120}^{t=-31} (AAR_t - \overline{A})^2}{N-1} \right]^{1/2}$$

$$\overline{A} = \frac{1}{N} \sum_{t=-120}^{1=-31} AAR_t.$$

The cumulative average residuals ($CAR_{k,l}$) are measured by summing average excess returns over days k to l:

$$CAR_{k,l} = \sum_{t=k}^{l} AAR_t$$

The t-statistic for $CAR_{k,l}$ is

$$t = \frac{CAR_{k,l}}{S(CAR_{k,l})},$$

where $S(CAR_{k,l}) = \sqrt{T} S(AAR_t)$.

The results of the event study are reported in Table Set 4. In particular, the average abnormal (market adjusted) returns of securities bought and sold sub-divided by type of investor during extreme rising markets are presented in Panel 4A, while those during extreme receding and normal markets are presented in Panels 4B and 4C, respectively (also see Figure Set 1). The results showed that, in general, any evidence of overreaction was not strong. It can be seen that although on the event days most of the abnormal returns were statistically significant, the post-event day abnormal returns were generally insignificant.

During extreme rising markets, however, it was surprising that securities bought by retail investors had strong negative and statistically significant returns on the event days. But, securities that were sold by retail investors yielded positive and had statistically significant abnormal returns on the next day (t+1). Securities bought by foreign investors on the event day also had negative abnormal returns, but were lower in magnitude, at -0.009 compared to -0.0002. Moreover, it can be seen that foreign investors tended to sell the losers; securities sold by foreign investors had average

abnormal returns of -0.006 and were statistically significant. Institutional investors bought winners and sold losers on the event day; stocks bought by institutional investors yielded statistically significant positive average abnormal returns, and vice versa. Similar patterns are found during extreme receding markets. Retail investors tended to buy losers, while institutional investors sold winners. Foreign investors tended to buy and sell losers. In a normal market, it was found that retail investors sold winners, while institutional and foreign investors tended to buy winners.

4.3. Intraday Returns and Volatility around Largest Price-Setting Order Imbalance

To further investigate the impact of trading by investor type, we calculated the returns and volatility around the largest price-setting order imbalance using intraday data. The standard event study type was applied as with Choe, Kho, and Stulz (1997) who examined whether foreign trades had destabilized the Korean market during the 1997 financial crisis. Briefly, each trading day was divided into 5-minute intervals, treating the time interval of 12.30-14.30 (lunch break) as a single interval. For each of the 5-minute intervals of trading days over the sampling period, we computed order imbalances by subtracting sell volume from buy volume during the interval for each type of investor. Then, the largest order imbalance was selected and marked as $t = 0$. Then, the average stock returns (adjusted by overall market returns) around the largest order imbalance at –5 to +5 intervals were examined to see the impact of price destabilization, graded by investor type.

Table Set 5 displays the average adjusted returns of stock classified by net buy order imbalance or net sell order imbalance for each type of investor around the largest imbalances. The results generally showed that at the largest order imbalance intervals, there were price impacts on order imbalances, regardless of the type of investor. The price impacts were negative for net sell imbalances and positive for net buy imbalances. For example, during extreme rising markets (Panel 5A), the returns of securities among the largest buy (sell) orders (at t=0) of foreign, institutional and retail investors were 1.18 (-0.60) percent, 0.87 (-0.32) percent, and 1.21 (-0.43) percent, respectively. These patterns are also seen during extreme receding and normal markets (see Panels 5B and 5C).

Further investigation of the results revealed some rather surprising observations. It seemed that retail investors' trades had more impact on prices than those of other investors. For example, during normal markets, it can be seen that only retail investors' trades incurred price impacts after the largest net buy order imbalances. However, their directions were opposite to what we would have expected.

Panel 5C shows that the returns after the largest net buy imbalances were all negatives with statistical significance for five intervals. Moreover, during extreme rising markets, only retail trades had negative impacts after the largest net buy order imbalances, and vice versa.

Again, these directions were not what we would have expected. During extreme receding markets, the results were not as pronounced as during other market conditions.

5. Trading Behavior across Markets during Extreme Markets

5.1. Relations of Price and Volume of Securities Listed on the Main and Foreign Boards

The trading behavior across the main and foreign boards was investigated by examining the linkage between the two boards. Again, each trading day was divided into 5-minute intervals, treating the time interval of 12.30-14.30 (lunch break) as a single interval. Test procedures following those of Stephan and Whaley (1990) and Easley et.al (1998) were used to investigate intraday price changes and relations in trading volume in the stock and option markets. In both studies, the technique of causality testing proposed by Granger (1969) was used. This procedure involved the prewhitening process[4], and then a causal regression model was estimated. In particular, the causality between the prices of securities on the main board and volume on the foreign board were investigated using the following regressions:

$$\Delta S_t = \alpha + \sum_{i=0}^{K} \beta_i VF_{t-i} + \varepsilon_t \qquad (1)$$

$$VF_t = \lambda + \sum_{i=0}^{K} \phi_i \Delta S_{t-i} + \xi_t \qquad (2)$$

where ΔS_t denotes the prewhitened time series of stock price changes, and VF_t is the volume of the same security listed on the foreign board. Lags in volume and stock price change series were denoted by the subscript *t*. α, λ are constants and ε_t , ξ_t are error terms. Price changes and volume were calculated over 5-minute intervals.

Similarly, the causality between the price of securities on the main board and their prices on the foreign board were investigated using:

$$\Delta S_t = \alpha + \sum_{i=0}^{K} \beta_i \Delta SF_{t-i} + \varepsilon_t \qquad (3)$$

$$\Delta SF_t = \lambda + \sum_{i=0}^{K} \phi_i \Delta S_{t-i} + \xi_t \qquad (4)$$

where ΔS_t denotes the prewhitened time series of stock price changes, and ΔSF_t being the corresponding price change on the same security listed on the foreign board. Lags

[4] In both Stephan and Whaley (1990) and Easley et al. (1998)'s studies, the stock price change series can be modeled as an MA(1) process.

of volumes and stock price change series are denoted by subscript *t*. α, λ are the constants and ε_t, ξ_t are error terms. Price changes and volume were calculated over 5-minute intervals.

The results of these regressions are reported in Table Set 6. It can be seen that generally there was a positive contemporaneous association found between price changes and trading volumes of securities on the main and foreign boards. The tables show that the estimated parameters of equations (1) through (4) are all positive and statistically significant, regardless of market conditions. For example, during extreme rising markets, the estimated coefficients of dependent variables are 0.191, 0.21, 0.24, and 0.23 for equations (1) through (4), respectively. This suggests that there was a contemporaneous positive association between the normalized price changes of securities on the main board and their trading activity on the foreign board, and vice versa.

There is also a positive association on normalized price changes between the main and foreign boards. The same patterns were found during extreme receding and normal markets (see Panels 6B and 6C). In lag relations, it was found that a positive association persisted in lag 1. All estimated coefficients were positive and statistically significant. In lag 2, all coefficients of equations (2) through (4) were positive and statistically significant. However, the lag 2 coefficients of equation (1) were all negative and statistically significant, except during normal markets.

Moreover, it can be observed that the contemporaneous coefficients are in general higher during extreme rising market than those of the normal market and the extreme down market. Overall, the results seem to suggest that there are positive associations (up to lag 1) between the price changes and trading activities of securities on the main and foreign boards. These associations were more pronounced during extreme rising markets than during extreme receding and normal markets.

5.2. Relations in Price and Volume of Warrants to Underlying Stock

The same procedure in the previous section was used to investigate the relations between stocks and warrants. In particular, the volume (price) of a security on the foreign board was replaced with the warrant volume (*VW*) and price (*SW*). Table Set 7 reports the results of those regressions. The overall results were similar to those

found for securities on the main and foreign boards. Generally, there were positive contemporaneous associations between price changes of warrants and the changes in their underlying securities, as well as with trading activity on them. For example, Panel 7A shows that during extreme rising markets, the contemporaneous and lag 1 estimated coefficients of equations (1) through (4) were all positive and statistically significant. Moreover, in consistency with the previous findings, it was found that the associations were more pronounced during extreme rising markets than during extreme down and normal markets.

6. Quality of the Market during Extreme Conditions

To measure the quality of a market, we adopt the method in Hasbrouck (1993). More specifically, the model for transaction price was:

$$s_t \equiv \ln S_t = m_t + \delta_t$$

where S_t is a transaction price. m_t is a random-walk process regarded as the implicit efficient price. δ_t is regarded as the pricing error term. The dispersion of δ_t, σ_δ^2, is our ultimate object of interest. Larger value of σ_δ^2 represents higher trading cost. The steps to estimating σ_δ^2 are outlined in the appendix.

The data are separated into three subsamples according to a classification of a given date into extreme rising, extreme receding or normal market condition. The dispersion of the pricing error for each subsample is then estimated. We expect that σ_δ^2 during normal market conditions should be smaller than σ_δ^2 during extreme market conditions.

The results are reported in Table Set 6. The three subsamples have about the same volumes of stock. The average beginning share prices were also approximately the same, though the price for the extreme receding subsample is higher than others by a small amount. Next, the average transaction volumes were about the same across the three subsamples. Nevertheless, the subsample from during normal market conditions had the lowest average transaction volume, suggesting that trading was less active during normal periods.

Finally, the measure of trading cost during various market conditions was reported in the last row. It turns out that the market, during extreme receding conditions, had the highest trading cost at 0.242 (i.e., approximately 0.242 percent of the stock price). The market during extreme rising conditions had a trading cost at 0.223, close to that of the market during extreme receding conditions. At 0.190, the trading cost in the market during normal conditions was substantially lower than during volatile conditions. These estimates confirm our expectation that trading costs during volatile markets were higher than normal.

7. Conclusion

This study was exploratory in nature. Based on the unique characteristics of the Stock Exchange of Thailand, we investigated various matters during volatile (extreme) market conditions. First, the trading behavior of three types of investors (domestic retail, local institutional and foreign) were investigated. Second, the casual relationships between the main and foreign boards, as well as with warrants and their underlying stock, were examined. Third, the quality of the market was investigated during extreme market events.

The data on trading activity sub-divided by each type of investor was compiled from the SET intraday database for the period July 2, 1999, through to November 3, 2003. Our preliminary investigations have suggested that retail investors follow contrarian trading strategies, while institutional and foreign investors seem to be momentum traders. They were net sellers, while other investors (institutional and foreign) tended to be net buyers during extreme rising markets. This pattern seemed to be reversed during extreme receding markets. Retail investors became net buyers while the others tended to become net sellers. Moreover, it has been documented that institutional and foreign investors bought lower risk stock during extreme receding markets than during extreme rising markets, and vice versa. These results suggest that institutional and foreign investors are more responsive to market conditions and adjust their trading activity in a more risk adverse manner.

Regarding abnormal trading activities during extreme market conditions, it was found that institutional investors seem to be more responsive to market conditions. The average value of securities bought by institutional investors was statistically significant at 42 percent higher than the control period, while the corresponding numbers for retail and foreign investors were 36 percent and 33 percent, respectively. Abnormal trading activity was more pronounced during extreme rising markets than during extreme receding markets. It was found that any evidence of overreaction in trading was not strong. Although on the event days most of the abnormal returns were statistically significant, the post-event day abnormal returns were generally statistically insignificant.

Using 5-minute trading intervals in sampling, it was observed that there were price impacts on order imbalances regardless of the type of investor. These price impacts were negative for net sell imbalances and positive for net buy imbalances. Contrary to anecdotal beliefs, retail investors' trades had more impact on prices than those of other investors. However, their directions were typically the opposite of what we would have expected. During normal markets, returns after the largest net buy imbalances were all negatively statistically significant for five intervals. During extreme rising markets, only retail trades had a negative impact after the largest net buy order imbalances, and vice versa.

In addition, our regressions support that, regardless of market conditions, there are positive contemporaneous associations between price changes and the trading volumes of securities on the main and foreign boards, as well as with warrants and their underlying assets.

Lastly, the results confirm our expectation that the quality of exchange during normal periods is better than during volatile periods.

In conclusion, this study provides further insight into the trading behavior of market participants in emerging markets such as Thailand. The unique structure (with the main and foreign boards) and types of investors (foreign nationals, domestic institutional investors, and domestic retail investors) in the Thai market certainly provides further insights into this issue. Our study adds to the limited body of literature on trading behavior during volatile market conditions. Unlike Dennis and Strickland (2002)'s study that inferred a relationship between behavior in ownership changes and returns, this study uses the direct observed trade volume research categorized by type of investor using intraday data provided by the SET. This information on trading behavior sub-divided into various types of investors and the quality of the market during extreme market conditions should thus be useful in deciding on policies and the implications of such planning as a preferences toward the promotion of foreign, domestic institutional, or retail investor participation in markets. Since this study was intended to be an exploratory investigation, plausible explanations of our findings are left for future research.

Appendix An Estimation Procedure of Quality of the Market

Recall that $s_t = m_t + \delta_t$, where m_t is a random walk, i.e.,

$$m_t = m_{t-1} + w_t,$$

w_t is the innovation term representing updates to the information set, and hence can be viewed as capturing both public non-trade information and innovation in trades:

$$w_t = \beta \cdot x_t + u_t.$$

The elements of the vector x_t may be nonlinear functions of trade volume V_t. For example, Hasbrouck (1993) define x_t as follow:

$$x_t = \begin{bmatrix} V_t^0 & V_t^1 & V_t^{1/2} \end{bmatrix}'$$

$$V_t^k = sign(V_t)|V_t|^k \text{ for } k = 0,1,\frac{1}{2}.$$

δ_t can be related to the data through the returns r_t as follow:

$$\begin{aligned} r_t &= s_t - s_{t-1} \\ &= m_t - m_{t-1} + \delta_t - \delta_{t-1} \\ &= w_t + \delta_t - \delta_{t-1} \end{aligned}$$

A multivariate generalization of the model above to allow for lagged dependencies results in the following Vector Autoregressive (VAR) specification:

$$\begin{aligned} r_t &= a_1 r_{t-1} + a_2 r_{t-2} + \cdots + b_1 x_{t-1} + b_2 x_{t-2} + \cdots + v_{1,t} \\ x_t &= c_1 r_{t-1} + c_2 r_{t-2} + \cdots + d_1 x_{t-1} + d_2 x_{t-2} + \cdots + v_{2,t} \end{aligned} \qquad \text{(A1)}$$

where $v_{1,t}$ and $v_{2,t}$ are the error terms with conforming dimensions.

The VAR equation may be transformed into an equivalent representation of Vector Moving Average (VMA) form with the following expression:

$$\begin{aligned} r_t &= a_0^* v_{1,t} + a_1^* v_{1,t-1} + a_2^* v_{1,t-2} + \cdots + b_0^* v_{2,t} + b_1^* v_{2,t-1} + b_2^* v_{2,t-2} + \cdots \\ x_t &= c_0^* v_{1,t} + c_1^* v_{1,t-1} + c_2^* v_{1,t-2} + \cdots + d_0^* v_{2,t} + d_1^* v_{2,t-1} + d_2^* v_{2,t-2} + \cdots \end{aligned} \quad \text{(A2)}$$

δ_t may be considered as consisting of two components: the information-related components and the non-information related component. The information-related components vary with w_t, while the non-information related component is uncorrelated to w_t. Thus, the expanded representation of the pricing error may be written as:

$$\delta_t = \alpha_0 v_{1,t} + \alpha_1 v_{1,t-1} + \cdots + \beta_0 \cdot v_{2,t} + \beta_1 \cdot v_{2,t-1} + \cdots + \eta_t + \gamma_1 \eta_{t-1} + \cdots$$

where η_t represents the non-trade public information. This model is under-identified. In order to identify the coefficients, the following Beveridge-Nelson restriction is imposed:

$$\eta_t = \gamma_1 = \gamma_2 = \ldots = 0 ,$$

resulting in the following identification:

$$\alpha_j = -\sum_{k=j+1}^{\infty} a_k^* , \beta_j = -\sum_{k=j+1}^{\infty} b_k^* , j = 0,1,2,\ldots \quad \text{(A3)}$$

Then, the dispersion of the pricing error can be obtained from the following expression:

$$\sigma_\delta^2 = \sum_{j=0}^{\infty} \begin{bmatrix} \alpha_j & \beta_j \end{bmatrix} Cov(v) \begin{bmatrix} \alpha_j \\ \beta_j \end{bmatrix}' \quad \text{(A4)}$$

The data required for VAR estimation includes returns data and signed trade volume. Three data subsamples are extracted according to the event day classification. We also restrict the data to only stock on the main board that had at least 500 trades per day.

We started by estimating the VAR model in equation (A1). The VAR model above involves infinite lags. In practice, it is necessary to make a truncation at some lags. We chose to truncate at lag 5 as did Hasbrouck (1993). Given the coefficient estimates from equation (A1), we converted the VAR representation to an equivalent VMA representation in equation (A2) (see Hamilton (1994), page 260 for an example).

Given a_k^* and b_k^*, α_j and β_j can be obtained via equation (A3). In the final step, σ_δ^2 can be computed from equation (A4). The VMA representation will generally be infinite. However, terms that have negligible effects on σ_δ^2 may be omitted.

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Table Set 1: Descriptive Statistics of Trading Activities by Type of Investor

These tables report on descriptive statistics in trading activity during volatile and normal markets by type of investor (local retail, local institutional, and foreign). The sampling period is July 2, 1999 through November 3, 2003. Trading activities are reported by value trade, volume of trade, and number of deals.
MB = Million Baht, MS = Million Shares.

Panel 1A: Extreme markets (108 days) – Days that absolute returns exceeded the 90th percentile MB = Million Baht, MS = Million Shares

Type	Value					Volume					Number of deals				
	Buy (MB)	Sell (MB)	Net (MB)	% Buy	% Sell	Buy (MS)	Sell (MS)	Net (MS)	% Buy	% Sell	Buy (‘000)	Sell (‘000)	Net (‘000)	% Buy	% Sell
Retail	701,593	693,231	8,362	72.82	71.95	80,773	80,055	718	86.42	85.65	6,570	6,397	173	83.78	81.58
Institutional	51,881	49,864	2,017	5.38	5.18	2,423	2,737	-313	2.59	2.93	284	310	-26	3.62	3.95
Foreign	209,970	220,349	-10,379	21.79	22.87	10,266	10,671	-404	10.98	11.42	988	1,135	-147	12.60	14.47
Total	963,443	963,443				93,462	93,462				7,842	7,842			

Panel 1B: Extreme rising markets (54 days) – Days that returns exceeded the 95th percentile MB = Million Baht, MS = Million Shares

Type	Value					Volume					Number of deals				
	Buy (MB)	Sell (MB)	Net (MB)	% Buy	% Sell	Buy (MS)	Sell (MS)	Net (MS)	% Buy	% Sell	Buy (‘000)	Sell (‘000)	Net (‘000)	% Buy	% Sell
Retail	374,601	396,297	-21,695	71.47	75.61	42,997	43,909	-912	85.39	87.20	3,451	3,520	-69	82.75	84.42
Institutional	28,330	25,214	3,116	5.41	4.81	1,385	1,422	-38	2.75	2.82	150	149	1	3.60	3.58
Foreign	121,177	102,598	18,579	23.12	19.58	5,972	5,022	950	11.86	9.97	569	501	68	13.64	12.00
Total	524,109	524,109				50,353	50,353				4,170	4,170			

Panel 1C: Extreme receding markets (54 days) – Days that returns were less than the 5th percentile

Type	Value					Volume					Number of deals				
	Buy (MB)	Sell (MB)	Net (MB)	% Buy	% Sell	Buy (MS)	Sell (Ml'/S)	Net (MS)	% Buy	% Sell	Buy ('000)	Sell ('000)	Net ('000)	% Buy	% Sell
Retail	326,991	296,934	30,057	74.43	67.59	37,776	36,146	1,630	87.63	83.85	3,119	2,876	242	84.94	78.35
Institutional	23,551	24,650	-1,099	5.36	5.61	1,039	1,314	-276	2.41	3.05	134	161	-27	3.64	4.37
Foreign	88,792	117,750	-28,958	20.21	26.80	4,294	5,648	-1,354	9.96	13.10	419	634	-215	11.42	17.28
Total	439,334	439,334				43,109	43,109				3,671	3,671			

Panel 1D: Normal markets (54 days) – Days that returns were between ±2.5 percent of the median

Type	Value					Volume					Number of deals				
	Buy (MB)	Sell (MB)	Net (MB)	% Buy	% Sell	Buy (MS)	Sell (MS)	Net (MS)	% Buy	% Sell	Buy ('000)	Sell ('000)	Net ('000)	% Buy	% Sell
Retail	315,266	311,025	4,241	74.68	73.67	40,278	39,750	528	87.92	86.77	3,131	3,068	63	85.54	83.82
Institutional	23,584	23,862	-278	5.59	5.65	1,250	1,289	-39	2.73	2.81	133	144	-11	3.64	3.94
Foreign	83,316	87,278	-3,963	19.74	20.67	4,282	4,771	-489	9.35	10.42	396	448	-52	10.81	12.23
Total	422,165	422,165				45,811	45,811				3,660	3,660			

Table 2: Characteristics of Stocks Traded during Extreme and Normal Market by Type of Investors

This table reports on the characteristics of stock traded by local retail, local institutional and foreign investors during extreme and normal markets. These characteristics were measured by their average value weighted beta and size (market capitalization in millions of Baht). Standard errors are in parentheses.

	Retail				Institutional				Foreign			
	Buy		Sell		Buy		Sell		Buy		Sell	
	Beta	Size (MB)	Beta	Size (MB)	Beta	Size (MB)	Beta	Size (MB)	Beta	Size (MB)	Beta	Size (MB)
Extreme event	1.3211	17687	1.3241	17348	1.1650	36274	1.1627	32393	1.1256	29696	1.1503	31017
	(0.0003)	(16)	(0.0003)	(16)	(0.0010)	(96)	(0.0010)	(85)	(0.0007)	(54)	(0.0006)	(55)
Extreme rising	1.3462	16795	1.3401	18260	1.2035	37825	1.1263	29620	1.1576	32574	1.1254	26740
	(0.0004)	(21)	(0.0004)	(22)	(0.0014)	(133)	(0.0015)	(117)	(0.0009)	(74)	(0.0010)	(73)
Extreme receding	1.2971	18631	1.3030	16276	1.1173	34524	1.1911	34952	1.0682	25626	1.1642	34084
	(0.0004)	(24)	(0.0004)	(23)	(0.0015)	(138)	(0.0014)	(123)	(0.0010)	(78)	(0.0008)	(77)
Normal	1.3264	13079	1.3201	12902	1.1591	32452	1.1462	32191	1.0952	29660	1.1517	28380
	(0.0004)	(19)	(0.0004)	(18)	(0.0016)	(132)	(0.0016)	(131)	(0.0011)	(86)	(0.0010)	(80)

Table Set 3: Abnormal Trading Activities during Extreme and Normal Markets

These tables report on average abnormal trading activity for each type of investor during extreme and normal markets. Abnormal trading activity was measured relative to previous days. To measure abnormal volume, we adopted Field and Hanka (2001)'s measure of abnormal volume trades during lock-up periods. Specifically, the abnormal volume is measured relative to the mean volume over the period –50 to –6 days, and was defined as:

$$\text{Abnormal Volume}_T = \frac{V_T}{\frac{1}{45}\sum_{t=-50}^{-6} V_t} - 1,$$

where V_t is the trade volume for each type of investor on day t and T is an event day. For abnormal trade value (abnormal number of deals), V_t is replaced by trade value (number or deals).

Panel 3A: Average Abnormal Trade Value

By Value	Retail			Institutional			Foreign		
	Buy	Sell	Total	Buy	Sell	Total	Buy	Sell	Total
Extreme Event	0.3650	0.3895	0.3767	0.4284	0.3542	0.3806	0.3376	0.2809	0.3066
t-statistic	4.168	3.878	4.030	3.877	4.503	4.492	3.761	4.714	4.330
Extreme Rising	0.6724	0.8139	0.7417	0.7422	0.5249	0.6157	0.6521	0.3211	0.4805
t-statistic	4.6752	4.8724	4.7899	3.7512	5.0240	4.5197	4.2277	3.5634	4.0318
Extreme Receding	0.0575	-0.0348	0.0117	0.1145	0.1835	0.1455	0.0231	0.2407	0.1327
t-statistic	0.7024	-0.4482	0.1481	1.4284	1.6114	1.5934	0.3259	3.0671	1.8949
Normal	0.0464	0.0431	0.0448	0.0019	0.0712	0.0322	-0.0390	-0.0364	-0.0383
t-statistic	0.5622	0.4991	0.5306	0.0275	1.0053	0.4894	-0.5949	-0.6028	-0.6216

Panel 3B: Average Abnormal Trade Volume

By Volume	Retail			Institutional			Foreign		
	Buy	Sell	Total	Buy	Sell	Total	Buy	Sell	Total
Extreme Event	0.4123	0.4284	0.4201	0.4371	0.4605	0.4379	0.4330	0.3238	0.3727
t-statistics	3.8107	3.7227	3.7679	3.4104	3.1503	3.4629	3.9659	5.0145	4.5679
Extreme Rising	0.7510	0.8251	0.7874	0.8487	0.7418	0.7756	0.7613	0.3692	0.5510
t-statistics	3.9233	4.0646	3.9960	3.6316	2.7940	3.3740	3.9680	3.4759	3.8442
Extreme Receding	0.0735	0.0318	0.0529	0.0255	0.1792	0.1001	0.1048	0.2783	0.1944
t-statistics	0.9274	0.3995	0.6669	0.3495	1.5841	1.1633	1.2294	3.7625	2.7122
Normal	0.0684	0.0685	0.0684	0.0361	0.0226	0.0232	-0.0466	-0.0161	-0.0313
t-statistics	0.6778	0.6565	0.6671	0.4127	0.3425	0.3454	-0.7025	-0.2670	-0.5099

Panel 3C: Average Abnormal Number of Trade Deals

By Number of Deals	Retail			Institutional			Foreign		
	Buy	Sell	Total	Buy	Sell	Total	Buy	Sell	Total
Extreme Event	0.2730	0.2812	0.2769	0.3469	0.3072	0.3187	0.2858	0.2461	0.2618
t-statistics	4.6780	4.3177	4.5022	4.3408	5.1459	5.3445	4.5301	5.7852	5.7890
Extreme Rising	0.4849	0.5616	0.5225	0.5563	0.3831	0.4527	0.5447	0.1836	0.3490
t-statistics	5.1500	5.3633	5.2652	3.9403	5.2879	4.9748	5.5063	3.4521	4.9341
Extreme Receding	0.0611	0.0007	0.0313	0.1375	0.2313	0.1847	0.0269	0.3085	0.1746
t-statistics	1.0815	0.0132	0.5583	2.1217	2.4484	2.5136	0.4390	4.6893	3.2049
Normal	0.0627	0.0641	0.0634	0.0460	0.0863	0.0623	-0.0171	-0.0217	-0.0207
t-statistics	0.9299	0.9092	0.9197	0.7873	1.4665	1.1582	-0.3282	-0.4976	-0.4576

Table Set 4: The Average Adjusted Returns of Securities Bought and Sold during the Event Days

These tables report on the average adjusted returns of securities bought and sold on a given event date (day = 0) sub-divided by type of investor. Panel A shows the results for extreme rising events, while Panel B shows the results for extreme receding events. Panel C reports the results for normal events. The equally weighted returns are adjusted by the SET index returns. An asterisk (*) denotes statistical significance at a 99 percent confidence level.

Panel 4A: Extreme rising markets

Relative Day	Retail		Institutional		Foreign	
	Buy	Sell	Buy	Sell	Buy	Sell
-20 to -16	0.00024	0.00020	0.00041	-0.00013	-0.00007	0.00035
-15 to -11	0.00018	0.00054	0.00100	0.00042	0.00036	0.00025
-10	-0.00108	-0.00141*	0.00059	-0.00144*	-0.00157*	-0.00081
-9	-0.00204*	-0.00130*	0.00006	-0.00131	-0.00144*	-0.00212*
-8	-0.00142*	-0.00102	-0.00009	-0.00143*	-0.00141	-0.00100
-7	0.00083	0.00065	-0.00058	0.00130	0.00069	0.00043
-6	0.00115*	0.00065	0.00089	0.00107	-0.00006	0.00152
-5	-0.00006	-0.00029	0.00067	-0.00248*	-0.00073	0.00073
-4	-0.00196*	-0.00025	0.00072	-0.00012	-0.00017	-0.00216*
-3	-0.00304*	-0.00175*	-0.00070	-0.00049	-0.00212*	-0.00252
-2	-0.00296*	-0.00021	0.00042	-0.00170*	-0.00076	-0.00213*
-1	-0.00205*	0.00357*	0.00203*	-0.00058	0.00267	-0.00116
0	-0.00960*	0.00132	0.00348*	-0.00620*	-0.00026*	-0.00624*
1	-0.00121	0.00168*	0.00066	-0.00109	0.00103	-0.00129
2	0.00035	-0.00054	-0.00042	0.00003	-0.00031	0.00030
3	-0.00049	0.00172*	0.00206*	-0.00143	0.00144*	0.00029
4	-0.00058	0.00092	0.00101	-0.00040	0.00039	-0.00014
5	0.00114*	0.00134*	-0.00024	0.00261*	0.00178*	0.00067
6	0.00128*	0.00066	0.00013	0.00032	0.00053	0.00090
7	-0.00068	-0.00082	-0.00073	-0.00185*	-0.00079	-0.00044
8	-0.00101	0.00042	-0.00018	-0.00013	0.00056	-0.00136*
9	-0.00040	-0.00027	-0.00061	-0.00065	-0.00029	-0.00027
10	-0.00149*	-0.00085	-0.00028	-0.00154*	-0.00112*	-0.00148*
11 to 15	0.00070	0.00044	-0.00029	0.00020	0.00048	0.00075
16 to 20	-0.00054	-0.00064	-0.00063	-0.00076	-0.00071	-0.00049
CAR(-10,10)	-0.02532	0.00420	0.00888	-0.01752	-0.00194	-0.01830
CAR(0,+2)	-0.01046*	0.00246*	0.00372*	-0.00727*	0.00046*	-0.00724*

Panel 4B: Extreme receding market days

Relative Day	Retail		Institution		Foreign	
	Buy	Sell	Buy	Sell	Buy	Sell
-20 to -16	0.00042	0.00077	0.00086	0.00027	0.00060	0.00059
-15 to -11	-0.00029	-0.00032	0.00092	-0.00035	-0.00056	0.00009
-10	0.00045	0.00094	0.00078	0.00003	0.00066	0.00093
-9	-0.00067	0.00041	0.00071	-0.00088	0.00012	-0.00028
-8	0.00201	-0.00010	0.00091	0.00123	-0.00015	0.00201*
-7	0.00088	0.00243*	0.00339*	0.00136	0.00284*	0.00050
-6	0.00145	0.00158*	0.00110	0.00171*	0.00179*	0.00127
-5	-0.00113	0.00052	-0.00063	0.00187	0.00082	-0.00129
-4	-0.00193*	-0.00189	-0.00123	-0.00042	-0.00194*	-0.00174*
-3	-0.00130*	0.00039	0.00004	-0.00221*	-0.00058	-0.00022
-2	-0.00060	0.00170*	0.00263*	-0.00083	0.00079	0.00017
-1	0.00004	0.00032	0.00212*	-0.00002	-0.00042	0.00089
0	-0.00522*	0.00088	-0.00077	-0.00567*	-0.00238*	-0.00421*
1	-0.00006	-0.00035	0.00112	-0.00002	-0.00019	-0.00020
2	-0.00108	0.00035	-0.00145	-0.00059	0.00073	-0.00170*
3	0.00026	-0.00087	-0.00158*	0.00147	-0.00064	0.00000
4	-0.00006	-0.00072	-0.00075	0.00007	-0.00062	0.00003
5	-0.00097	-0.00002	0.00036	-0.00044	-0.00049	-0.00073
6	-0.00012	0.00220*	0.00061	-0.00147	0.00205*	0.00036
7	-0.00027	0.00022	0.00110	0.00077	0.00031	-0.00023
8	0.00017	0.00185*	0.00088	-0.00007	0.00181*	0.00042
9	0.00181*	0.00167*	0.00130*	0.00131	0.00170*	0.00188*
10	0.00034	0.00135*	0.00098	-0.00045	0.00104	0.00051
11 to 15	-0.00085	-0.00043	-0.00022	-0.00086	-0.00049	-0.00084
16 to 20	-0.00031	-0.00025	-0.00059	-0.00063	-0.00016	-0.00036
CAR(-10,10)	-0.00601	0.01286	0.01161	-0.00324	0.00725	-0.00163
CAR(0,+2)	-0.00636*	0.00088	-0.00110	-0.00628*	-0.00184*	-0.00611*

Panel 4C: Normal market days

Relative Day	Retail		Institutional		Foreign	
	Buy	Sell	Buy	Sell	Buy	Sell
-20 to -16	-0.00010	0.00045	0.00070	-0.00024	0.00026	0.00010
-15 to -11	0.00093	0.00145	0.00126	0.00071	0.00127	0.00119
-10	0.00125*	-0.00032	0.00166*	0.00085	-0.00016	0.00138*
-9	0.00136*	0.00104	0.00172*	0.00201*	0.00062	0.00176*
-8	-0.00161*	-0.00031	0.00083	-0.00055	-0.00039	-0.00130*
-7	0.00101	0.00168*	0.00214*	0.00073	0.00124*	0.00143*
-6	0.00106*	0.00141*	0.00085	0.00085	0.00127*	0.00124*
-5	0.00033	0.00143*	0.00101	0.00080	0.00128*	0.00042
-4	-0.00040	0.00009	0.00029	-0.00049	-0.00031	0.00031
-3	0.00200*	0.00262*	0.00135*	0.00312*	0.00359*	0.00144
-2	0.00031	0.00148*	0.00081	0.00124	0.00107	0.00095
-1	0.00120	0.00437*	0.00368*	0.00283	0.00393*	0.00205*
0	0.00073	0.00817*	0.00437*	0.00172*	0.00666*	0.00210*
1	0.00074	0.00117*	-0.00034	0.00015	0.00152*	0.00075
2	-0.00053	0.00053	-0.00012	-0.00072	0.00046	-0.00048
3	0.00066	-0.00039	-0.00028	-0.00138	-0.00014	0.00028
4	-0.00068	-0.00115	-0.00107	-0.00084	-0.00133*	-0.00063
5	-0.00129*	-0.00062	-0.00033	-0.00192	-0.00102	-0.00083
6	0.00026	-0.00109	-0.00088	-0.00045	-0.00123	0.00020
7	0.00005	0.00011	-0.00044	-0.00007	0.00010	-0.00022
8	-0.00048	0.00004	-0.00118*	-0.00028	-0.00019*	-0.00006
9	-0.00156*	-0.00145*	-0.00075	-0.00184*	-0.00160*	-0.00141*
10	-0.00141*	-0.00147*	-0.00097	-0.00135	-0.00152	-0.00156*
11 to 15	0.00061	0.00091	0.00042	0.00046	0.00096	0.00062
16 to 20	-0.00011	0.00004	-0.00037	-0.00027	-0.00004	-0.00024
CAR(-10,10)	0.00300*	0.01734	0.01234	0.00440	0.01385	0.00782*
CAR(0,+2)	0.00094	0.00987*	0.00391*	0.00115	0.00863*	0.00237

Table Set 5: Intraday Returns relative to Price Setting Orders

These tables report the mean adjusted returns of stock bought and sold by each type of investor around the largest price setting orders. Order imbalances were computed by subtracting the sell volume from buy volume during 5-minute intervals over a day. Then periods that contained the largest order imbalances were selected and marked as t = 0. The mean adjusted stock returns around the largest order imbalances from –5 to +5 intervals are presented in the tables. Note also that N = number of observations and *t*-statistics are in parentheses.

Panel 5A: The extreme rising market

		5-minute intervals vis-à-vis large price setting orders											
		-5	-4	-3	-2	-1	0	1	2	3	4	5	CAR(0,5)
Net buy (positive) imbalances													
Foreign	N = 672												
Returns		0.086%	0.044%	0.091%	0.130%	0.155%	1.182%	0.001%	-0.023%	-0.008%	0.059%	0.024%	1.235%
		(2.43)	(1.70)	(4.75)	(4.95)	(5.44)	(14.40)	(0.04)	(-0.94)	(-0.33)	(2.16)	(0.90)	(13.54)
Institutional	N = 255												
Returns		0.053%	0.079%	0.077%	0.148%	0.233%	0.868%	0.042%	0.007%	-0.005%	-0.030%	-0.041%	0.840%
		(1.47)	(2.22)	(2.27)	(4.09)	(5.55)	(10.54)	(0.71)	(0.16)	(-0.16)	(-0.78)	(-1.17)	(9.19)
Retail	N = 4077												
Returns		0.057%	0.053%	0.040%	0.082%	0.205%	1.217%	-0.032%	-0.050%	-0.032%	-0.011%	0.002%	1.095%
		(5.59)	(5.02)	(3.60)	(8.10)	(10.77)	(30.00)	(-2.03)	(-3.79)	(-2.64)	(-0.69)	(0.15)	(24.96)
Net sell (negative) imbalances													
Foreign	N = 635												
Returns		0.019%	-0.012%	0.028%	0.014%	-0.001%	-0.602%	0.039%	0.054%	0.013%	0.042%	0.009%	-0.445%
		(0.93)	(-0.55)	(1.43)	(0.69)	(-0.04)	(-6.80)	(1.46)	(2.28)	(0.70)	(1.23)	(0.44)	(-4.81)
Institutional	N = 243												
Returns		0.010%	0.013%	0.009%	-0.010%	0.025%	-0.326%	0.068%	0.043%	0.019%	-0.026%	0.067%	-0.155%
		(0.35)	(0.36)	(0.44)	(-0.32)	(1.16)	(-5.94)	(1.20)	(1.77)	(0.68)	(-0.73)	(1.46)	(-2.02)
Retail	N = 3212												
Returns		0.012%	0.005%	0.035%	0.034%	0.040%	-0.434%	0.057%	0.041%	0.031%	0.025%	0.043%	-0.238%
		(1.05)	(0.56)	(3.21)	(3.14)	(2.89)	(-12.27)	(4.12)	(4.46)	(3.25)	(2.39)	(3.61)	(-5.85)

Panel 5B: Extreme receding markets

	5-minute intervals vis-à-vis large price setting orders											
	-5	-4	-3	-2	-1	0	1	2	3	4	5	CAR(0,5)
Net buy (positive) imbalances												
Foreign	N = 373											
Returns	0.044%	0.059%	-0.008%	0.145%	0.072%	0.699%	-0.074%	-0.119%	-0.006%	-0.044%	-0.044%	0.411%
	(1.80)	(1.27)	(-0.20)	(2.50)	(2.82)	(8.15)	(-1.99)	(-2.45)	(-0.13)	(-1.44)	(-1.12)	(4.20)
Institutional	N = 115											
Returns	0.048%	-0.002%	0.019%	-0.007%	0.221%	1.022%	-0.022%	-0.087%	-0.062%	-0.119%	-0.101%	0.631%
	(1.29)	(-0.03)	(0.37)	(-0.06)	(1.77)	(5.37)	(-0.54)	(-2.46)	(-1.13)	(-2.46)	(-1.50)	(3.17)
Retail	N = 1783											
Returns	0.004%	0.027%	0.066%	0.047%	0.175%	1.188%	-0.076%	-0.017%	-0.057%	-0.101%	-0.077%	0.859%
	(0.21)	(1.29)	(2.79)	(1.78)	(8.07)	(14.79)	(-3.41)	(-0.62)	(-3.39)	(-6.30)	(-4.32)	(9.80)
Net sell (negative) imbalances												
Foreign	N = 969											
Returns	-0.033%	-0.045%	-0.055%	-0.052%	-0.120%	-0.752%	-0.028%	-0.009%	-0.036%	0.011%	-0.011%	-0.825%
	(-1.93)	(-2.38)	(-2.71)	(-1.29)	(-5.94)	(-16.56)	(-1.07)	(-0.39)	(-2.49)	(0.66)	(-0.60)	(-13.96)
Institutional	N = 309											
Returns	0.000%	-0.089%	-0.042%	-0.098%	-0.178%	-0.779%	-0.093%	-0.076%	-0.014%	0.027%	-0.021%	-0.956%
	(-0.01)	(-2.82)	(-1.74)	(-3.66)	(-5.05)	(-7.51)	(-2.33)	(-2.21)	(-0.38)	(0.57)	(-0.58)	(-7.99)
Retail	N = 5367											
Returns	-0.033%	-0.004%	-0.023%	-0.043%	-0.106%	-0.818%	-0.033%	0.013%	-0.006%	0.008%	-0.020%	-0.855%
Foreign	(-3.92)	(-0.45)	(-2.75)	(-4.27)	(-9.56)	(-32.39)	(-3.12)	(1.29)	(-0.47)	(0.88)	(-1.77)	(-26.63)

Panel 5C: Normal markets

		5-minute intervals vis-à-vis large price setting orders										
		-5	-4	-3	-2	-1	0	1	2	3	4	5	CAR(0,5)
Net buy (positive) imbalances													
Foreign	N =564												
Returns		0.064%	0.032%	0.178%	0.128%	0.114%	0.865%	-0.015%	0.019%	-0.045%	-0.016%	-0.002%	0.807%
		(3.67)	(1.83)	(1.10)	(1.96)	(5.56)	(12.02)	(-0.56)	(0.68)	(-1.71)	(-0.75)	(-0.10)	(9.77)
Institutional	N = 209												
Returns		0.074%	0.027%	-0.030%	0.054%	0.173%	0.799%	-0.041%	-0.022%	-0.007%	-0.077%	-0.026%	0.626%
		(2.68)	(1.13)	(-1.32)	(1.74)	(3.26)	(7.79)	(-1.03)	(-0.73)	(-0.25)	(-2.56)	(-0.93)	(6.03)
Retail	N = 3459												
Returns		0.010%	0.056%	0.047%	0.112%	0.213%	1.132%	-0.069%	-0.044%	-0.075%	-0.047%	-0.052%	0.845%
		(0.71)	(4.03)	(3.80)	(5.49)	(12.32)	(28.06)	(-3.84)	(-2.76)	(-4.97)	(-3.14)	(-3.96)	(19.11)
Net sell (negative) imbalances													
Foreign	N = 737												
Returns		-0.031%	-0.020%	-0.041%	-0.058%	-0.057%	-0.570%	-0.015%	0.001%	0.031%	0.002%	0.011%	-0.540%
		(-1.69)	(-1.07)	(-2.70)	(-2.90)	(-2.35))	(-12.36)	(-0.90)	(0.04)	(1.76)	(0.16)	(0.65)	(-9.99)
Institutional	N = 311												
Returns		0.039%	-0.005%	-0.050%	-0.066%	-0.081%	-0.553%	-0.033%	-0.012%	0.001%	0.013%	-0.034%	-0.620%
		(1.37)	(-0.25)	(-2.12)	(-2.27)	(-2.36)	(-6.65)	(-1.39)	(-0.54)	(0.04)	(0.74)	(-1.47)	(-7.00)
Retail	N = 4261												
Returns		0.005%	0.001%	0.029%	0.011%	-0.005%	-0.476%	0.018%	0.044%	0.013%	0.002%	-0.001%	-0.400%
		(0.50)	(0.06)	(2.55)	(0.82)	(-0.44)	(-19.45)	(1.15)	(3.08)	(1.82)	(0.22)	(-0.11)	(-14.08)

Table Set 6: Relations of Price and Volume of Securities across the Alien and Main Board

These tables investigate the causality between the price of a security on the main board and the volume of the foreign board using the following regressions:

$$\Delta S_t = \alpha + \sum_{i=0}^{K} \beta_i VF_{t-i} + \varepsilon_t \qquad (1)$$

$$VF_t = \lambda + \sum_{i=0}^{K} \phi_i \Delta S_{t-i} + \xi_t \qquad (2)$$

$$\Delta S_t = \alpha + \sum_{i=0}^{K} \beta_i \Delta SF_{t-i} + \varepsilon_t \qquad (3)$$

$$\Delta SF_t = \lambda + \sum_{i=0}^{K} \phi_i \Delta S_{t-i} + \xi_t \qquad (4)$$

where ΔS_t denotes the prewhitened time series of stock price changes, and VF_t is the volume of the same security listed on the alien board. α, λ are the constants and ε_t, ξ_t are error terms. Price changes and volume were calculated over 5-minute intervals. Returns and net trade volumes are standardized by subtracting the mean and dividing by the standard deviation of the day, as suggested by Stephan and Whaley (1990). An asterisk (*) indicates a significance level at 0.01.

Panel 6A: Extreme rising markets

	(1)		(2)		(3)		(4)	
	Parameter Estimate	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**
Intercept	-0.00559	0.00431	-0.00108	0.00450	-0.00210	0.00434	-0.00442	0.00427
Dependent variable	0.19129*	0.00426	0.21718*	0.00469	0.24774*	0.00452	0.23481*	0.00435
Lag 1	0.04108*	0.00440	0.07417*	0.00475	0.08303*	0.00458	0.07242*	0.00447
Lag 2	-0.02266*	0.00447	0.02601*	0.00477	0.02463*	0.00459	0.00889*	0.00451
Lag 3	-0.01914*	0.00454	0.02667*	0.00477	0.02175*	0.00460	-0.00095	0.00454
Lag 4	-0.01120*	0.00457	0.01444*	0.00476	0.01386*	0.00459	-0.00391	0.00456
Lag 5	-0.00734	0.00461	0.01309*	0.00474	-0.00130	0.00457	-0.00150	0.00456
Lag 6	-0.00015	0.00463	-0.00242	0.00472	0.00064	0.00455	-0.00833	0.00453

Panel 6B: Extreme receding markets

	(1)		(2)		(3)		(4)	
	Parameter Estimate	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**
Intercept	0.01993*	0.00438	0.00129	0.00461	0.00505	0.00447	0.01795*	0.00434
Dependent variable	0.14472*	0.00440	0.16662*	0.00490	0.19953*	0.00475	0.18348*	0.00447
Lag 1	0.05004*	0.00452	0.08133*	0.00498	0.10240*	0.00483	0.08061*	0.00460
Lag 2	-0.00521*	0.00457	0.03241*	0.00497	0.04324*	0.00482	0.01346*	0.00461
Lag 3	-0.00943*	0.00464	0.01792*	0.00495	0.01736*	0.00480	-0.00243	0.00463
Lag 4	-0.01867*	0.00471	0.00856	0.00492	0.00934	0.00477	-0.00592	0.00463
Lag 5	-0.01626*	0.00473	0.00425	0.00486	0.00342	0.00471	-0.01397*	0.00460
Lag 6	-0.01134	0.00467	-0.00874	0.00477	0.00244	0.00462	-0.00579	0.00455

Panel 6C: Normal markets

	(1)		(2)		(3)		(4)	
	Parameter Estimate	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**
Intercept	0.00890	0.00490	-0.00578	0.00507	-0.00380	0.00499	0.00854	0.00487
Dependent variable	0.16964*	0.00487	0.18973*	0.00525	0.20702*	0.00517	0.19312*	0.00490
Lag 1	0.05237*	0.00502	0.06920*	0.00536	0.09504*	0.00527	0.07180*	0.00507
Lag 2	-0.00738	0.00511	0.03764*	0.00537	0.03727*	0.00528	0.02028*	0.00512
Lag 3	-0.00991	0.00517	0.01664*	0.00536	0.01787*	0.00528	0.00367	0.00513
Lag 4	-0.01172*	0.00523	0.01590*	0.00535	0.01200*	0.00526	-0.00117	0.00519
Lag 5	-0.00871	0.00527	0.01082*	0.00531	0.00714	0.00523	-0.00115	0.00520
Lag 6	-0.00642	0.00529	0.00226	0.00529	0.00723	0.00520	0.00077	0.00521

Table 7: Relations between Price and Volume on Warrants and Underlying Stocks

These tables investigate the relations between price and volume on warrants and their underlying stocks during extreme and normal market conditions. In particular, they report the coefficients of the following regressions:

$$\Delta S_t = \alpha + \sum_{i=0}^{K} \beta_i VW_{t-i} + \varepsilon_t \qquad (1)$$

$$VW_t = \lambda + \sum_{i=0}^{K} \phi_i \Delta S_{t-i} + \xi_t \qquad (2)$$

$$\Delta S_t = \alpha + \sum_{i=0}^{K} \beta_i \Delta SW_{t-i} + \varepsilon_t \qquad (3)$$

$$\Delta SW_t = \lambda + \sum_{i=0}^{K} \phi_i \Delta S_{t-i} + \xi_t \qquad (4)$$

where ΔS_t denotes the prewhitened time series of stock price changes, VW_t is the volume of the warrant, ΔSW_t is the warrant price change. α, λ are the constants and ε_t, ξ_t are error terms. Returns and net trade volumes are standardized by subtracting the mean and dividing by the standard deviation of the day, as suggested by Stephan and Whaley (1990). An asterisk (*) indicates a significance level at 0.01.

Panel 7A: Extreme rising markets

	(1)		(2)		(3)		(4)	
	Parameter Estimate	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**
Intercept	-0.00144	0.00408	-0.00779	0.00413	-0.00103	0.00414	-0.00269	0.00408
Dependent variable	0.23196*	0.00413	0.25294*	0.00430	0.24273*	0.00430	0.23063*	0.00415
Lag 1	0.02471*	0.00419	0.10925*	0.00432	0.09506*	0.00432	0.06520*	0.00422
Lag 2	-0.01037*	0.00422	0.04065*	0.00435	0.02306*	0.00435	0.00201	0.00428
Lag 3	-0.01418*	0.00422	0.02405*	0.00435	0.00502	0.00435	-0.00418	0.00428
Lag 4	-0.01147*	0.00423	0.03428*	0.00432	0.01743*	0.00432	-0.00243	0.00427
Lag 5	-0.01043*	0.00424	0.01356*	0.00430	0.00529	0.00430	-0.00461	0.00427
Lag 6	-0.00118	0.00424	0.01657*	0.00429	0.00047	0.00429	-0.00519	0.00428

Panel 7B: Extreme receding markets

	(1)		(2)		(3)		(4)	
	Parameter Estimate	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**
Intercept	0.01201*	0.00399	-0.00669	0.00413	-0.00259	0.00408	0.01119*	0.00398
Dependent variable	0.16508*	0.00407	0.18664*	0.00439	0.18460*	0.00434	0.17242*	0.00413
Lag 1	0.04969*	0.00413	0.10561*	0.00444	0.10080*	0.00439	0.07016*	0.00419
Lag 2	0.00119	0.00413	0.05003*	0.00444	0.03303*	0.00439	0.01042*	0.00419
Lag 3	-0.01819*	0.00418	0.02006*	0.00443	-0.00212	0.00437	-0.00966*	0.00421
Lag 4	-0.03111*	0.00418	0.01143*	0.00438	0.00170	0.00433	-0.02499*	0.00420
Lag 5	-0.00913*	0.00418	0.00110	0.00431	-0.00011	0.00425	-0.01185*	0.00417
Lag 6	0.00085	0.00414	0.01701*	0.00423	0.00615	0.00418	0.00123	0.00413

Panel 7C: Normal markets

	(1)		(2)		(3)		(4)	
	Parameter Estimate	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**	**Parameter Estimate**	**Standard Error**
Intercept	-0.00046	0.00382	-0.01095*	0.00392	-0.00631	0.00392	-0.00134	0.00382
Dependent variable	0.21447*	0.00383	0.23549*	0.00407	0.22542*	0.00408	0.20993*	0.00385
Lag 1	0.04633*	0.00387	0.09273*	0.00410	0.09236*	0.00411	0.07037*	0.00390
Lag 2	-0.00847*	0.00388	0.04078*	0.00410	0.03283*	0.00411	0.01524*	0.00392
Lag 3	-0.01211*	0.00391	0.02298*	0.00411	0.00700	0.00412	-0.00492	0.00396
Lag 4	-0.00869*	0.00392	0.01542*	0.00410	0.00526	0.00411	-0.00418	0.00395
Lag 5	-0.00736	0.00394	0.00891*	0.00407	0.00520	0.00408	-0.00324	0.00397
Lag 6	-0.00619	0.00394	0.00307	0.00405	0.00303	0.00405	-0.00155	0.00397

Table Set 8: Quality of exchange during normal and extreme market conditions

These tables investigate the dispersion of pricing errors during various market conditions. The pricing error δ_t is defined by the following equation:

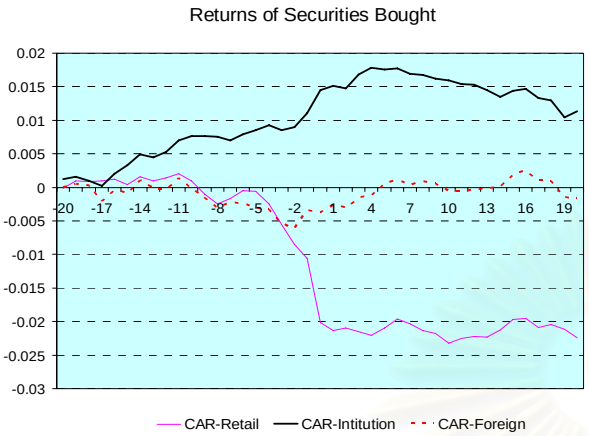
$$s_t = m_t + \delta_t$$

where s_t is the natural log of the transaction price. m_t is the efficient price modelled by a random-walk process, and hence is non-stationary. The first row reports the number of stock issues observed on which the trade data was used in each market condition. The second row reports the average beginning share price across all stock and all days in each subsample. The third row reports the average number of transactions across all firms. The last row reports σ_δ, which is a measure of price dispersion.

	Market Conditions		
	Extreme Rising	**Extreme Receding**	**Normal**
No. of stocks observed	271	278	292
Average beginning share price	29.48	32.32	29.74
Average number of transactions	11176	10010	9864
σ_δ x100	0.223	0.242	0.190

Figure Set 1: Average Adjusted Returns of Securities Bought and Sold around the Event Days

Figure 1A: Extreme rising markets



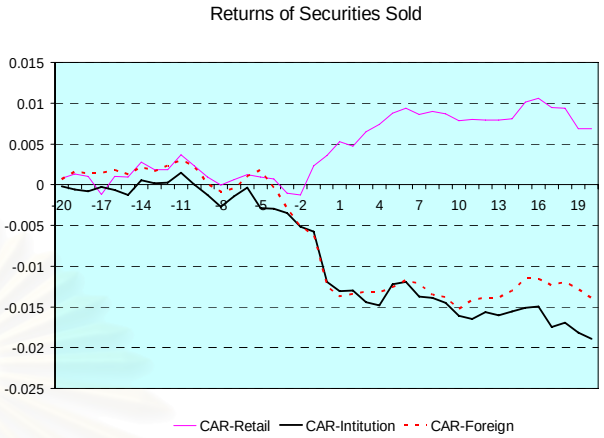
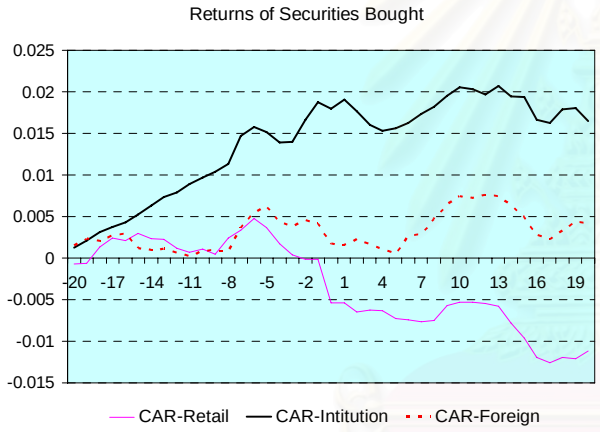


Figure 1B: Extreme receding markets



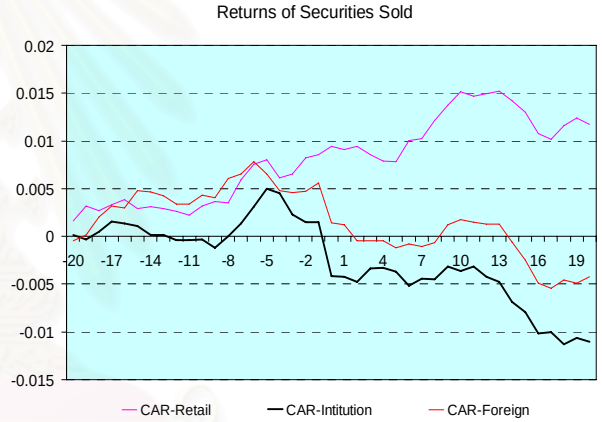
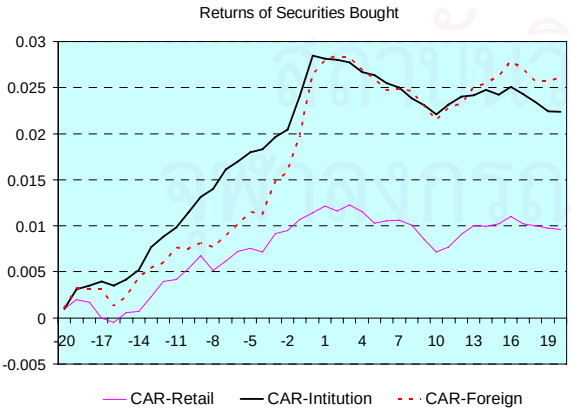


Figure 1C: Normal markets



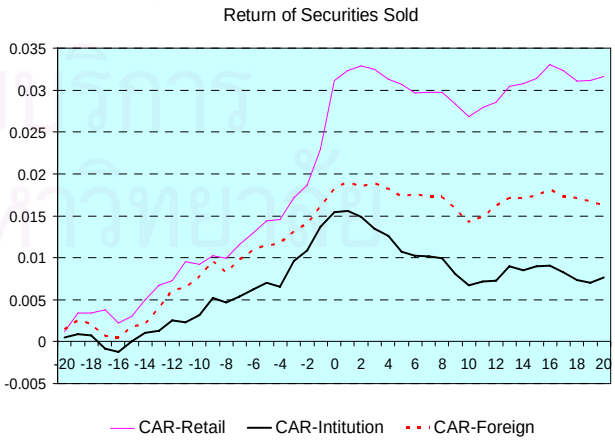
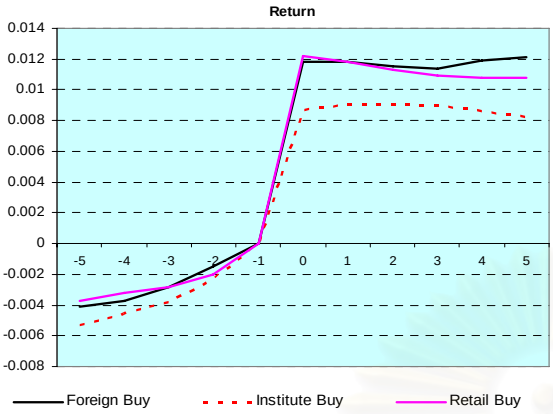


Figure 2: Intraday Returns around Order Imbalances

Figure 2A: Extreme rising markets



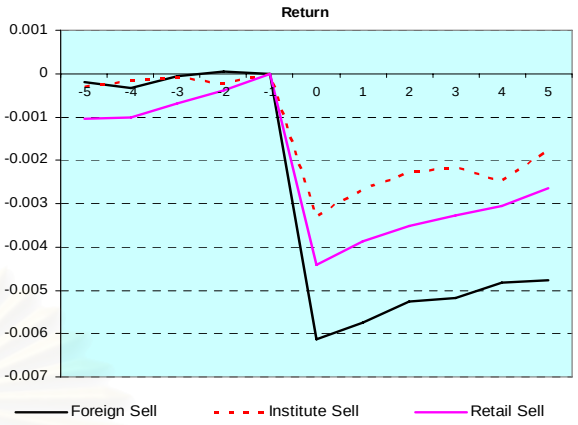
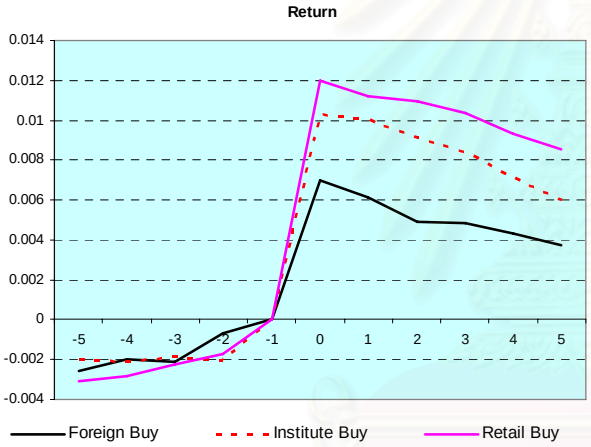


Figure 2B: Extreme receding markets



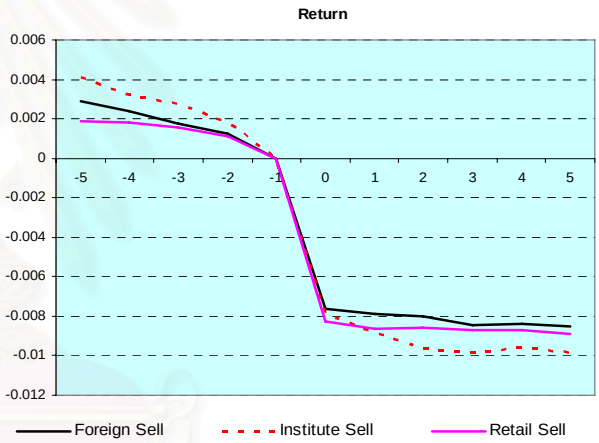
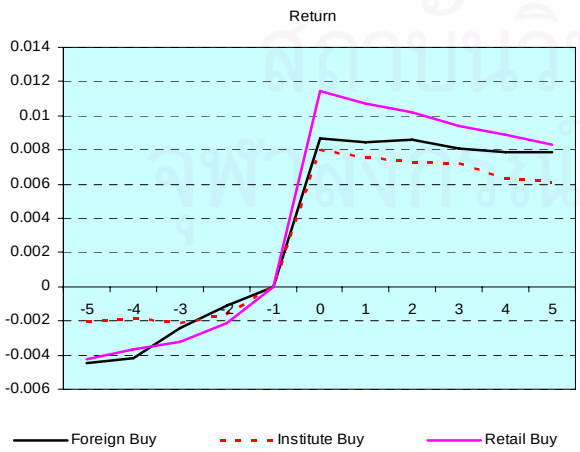
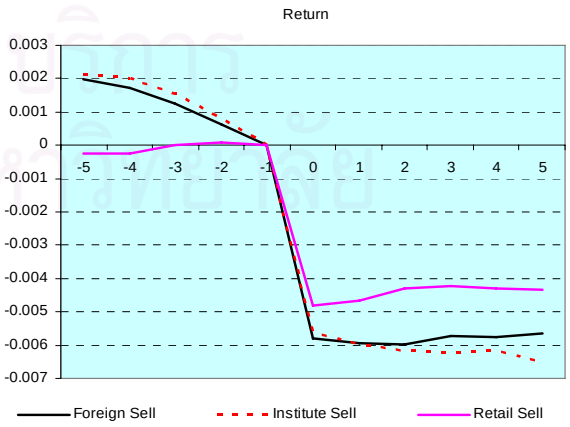


Figure 2C: Normal Market Events





Memo: การปรับปรุงรายงานผลการวิจัย ทุนวิจัยรัชดาภิเษกสมโภชเรื่อง “พฤติกรรมการซื้อขายในตลาดที่ผันผวน:กรณีประเทศไทย”

ได้ทำการปรับปรุงรายงานดังต่อไปนี้

1. โดยทั่วไป แก้ไขคำผิด พร้อมทั้งสมการบางสมการที่ไม่สมบูรณ์
2. แยกระเบียบวิธีวิจัยใน Section 6: Quality of the Market คือส่วนวิธีการประมาณค่ามาอยู่ใน Appendix