The Effect Of Price Limits Changes On Return Volatility: Evidence From The Stock Exchange Of Thailand

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Abstract

This paper investigates the effect of price limits changes on stock return behavior on the Stock Exchange of Thailand (SET). We compare the short run behavior of stock return under different regimes of price limits. The comparison is based on structural volatility, as measured by ratio of open-to-open return variance and close-to-close return variance. We also examine the covariance components of the 24-hour return and 12-hour return to detect the relation between limit width and the pattern of overreaction. We analyze the impact of trading volume and market value on structural volatility and overreaction as well. We find that return behavior at the SET is found to be rather consistent with those of other exchanges that employed price limit namely, Tokyo Stock Exchange and Taiwan Stock Exchange. In particular, the changes of price limit at the SET magnify the pattern of return behavior that exists before and after the changes resulting in increases in structural price volatility and overreaction during the narrow limit regime.

Introduction

Is price limit an effective mechanism in providing stability for the stock market? By examining the Tokyo Stock Exchange price limit system, Kim and Rhee (1997) argue that price limits may be ineffective. According to Kim and Rhee (1997), price limits are attributed to volatility spillovers, price discovery delays, and trading interference. These empirical findings support the notions of price limit critics such as Kyle (1988), Fama (1989), Lehmann (1989), Miller (1989), Kuhn, Kurserk, and Locke (1991), and Lauterbach and Ben-Zion (1993).

The obvious costs of price limit are delay price change and interfere with trading. The effect of price limit on reducing volatility is, however, seemingly inconclusive.[1] Kim and Rhee (1997) show that price limits cause volatility to spillover to the subsequent days. Chung (1991) examines the Korean Stock Exchange and finds no evidence that price limit decrease volatility. Kuhn et al. (1991) finds that price limits are ineffective in reducing volatility during the 1989 U.S. mini-crash. Chen (1993) examines the Taiwan Stock Exchange and concludes that price limits do not exhibit any significant impact on reducing stocks prices volatility. Lauterbach and Zion (1993) do not find any evidence that price-limit-induced circuit breaker is effective in reducing volatility during October crash on the Tel Aviv Stock Exchange. On the other hand, Lee and Kim (1995) by comparing portfolios of stocks with wider limit range to the ones with narrow limit range on Korea Stock Exchange, find that portfolios of wider limit range stocks are more volatile than the narrow limit ones. They conclude that price limits can reduce return volatility.

The proponents of price limit argue that the implement of price limit rule is to prevent the extreme changes in share prices, the changes which are possibly caused by either sudden changes in economic fundamental or a temporary surge in demand or supply. The justification of implementing price limit in the first place is to give traders a time to review whether the large price movement is a result of mismatch in demand/supply or something

[1] Harris (1997) provides a comprehensive survey on this issue.

more fundamental. In other words, the rules is meant to calm traders down by provide a “cool off” period thus help curb overreaction by panic traders.

Stock market regulators in many Asian countries appear to be in favor of the notion that price limit can reduce price volatility for price limit rules are widely used as a tool to “stabilize” the market in many Asian stock exchanges (Rhee and Chang (1993) provide an overview of six stock markets in Asia). The level of price limits is altered through time. For example, after the market crash in October 1987, the Stock Exchange of Thailand (SET) narrowed the price limit from 10 percent to 5 percent in an attempt to reduce price volatility thus preventing market crash. Change in price limit will affect stock price behavior. The issue of interest is whether the change would yield a desirable result of curbing stock market volatility.

The purpose of this paper is to examine the effect of price limit change on return behavior by exploiting the changes of price limits at the SET in 1987 as the basis of comparison. Following the October 1987 crash, the SET narrowed price limit from 10 percent of the previous trading day’s closing price to 5 percent of the previous day’s closing price. The 5 percent regime was effective on October 30 to November 26 covering 20 trading days. This 20-trading-day window provides an opportunity to examine the effect of limit change on short-run stock price behavior. A study of this nature will not escape the criticism levied upon as one-shot event study. Nevertheless, we hope that we can provide a small piece of evidence about the impact of price limit on stock return behavior thus contribute to the market microstructure literature.

Established in 1975 with 21 listed companies, the SET has grown to 109 listed companies by the end of 1987. Total annual turnover had reached $4.6 billion, or a daily average of $19.5 million, by the end of 1987 (1987 year end exchange rate was bath25.19/$US (IFC Fact book)). Similar to the Tokyo Stock Exchange, the SET does not use a market maker or a specialist. Instead, the SET is an order-driven market employing a call auction system for opening trades and a continuous floor trading system for the remaining trading period. The trading hours in 1987 was 9:00 am to 12:00 p.m.

It is very well documented that market microstructure can greatly affect behavior of stock prices. For example, Amihud, Mendelson and Lauterbach (1997) find that an improved in trading mechanism at Tel Aviv Stock Exchange can improve price discovery process. The magnitude of opening price volatility is different between NYSE and TSE (Amihud and Mendelson (1987, 1991) and George and Hwang (1995)). However, it is naturally difficult to isolate the effect of price limit from other confounding factors. For example, the effect of overnight non-trading on opening volatility, the relationship between trading actively and volatility, and the effect of price limit on return autocorrelation, to name a few. A change in price limit is very likely to affect significantly stocks return behavior. The direct comparison of return behavior under two different limit regimes is expected to provide meaningful information about the effect of price limit on short-run return behavior. Thus conclusion about the effect of price limit on volatility can be drawn from such careful investigation.

It should be noted that 24-hour return volatility as measured by variances of open-to-open return and close-to-close return would naturally be higher in wider limit regimes than in the narrow limit one. In case of the SET, return volatility during the 10 percent limit is likely to be higher than that during the 5 percent limit. To examine return volatility is simply examining total volatility which including fundamental and transitory volatility, according to Harris (1997). We do not attempt to separate fundamental and transitory volatility. We simply investigate how structural changes, price limit changes in our case, affect short-run return behavior. It follows that structural return volatility as measured by variance ratio of open-to-open and close-to-close returns (Var(Roo)/Var(Rcc)) and return correlation between trading and non-trading periods would be more relevant in an attempt to study the effect of limit changes on return behavior.

Stoll and Whaley (1990), among others, show that several structural factors of the market, such as opening trading mechanism or in our case price limit rule, can contribute to increased volatility of price at open. Stoll and Whaley (1990) call the structural induced volatility as structural volatility. The authors use ratio of variance of open-to-open and close-to-close return to measure the structural volatility. The authors attribute the high price volatility at open at NYSE to the presence of specialist. In our case of the SET, the price limit rule as one of the important market structure can cause more price volatility at open. Analyzing structural volatility of the two limit regimes would capture the effect of price limit change as the change of market structure. The degree of price continuation and price reversal will be exhibited in structural volatility. The difference in magnitude of structural volatility and serial correlation between the two limit regimes would capture the effect of price limit change that is an indication of the effect of the structural change of the market.

Since price limit rule allows trade to continue at a specific price range, i.e., within 10 percent of previous day closing price, price limits simply prevent prices to adjust to the new level. In a period of price change, price continuation is expected in the following day open, as empirically shown by Kim and Rhee (1997). Narrowing a limit would result in a small ban for price movement. It follows that the width of price limit should have a negative relation to the degree of price continuation; the narrower the limit the higher price continuation at close. We hypothesize that by narrowing price limit from 10 percent to 5 percent of previous day closing, the SET in average would experience more price continuation at close.

Further, we examine the relation between price limit and degree of overreaction. The very benefit of price limit that market regulators is ready to trade with the cost of implementing price limit is the notion that price limit can help curb overreaction because it provides a “cool off” period for traders after limit hits. Harris (1997) argues that in such a case when uninformed traders panic when price is moving quickly, the trading halt or price limit may cut them off before they can act and protect market from volatility-inducing trades. This notion can also be viewed as providing a “cool off’ period to panic traders. The main reason for the SET to narrow limit from 10 to 5 percent after market crash in 1987 was to reduce overreaction of panic traders. Had price limit shown to be inefficient in reducing overreaction, there would be one fewer good reasons to put price limit in place. We examine the pattern of overreaction between the two different limit regimes.

Daniel, Hirshleifer and Subrahmanyam (1997) analyze covariance components to detect the pattern of overreaction in short-run stock return. To detect the relation of overreaction and price limit, we examine the two regimes return serial correlation and their covariance components among different series of return intervals, e.g. daytime and overnight return and etc. The reduction of overreaction in the 5 percent limit regime would render support to the notion that price limit help traders calm down. This is because at a 5 percent limit the “cool off” period would occur more often than it would at a 10 percent limit. It follows that overreaction, if exist, would be less pronounced in the narrow limit than in the wider limit. The opposite result would compliment the empirical findings by Kim and Rhee (1997), among others, that price limits do more harm than good.

Data

This study uses daily stock price and return data during 1987 of the Stock Exchange of Thailand. The price and return data is complied by the Sandra Ann Morsilli Pacific-Basin Capital Markets (PACAP) Research Center at the University of Rhode Island. In this database, the daily opening, closing, high, and low prices are reported. The price and return data are adjusted to reflect capital distributions that include stock splits, reduction of capital, rights offerings, and stock dividends. Information on capital distributions is also obtained from the PACAP databases.

Methodology

In conduct the study, we define event-month, month 0, as the 20 trading-days window that 5 percent limit regime was effective, October 30 to November 26. Month -1 and +1 are the 20 trading-days before and after the event month. As we omit October 1987 from our study, month –1 is 20 trading-days in September and month +1 is 20 trading days in December 1987. Seven stocks that were newly listed in 1987 are excluded from the sample. Stocks that included in the sample are stocks that being traded more than 10 trading-days in each month. Given these criteria, there are 80 stocks in month -1, 65 stocks in month 0 and month +1. To separate the effect of price limit from those of trading volume and firm size in each month, we sort stocks by quintile of market value and trading volume as measured by number of shares traded. The average market value of the sample stocks is 1.26 billion baht with an average trading volume of 553,380 thousand shares traded each month.

After excluding stocks that are being traded less than 10 days a month, in average, SET stocks are traded almost everyday with an average of 18 days a month. Month 0 has the highest trading volume. Trading activities seem to be concentrated on a limited group of stocks for trading volume in the most active stock are much higher than the rest. Forty-four out of 109 stocks are being traded less than 10 days a month leaving 65 stocks in the sample for month 0 and +1.

To examine the extent to which the limit changes affect stock return behavior, we compare among the three subperiods structural volatility, as measured by ratio of open-to-open return variance to close-to-close return variance. We also decompose serial correlation of open-to-open return and that of close-to-close return to detect the pattern of short run price behavior under different limit regimes. To entangle the effect of trading volume and firm size, stocks are sorted into quintile of trading volume and firm size. We computed all return statistics for each stock within each quintile in each subperiod and then average across all stocks within each quintile. The following cross-sectional averages return components of each month, -1, 0, and +1, are computed. 1) Open-to-open return, 2) close-to-close return, 3) variance of open-to-open and close-to-close return, 4) variance ratios of open-to-open and close-to-close return, 5) serial correlations of 12-hour return and 6) serial correlation of 24-hour return.

Variance ratios of open-to-open and close-to-close return or structural volatility are our measurement of the effect of limit changes on short-run return behavior. We analyze correlation of 12-hour return, i.e., correlation of daytime and following night return, to find the effect of price limit change on degree of price continuation at close and price reversal at open.

To further examine the relation of price limit and the degree of overreaction, covariance components of serial correlation of open-to-open and close-to-close returns are also examined. Each component of the serial correlation is shown as follow.

$$\mathrm{Corr}[R_{o,t}, R_{o,t-1}] = \frac{\mathrm{Cov}[R_{o,t}, R_{o,t-1}]}{\mathrm{Var}(R_{o,t-1})} \tag{1}$$

$$= \frac{\mathrm{Cov}[r_{d,t-1}, r_{d,t-2}] + \mathrm{Cov}[r_{d,t-1}, r_{n,t-1}] + \mathrm{Cov}[r_{n,t}, r_{d,t-2}] + \mathrm{Cov}[r_{n,t}, r_{n,t-1}]}{\mathrm{Var}(R_{o,t-1})} \tag{2}$$

$$\mathrm{Corr}[R_{c,t}, R_{c,t-1}] = \frac{\mathrm{Cov}[R_{c,t}, R_{c,t-1}]}{\mathrm{Var}(R_{c,t-1})} \tag{3}$$

$$= \frac{\mathrm{Cov}[r_{n,t}, r_{n,t-1}] + \mathrm{Cov}[r_{n,t}, r_{d,t-1}] + \mathrm{Cov}[r_{d,t}, r_{n,t-1}] + \mathrm{Cov}[r_{d,t}, r_{d,t-1}]}{\mathrm{Var}(R_{c,t-1})} \tag{4}$$

Equation 1) and 2) decompose open-to-open return correlation into four components. Equation 3) and 4) decompose close-to-close return correlation into four covariance components. Altogether there are six covariance components. These 6 components capture the covariance of the following return intervals 1) Covariance 1, Cov($r_{n,t}$, $r_{n,t\text{-}1}$) or COV1, captures overnight return and the following overnight return, 2) Covariance 2, Cov($r_{n,t}$, $r_{d,t\text{-}2}$) or COV2, captures overnight returns and the day after daytime returns, 3) Covariance 3, Cov($r_{d,t}$, $r_{n,t\text{-}1}$) or COV3, captures daytime returns and the preceding overnight returns, 4) Covariance 4, Cov($r_{d,t}$, $r_{d,t\text{-}1}$) or COV4, captures daytime returns and the following daytime returns, 5) Covariance 5, Cov($r_{d,t}$, $r_{n,t}$) or COV5, captures daytime return and the preceding overnight return, and 6) Covariance 6, Cov($r_{d-1,t}$, $r_{n,t}$) or COV6, captures daytime return and the following overnight return.

The covariance component of interest is Cov 4, the covariance of day time return and following daytime return, Cov($r_{d,t}$, $r_{d,t-1}$). Following Daniel et al. (1997), we analyze Cov 4 to detect the pattern of overreaction and its relation, if any, with price limit changes at the SET. According to Daniel et al. (1997), negative Cov 4 indicates that overreaction exists. In the framework of Harris (1997), transitory volatility is a result of uninformed traders pushing prices away from the fundamental values. It is indicated by the tendency of prices to bounce around their fundamental values. Negative Cov 4 also indicates the bouncing of prices. As a result, analyzing Cov 4 might help us detect the existence of transitory volatility as well.

Empirical Results

We find that changes in price limit do alter stock return behavior. Our results show that across the sample variance ratios are greater than one, and that month 0, the event month, has the highest variance ratios. This suggests that narrow price limit causes more pricing error than do the wider limit. The largest pricing error results in largest structural price volatility at open in month 0. Price continuations around close are predominant in all three months in which month 0 exhibits the largest proportion of price continuations. This indicates that narrow price limit is shown to be more hindrance to price discovery process. It lends support to the hypothesis of price discovery delays (Kim and Rhee, 1997). The finding that the magnitude of price continuation is largest in month 0 supports our hypothesis that the width of price limit has a negative relation with the degree of price continuation at close.

Price reversals around open are found in the entire sample. The magnitude and proportion of price reversal around open are largest in month 0. We do not find any evidence that price limit provide the "cool off' period for traders. Instead, return behavior exhibit overreaction as indicated by negative covariance of consecutive daytime returns, Cov 4. Again, the magnitude of overreaction is most substantial in month 0. This in turn lead to the conjecture that narrow price limit might not only cause the increase in structural volatility but also induce more overreaction among traders. It seems that narrow price limit did not deliver the performance that the SET would have expected for.

Trading activity is shown to have positive relation with structural volatility and return volatility as measured by 24-hour return variance. Structural volatility and return volatility increase monotonically with the level of trading activities, with the exception of quintile 1, the least active quintile, of month - 1 and 1. These results are similar to what is found on Tokyo Stock Exchange by George and Hwang, (1995). George and Hwang (1995) find that variance ratios are highest in the quartile of the most active stocks and lowest in the least active stock, and the two least active quartiles have variance ratio less than one. In ours, all trading quintiles have variance ratios of greater than one. Size is also shown to have positive relation with structural volatility and price continuation at close, especially in month 0.

In all, return behavior at SET is found to be rather consistent with those of other exchanges that employed price limit namely, Tokyo Stock Exchange and Taiwan Stock Exchange. In particular, the changes of price limit at SET magnify the pattern of return behavior that exist before and after the changes resulting in increases in structural price volatility and overreaction during the narrow limit regime. We also found the evidence that suggest that price limit block flow of information through trade as shown by the large degree of price continuation in the largest quintiles of size in the event month.

Structural Volatility

We find that in month 0 the pattern of structural volatility is dramatically highest as indicated by variance ratio, price continuation around close and price reversal around open. It should be noted that on average the 24-hour return variance is largest in month +1. As it is supposed to be because price can move by plus or minus 10 percent in the period of 10 percent limit, month –1 and +1, as oppose to that of plus or minus 5 percent in the period of 5 percent limit. This is precisely one of the reasons for us to use structural volatility as measured by variance ratio of open-to-open return and close-to-close return as the measurement to capture the effects of change in price limit on return behavior.

Table 1 A, B report the cross-sectional averages of variance ratios ranked by trading volume and market value. For the entire sample, variance ratios are substantially greater than 1 and all are significantly different from 0 at a conventional significant level. The average ratio is highest in month 0. For month 0, the average variance ratio is 1.84 comparing to those of 1.32 and 1.48 in month –1 and +1, and the differences are significant at a 1% level. In Shastri et al (1995), the authors calculate variance ratio of all SET stocks that being traded more than 400 days during 1987-1988, excluding October 1987, and report that the average variance ratio is 1.37. It is shown that the average variance ratio in month 0 is significantly higher than those of all stocks as reported in Shastri et al, whereas those of month –1 and +1 are more consistent with the result in Shastri et al.

The pattern of the observed structural volatility or variance ratio is attributed to the difference between correlations between daytime and overnight returns, Corr(Rdt-1, Rnt) and Corr(Rnt, Rdt). The positive correlations between daytime and following overnight return, Corr(Rdt-1, Rnt), indicate that price continuation at close exist across sample. Price continuation is shown to be more pronounced in month 0. The correlations are 0.25, 0.38, and 0.37 for month –1, 0, and +1 comparing to the reported 0.18 in the Shastri et al study. The proportion of positive correlation is the highest in month 0. This finding supports the delay price discovery hypothesis in Kim and Rhee (1997). In Kim and Rhee (1997), stocks that hit the limit experience more price continuation at close than those that prices come within 90 percent of the limits. Our finding also supports the notion that in a period of price change, price limit just delays the inevitable and the magnitude of delay is highest in the narrower limit period.

The pattern of price persistent at close at SET is found to be different from Tokyo Stock Exchange. George and Hwang (1995) report that only the most active TSE stocks experience price continuation at close while the rest exhibit price reversal at close. Our results report price continuation at close across the sample. Trading hours, another market structure seems to have an influence on the price persistence observed at the SET. During the study period, the SET is being traded only for 3 hours, from 9am. to 12 noon compare with 9-11 am. and 1-3 pm. TSE in George and Hwang (1995). Price limit and relatively short trading hours might hinder price discovery process resulting in price continuation at close across sample observed at the SET. The finding that month 0 experience the highest price continuation around close can be attributed in part to the change in market structure by narrowing price limit from 10 to 5 percent.

The difference in magnitude of the correlation of the twelve-hour return is more substantial among the correlation between overnight and following daytime, Corr(Rnt, Rdt), or Corr open. For month 0, Corr(Rnt, Rdt) is –0.22, and 0.004 for month –1, and –0.05 for month +1. The negative correlations indicate that price reversal around open is substantial in month 0. The Shastri et al study also report average all stocks Corr(Rdt, Rnt) of –0.06 which indicate some level of price reversal at open. The SET employs call auction to determine opening price, as a result, opening price will be the price that generate the highest volume, if there are more than one price, the price that is closest to closing price will be chosen. Return reversals at open at SET indicate similar pattern of a market with dealers where price reversal at open compensates for loss of dealer (Stoll and Whaley, 1990). Substantially strong price reversal at open in month 0 implies that informed traders tend to trade at open and that they might benefit from overreaction induced by narrow limit.

It is shown that, in a narrow price limit regime, structural volatility is higher than in the wider limit regime. The pattern of higher structural volatility is indicated by variance ratio, price continuation at close and price reversal at open. The same pattern of difference in magnitude of variance ratio, price continuation and price reversal is also found in the Chan (1997) study on Taiwan Stock Exchange. Chan (1997) reports that during the narrowest price limit regime of 3 percent, variance ratio, price continuation at close and price reversal at open are also the highest (table 4c). According to our evidence together with Chan (1997), we posit that narrow price limit cause an increase in structural volatility of stock return.

Table 1 A

Variance ratio open-to-open and close-to-close, and Var(Roo), Var(Rcc) ranked by trading volume

We report means of variance ratios of open-to-open and close-to-close return, variances of open-to-open and close-to-close return, Var(Roo)/Var(Rcc), and the correlations of daytime and subsequent overnight return (Rdt-1, Rnt) and the correlations of the next daytime return and the preceeding night (Rnt, Rdt). All are ranked by trading volume. Quintile 1 is the smallest trading volume. Companies with fewer than ten trading days in one month are not included. Month 0 is the event-month (price limit of 5%).

Quintile	N		Variance Ratio	Var(Roo)	Var(Rcc)	Cor(Rnt,Rdt)	Cor(Rdt-1,Rnt)
Month -1						Cor open	Cor close
Smallest	16	Mean	1.33721	0.004620	0.004426	0.25098	0.32537
		Std err	0.88567	0.014663	0.014584	0.31148	0.35163
2	16	Mean	1.18210	0.000883	0.000829	0.21347	0.24072
		Std err	0.53620	0.000738	0.000729	0.34841	0.29272
3	16	Mean	1.25273	0.001310	0.001082	0.03447	0.26625
		Std err	0.38079	0.001028	0.000834	0.23362	0.30066
4	16	Mean	1.47184	0.001479	0.001069	-0.19369	0.32157
		Std err	0.35511	0.001084	0.000922	0.21087	0.31816
Largest	16	Mean	1.35965	0.001646	0.001406	-0.30867	0.08955
		Std err	0.26984	0.003425	0.003207	0.20875	0.24813
All stocks	80	Mean	1.32071	0.001988	0.001763	-0.00387	0.24869
		Std err	0.52787	0.006738	0.006676	0.34222	0.30869
		Proportion >1	0.80	-	-	-	-
		or negative	-	-	-	0.55	0.28
Month 0							
Smallest	13	Mean	1.16827	0.001343	0.001163	-0.10201	0.14213
		Std err	0.36799	0.000580	0.000420	0.34025	0.32184
2	13	Mean	1.73820	0.002105	0.001265	-0.12744	0.33440
		Std err	0.63244	0.000900	0.000415	0.32259	0.25715
3	13	Mean	1.98260	0.003396	0.001739	-0.28346	0.46330
		Std err	0.39034	0.000646	0.000293	0.09140	0.17661
4	13	Mean	1.96895	0.003422	0.001741	-0.25390	0.53048
		Std err	0.46278	0.001202	0.000416	0.17250	0.13545
Largest	13	Mean	2.34017	0.004113	0.002061	-0.35042	0.41320
		Std err	0.88295	0.001907	0.001982	0.21134	0.15544
All stocks	65	Mean	1.83964	0.002876	0.001594	-0.22345	0.37670
		Std err	0.68365	0.001507	0.000981	0.25652	0.25254
		Proportion >1	0.94	-	-	-	-
		or negative	-	-	-	0.82	0.09
Month +1							
Smallest	13	Mean	1.42328	0.003174	0.002048	0.00061	0.26278
		Std err	0.96825	0.004648	0.002486	0.29814	0.37449
2	13	Mean	1.17085	0.003687	0.002836	-0.03378	0.17307
		Std err	0.37808	0.003257	0.001802	0.16030	0.37998
3	13	Mean	1.48258	0.004800	0.003128	0.02751	0.52892
		Std err	0.32890	0.002428	0.001230	0.19835	0.15907
4	13	Mean	1.62555	0.006737	0.004115	-0.03532	0.54892
		Std err	0.41396	0.003576	0.001906	0.21134	0.20998
Largest	13	Mean	1.68762	0.007081	0.003966	-0.21886	0.33211
		Std err	0.49722	0.005382	0.002650	0.21130	0.31555
All stocks	65	Mean	1.47798	0.005096	0.003219	-0.05197	0.36916
		Std err	0.57834	0.004182	0.002153	0.23072	0.32739
		Proportion >1	0.85	-	-	-	-
		or negative	-	-	-	0.66	0.17

Variance ratios, twenty-four hour return variance, and autocorrelation are computed for each stock within each quintile in each month and are then averaged across all stocks within each quintile of trading volume.

Table 1 B

Variance ratio open-to-open and close-to-close, and Var(Roo), Var(Rcc) ranked by market value

We report means of variance ratios of open-to-open and close-to-close return, variances of open-to-open and close-to-close return, Var(Roo)/Var(Rcc), the correlations of daytime and subsequent overnight return (Rdt-1, Rnt) and the correlations of the next daytime return and the preceeding night (Rnt, Rdt). All are ranked by market value. Quintile 1 is the smallest market value. Companies with fewer than ten trading days in one month are not included. Month 0 is the event-month (price limit of 5%).

Quintile	N		Variance ratio	Var(Roo)	Var(Rcc)	Cor(Rnt,Rdt)	Cor(Rdt-1,Rnt)
Month -1						Cor open	Cor close
Smallest	16	Mean	1.37787	0.001708	0.001442	0.19606	0.40534
		Std err	0.66722	0.001086	0.000901	0.32164	0.29560
2	16	Mean	1.38197	0.001141	0.000865	0.04324	0.33241
		Std err	0.47945	0.000955	0.000703	0.34325	0.34616
3	16	Mean	1.28455	0.001076	0.000861	0.11216	0.27663
		Std err	0.67566	0.001159	0.000931	0.33238	0.30411
4	16	Mean	1.10261	0.005316	0.005169	-0.04257	0.18300
		Std err	0.28351	0.014836	0.014713	0.24654	0.24368
Largest	16	Mean	1.45653	0.000697	0.000477	-0.31575	0.04608
		Std err	0.41987	0.000476	0.000286	0.24759	0.24480
All stocks	80	Mean	1.32071	0.001988	0.001763	-0.00387	0.24869
		Std err	0.52787	0.006738	0.006676	0.34222	0.30869
		Proportion > 1	0.80	-	-	-	-
		or negative	-	-	-	0.55	0.28
Month 0							
Smallest	13	Mean	1.65577	0.002391	0.001460	-0.21888	0.20303
		Std err	0.98549	0.001306	0.000472	0.22375	0.33124
2	13	Mean	1.75952	0.002989	0.001895	-0.16574	0.39689
		Std err	0.66586	0.002206	0.002037	0.33848	0.20201
3	13	Mean	1.83986	0.003377	0.001774	-0.23018	0.41500
		Std err	0.61565	0.001564	0.000425	0.21190	0.25557
4	13	Mean	2.00750	0.002864	0.001450	-0.25982	0.43886
		Std err	0.50171	0.001009	0.000385	0.30681	0.19235
Largest	13	Mean	1.93554	0.002758	0.001391	-0.24260	0.42973
		Std err	0.60273	0.001232	0.000467	0.20436	0.21296
All stocks	65	Mean	1.83964	0.002876	0.001594	-0.22345	0.37670
		Std err	0.68365	0.001507	0.000981	0.25652	0.25254
		Proportion > 1	0.94	-	-	-	-
		or negative	-	-	-	0.82	0.09
Month +1							
Smallest	13	Mean	1.44098	0.004909	0.003101	0.01760	0.37184
		Std err	0.50746	0.003727	0.001887	0.26250	0.31430
2	13	Mean	1.47510	0.004893	0.003071	-0.09284	0.25892
		Std err	1.00345	0.004804	0.002346	0.23905	0.45824
3	13	Mean	1.54629	0.006794	0.004132	-0.00842	0.44343
		Std err	0.50232	0.004230	0.001901	0.21072	0.24926
4	13	Mean	1.52492	0.005741	0.003492	-0.11336	0.41207
		Std err	0.26619	0.004824	0.002548	0.13881	0.23949
Largest	13	Mean	1.40259	0.003142	0.002297	-0.06281	0.35954
		Std err	0.42566	0.002714	0.001900	0.28438	0.34950
All stocks	65	Mean	1.47798	0.005096	0.003219	-0.05197	0.36916
		Std err	0.57834	0.004182	0.002153	0.23072	0.32739
		Proportion > 1	0.85	-	-	-	-
		or negative	-	-	-	0.66	0.17

Variance ratios, twenty-four hour return variance, and autocorrelation are computed for each stock within each quintile in each month and are then averaged across all stocks within each quintile of market value.

Table 2 A
Autocorrelations of open-to-open returns and covariance components ranked by trading volume

We report the means autocorrelation of open-to-open returns and covariance components of 24-hour returns. Quintile 1 is the smallest trading volume. Companies with fewer than ten trading days in one month are not included. Month 0 is the event-month (price limit of 5%).

Quintile	N		Cor(Roo)	Cov(Rnt, Rnt-1)	Cov(Rnt, Rdt-2)	Cov(Rdt-1,Rnt-1)	Cov(Rdt-1, Rdt-2)
Month -1				Cov 1	Cov 2	Cov 3	Cov 4
Smallest	16	Mean	0.24332815	-0.00080931	0.00003939	0.00005358	0.00007197
		Std err	0.36791969	0.00340327	0.00018650	0.00014205	0.00013142
2	16	Mean	0.20522039	0.00002551	0.00001521	0.00004866	0.00011059
		Std err	0.27931768	0.00003503	0.00010538	0.00015498	0.00015435
3	16	Mean	0.11868182	0.00005581	0.00005850	0.00001733	0.00011808
		Std err	0.15256601	0.00011197	0.00014570	0.00012766	0.00017229
4	16	Mean	-0.11152756	0.00013028	0.00003350	-0.00006121	-0.00007727
		Std err	0.23354087	0.00053617	0.00015609	0.00008259	0.00015956
Largest	16	Mean	-0.14840355	-0.00005762	0.00001909	-0.00013172	-0.00008676
		Std err	0.20864386	0.00024156	0.00012760	0.00024876	0.00013210
All stocks	80	Mean	0.06145985	-0.00013106	0.00003314	-0.00001467	0.00002732
		Std err	0.30014250	0.00154518	0.00014389	0.00017236	0.00017296
		Prop negative	0.47	0.32	0.48	0.53	0.45
Month 0							
Smallest	13	Mean	0.11625998	0.00039586	0.00010610	-0.00005850	0.00000160
		Std err	0.53109701	0.00073741	0.00011727	0.00017190	0.00008180
2	13	Mean	0.15385406	0.00031446	0.00010852	-0.00014505	-0.00001053
		Std err	0.29060887	0.00030483	0.00016197	0.00021320	0.00018823
3	13	Mean	0.03708818	0.00038396	0.00023482	-0.00036437	-0.00015265
		Std err	0.17627058	0.00022665	0.00024124	0.00014423	0.00019801
4	13	Mean	0.01904246	0.00019765	0.00026202	-0.00036700	-0.00004611
		Std err	0.13544274	0.00013755	0.00021757	0.00029860	0.00020029
Largest	13	Mean	-0.09213050	0.00021218	0.00016544	-0.00051998	-0.00026661
		Std err	0.07353722	0.00013393	0.00023221	0.00043633	0.00028256
All stocks	65	Mean	0.04682284	0.00030082	0.00017538	-0.00029098	-0.00009486
		Std err	0.29394857	0.00037810	0.00020382	0.00031401	0.00021961
		Prop negative	0.49	0.09	0.17	0.83	0.60
Month +1							
Smallest	13	Mean	0.17424607	0.00019273	0.00005973	-0.00012396	0.00000642
		Std err	0.43049912	0.00042014	0.00030199	0.00042494	0.00022486
2	13	Mean	0.11385290	0.00072594	0.00015740	-0.00008316	-0.00001666
		Std err	0.22579141	0.00112797	0.00046745	0.00017786	0.00016076
3	13	Mean	0.08001968	0.00029980	0.00003644	-0.00001798	-0.00025491
		Std err	0.26093586	0.00037755	0.00029579	0.00027214	0.00051517
4	13	Mean	0.13596864	0.00039493	0.00047455	-0.00002763	0.00027000
		Std err	0.22559274	0.00065482	0.00054832	0.00046464	0.00087191
Largest	13	Mean	0.08736917	0.00066530	0.00080812	-0.00038506	0.00009171
		Std err	0.17120054	0.00083788	0.00095392	0.00050195	0.00052034
All stocks	65	Mean	0.11829129	0.00045574	0.00030725	-0.00012756	0.00001931
.		Std err	0.27075410	0.00074425	0.00062451	0.00039967	0.00053553
		Prop negative	0.38	0.22	0.37	0.60	0.45

Autocorrelation of open-to-open return and covariance components are computed for each stock within each quintile in each month and are then averaged across all stocks within each quintile of trading volume.

Table 2 B
Autocorrelations of open-to-open returns and covariance components ranked by market value

We report the means autocorrelations of open-to-open returns and covariance components of 24-hour returns. Quintile 1 is the smallest trading volume. Companies with fewer than ten trading days in one month are not included. Month 0 is the event-month (price limit of 5%).

Quintile	N		Corr(Roo)	Cov(Rnt, Rnt-1)	Cov(Rnt, Rdt-2)	Cov(Rdt-1,Rnt-1)	Cov(Rdt-1, Rdt-2)
				Cov 1	Cov 2	Cov 3	Cov 4
Month -1							
Smallest	16	Mean	0.29775387	0.00005320	0.00009325	0.00008475	0.00017884
		Std err	0.32880760	0.00009418	0.00019334	0.00017955	0.00024294
2	16	Mean	0.07587607	0.00001856	-0.00000388	0.00000785	-0.00000340
		Std err	0.20771644	0.00003210	0.00007518	0.00010735	0.00014418
3	16	Mean	0.07849272	0.00015021	0.00005521	0.00001777	0.00003786
		Std err	0.30682811	0.00053083	0.00018551	0.00005539	0.00008372
4	16	Mean	0.02339527	-0.00087387	0.00003707	-0.00009054	-0.00001767
		Std err	0.27140113	0.00339582	0.00013416	0.00026594	0.00014622
Largest	16	Mean	-0.16821867	-0.00000342	-0.00001595	-0.00009320	-0.00005903
		Std err	0.19361016	0.00002955	0.00007193	0.00011823	0.00011670
All stocks	80	Mean	0.06145985	-0.00013106	0.00003314	-0.00001467	0.00002732
		Std err	0.30014250	0.00154518	0.00014389	0.00017236	0.00017296
		Prop negative	0.47	0.32	0.48	0.53	0.45
Month 0							
Smallest	13	Mean	-0.04620333	0.00025622	0.00016735	-0.00028091	-0.00012158
		Std err	0.39177827	0.00041559	0.00024153	0.00036739	0.00027608
2	13	Mean	0.10059017	0.00039650	0.00012262	-0.00019213	-0.00009405
		Std err	0.36849430	0.00063850	0.00017102	0.00030228	0.00027807
3	13	Mean	0.08258290	0.00039087	0.00020751	-0.00035981	-0.00011203
		Std err	0.18811726	0.00027021	0.00020828	0.00034995	0.00019533
4	13	Mean	0.07617935	0.00029565	0.00020851	-0.00031472	-0.00003887
		Std err	0.23751551	0.00023130	0.00020247	0.00025557	0.00015887
Largest	13	Mean	0.02096509	0.00016486	0.00017091	-0.00030733	-0.00010776
		Std err	0.25337830	0.00012092	0.00021018	0.00030828	0.00018871
All stocks	65	Mean	0.04682284	0.00030082	0.00017538	-0.00029098	-0.00009486
		Std err	0.29394857	0.00037810	0.00020382	0.00031401	0.00021961
		Prop negative	0.49	0.09	0.17	0.83	0.60
Month +1							
Smallest	13	Mean	0.16258119	0.00057382	0.00026792	-0.00015326	-0.00018754
		Std err	0.36073067	0.00080066	0.00062194	0.00033462	0.00041910
2	13	Mean	0.19255015	0.00086550	0.00035854	-0.00018422	-0.00003528
		Std err	0.27960850	0.00107907	0.00075159	0.00035522	0.00025149
3	13	Mean	0.18881938	0.00049566	0.00058973	-0.00010769	0.00021167
		Std err	0.24231785	0.00057552	0.00084574	0.00058422	0.00079388
4	13	Mean	0.00942961	0.00016883	0.00020036	-0.00023129	0.00010459
		Std err	0.24098975	0.00022818	0.00038981	0.00041815	0.00068325
Largest	13	Mean	0.03807612	0.00017490	0.00011968	0.00003866	0.00000311
		Std err	0.18048958	0.00062618	0.00034590	0.00022671	0.00030949
All stocks	65	Mean	0.11829129	0.00045574	0.00030725	-0.00012756	0.00001931
		Std err	0.27075410	0.00074425	0.00062451	0.00039967	0.00053553
		Prop negative	0.38	0.22	0.37	0.60	0.45

Autocorrelation of open-to-open return and covariance components are computed for each stock within each quintile in each month and are then averaged across all stocks within each quintile of market value.

Overreaction, return correlation and covariance

Table 2 reports serial correlation of open-to-open return and covariance of return intervals within the 48-hour return. Average correlation of open-to-open return, Corr(Roo), for month 0 is 0.047, and 0.061 and 0.118 for month -1 and +1. Shastri et al report a comparable correlation, Corr(Roo), of 0.0654. The proportions of positive open-to-open return correlations are quite similar among the three subperiods.

By decomposing the covariance of returns components within the 24-hour return, we can analyze the covariance of our interest, Cov 4 or the consecutive daytime return, Cov(Rdt-1, Rdt). Cov 4 indicates that daytime return reversals are found on average only in month 0. The proportions of negative Cov 4 are 0.60 in month 0, 0.45 and 0.45 in month –1 and +1. This indicates that overreaction exist in month 0. Daniel, Hirshleifer and Subrahmanyam (1997) interpret negative Cov 4 as an indication of overreaction. Chan (1997) also finds that daytime return reversal is most pronounced in the narrowest limit regime in Taiwan Stock Exchange. Chan (1997) reports the most negative Cov 4 in the limit range of 3 percent.

Table 3 reports autocorrelation between close-to-close returns and the covariance components among the return intervals. Corr(Rcc) are positive across sample, and again month 0 having the highest proportion of positive correlations; the correlations are .69, .91 and .78 for month -1, 0 and +1.

From the results in table 2 and 3, we may interpret further that on average stock prices move in the same direction within each month across the sample. Opening price exhibit a reversal pattern only in month 0. As a result, daytime return becomes relatively volatile in month 0, and the consecutive daytime return yield the opposite result on average, as shown by negative Cov 4. This indicates a pattern of overreaction in month 0. The presence of overreaction in month 0 also suggests that transitory volatility is largest in month 0.

The effects of limit changes on average can be seen as to delay price discovery and to induce overreaction thus increase transitory volatility. This is shown by the patterns of price continuation at close, price reversal at open, and negative covariance of consecutive daytime return, the patterns of which are most pronounced or exhibit only in month 0.

Trading Volume and Market Value

Trading volume is shown to have positive relationship with volatility patterns, both structural volatility and variance of 24-hour return, as shown in table 1 A. Structural volatility increases as trading volume increases, except for the lowest quintile in month -1 and +1. The relationship is also true for variance of 24-hour return. The interesting pattern is observed between the relationship between trading volume and price continuation around close, Cor(Rdt-1, Rnt). Price continuation increase as trading volume increase and it is significantly different from 0 only among the three most actively traded stocks in month 0. This positive relation between trading volume and price continuation at close is observed across the sample. Price continuation in the most actively traded quintile is smaller than the second most actively trade ones. This might indicates that among actively traded stocks, quintile 4 and 5, more trade aids price discovery process. For opening price, the most active stocks experience the highest degree of price reversal, as month 0 being the highest. The pattern is also exhibited across the sample. This implies that the level of overreaction is higher among the most active stocks.

Trading volume is also found to have negative relationship with Cov 4, Cov(Rdt-1, Rdt-2), except for month +1, as shown in table 2 A. This indicates that actively traded stocks are stocks that exhibit the highest of overreaction. The degree of overreaction is more pronounced in active stocks as shown in month -1 and 0. The level of overreaction increases as trading activity increase as shown by the negative relation between Cov 4 and trading activity. The proportion of negative is largest in month 0.

We find some evidence of the effect of market value on return behavior, as shown in table 1 B. The influence of market value is found in month 0 where size has a positive relation with structural volatility. The

Table 3 A

Autocorrelations of close-to-close returns and covariance components ranked by trading volume

We report the means autocorrelations of close-to-close returns and covariance components of 24-hour returns. Quintile 1 is the smallest trading volume. Companies with fewer than ten trading days in one month are not included. Month 0 is the event-month (price limit of 5%).

Quintile	N		Corr(Rcc)	Cov(Rdt, Rdt-1) Cov 4	Cov(Rdt, Rnt-1) Cov 5	Cov(Rnt,Rdt-1) Cov 6	Cov(Rnt, Rnt-1) Cov 1
Month -1							
Smallest	16	Mean	0.09561826	0.00006803	-0.00001355	0.00011072	-0.00057691
		Std err	0.35681015	0.00013141	0.00012975	0.00021713	0.00225817
2	16	Mean	0.23353722	0.00010918	0.00002055	0.00007844	0.00000419
		Std err	0.32630714	0.00015229	0.00012576	0.00009190	0.00009466
3	16	Mean	0.15981380	0.00011895	-0.00003355	0.00010694	0.00002347
		Std err	0.30199628	0.00017481	0.00024681	0.00026260	0.00007924
4	16	Mean	0.04184084	-0.00007727	0.00003865	0.00013143	0.00013406
		Std err	0.26995904	0.00015956	0.00013040	0.00014613	0.00053607
Largest	16	Mean	-0.04852485	-0.00008676	-0.00003981	-0.00000613	-0.00005762
		Std err	0.19695578	0.00013210	0.00026694	0.00013201	0.00024156
All stocks	80	Mean	0.09645705	0.00002643	-0.00000554	0.00008428	-0.00009456
		Std err	0.30395808	0.00017285	0.00018833	0.00018268	0.00104859
		Prop negative	0.36	0.45	0.45	0.28	0.31
Month 0							
Smallest	13	Mean	0.05224718	0.00000160	-0.00004047	0.00005101	0.00005399
		Std err	0.22206613	0.00008180	0.00015395	0.00013876	0.00041363
2	13	Mean	0.34118375	0.00000205	-0.00001212	0.00016220	0.00028391
		Std err	0.26882320	0.00016019	0.00016382	0.00032349	0.00022017
3	13	Mean	0.41878680	-0.00017350	0.00004754	0.00051704	0.00030905
		Std err	0.17009038	0.00020562	0.00019293	0.00020408	0.00029983
4	13	Mean	0.26135702	-0.00004611	-0.00020421	0.00058172	0.00014946
		Std err	0.14082185	0.00020029	0.00017704	0.00026571	0.00022136
Largest	13	Mean	0.11899508	-0.00026661	0.00046666	0.00114425	-0.02711763
		Std err	0.12727968	0.00028256	0.00316161	0.00210488	0.09847982
All stocks	65	Mean	0.24124537	-0.00009768	0.00005142	0.00049164	-0.00517980
		Std err	0.23212942	0.00021912	0.00138492	0.00100482	0.04370801
		Prop negative	0.09	0.60	0.68	0.09	0.09
Month +1							
Smallest	13	Mean	0.32375832	0.00000642	-0.00003037	0.00047419	0.00019273
		Std err	0.44549925	0.00022486	0.00074379	0.00098477	0.00042014
2	13	Mean	0.33667671	-0.00001666	0.00003106	0.00032884	0.00072594
		Std err	0.42812661	0.00016076	0.00025766	0.00071160	0.00112797
3	13	Mean	0.22597608	-0.00025491	0.00008571	0.00076988	0.00029980
		Std err	0.20913941	0.00051517	0.00047800	0.00049341	0.00037755
4	13	Mean	0.39182993	0.00027000	0.00029894	0.00113697	0.00039493
		Std err	0.26516675	0.00087191	0.00050482	0.00077025	0.00065482
Largest	13	Mean	0.33706536	0.00009171	0.00035205	0.00106372	0.00066530
		Std err	0.33393530	0.00052034	0.00064905	0.00107964	0.00083788
All stocks	65	Mean	0.32306128	0.00001931	0.00014748	0.00075472	0.00045574
		Std err	0.34179914	0.00053553	0.00055579	0.00086843	0.00074425
		Prop negative	0.17	0.45	0.39	0.17	0.22

Autocorrelation of close-to-close return and covariance components are computed for each stock within each quintile in each month and are then averaged across all stocks within each quintile of trading volume.

Table 3 B
Autocorrelations of close-to-close returns and covariance components ranked by market value

We report the means autocorrelations of close-to-close returns and covariance components of 24-hour returns. Quintile 1 is the smallest trading volume. Companies with fewer than ten trading days in one month are not included. Month 0 is the event-month (price limit of 5%).

Quintile	N		Corr(Rcc)	Cov(Rdt, Rdt-1) Cov 4	Cov(Rdt, Rnt-1) Cov 5	Cov(Rnt,Rdt-1) Cov 6	Cov(Rnt, Rnt-1) Cov 1
Month -1							
Smallest	16	Mean	0.22580320	0.00017543	0.00001644	0.00019490	0.00002440
		Std err	0.39755869	0.00024518	0.00026419	0.00025919	0.00011412
2	16	Mean	0.08219774	-0.00000393	-0.00004710	0.00012913	-0.00000872
		Std err	0.25710520	0.00014364	0.00013770	0.00016461	0.00009544
3	16	Mean	0.16745209	0.00003727	0.00004194	0.00010092	0.00013478
		Std err	0.33924758	0.00008337	0.00008639	0.00015125	0.00053692
4	16	Mean	0.01180601	-0.00001760	-0.00007058	-0.00001110	-0.00062074
		Std err	0.26237375	0.00014622	0.00026670	0.00014428	0.00225746
Largest	16	Mean	-0.00497376	-0.00005903	0.00003158	0.00000754	-0.00000253
		Std err	0.19091504	0.00011670	0.00009326	0.00007940	0.00003133
All stocks	80	Mean	0.09645705	0.00002643	-0.00000554	0.00008428	-0.00009456
		Std err	0.30395808	0.00017285	0.00018833	0.00018268	0.00104859
		Prop negative	0.36	0.45	0.45	0.28	0.31
Month 0							
Smallest	13	Mean	0.15024410	-0.00012158	0.00001243	0.00026583	0.00011744
		Std err	0.26214062	0.00027608	0.00018445	0.00027643	0.00042126
2	13	Mean	0.22762934	-0.00010741	-0.00012582	0.00030714	0.00017566
		Std err	0.32352877	0.00027180	0.00033569	0.00037306	0.00030520
3	13	Mean	0.26656978	-0.00011203	0.00071206	0.00105210	-0.02704390
		Std err	0.14823584	0.00019533	0.00307748	0.00216141	0.09850233
4	13	Mean	0.31873201	-0.00003887	-0.00016885	0.00041765	0.00027513
		Std err	0.20163639	0.00015887	0.00027372	0.00025335	0.00016949
Largest	13	Mean	0.24409903	-0.00010776	-0.00015909	0.00042964	0.00016471
		Std err	0.17531124	0.00018871	0.00027481	0.00024613	0.00012101
All stocks	65	Mean	0.24124537	-0.00009768	0.00005142	0.00049164	-0.00517980
		Std err	0.23212942	0.00021912	0.00138492	0.00100482	0.04370801
		Prop negative	0.09	0.60	0.68	0.09	0.09
Month +1							
Smallest	13	Mean	0.35423820	-0.00018754	0.00000983	0.00070730	0.00057382
		Std err	0.39083414	0.00041910	0.00039194	0.00074572	0.00080066
2	13	Mean	0.40466183	-0.00003528	0.00027298	0.00068094	0.00086550
		Std err	0.44662304	0.00025149	0.00056685	0.00106039	0.00107907
3	13	Mean	0.47924704	0.00021167	0.00040012	0.00110344	0.00049566
		Std err	0.23970347	0.00079388	0.00045956	0.00088454	0.00057552
4	13	Mean	0.22391852	0.00010459	-0.00007254	0.00087852	0.00016883
		Std err	0.28179454	0.00068325	0.00077693	0.00097436	0.00022818
Largest	13	Mean	0.15324080	0.00000311	0.00012700	0.00040340	0.00017490
		Std err	0.23958737	0.00030949	0.00044507	0.00056527	0.00062618
All stocks	65	Mean	0.32306128	0.00001931	0.00014748	0.00075472	0.00045574
		Std err	0.34179914	0.00053553	0.00055579	0.00086843	0.00074425
		Prop negative	0.17	0.45	0.39	0.17	0.22

Autocorrelation of close-to-close return and covariance components are computed for each stock within each quintile in each month and are then averaged across all stocks within each quintile of market value.

opposite is found in month +1 where the largest firms exhibit on average lower structural volatility than two out of three smaller quintile firms. Taken together the results in Table 1 A and B for month 0, it indicates that actively traded firms are large firms. The results of monotonically increase in structural volatility with the increase in trading activity and firm size render a serious drawback to price limit performance. If large firms proxy for more available information and, if trade aids price formation process, the largest firms and most actively traded firms are the firms that are likely to be the firms of which trades are the most likely to contain the information. The largest structural volatility and overreaction in the largest quintile of trading and firm size in month 0 simply implies that narrow price limit block flow of information through trade in a group of stocks of which trades are the mostly likely to contain information.

Table 4 presents the overall picture of the impact of price limit changes on return behavior at the SET. Table 4 Panel A reports variance ratio or structural volatility during the three subperiods. Panel A shows that variance ratio of the three subperiods are significantly different from zero. Month 0, the event month, has larger structural volatility than the other two subperiods and the difference between the variance ratios is significantly different from zero.

Panel B reports the difference in proportion of variance ratio greater than one, correlation around open and close, and covariance between 2 consecutive daytime trading, COV 4. Panel B row 1 reports that Month 0 has the highest proportion of variance ratio that is greater than 1, indicating that Month 0 has the highest volatility. Row 2 reports the negative proportion of Corr(Rdt-1, Rnt), Corr open, which indicates price reversal around open. Row 3 report positive of Corr(Rnt, Rdt), Corr close, which indicates price continuation at close. Row 4 reports the negative proportion of Cov 4 which indicates overreaction. The proportion of price reversal at open, price continuation at close, and overreaction are found to be the largest in month 0 as reported in panel B. The differences in proportion are all significant.

Conclusion

This paper investigates the effect of price limits changes on stock return behavior on the Stock Exchange of Thailand (SET). We compare the short run behavior of stock return under different regimes of price limits. The comparison is based on structural volatility, as measured by ratio of open-to-open return variance and close-to-close return variance. We also examine the covariance components of the 24-hour return and 12-hour return to detect the relation between limit width and the pattern of overreaction. We analyze the impact of trading volume and market value on structural volatility and overreaction as well.

Our results show that changes in price limit affect return behavior. The magnitude and proportion of structural volatility is significantly largest during the narrow limit regime. We do not find any evidence that price limit provide any "cool off" period for traders. We, instead, find an evidence of overreaction during the narrow limit range. The evidence of overreaction suggests transitory volatility. This indicates that price limit interfere with trading and induce overreaction.

We hypothesize that the width of the limit has a negative relation with the degree of price continuation. In case of the SET, changes in price limit from 10 percent to 5 percent yield the results just that. Price continuation increase substantially during the narrow limit regime, and decline when the 5 percent limit is lifted. Price reversals are also found to increase substantially during the 5 percent limit. The pattern of reversal at the SET is similar to those at NYSE that employ different trading mechanism.

We find that the pattern of structural volatility is related with trading activity and firm's size. Structural volatility increases monotonically with trading activity. The same relation is observed only in month 0 when firms are ranked by size. Further analysis reveals that in month 0, most actively traded firms are the largest firms. Price limit adversely affects this group the most because this group of firms exhibits the largest structural volatility and overreaction. Had price limit not in place, this group of firms are the most likely to be more informational efficient in price formation. High degree of price continuation at close exhibited by a group of largest stocks might simply indicate the impact of long non-trading period. However, the largest price continuation in the largest firms during the narrowest limit regime clearly indicates that price limit block information flow through trading. This alone is enough to render the verdict of guilty of tampering with market efficiency.

Table 4
Variance Ratio and Proportion Difference
Variance ratio, correlation of return around open, Cor open, correlation of return around close, Cor close, and covariance of daytime return and following daytime return, Cov 4.

Panel A Variance ratio difference

For all subperiods, month -1, month 0, month +1, we compute variance ratio for each stock for each month and then average variance ratio across stocks for each month. Variance ratio is the ratio of variance of open-to-open and close-to-close return. Here average variance ratio for each month is reported. >> indicates that the left hand figure is greater than the right hand figure at the .01 level of significant using Wilcoxon signed-rank test.

	Month 0	Month +1	Month –1
Mean	1.83964	>>1.47798	1.32071
Std err	(0.6839)	(0.5783)	(0.5278)

Panel B Proportion difference

We present the total proportion of variance ratio that is greater than 1 for each month. Total negative proportion of correlation of return around open, and covariance of consecutive daytime returns and the total positive proportion of correlation of return around close are reported for each month. Z-value based on a binomial test statistic is given in parenthesis. We report only z-value for the difference between month 0 and month +1.

	Month 0	Month +1	Month –1	(Month 0) – (Month +1) (z-value)
Variance ratio (proportion greater than 1)	0.94	0.85	0.80	0.09 (2.05)
Correlation around open Cor(Rnt, Rdt), Cor open (negative proportion)	0.82	0.66	0.55	0.16 (3.65)
Correlation around close Cor(Rdt-1, Rnt), Cor close (positive proportion)	0.91	0.83	0.89	0.08 (1.82)
Covariance daytime and following daytime Cov(Rdt-1, Rdt), Cov 4 (negative proportion)	0.60	0.45	0.45	0.15 (3.42)

Finally we interpret the results to mean that in general at the Stock Exchange of Thailand actively traded stocks are usually large stocks. Trade can aid price formation process. The effect of long overnight non-trading reflects on the average high price reversal at the SET. Stocks that are actively traded will be more likely to experience overreaction at the open, indicating overreaction among traders. Narrow price limits magnify the patterns that observed during others period i.e. the period of 10 percent limit. It is shown that by reducing the price limit from 10 to 5 percent of the previous day closing price, the SET on average experience more structural volatility and overreaction.

I thank Kenneth A. Kim, and S. Ghon Rhee, for their helpful comments and suggestions. I also thank Piman Limphapayom, S.H. Chan, Anya Khantavit and participants at the PACAP 2000 Melbourne Annual Conference for their comments.

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