Price Limits and Volatility: A New Approach and Some New Empirical Evidence from the Tokyo Stock Exchange

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Abstract

This study aims to examine regularities of price limit hits for stocks listed in the Tokyo Stock Exchange. Regularities of limit hits have not been examined before. The results show an increase of limit hits on Monday and Tuesday. These results of limit hits are consistent with the existing literature for the day-of-the-week effect of stock returns carried out on Japan. This indicates that such patterns of price limit hits are not all due to noise trading. The results also show that high limit hit occurrences are associated with high volatility and low limit hit occurrences are associated with low volatility.

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Keywords: Price Limits, Regularities, Japan

JEL classification: G10, G11, G12, G14, G15

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1. Introduction

After the stock market crash of October 1987, there were widespread concerns about the causes of the crash and whether the microstructure of the equity market should be closely monitored to protect the market from drastic fluctuations, and price limits have been recommended as a mechanism for market stabilization. Price limits are artificial boundaries that restrict daily price changes of a stock to a pre-specified range. Price limits rules are applied in many stock markets around the world, including Austria, Belgium, France, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, Spain, Switzerland, Taiwan, and Thailand. Price limits are also used in the U.S. futures market.

Advocates of price limits argue that price limits prevent extreme price movements by setting a ceiling and a floor in the range in which the price can move within a trading day. Other proponents argue that price limits reduce the potential default risk[i], and counter overreaction, without interfering with trading activity (Cho et al, 2003). However, critics of price limits argue that price limits reduce market liquidity,[ii] delay price discovery[iii] and weaken market efficiency. Price limits may also cause volatility to spread over longer periods of time, because limits prevent large one-day changes, and prevent immediate correction in order imbalance[iv].

The effectiveness of price limits in curbing undesired fluctuations of stock prices is tested in the existing literatures using deferent approaches. Some studies applied an event-study methodology to test for the effectiveness of price limits such as the study of Ma et al, 1989a and Ma et al, 1989b. Other studies applied a GARCH model to test for the effect of price limits on volatility, such as the study of Henke and Voronkova, 2003.However, Harris, (1998) argue that there is no perfect way to measure the effectiveness of price limits, as it is impossible to know what would have happened in the absence of price limits (AlShattarat et al, 2009; Maghyereh et al, 2007; Nobanee, 2007; Nobanee and Alhajjar, 2009).

This study analysis the effect of price limits in curbing undesired fluctuations of stock prices using a deferent approach that not examined before. Patterns of limit hits are analysed by testing regularities of limit hits, such as the day-of-the-week effect of limit hits. The rationales behind analysing such regularities of limit hits is to test whether limit hits follow systematic patterns, and whether these patterns can be explained in the same way as the regularities occur in stock prices. If regularities of limit hits interpreted in the same way as the regularities of stock returns, then limit hits could follow systematic patterns that cannot be interpreted only by noise trading.

Day-of-the-week effect in stock returns is commonly reported in finance literature. Day-of-the-week effect refers to a higher average rate of return usually observed on Monday relative to other days. The day-of-the-week effect of stock returns exists in Japan. However, in addition to Monday, Tuesday sometimes is the day associated with the negative and significant differences than most of other days (see Jaffe and Westerfield, 1985 and Kato, 1990). There are two potential explanations for the Tuesday effect that exists in the Tokyo Stock Exchange. The first explanation is referring to the time-zone differences between United States and Japan[v]. Japanese Tuesday effect is also explained by some institutional factors unique to Japan, which are the limitations of short selling opportunities. These institutional factors could restrict the transmission of negative news into prices in a timely manner (Hiraki and Marberly, 1995). However, Hiraki, Maberly and Taube (1998) argue that Tuesday effect disappears in Japan after introduction of index futures in the year 1982 and Monday returns are found to be anomalous.

In this study we hypothesise that Monday and Tuesday experience more limit hit occurrences comparing with other days of the week. The relationship between price limits and volatility is also examined in this paper. We hypothesise that stocks that hit the limits associated with high volatility and stocks that do not hit the limits are associated with low volatility.

The rest of the paper is organized along the following lines. The next section describes the data and methodology. Section three contains an analysis of the day-of-the-week effect of price limit hits, and finally, section three concludes.

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2. Data and Methodology

The data are downloaded from the *Datastream* . The data includes daily closing prices, cash dividends and ex-dividends dates. The data includes all stocks listed in the Tokyo Stock Exchange during the sample period of this study, 1 January 1990 until 12 July 2002. Preferred stocks and newly issued common stocks are excluded from the sample[vi]. The final sample contains 1467 companies[vii]. Limit hits are determined according to price limits rules shown on Table 1 Bellow. Prices are adjusted for cash dividends. An amount equivalent to the dividend payment is deducted from the closing price of the day previous to the ex-dividend date[viii]. Base prices are also adjusted for corporate actions and tick size.

Table 1: Daily Price Limits for Different Stock Price Levels before and after July, 2000 Revision

Previous Day's Closing Price (yen)		Price Limits (before July 2000)	Price Limits (after July 2000)
Less than	100	30	30
Less than	200	50	50
Less than	500	80	80
Less than	1,000	100	100
Less than	1,500	200	200
Less than	2,000	300	300
Less than	3,000	400	400
Less than	5,000	500	500
Less than	10,000	1,000	1,000
Less than	20,000	2,000	2,000
Less than	30,000	2,000	3,000
Less than	50,000	3,000	4,000
Less than	70,000	5,000	5,000
Less than	100,000	5,000	10,000
Less than	150,000	50,000	20,000
Less than	200,000	50,000	30,000
Less than	300,000	80,000	40,000
Less than	500,000	80,000	50,000
Less than	1 million	100,000	100,000
Less than	1.5 million	200,000	200,000
Less than	2 million	300,000	300,000
Less than	3 million	400,000	400,000
Less than	5 million	500,000	500,000
Less than	10 million	1 million	1 million
Less than	15 million	2 million	2 million
Less than	20 million	2 million	3 million
Less than	30 million	2 million	4 million
Less than	50 million	2 million	5 million
Greater than or equal	50 million	2 million	10 million

Table 1 reports daily price limits applied in the Tokyo Stock Exchange for different stock price levels before and after July 2000 Revision. Source: Tokyo Stock Exchange Fact Book, 2003.

Day-of-the-week effect of limit hits analysed in this study using EGARCH, which has proposed by Nelson (1991). Non-linear time series models such as ARCH and GARCH models introduced by Engle (1982) and Bollerslev (1986) are widely used to model financial time series, since they allow the conditional variance to depend on past information. As pointed out by Black (1976), there is empirical evidence that stock returns are negatively correlated with changes in returns volatility, i.e. volatility tends to rise in response to 'bad news' and tends to fall in response to 'good news'. In order to model this asymmetry, Nelson (1991) introduced the exponential GARCH model. EGARCH is applied in this study in order to test the day-of-the-week effect of limit hits for the following reasons. First, it allows for the information asymmetry, the leverage effect in the model captures the asymmetric effect of the good news and bad news. In Tokyo Stock Exchange good news is more likely to reveal faster in spot prices than bad news due to the restricted short selling (Chung et al, 1994). Second, unlike GARCH specification, the EGARCH model, specified in logarithms, does not impose the non-negativity constraints on parameters. Hence, to test for the-day-of-the-week effect, an E-GARCH-M model with the following form is used:

$$L_t = \alpha_t \sum_{t=1}^{5} d_t + \delta_t \sigma_t^2 + \varepsilon_t \quad (1)$$

$$\log(\sigma_t^2) = \alpha + \vartheta.\log(\sigma_{t-1}^2) + \phi.\frac{\varepsilon_{t-1}}{\sqrt{\sigma_t^2}} + \lambda\left[\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}}\right] \quad (2)$$

where L_t is the limit hits in time t, d_t is a dummy variable where d_1 equals 1 for Monday and zero otherwise, d_2 equals 1 for Tuesday and zero otherwise, and so on. The test concerns the hypothesis that the day-of-the-week coefficients should be equal, such that $\alpha_1 = \alpha_2 = \ldots = \alpha_5$. If Monday's limit hits or Tuesday's limit hits are significantly different than other days of the week, then α_1 or α_2 should be significant.

To examine the relationship between price limits and volatility, first total number of limit hits, number of upper limit hits and number of lower limit hits for each company is identified using price limit rules described on Table 1. After that a three grouping variable ware established: the first grouping variable has tow values: zero and one. Zero refers to the stocks that never hit the limits and one refers to the stocks that hit the limits. The second grouping variable has also two values: zero and one. Zero refers to the stocks that never hit the limits and one refers to the stocks that hit the upper limits. And finally, the third grouping variable has two values: zero and one. Zero refers to the stocks that never hit the limits and one refers to the stocks that hit the lower limits. A non-parametric test is used to compare the volatility means between the above mentioned groups. Volatility is measured for each company using EGARCH model, in addition to the above mentioned reasons of using the EGARCH model in this study, modelling volatility in logarithms reduce the effect of outliers on the estimation results. Therefore, to measure volatility in this study, an E-GARCH-M model with the following form is used:

$$\ln(\sigma_t^2) = \alpha_t + \sum_{k=1}^{\infty} \beta_k g(Z_{t-k}), \qquad \beta_1 \equiv 1 \quad (3)$$

Where α_t and β_k are real numbers, Z_t is an iid (0, 1) noise with symmetric distribution, and the function g is suitably chosen to model the asymmetry in the reaction to bad and good news (leverage effect). Nelson suggests using:

$$g(Z_t) \equiv \theta Z_t + \lambda\,[\,|Z_t| - E|Z_t|\,]. \quad (4)$$

Where θ and λ are fixed parameters such that $\theta^2 + \lambda^2 \neq 0$.

For the iid noise sequence (Z_t), Nelson takes the Generalized Error Distribution GED (v) for $v > 0$, the density is given by:

$$f(Z) = \frac{v \exp\left[-(1/2)|z/\lambda|^v\right]}{\lambda 2^{(1+1/v)}\Gamma(1/v)}, \qquad -\infty < z < \infty, \quad 0 < v \leq \infty, \quad (5)$$

Where $\Gamma(.)$ is the gamma function and,

$$\lambda \equiv \left[2^{(-2/v)}\Gamma(1/v)/\Gamma(3/v)\right]^{1/2} \quad (6)$$

The choice $v = 2$ corresponds to the standard normal distribution. EGARCH model are mainly suggested and used for modelling stock return volatility (e.g. Nelson, 1991).

3. Empirical Results

Occurrences of limit hits are sorted by day for entire sample, small, medium and large stocks. Table 2 reports the occurrences and percentages of limit hits by day. The results of Table 2 show that percentages of limit hits are high on Monday and Tuesday comparing with other days of the week for the entire sample. The percentages of limit hits also increases on Monday and Tuesday for all the sub samples which, includes small, medium and large stocks as shown on Table 2 this results support the Monday and Tuesday effect of limit hits on Japan.

Table 2: Limit Hit Occurrences by Day

Day	All	Small	Medium	Large
Monday	1,825	594	646	585
Tuesday	1,844	667	578	599
Wednesday	1,430	582	463	385
Thursday	1,457	553	478	426
Friday	1,494	492	499	503
Total	**8,050**	**2,888**	**2,664**	**2,498**
Monday	23%	21%	24%	23%
Tuesday	23%	23%	22%	24%
Wednesday	18%	20%	17%	15%
Thursday	18%	19%	18%	17%
Friday	19%	17%	19%	20%
Total%	**100%**	**100%**	**100%**	**100%**

Table 2 reports the occurrences of limit hits for stocks listed in the Tokyo Stock Exchange during the period 1990-2002. I report the numbers and percentages of price limit hits by day for the entire sample and for small stocks, medium stocks and large stocks. Percentages of limit hits are the number of limit hits on each day as a percentage of total number of limit hits on all days.

The EGARH-M results of limit hits also show significant differences for Monday in the entire sample and medium stocks. It also shows significant differences for Tuesday in small stocks. However, the results do not show any significant differences between days of the week for large stocks. The EGARH-M results shown on Table 3 strongly support the Monday and Tuesday effect of limit hits on Japan.

Table 3: EGARCH-M results of limit hits across days.

	Mean Equation					Variance Equation			
Entire Sample	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**C**	**ARCH**	**GARCH**	**Leverage**
Coefficient	41.82	18.87	9.67	7.58	11.98	1.37	0.33	0.33	0.78
Std. Errors	17.34	19.42	23.09	20.11	23.89	0.72	0.08	0.06	0.09
Z Statistics	2.41*	0.97	0.42	0.38	0.50	1.91	4.38**	5.46**	8.19**
Small Stocks	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**C**	**ARCH**	**GARCH**	**Leverage**
Coefficient	7.03	11.12	5.56	5.14	4.18	-0.04	0.07	0.18	0.99
Std. Errors	5.89	5.27	5.18	6.22	6.87	0.31	0.10	0.05	0.06
Z Statistics	1.19	2.11*	1.07	0.83	0.61	-0.14	0.70	3.28**	15.89**

Medium Stocks	Mon	Tue	Wed	Thu	Fri	C	ARCH	GARCH	Leverage
Coefficient	13.79	0.13	-2.38	-3.15	0.69	0.34	0.23	0.22	0.90
Std. Errors	6.84	6.23	7.29	7.02	5.95	0.29	0.08	0.04	0.06
Z Statistics	2.02*	0.02	-0.33	-0.45	0.12	1.17	3.02**	5.93**	16.26**
Large Stocks	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**C**	**ARCH**	**GARCH**	**Leverage**
Coefficient	-1.04	-16.01	-8.49	-23.17	-15.72	6.14	0.41	0.20	-0.01
Std. Errors	37.15	36.36	35.10	39.34	38.09	1.28	0.24	0.13	0.15
Z Statistics	-0.03	-0.44	-0.24	-0.59	-0.41	4.81**	1.73	1.60	-0.05

Table 3 reports EGARCH-M results of limit hits for the entire sample, small stocks, medium stocks and large stocks across days.

*** Coefficients are significant at 0.05 level.**

**** Coefficients are significant at 0.01 level.**

The results of the relationship between price limits and volatility presented in table 4 bellow shows significant differences in volatility between the sample of stock that hit the limits and stocks that do not hit the limits ,

Table 4: Descriptive Statistics and Mann-Whitney Results

Grouping Variables	Means	Standard Deviation	Z statistics
0: Stocks that do not hit the limits	**0.00042**	**0.00022**	**-12.359***
1: Stocks that hit the limits	**0.00131**	**0.01216**	
0: Stocks that do not hit the limits	**0.00042**	**0.00022**	**-12.697***
1: Stocks that hit the upper limits	**0.00132**	**0.01250**	
0: Stocks that do not hit the limits	**0.00042**	**0.00022**	**-13.042***
1: Stocks that hit the lower limits	**0.00157**	**0.01490**	

Table 4 reports the means; standard deviation and Mann-Whitney results for stocks that hit the limits and stocks do not hit the limits. The results also reported for non-limit hit group and upper limit hit group and finally, the results are reported for the non-limit hit group and lower limit hit group.

4. Conclusion

Day-of-the-week effect of limit hits is discussed in this study. Day-of-the-week effect of limit hits has not been examined before. Explanations are provided for the empirical findings and the extent to which the price limit hit regularities are related to existing stock returns regularities. We argue that if the seasonality of price limits can be explained in the same way as the seasonality of stock returns, this might mean price limit hits are not entirely due to noise trading.

The results for entire sample and medium stocks show that Monday has higher and significant limit hits comparing with other days. The results for limit hits for small stocks show that Tuesday has higher and significant limit hits comparing with other days. The results for the large stocks do not any differences of limit hits between days. This is logical since large capitalization stocks are least likely to have suffered losses. Theses results of limit hits are consistent with the existing literature for the day-of-the-week effect of stock returns carried out on Japan such as the study of Jaffe and Westerfield (1985), the study of Kato (1990) and the study of Hiraki, Maberly and Taube (1998). The results for day-of-the-week effect of price limit hits show that regularities of price limit hits could be interpreted similarly as regularities of stock returns. This is an indication that price limit hits are not entirely due to noise trading.

References

[1] AlShattarat, W. K., Nobanee, H., Haddad, A. E. (2009). Empirical Analysis of Price Limit Hits of Tokyo Stock Exchange. Journal of International Business and Finance, 1(January-June), 41-72.

[2] Black .F.,1976, Studies of stock market volatility changes. *Proceedings of the American Statistical Association, Business and Economic Statistics Section*, 177-181.

[3] Bollerslev, T. 1986. Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics*, 31, 307–327.

[4] Brennan, M.J., 1986, A Theory of Price Limits in the Futures Markets, *Journal of Financial Economics*, 16, 213-233.

[5] Chiang, R., Wei, K.C.J., and Wu, S., 1997, Price Limits in Taiwan and Risk-Return Estimation, *Pacific-Basin Capital Markets Research*, 1, 173-181.

[6] Cho, D.D., George, J.R., Tiao, C., and Tsay, R., 2003, The Magnet Effect of Price Limits: Evidence from High Frequency Data on Taiwan Stock Exchange, *Journal of Empirical Finance*, 10, 133-168.

[7] Choi, W.S, and Lee, 2002, S.B, Price Limits and Asymmetry of Transitory Price Dynamics: Intraday Evidence from the Korea Stock Exchange, Unpublished Working Paper.

[8] Chung, Y.P., Kang, J. and Rhee, G., 1994, The Lead-Lag relationship between the Stock Market and the Index Future Market in Japan, Working Paper, University of Rhode Island.

[9] Cross, F.,1973, The Behaviour of Stock Prices on Fridays and Mondays, *Financial Analysts Journal*, 29, 67- 9.

[10] Damodaran, A., 1989, The Weekend Effect in Information Releases: A Study of Earnings and Dividend Announcements, *Review of Financial Studies*, 2, 607- 23.

[11] Engle, R., 1982, Autoregressive Conditional Heteroskedasticity with estimates of the Variance of the United Kingdom Inflation, *Econometrica*, 50, 987-1007.

[12] Fama, .E., 1989, Perspectives on October 1987, or, What Did We Learn from the crash? In Black Monday and the Future of Financial markets, Kampuis, Kormendi and Watson (eds.) (Mid America Institute for public Policy Research, Inc., Chicago Illinois), 71-82.

[13] Figlewski, S., 1984, Margin and Market Integrity: Margin Setting for Stock Index Futures and Options, *Journal of Futures Markets*, 4, 385-416.

[14] French, D. W.,1980, Stock Returns and the Weekend Effect, *Journal of Financial Economics*, 8, 55- 69.

[15] Harris, L., 1998, Circuit breakers and program trading limits: What have we learned? in: R.E. Litan and A.M. Santomero, eds., Brookings-Wharton Papers on Financial Services,(Brookings Institutions Press, Washington DC) 17-63.

[16] Henke, H., and Voronkova, S., 2003, Working Paper.

[17] Hiraki, T., and Maberly, E.D., 1995, Are Preholiday in Tokyo really anomalous? If so Why?, *Pacific-Basin Finance Journal*, 3, 93-111.

[18] Hiraki, T., Marberly, E.D., and Taube, P.M., 1998, The Impact of Index Future Trading on Day-of-the-Week Effects in Japan, *Pacific-Basin Finance Journal*, 6, 493-506.

[19] Jaffe, J., and Westerfield, R., 1985, The Weekend Effect in Common Stock Returns: The International Evidence, *Journal of Finance*, 40, 433–54.

[20] Kato, K., and J., Schallheim, 1985, Seasonal and Size Anomalies in The Japanese Stock Market, *Journal of Financial and Quantitative Analysis*, 20, 243-272.

[21] Keim, D. and Stambaugh, R.,1984, A Further Investigation of the Weekend Effect in Stock Returns, *Journal of Finance*, 39,819- 40.

[22] Kim, K.A., and Rhee, S.G., 1997, Price Limit Performance: Evidence from the Tokyo Stock Exchange, *Journal of Finance*, 52, 885-901.

[23] Kuhn, B.A., Kuserk, G.J., and Locke, P., 1991, Do Circuit Breakers Moderate Volatility? Review of Futures Markets, 7, 426-434.

[24] Kyle, A.S., 1988, Trading Halts and Price Limits, Review of Futures Markets, 7,426-434.

[25] Lakonishok, J. and Levi, M., 1982, Weekend Effects on Stock Returns: A Note, *Journal of Finance*, 37, 883- 9.
[26] Lauterbach, B., and Ben-Zion, U., 1993, Stock Market Crashes and The Performance of Circute Breakers: Empirical Evidence, *Journal of Finance*, 48, 1909-1925.
[27] Lee, C., Ready, M., and Seguin, P., 1994, Volume, Volatility, and, NYSE Trading Halts, *Journal of Finance*, 49, 183-214.
[28] Lee, S.B., and Kim, K.J., 1995, The effect of Price Limits on Stock Price Volatility: Empirical Evidence In Korea, *Journal of Business Finance and Accounting*, 22, 257-306.
[29] Lehmann, B., 1989, Commentary: Volatility, Price Resolution, and the Effectiveness of Price Limits, *Journal of Financial Services Research*, 3, 205-209.
[30] Ma, C.K., Roa, R.P., and Sears, R.S., 1989a, Volatility, Price Resolution, and the Effectiveness of Price Limits, *Journal of Financial Services Research*, 3, 67-101.
[31] Ma, C.K., Roa, R.P., and Sears, R.S., 1989b, Limit Moves and Price Resolution: the Case of the Treasury bond Futures Market, *Journal of Futures Markets*, 9, 321-335.
[32] Meltzner, A., 1989, "Overview", In: Kampuis, R., Kormendi, R., and Watson, J., eds, Black Monday and the Future of Financial Markets, Homewood,il, Irwin.
[33] Miller, M., Sholes, M., Malkiel, B., and Hawke, J., 1987, Final Report of the Committee of Inquiry Appointed by the Chicago Mercantile Exchange to Examine the Events Surrounding October 1987, December.
[34] Moser, J.T., 1990, Circuit Breakers, Economic Perspectives, Federal Reserve Bank of Chicago, 14, 2-13.
[35] Maghyereh, A. K., Al-Zoubi, H. K., Nobanee, H. (2007). Price Limit and Volatility in Taiwan Stock Exchange: Some Additional Evidence from the Extreme Value Approach. Review of Pacific Basin Financial Markets and Policies, 10(1), 51-61.
[36] Nobanee, H., AlHajjar, M. (2009). Effectiveness of Price Limit Hits of Japan. Global Journal of Finance and Management, 1(1), 21-31.
[37] Nobanee, H. (2007). Are Limit Hits Industry Specific?. Applied Economics Letters (incorporating Applied Financial Economics Letters), 3(2), 115-119.
[38] Nelson D.B., 1991,Conditional Heteroskedasticity in Asset Returns: a New Approach. *Econometrica* , 59/2, 347-370.
[39] Penman, S. H.,1987, The Distribution of Earnings News Over Time and Seasonalities in Aggregate Stock Returns, *Journal of Financial Economics*, 18, 199- 228.
[40] Rogalski, R.,1984, New Findings Regarding Day Of The Week Returns Over Trading and Non-Trading Periods: A Note, *Journal of Finance*, 39, 1603-1614.
[41] Smirlock, M. and Starks, L., 1986, Day-Of-The-Week and Interday Effects in Stock Returns, *Journal of Financial Economics*, 17, 197-210.
[42] Telser, I.G., 1981, Margins and Futures Contracts, *Journal of Futures Markets*,1, 225-253.
Telser, I.G., 1989, October 1987 and the Structure of Financial Markets, In : Kampuis, R., Kormendi, R., and Watson, J., eds, Black Monday and the Future of Financial Markets, Homewood,il, Irwin.

[i] See Brennan, 1986; Moser, 1990; Ma et al, 1989b.

[ii] See Fama, 1989; Telser, 1989; Lehmann, 1989; Lauterbach and Ben-Zion, 1993; and Kim and Rhee, 1997.

[iii] See Fama, 1989; Lehmann, 1989; Lee et al., 1994; Figlewski, 1984; Kim and Rhee, 1997; Meltzner, 1989; Miller et al., 1987; Telser, 1981; Lee and Kim, 1995; Ma et al., 1989a, 1989b; Chiang et al, 1997; Kim and Rhee, 1997.

[iv] See Kim and Rhee, 1997; Lehmann, 1989; Fama, 1989; Kyle, 1988; Kuhn et al., 1991; Lee and Kim, 1995)
[v] The time difference between the two countries is about 14 hours (see Jaffe and Westerfield, 1985 and Kato, 1990).

[vi] Price limits are relaxed for the newly listed stocks in the first few days after they listed in the market because they do not have base prices (base price is usually the previous days' closing price except of some cases).

[vii] Long period and large number of companies is selected due to the fact that the Tokyo Stock Exchange applies wider price limits rules than other markets. This makes limit hit events rare. Choosing a long period also makes the analysis to cover both normal periods and crisis periods (periods of crisis such as the years, 1990, 1997 and 2000).

[viii] For example, for stock with cash dividend of ¥10, the base price on the ex-dividend date is the previous day's closing price minus ¥10. Therefore, if the previous day's closing price was ¥25,000, the base price on the ex-dividend date will be ¥24,990 and trading may take place between ¥27,990 and ¥22,990 according to current price limits rules.