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Association Between Price Limit and Stock Returns: Influences and Implication for Market-Based Research

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ABSTRACT

This paper examines the influences of price limit on price behavior in the Taiwan stock market, especially focusing on the random walk hypothesis for stock returns. Two methodologies; serial correlation, and scaled variogram; are applied for periods with different levels of price limit. The results are hypothesized varying with the change of price limit.

The results indicate that the serial correlations of stock returns are statistically non-zero and sensitive to the levels of price limit. Higher time-series correlations of stock returns associate with lower level of price limit. It supports that price limit for the market may deter reflecting of information and demean efficiency of the market. The test of scaled variogram positively supports the random walk hypothesis for weekly returns even when the periods with narrow price limit.

The results provide good evidence for policy-makers for Taiwan's stock market to consider to eliminate the price limit. The results also suggest that the market-based studies using short intervals as the testing period may be biased due to the influence of the price limit on stock returns.

Keywords: association, price limit, stock returns

I. INTRODUCTION

This paper examines the influence of price limit on Taiwan's stocks price behavior, especially on the random walk hypothesis, which was used frequently in testing the weak-form efficient market hypothesis. Serial correlation and scaled variogram are applied to test the sensitivity of stock returns' behavior to the levels of price limit.

In most people's mind, stock returns behavior under a weak-form efficiency hypothesis is expected to follow the random walk, even it is not necessary. The pattern of price behavior is always assumed stable and the stock returns is expected to be a random walk or random walk with a drift. Most of the U.S. studies show the similar results to support the random walk hypothesis. Additionally, the market-based research, especially the event studies, always assumes the price behavior is stable and follows a random walk hypothesis.

Chu (1991) investigated the price behavior in the Taiwan stocks market and found that short intervals returns follows a non-random walk, which differs from that in the U.S.. The paper argued that the institutional

difference between Taiwan's and the U.S. market, price limit in Taiwan, explains the results, and concluded that price limit would deter information reflecting to the market and demean the market efficiency. Several studies, i.e. Chou and Wu (1995), Fan (1995), Chen (1995), and Hwuan (1996), also found the behavior of the stock price in Taiwan would be altered by price limit. If the market is affected by the price limit as the above studies, the strength of its influence may vary with the level of price limit. Variant levels of price limit may impact on the price behavior differently. The time-serial correlations of stock returns may also affected with variant levels of price limit. Due to the possible impact of price limit on stock behavior, the market-based research, especially the event studies, should consider an adjustment to reduce the possible biased, if the stock returns follow a non-random walk. The adjustment, hopefully, would also be varied with the level of price limit.

Differ from previous price limit studies, the paper emphasizes on the change of impacts of price limit on stock price behavior during the past decade. Especially, the level of price limit has been altered several times, the efficiency of the stock market and the stock price behavior may also be different. Additionally, the study also try to compare the different serial correlations among the different periods and to provide some implications for the market-based studies which usually assumed that stock returns follow a random walk.

During the past decade, price limit has been changed several times. The SEC in Taiwan imposes price limit to the stocks market depending on volatility and her point of view about maturity of the market. Five percent, three percent, five percent again and seven percent are imposed for the periods from 1983 to 10/26 1986; from 10/27 1983 to 11/13 1988; from 11/14 1988 to 10/10 1989; and from 10/11 1989 to today respectively.

This study hypothesizes that price limit may change stocks behavior and examine its influences on stock returns by following methods. First, serial correlations of the periods with different levels of price limit are tested. Daily, two days, weekly and monthly returns are all examined to investigate the variance of effect with the length of interval. Instead of using the parametric method, the scaled variogram (a nonparametric method) is estimated to test the random walk hypothesis to avoid the non-normality assumption.

The results indicate that there is a significant difference in the levels of serial correlations of stock returns among the periods with variant price limits. Most of the companies' stock returns have followed non-random

walk during the period with 3% (the tightest) price limit. Reversibly, the period with 7% price limit has the lowest serial correlation.

The study also shows a significantly non-zero time-series correlation of stock returns for short intervals. All companies' monthly returns, on the other hand, support the random walk hypothesis. The price limit in the TSE is seen as a possible explanation for the non-random walk behavior for returns with short intervals.

The test of scaled variogram indicates that stock returns in Taiwan for shorter intervals may not follow a random walk due to price limit. It may also provide evidence for market-based accounting research, which should debut the influence of price limit. The results suggest that the price limit, in fact, does not help market efficiency. Additionally, no evidence show that the variance of stock prices could be reduced by price limit. The results also provide good evidence for policy-makers for Taiwan's stock market to consider to eliminate the price limit. The study also implies that the market-based accounting research, especially for event studies, may be biased if apply a window which is too short to catch the deterred information. A longer window is recommended.

The structure of this study is as follows. Section 2 describes theoretical models and hypothesis. Section 3 introduces methodology. Section 4 discusses results. Section 5 concludes the study.

II. THEORY & HYPOTHESIS

2.1. Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH), as defined in Fama (1970), states that a market is efficient if security prices "fully reflect" the information available. Information available was classified into three sets, past securities prices only, publicly available information and all information including privately held information. The market reflects all past securities prices is defined as the weak form efficiency. Several methods (i.e. serial correlation, the filter rules method and run test) have been developed to test price behavior in the U.S. market. These tests posited that observed prices could be viewed as the equilibrium prices following the Efficient Market Hypothesis (EMH). The random walk model is also widely applied to test the weak-form market efficiency hypothesis for price behavior.

The random walk model suggests that successive price changes (or more typically, successive one-period returns) are independent. (Fama, 1976) This model could be expressed as follows:

$$f(r_{j,t+1}|\Theta_t)=f(r_{j,t+1}) \quad (1)$$

where $r_{j,t+1}$ is the stock returns for company j at period t+1, and Θ_t is the information set available at period t. This model also implies that conditional and marginal probability distributions of an independent random variable are identical. Therefore, if the expected return on security j is constant over time, then

$$E(r_{j,t+1}|\Theta_t)=E(r_{j,t+1}) \quad (2)$$

This indicates that the mean of the distribution of $r_{j,t+1}$ is independent from the information available at period t, Θ_t, and follows the random walk model. The random walk model also suggests that the market equilibrium can be presented in terms of expected returns which fully reflect available information.

2.2. Price Limit and Stock Behavior

The demand/supply theory of economics has been widely applied in description the impact of price limit on the stock price. As the market in equilibrium, the market's demand would be equal to the supply both in price and quantity. The demand function would move with any exogenous variables such as accounting information. If the market is efficient, the market would be re-equilibrium immediately. However, under the price limit scenario, an impact to the market which move up or down the demand over the limit would create an temporary unbalance of demand and supply. For a good new which cause over demand would induce a delay market reflection. The insufficient market response in price would also change the supplier's expectation and reduce the market supply. The effects from both demanders and suppliers would enhance the stock appreciation. Therefore, price limit would cause a positive correlation of serial price. Similarly, price limit would enlarge the downward of stock price as the bad news happened.

Various studies have discussed the influence of price limit on the stock market, especially after the U.S. market crash in 1987. The results of the studies suggest that price limits and trading halts should be formulated and implemented to protect the market system. (Brady Commission, 1988) Several empirical studies, i.e. Ma, Rao, and Sears (1989), find that price

limits may reduce the volatility of stock price. While price limits may deter the market's adjustment to the new information, which may influence the market efficiency. (Coursey and Dyle, 1989)

In Taiwan, many studies have focused on the impact of price limit on the stock behavior. Hwuan (1996) found that price limit would alter investors' behavior, especially when the stock price closes to the limit. The study also pointed that the risk index, such as beta, may be biased due the price limit. Liang (1994), argued that the price limit may reduce the price movement, however, Fan (1995) found that price limit was not able to reduce the price movement. Chen (1995) concluded that change of price limit is not necessary to change the price movement or trading volume. He argued that the price movement would be altered only under certain conditions. In conclusion, the above studies showed that price limit would impact the price behavior, but the pattern of its impact is unconcluded.

2.3. Time-Serial Correlation

The random walk model is applied in the study. The testing results are expected to be indifferent from previous studies, if the price limit has no influence on the stock behavior. The null hypothesis of this test is:

$$\mathbf{H_0 :}\ \delta_t = 0$$

where δ_t is the serial correlation of one-period return with interval t.

However, Chu (1991) as well as Chou and Wu (1995) found that the price limit in the TSE might deter the market movements in reflecting information. Does the stock returns' behavior in the TSE change with the price limit? Theoretically, this limit will extend the time which is needed to reflect certain information.[i] Particularly, a tighter limit may come with a stronger effect on stock returns. Hence, the time-series of stock returns may not follow a random walk model due to this limit. The serial correlation would be different as the limit changes. The null hypothesis is assumed as follows:

$$\mathbf{H_0:}\ \delta_{5\%} = \delta_{\%} = \delta_{\%} = 0$$

The influence of price limit, which may defer the information reflection, nevertheless, may exist in testing the price behavior of shorter intervals, i.e. daily returns or two-day returns. For a longer interval, i.e. weekly or

[i]. The impact of the price limit would be affected by the frequency of the stock price hitting the limit. Hence, the hypothesis is limited to the price may hit the limit frequently.

monthly, the influence should be eliminated. (Chu, 1991) Hence, the serial correlation would be different with the length of the intervals. The null hypothesis is assumed as follows:

$$\mathbf{H_0:}\ \delta_{\text{daily}} = \delta_{\text{two-day}} = \delta_{\text{weekly}} = \delta_{\text{monthly}} = \mathbf{0}$$

2.4. Variogram Test

In addition to the serial correlation test of random walk model, scaled variogram (variance ratio), a nonparametric method, is applied in the study, which does not require the normality assumption. Cochrane's methodology of testing the random walk hypothesis by calculating the variogram is applied in the study.

Cochrane (1988) presents three ways to interpret the scaled variogram:

1. a test of the random walk hypothesis by comparing the scaled variogram of a time-series with the variogram of a simulated random walk;

2. a measure of the size of the unit root component of a time series; if we decompose a series into a unit root (random walk) component and a stationary component, this measure is the ratio of the variance of the unit root component to the total variance of the series.

3. a criterion for time series model identification that gives greater weight to the long-run properties of a series than frequently used ARIMA modelling tools such as the Box-Pierce Q statistics. (Kendall and Zarowin, 1990)

Several recent papers, such as Poterba and Summer (1987), Fama and French (1988), Kendall and Zarowin (1990) and etc.., have used the scaled variogram as a non-parametric way to extract information from a time series. This paper applies the method mainly in the first question, the random walk hypothesis. The rationality of the scaled variogram is explained as follows:[ii]

" A random walk can be written as follows:

$$\mathbf{X_t = a + X_{t-1} + e_t} \qquad \mathbf{(3)}$$

where e_t is the White Noise$(0,s^2)$. The variance of the first difference of the series is s^2; the variance of the kth difference of the random walk is $\mathrm{Var}(X_t - X_{t-k}) = ks^2$; since by assumption the e_t terms are serially uncorrelated.

[ii]. See Working Paper of Kendall and Zarowin, "Time Series Models of Earnings, Earnings Persistence and Earnings Response Coefficients", Feb., 1990.

The scaled variogram is the ratio of 1/k times the kth difference divided by the first difference:

$$V_k=(1/k)Var(X_t-X_{t-k})/Var(X_t-X_{t-1}) \quad (4)$$

For a random walk, this is equal to $(1/k)ks^2/s^2$ so that the scaled variogram should be equal to one for all k. For a time series that is less persistent than a random walk, the scaled variogram will approach zero as k increases; if a time series is more persistent than a random walk, the scaled variogram will be greater than one as k increases." (Kendall and Zarowin, Feb. 1990) To avoid the noise of daily price changes, only the monthly returns is being tested. The result is compared to a simulated variogram for 500 random walks which was done by Robert Lipe and Roger Kormendi (1989).

III. METHODOLOGY

3.1. Data Collection

The data for Taiwan's stock market is based on the official daily report of the Taiwan Stock Exchange (TSE), which is collected and maintained by the Taiwan Economic Journal (TEJ). All listed companies with at least one year data are selected. The newly listed companies with less than a year data are excluded to avoid the so-called "honey-moon effect" of initial public offering. The sample companies are also divided into two subgroups according to their listing categories. The comparison of the companies listed in Category A to those in Category B may robust the testing results.

The period from 1986 to 1992 are used because three different levels of price limit are all included. Under the hypothesis of random walk, the expected returns are assumed to be stationary through time. The serial correlations for different periods are expected to be zero. While, the price limit may influence the serial correlation as the results of Chu (1991) and Chou and Wu (1995). During the testing period (1986-1992), the price limit has been changed from 5% to 3%, then back to 5%, and enlarged to 7% in 1991. Hence, the testing period is divided into four subperiods with different levels of price limit to test the influence of price limit on the serial correlation.

3.2. Testing Methods

A. Serial Correlation

The random walk hypothesis, which assumes that serial correlation is zero, is tested first. Serial correlations of stock returns are estimated by the following steps.

The stock returns for an interval are defined as follows.

$$r_t=(P_t-P_{t-1}+D_t)/(P_{t-1}) \quad (5)$$

where P_t is the closing price of period t, and D_t is the dividend payout during period t (if any).

At the beginning, statistical summaries, which include mean and number as well as ratio of firms in excess of two standard errors, are used to test the hypothesis. The F test and Kruskal-Wallis test are also used to detect the differences among the subperiods.

B. Scaled Variogram Test

It is quite popular to compare the scaled variogram with the variogram estimated from a simulated random walk to test a random walk hypothesis for a particular return's series. (Lipe and Kermendi, 1989) The scaled variograms are estimated by the daily, weekly, and monthly returns for the period 1986-1992. The "k"th difference is varied from two to twelve. Each variogram is estimated from Equation (5). The statistical summaries are then compared to the simulated results which present the pattern of random walk.

3.3. Testing Intervals

In order to test the influences of price limit on different interval of stock returns. The daily, two-day, weekly and monthly returns are chosen as different testing intervals.[iii] Each interval's return is accumulated from daily stock returns. The serial correlations and scaled variogram of for different levels of price limit for the different lengths of returns intervals are compared.

IV. RESULTS ANALYSIS

[iii]. Daily stock return with dividend is used in the test. When using the stock return without dividend, the results are similar.

4.1. Serial Correlation

Table One exhibits the summary of first order serial correlations between successive stock returns for the intervals varied daily, two-day, weekly, bi-weekly, and monthly.

(Table One about here)

Panel 1 presents the serial correlations of daily stock returns for the four periods with different levels of price limit.

The results could be concluded as follows:

1. The nonrandom walk results cannot support the null hypothesis that the Taiwan stock market is weak-form efficient.

2. The non-random walk phenomenon is sensitive to the change of price limit.

3. When price limit is 3%, stock returns of all (111 out of 111) companies in Taiwan did not follow random walk.

4. When price limit is enlarged (loosed), there are more companies support the random walk hypothesis. The average serial correlation is also reduced.

The F test and Kruskal-Wallis test both support that the serial correlations of the four periods are different. When price limit changed from 5% to 3% at Oct. 26, 1988, the average serial correlation of the testing sample increased significantly. Similarly, the average serial correlation reduced significantly when the price limit was enlarged from 3% to 5% as well as from 5% to 7%. Interestingly, the average correlations of the first period and the third period are with insignificant difference. This phenomenon may suggest that the serial correlation of the stock returns in Taiwan is a function of the price limit with positive relationship.

When examine the returns of two-day, less companies have serial correlation over two standard deviations. Nevertheless, over 90% (103 out of 111) of companies in the period of 3% price limit still followed a non-random walk. The F test and Kruskal-Wallis test also provide some evidence to support the differences among the four periods. Both statistics present that the average serial correlation has increased significantly as the price limit being tighten from 5% to 3% and decreased significantly as the price limit being loosed from 3% to 5%. However, both tests also suggest that there is an insignificant change of the serial correlation when the price limit was enlarged from 5% to 7%. Similarly to the results of daily returns, two periods with 5% price limit present an insignificant difference in average serial correlations.

The results for weekly returns present a significant difference, especially for 3% period. Only 26 companies (23.4%) are rejected from the

random walk hypothesis. The periods 3 (5% price limit) and 4 (7% price limit) have only 3 and 2 companies are rejected. Nevertheless, there are 71 out of 111 companies present non-random walk in the first period.

The average serial correlation of the weekly returns shows a little difference from those of the daily and two-day returns. The first period (5% price limit) has the highest serial correlation, which is statistically different from the other three periods.

Panel 4 shows that all companies' monthly returns in the four testing periods support the random walk hypothesis, which is also consistent with Chu (1991). None corporation has a serial correlation which is over two standard errors. The average serial correlation presents a negative result for the first three periods, which suggests a possible circle relationship for the monthly returns but with statistical insignificance. The fourth period with the highest price limit (7%) presents a near-zero average serial correlation. This phenomenon also suggests that enlarging the price limit may improve the market efficiency.

The improvement of serial correlation with the increase of the length of interval also suggests that the price limit in the TSE may be one of the plausible explanations. Statistically, the impact of price limit would be eliminated gradually with the increase of interval, under the random walk hypothesis for price behavior. The strongest effect of price limit should be on the daily returns. The results in Table One supports this argument.

The non-random walk result for short intervals also suggests that more opportunities for arbitrage which may deter the market development due to the price limit. Enlarging or even removing the limit is able to facilitate further market efficiency to a certain degree.

For completeness of the test sample, all companies with at least one year daily stock returns are added. The results are presented in Table Two. It shows no significant difference from the sample with completed data. The study also divides the sample into Category A firms and Category B firms according to the firms' listing in the TSE to test the sensitivities of the results to size and risk. Table Three presents the comparison and indicates consistent results as the above mentioned conclusions. Category A's companies, on average, have a lower serial correlation and a lower percentage of firms which are statistically significant. This result may suggest that the firms of Category A are relatively more efficient than those of Category B, or that the firms of Category A are less influenced by the price limit. The trend of autocorrelation with the levels of price limit and the length of interval is consistent with that of the total sample.

(Table Two about here)

(Table Three about here)

4.2. Test of Scaled Variogram

Chu (1991) used scaled variogram, a nonparametric method, to test the random walk model, and found that scaled variogram of monthly returns in Taiwan follow a trend which is similar to the simulated random walk model. The study suggested that long interval of stock returns, which were affected by the price limit much less than the short interval, did follow the random walk hypothesis. The study examines scaled variogram of daily, two-day, and weekly returns, which have not examined in Chu (1991), in additional to the serial correlation, for the random walk test.

The estimated scaled variogram and simulated variogram are presented in Table Four. The statistical summaries in Panel 1 present a increasing trend of scaled variograms for daily returns. The mean and median of R(2) to R(12), where the R(k) means the scaled variogram for the kth difference, are both increasing from one to more, which reflects a theoretical value of a non-random walk. The results also suggest that the daily stock returns are more persistence than a random walk. The phenomenon is consistent to the theoretical expectation of the effect of price limit. The price limit may deter the reflection of information and may cause a persistence pattern of stock returns. The test of two-day returns show a similar results as test of daily returns, which suggests that the influences of price limit may still exist for a short interval like two days.

(Table Four about here)

Compared to daily returns, the weekly returns in Taiwan present a statistically random walk pattern. It also forms a good basis for the tests of the association between accounting information and market returns, which assume the price behavior follows random walk.

There is no significant difference between the scaled variograms series for Category A's firms and Category B's. The result is consistent with Chu (1991) in testing monthly returns. It also indicates that the price limit effect is overwhelming for all companies in the TSE.

V. CONCLUSION

The efficient market hypothesis, where the prices at any point in time "fully reflect" available information, has been widely examined. Weak form tests for the efficient market model are the most voluminous, and it seems that the results strongly support the hypothesis of market efficiency and that stock returns follow a random walk model. This study applies the

methodologies of these tests to the Taiwan stock market. The results indicate that there is a high percentage of companies with statistically significant non-zero autocorrelation than the theoretical expectation for the random walk. The price limit is argued as the explanation. The study finds that during the periods with a tighter price limit, the average serial correlation and percentage of companies with statistically significant non-zero autocorrelation are more than the periods with a looser price limit. The results also suggest that the above phenomenon may be removed for a longer interval. Both of the results conclude that the price limit may be a major effect for the non-random walk scenario in the TSE. Additionally, the scaled variogram test presents results which are consistent with those of the serial correlation tests, and enforces the argument of the study. Finally, the results suggest that the price limit in Taiwan may not reduce the volatility of stock prices, but may deter market efficiency. Removing this limit is a necessary requirement for the market development of the TSE.

Additionally, the results also suggest that the market-based studies using short interval as the testing period may be biased due to the influence of the price limit on stock returns. The non-zero serial correlation may cause the so-called abnormal returns for event studies, if the stock return is assumed to follow a random walk. An adjustment for these market-based studies under the price limit environment is also suggested in order to detect the real market responses for the tested events.

REFERENCES

Alexander, Sidney S., "Price Movements in Speculative Markets: Trends or Random Walks", *Industrial Management Review II*, May, 1961, pp.7-26.

Brady Commission, "Report of the Presidential Task Force on Market Mechanisms", January 1988.

Chiang, R., and K. C. J. Wei, "Estimation of Volatility Under Price Limit", Working Paper, University of Miami, 1991.

Chen, C., "Price Change Limit Effect on the Event Studies: A Simulation Approach", Working Paper, National Taiwan University, 1992.

Chen, J. C., "The Impact of Price Limit on Stocks Behavior", MBA Thesis, National Chun-Chen University, 1995.

Chou and Wu, "Measuring the Impact and Effectiveness of Price Limits in Taiwan", working paper, 1995.

Chu, L., "Do Stock Returns Follow a Random Walk?", *Globalization of Asian Economies and Capital Markets*, St. John's University, 1994.

Chu, L., "Market-based Accounting Research: An International Comparison and New Evidence", Doctoral Dissertation, New York University, 1991.

Cochrane, J. H., "How Big is the random walk in GNP?", *Journal of Political Economy*, 96, 1988, pp.839-880.

Coursey, Don L., and E. R. Dyl, "Price Limits, Trading Suspensions, and the Adjustment of Prices to New Information", *Review of Future Markets*, 1990, V9(2), pp.342-360.

Fama, Eugene F., *Foundations of Finance*, New York: Basic Books, 1976.

Fama, Eugene F., "Efficient Capital Market: A Review of Theory and Empirical Work", *Journal of Finance*, May, 1970, pp.383-417.

Fama, Eugene F., "The Behavior of Stock Market Prices", *Journal of Business*, Jan. 1965, pp.34-105.

Fama, Eugene F., L. Fisher, M. Jensen, and R. Roll, " The Adjustment of Stock Price to New Information", *International Economic Review*, Feb. 1969, pp.1-21.

Fama, Eugene F., and Blume, "Filter Rules and Stock-Market Trading", *Journal of Business*, 1968, pp.226-241.

Fama, E. F. and K.R. French, "Permanent and Temporary Components of Stock Prices", *Journal of Political Economy*, 96, 1988, pp.249-273.

Fan, H., "The Influence of Change of Price limit to Stock Price", MBA Thesis, Soo-Chow University, 1995.

Hwuan, J. Z., "The Impact of Price Limit on Stock Price and Financial Index", MBA Thesis, National Chen-Chi University, 1996.

Kendall, C. and P. Zarowin, "Time Series Models of Earnings, Earnings Persistence and Earning Response Coefficients", Working Paper, Feb. 1990.

Liang, M. F., "The Impact of Price Limit on Stocks Movement", MBA Thesis, National Taiwan University, 1994.

Lipe, R. and R. Kormendi, "The Long-Horizon Properties of Annual Earnings: An Analysis of Persistence and Valuation", Working Paper, May. 1990.

Lev B., and J. Ohlson, "Market-Based Empirical Research in Accounting: A Review, Interpretation, and Extension", *Journal of Accounting Research*, Sep. 1982, pp.249-295.

Ma, C., R. Rao, and R.S. Sears, "Volatility, Price Resolution, and the Effectiveness of Price Limits", *Journal of Financial Services Research*, 3: 165-199, 1989, pp.67-101.

Poterba, J.M, and L.H. Summers, "Mean Reversion in Stock Prices: Evidence and Implication", *Journal of Financial Economics*, 22, 1988, pp.27-59.

Tobin, J., "Estimation of Relationships for Limited Dependent variables", 1958.

Appendix

Table One. Summary of Autocorrelation for Stock Returns:

Panel 1: Daily Stock Returns (With complete daily return for 86-91)

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	0.1765	0.3212	0.1535	0.1076
Std. Error	0.0423	0.0569	0.0588	0.0402
Ratio of firm > 2 Std. Errors	98/111	111/111	70/111	76/111

	F Test (p value)	K-W Test (p value)
Four Periods	140.717**	220.351**
	(0.0001)	(0.0001)
1st vs 2nd	161.266**	105.830**
	(0.0001)	(0.0001)
2nd vs 3rd	244.619**	126.531**
	(0.0001)	(0.0001)
3rd vs 4th	18.751**	15.314**
	(0.0001)	(0.0001)
1st vs 3rd	3.723*	4.504*
	(0.0550)	(0.0338)
1st vs 4th	37.464**	35.562**
	(0.0001)	(0.0001)
2nd vs 4th	462.231**	157.440**
	(0.0001)	(0.0001)

* 90% significance

** 95% significance

(Table One continued)

Panel 2: Two-day Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	0.1086	0.2801	0.0884	0.0923
Std. Error	0.0599	0.0806	0.0833	0.0569
Ratio of firm > 2 Std. Errors	55/111	103/111	23/111	46/111

	F Test (p value)	K-W Test (p value)
Four Periods	96.886**	122.850**
	(0.0001)	(0.0001)
1st vs 2nd	149.889**	96.252**
	(0.0001)	(0.0001)
2nd vs 3rd	257.121**	128.820**
	(0.0001)	(0.0001)
3rd vs 4th	0.160	0.033
	(0.6897)	(0.8557)
1st vs 3rd	1.125	0.9201
	(0.2900)	(0.3374)
1st vs 4th	2.169	1.5488
	(0.1422)	(0.2133)
2nd vs 4th	257.212**	128.820**
	(0.0001)	(0.0001)

* 90% significance

** 95% significance

(Table One continued)

Panel 3: Weekly Stock Returns (With complete daily return for 86-91)

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	0.2371	0.1896	0.0518	-0.0132
Std. Error	0.1043	0.1374	0.1429	0.0990
Ratio of firm > 2 Std. Errors	71/111	26/111	3/111	2/111

	F Test (p value)	K-W Test (p value)
Four Periods	103.341**	193.260**
	(0.0001)	(0.0001)
1st vs 2nd	6.761**	8.493**
	(0.0099)	(0.0036)
2nd vs 3rd	68.015**	56.555**
	(0.0001)	(0.0001)
3rd vs 4th	21.888**	19.160**
	(0.0001)	(0.0001)
1st vs 3rd	112.914**	76.457**
	(0.0001)	(0.0001)
1st vs 4th	251.988**	118.550**
	(0.0001)	(0.0001)
2nd vs 4th	183.919**	110.480**
	(0.0001)	(0.0001)

* 90% significance

** 95% significance

(Table One continued)

Panel 4: Monthly Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	-0.1018	-0.1752	-0.2855	0.0102
Std. Error	0.2182	0.2887	0.3162	0.1961
Ratio of firm > 2 Std. Errors	0/111	0/111	0/111	0/111

	F Test (p value)	K-W Test (p value)
Four Periods	68.492**	146.930**
	(0.0001)	(0.0001)
1st vs 2nd	11.706**	8.818**
	(0.0007)	(0.0030)
2nd vs 3rd	25.244**	26.409**
	(0.0001)	(0.0001)
3rd vs 4th	196.925**	111.230**
	(0.0001)	(0.0001)
1st vs 3rd	3.723*	4.504**
	(0.0550)	(0.0338)
1st vs 4th	63.711**	54.192**
	(0.0001)	(0.0001)
2nd vs 4th	91.879**	68.161**
	(0.0001)	(0.0001)

* 90% significance

** 95% significance

Table Two. Summary of Autocorrelation for Stock Returns: (Sample with at Least One Year Data)

Panel 1: Daily Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	0.1765	0.2704	0.1372	0.0774
Std. Error	0.0423	0.0569	0.0588	0.0402
Ratio of firm > 2 Std. Errors	98/111	112/130	82/149	102/213

Panel 2: Two-day Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	0.1086	0.2426	0.0762	0.0656
Std. Error	0.0599	0.0806	0.0833	0.0569
Ratio of firm > 2 Std. Errors	55/111	103/130	28/149	65/213

Panel 3: Weekly Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	0.2371	0.1618	0.0376	-0.0126
Std. Error	0.1043	0.1374	0.1429	0.0990
Ratio of firm > 2 Std. Errors	71/111	26/130	3/149	4/213

(Table Two continued)

Panel 4: Monthly Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Mean	-0.1009	-0.1646	-0.2354	-0.0118
Std. Error	0.2182	0.2887	0.3162	0.1961
Ratio of firm > 2 Std. Errors	0/111	0/130	0/149	0/213

Table Three. Comparison of Companies in Category A and Category B: (Sample with Completed Data)

Panel 1: Daily Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Category A:				
Mean	0.1686	0.3086	0.1263	0.0845
Std. Error*	0.0423	0.0569	0.0588	0.0402
Ratio of firm > 2 Std. Errors	69/81	81/81	42/81	47/81
Category B:				
Mean	0.1980	0.3553	0.2268	0.1701
Std. Error*	0.0423	0.0569	0.0588	0.0402
Ratio of firm > 2 Std. Errors	28/30	30/30	28/30	29/30

(Table Three continued)

Panel 2: Two-day Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Category A:				
Mean	0.0994	0.2654	0.0698	0.0603
Std. Error*	0.0599	0.0806	0.0833	0.0569
Ratio of firm > 2 Std. Errors	34/81	74/81	11/81	19/81
Category B:				
Mean	0.1333	0.3195	0.1384	0.1825
Std. Error*	0.0599	0.0806	0.0833	0.0569
Ratio of firm > 2 Std. Errors	21/30	29/30	12/30	27/30

Panel 3: Weekly Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Category A:				
Mean	0.2367	0.1662	0.0320	-0.0311
Std. Error	0.1043	0.1374	0.1429	0.0990
Ratio of firm > 2 Std. Errors	52/81	14/81	2/81	1/81
Category B:				
Mean	0.2383	0.2528	0.1054	0.0350
Std. Error	0.1043	0.1374	0.1429	0.0990
Ratio of firm > 2 Std. Errors	19/30	12/30	1/30	1/30

(Table Three continued)

Panel 4: Monthly Stock Returns

Interval	01/01/86 to 10/26/87	10/27/87 to 11/13/88	11/14/88 to 10/10/89	10/11/89 to 12/31/91
% of Price Limit	5%	3%	5%	7%
Category A:				
Mean	-0.0896	-0.1787	-0.2965	0.0350
Std. Error	0.2182	0.2887	0.3162	0.1961
Ratio of firm > 2 Std. Errors	0/81	0/81	0/81	0/81
Category B:				
Mean	-0.1348	-0.1659	-0.2560	-0.0565
Std. Error	0.2182	0.2887	0.3162	0.1961
Ratio of firm > 2 Std. Errors	0/30	0/30	0/30	0/30

Table Four. Distribution of Scaled Variogram:

Panel 1. Daily Stock Returns:

	Period 1		Period 2		Period 3		Period 4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
R(2)*	1.31	1.29	1.38	1.38	1.15	1.15	1.10	1.10
R(3)	1.46	1.43	1.64	1.64	1.19	1.17	1.14	1.13
R(4)	1.58	1.52	1.87	1.87	1.24	1.21	1.19	1.19
R(5)	1.70	1.63	2.07	2.04	1.28	1.23	1.23	1.23
R(6)	1.81	1.76	2.24	2.20	1.32	1.26	1.24	1.24
R(7)	1.91	1.85	2.38	2.35	1.34	1.28	1.24	1.23
R(8)	2.00	1.91	2.48	2.43	1.34	1.29	1.26	1.24
R(9)	2.07	1.95	2.56	2.50	1.35	1.29	1.28	1.24
R(10)	2.12	1.98	2.63	2.56	1.34	1.29	1.29	1.24
R(11)	2.14	2.00	2.67	2.58	1.33	1.28	1.32	1.25
R(12)	2.15	2.01	2.72	2.62	1.32	1.27	1.35	1.26

(Table Four continued)

Panel 2. Two-Day Stock Returns:

	Period 1		Period 2		Period 3		Period 4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
R(2)	1.17	1.18	1.36	1.36	1.05	1.05	1.11	1.08
R(3)	1.38	1.38	1.63	1.59	1.10	1.09	1.12	1.13
R(4)	1.54	1.54	1.79	1.77	1.11	1.07	1.14	1.14
R(5)	1.60	1.57	1.91	1.90	1.09	1.05	1.17	1.14
R(6)	1.61	1.57	1.98	1.99	1.08	1.03	1.18	1.14
R(7)	1.55	1.49	2.02	2.03	1.06	1.01	1.17	1.15
R(8)	1.47	1.42	2.03	2.03	1.05	0.98	1.21	1.16
R(9)	1.35	1.26	2.03	2.03	1.05	0.98	1.33	1.20
R(10)	1.27	1.19	2.01	1.98	1.04	0.96	1.26	1.22
R(11)	1.20	1.09	1.96	1.91	1.02	0.94	1.30	1.25
R(12)	1.16	1.06	1.90	1.81	1.01	0.94	1.44	1.25

Panel 3. Weekly Stock Returns:

	Period 1		Period 2		Period 3		Period 4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
R(2)	1.29	1.32	1.26	1.25	1.06	1.08	0.95	0.03
R(3)	1.31	1.32	1.37	1.35	1.02	1.04	0.99	1.00
R(4)	1.18	1.14	1.35	1.30	0.95	0.96	1.05	1.04
R(5)	1.03	0.95	1.25	1.17	0.93	0.86	1.06	1.05
R(6)	0.96	0.89	1.17	1.10	0.91	0.85	1.11	1.10
R(7)	0.92	0.86	1.04	0.96	0.87	0.78	1.16	1.16
R(8)	0.88	0.84	0.89	0.82	0.80	0.72	1.23	1.24
R(9)	0.84	0.78	0.79	0.70	0.72	0.66	1.26	1.27
R(10)	0.80	0.75	0.70	0.60	0.64	0.56	1.29	1.29
R(11)	0.76	0.71	0.62	0.52	0.59	0.52	1.31	1.28
R(12)	0.74	0.67	0.56	0.47	0.52	0.46	1.39	1.31

(Table Four continued)

Panel 4. Monthly Stock Returns: **

	Mean	Std. Dev.	Minimum	25%	Median	75%	Maximum
R(2)	0.86	0.21	0.47	0.70	0.87	1.02	1.44
R(3)	1.23	0.34	0.36	0.99	1.26	1.50	1.93
R(4)	0.92	0.32	0.37	0.67	0.85	1.12	1.68
R(5)	0.92	0.28	0.42	0.69	0.88	1.11	1.66
R(6)	0.86	0.28	0.25	0.64	0.84	1.05	1.68
R(7)	0.96	0.32	0.25	0.78	0.93	1.14	2.18
R(8)	1.00	0.42	0.31	0.71	0.96	1.22	2.58
R(9)	0.93	0.42	0.17	0.60	0.86	1.12	2.76
R(10)	0.94	0.41	0.24	0.65	0.90	1.15	2.56
R(11)	0.89	0.46	0.22	0.55	0.81	1.08	2.64
R(12)	0.96	0.45	0.16	0.59	0.90	1.13	2.64

Panel 5: Simulated Variogram for 500 Random Walk: ***

	Mean	Std. Dev.	Median
R(2)	1.01	0.16	1.02
R(3)	1.01	0.24	1.00
R(4)	1.01	0.31	0.99
R(5)	1.00	0.37	0.95
R(6)	1.00	0.42	0.93
R(7)	0.99	0.46	0.91
R(8)	0.99	0.50	0.90
R(9)	1.00	0.54	0.89
R(10)	1.00	0.58	0.87
R(11)	1.00	0.62	0.86
R(14)	1.01	0.70	0.83
R(17)	1.02	0.75	0.83
R(20)	1.04	0.75	0.86

* R(2), R(3), and etc. are the values of the scaled variogram
(= (1/k) $Var(X_t-X_{t-k})/Var(X_t-X_{t-1})$ for k=2,3,...) for stock returns with dividend.

** Cited from Chu (1991) for monthly returns with dividend for period 1990-1988.

*** Cited from "The Long Horizon Properties of Annual Earnings: An Analysis of Persistence and Valuation" R. Lipe, R. Kormendi, Working paper, May, 1990

漲跌幅限制與股票報酬關聯性研究

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摘要

本研究探討漲跌幅限制對台灣股市股價行為之關聯性，尤其針對該限制是否對股價報酬之隨機漫步假設有所影響。本研究並比較不同漲跌幅對上述假說影響之程度。

研究結果顯示，台灣股市之股價行為的確受到漲跌幅限制之影響，不同漲跌幅也造成股價報酬之不同程度時間序列相關。亦即漲跌幅限制可能是造成台灣股市報酬違反隨機漫步假說之主因。

本研究之結果也建議主管機關應考慮消除該限制以利股市之健全，同時本研究之結果也提醒相關實證研究應注意股價短期之相關性。

關鍵詞彙：關聯性，漲跌幅限制，股價報酬