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DAY OF THE WEEK EFFECTS IN COMMON STOCK RETURNS : THE CASE OF THE ASIAN STOCK MARKETS

INSUP LEE* and R. RICHARDSON PETTIT**

I. INTRODUCTION

A standard assumption in empirical studies of short term speculative market price changes is that the distribution of daily returns is independent of the day of the week from which the return is drawn. Recently, however, this assumption has been questioned. Studies of some of the world's major stock, bond, and foreign exchange markets by Cross (1973), French (1980), Gibbons and Hess (1981), Keim and Stambaugh (1984), Jaffe and Westerfield (1985a, 1985b) and McFarland, Pettit, and Sung (1982) have revealed important "seasonal" variations in both expected returns and the variability of returns. These studies have found that returns on Mondays and Fridays have been statistically different from each other, and different from the returns recorded on other days of the week. Explanations for this apparent anomaly have concentrated on settlement practices in these markets, but no theory has been sufficiently general to provide much insight into ths reasons for this day-of-the-week pattern.

This study is directed to determining if day-of-the-week patterns exist in a sample of what most logically might be called the world's "second tier" stock markets -such as those in Korea, Taiwan, Singapore, and Hong Kong. The investigation is part of a larger ongoing study of the behavior of stock prices on the world's second tier markets. The rationale for such an investigation is derived form two sources.

First, there is accumulating empirical evidence in foreign currency markets and the world's leading stock markets that price changes are not always generated from a randomized process with a constant expectation and variance (e. g. McFarland, Pettit, and Sung (1982)). Indeed, sufficient evidence exists to conclude that seasonal patterns are rather strong and persistent, and that the pattern of returns does not always seem to be consistent with the efficient market hypothesis or with any well accepted theory of the pricing of capital assets. Moreover, there are reasons to wonder whether some of these anomalies are functions of the trading processes adopted by these exchanges, (e. g. written or verbal order entry, batch or continuous markets, single or multiple market makers), rather than being a result of the underlying supply of and demand for the securities themselves. Only through a cross sectional comparison of exchanges with different trading mechanisms can one hope to attribute

* Assistant Professor of Finance. Department of Finance, College of Business and Economics, University of Delaware, Newark, DE. 19716

** Duncan Professor of Finance. Department of Finance, College of Business Administration, University of Houston, Houston, TX. 77004

a cause to the "anomalies."

Second, the growing interest in, and apparent need to diversify internationally requires that money managers understand the process by which returns are generated in a particular local exchange. Seasonal variation in returns or serially correlated returns (perhaps generated by the actions of informed traders) may give portfolio managers cause for concern. It has clearly been the case, for example, that money managers, while understanding the theoretical benefits of international diversification, have been reticent to invest beyond their own borders (beyond the U. S. and Japan, for the most part) for fear that their lack of understanding of the trading process or the information delivery process will put them at a disadvantage vis-a-vis local traders. These relationship, if important, may prevent international money managers from forming index funds that can duplicate the market averages, much less enable them to form portfolios that provide security selection or market timing services to investors.

Ⅱ. PRIOR RESEARCH

Best known of the studies that have compared the seasonal characteristics of international equity markets are those of Jaffe and Westerfield (1985a, 1985b). They find strong daily patterns in the major markets they stundy, though these markets exhibit different patterns. Japanese and Australian markets seem to generate lower returns on Tuesdays, as opposed to the Monday effects found in Canadian and U. S. markets. Moreover, they find no evidence of a connection between the daily seasonals in these countries. Thus, the daily returns in Australia and Japan seem to be independent of the seasonal component in U. S. markets. While the empirical methods used to test this proposition are not particularly powerful, the results suggest that there is not a single cause of the estimated major market seasonality (e. g. the results do not suggest that the seasonality in Japan and Australia can be attributed to the seasonality in the U. S. and the time zone difference between New York and the Far East).

Studies of smaller exchanges in Europe (France and Finland) show some evidence of seasoality as well (see Hawawini (1988) for a summary). Once again, however, thers is little consistency regarding which days of the week provide the most negative and the most positive returns. In general, it seems to be the case that Mondays and Tuesdays provide lower returns, with the latter three days of the week providing higher returns. To this point, more than this cannot be concluded.

Based on these existing results, the purpose of this paper is to provide additional evidence on this issue through an analysis of stock market returns on five Asian markets plus the U. S. market (shortly to be expanded to included five European markets of approximately equal size). Specifically, the empirical results presented here study markets in Korea, Singapore, Taiwan, Hong Kong, Japan and the U. S. With the exception of the U. S., these markets are in countries that have experienced substantial growth in recent years, and whose stock markets have been the subject

of increasing interest on the part of the world's investors. Yet, the genral reluctance of "outside" investors to commit substantial sums to these markets undoubtedly reflects a lack of knowledge of the liquidity and efficiency of these market places. U. S. dollar investors, for example, are estimated to devote less than 10 percent of their equity investments to equity markets outside the united states, in spite of those markets' making up over half of the world's aggregate equity market value in publicly trade common stocks. Studies that show how these markets differ from or are the same as the larger markets of Japan and the U. S. should prove valuable to those forming plans for the allocation of investable funds in the near future.

The data used is described in the next section, followed by parameter estimates and statistical analyses in sections IV and V. Section VI presents the conclusions.

Ⅲ. DATA

The data set consists of daily closing prices on the major stock market indicator on each of the following exchanges :

Korea	.....	Korean Stock Index
Taiwan	.....	Taiwan Index
Singapore	.....	Straits Times Index
Hong Kong	.....	Hang Seng Index
Japan	.....	Nikkei Dow
U. S.	.....	Standard & Poor's 500 Composite Stock Price Index

The Korean Stock Index is a value weighted index of approximately 400 leading common stocks, and the Taiwan Index is a price weighted index of 120 of the market's largest securities. The Hang Seng Index and Straits Times Index are both value weighted indexes containing 30 and 35 of the largest firms domiciled in their respective countries. The Nikkei Dow is a price weighed index of 225 leading common stock in Japan.

Values also were collected on the Nikkei Dow and the Standard and Poor's 500. These two major market indexes not only provide a basis for comparison of the results presented here with prior studies of these larger markets, they also provide a standard from which it is possible to measure the correlation and cross-serial correlation present in the structure of daily prices. In other words, these major market indexes will allow us to determine the systematic tendency for short-term price changes in one market to be associated with those in another market. This, of course, is an increasingly important quesion in an economic environment in which the importance of market wide factors may vary over time.

For the results presented in the sections that follow, the date cover the trading period between January, 1984 and June, 1987. This period includes approximately 175 trading days for each of the days of the week. Currently, results are being run with a longer interval, as well, to improve the power of the tests and to determine if cyclical of secular changes have taken place in the pattern of daily returns.

Importantly, three of the six markets studied were open for all or a portion of the day on Saturday (Korea, Taiwanese, and Japanese markets). Prior studies of the Tokyo Exchange have not explored in detail how the analysis of Saturdays affects the calculation of Friday or Monday returns, offering us the opportunity to determine the relevance of Saturday trading to expected returns and variances — at least in these three markets.

Ⅳ. EMPIRICAL METHODOLOGY

In large part, our investigation can be thought of as an attempt to generize and integrate on research that has concentrated on the manner in which the world's most important stock market averages or indexes generate returns. Our approach is integrative in that a number of seemingly disparate issues are statistically examined. For the most part, these issues, and the empirical methodology used to investigate them, have been the focus of prior major equity market research.

The principle variate upon which we concentrate our attention is the daily return, defined as,

(1) $R_{dit} = (P_{dit} - P_{di,t-1}) / P_{di,t-1}$

where R_{dit} is the day to day return computed from sequential closing prices for day of the week "*d*" between daily calendar days t and t-1 for stock index i. Thus, the variate measures the daily return for each trading day over the study period, classified by the day of the week.

Our study of this variate is divided three categories, based on the dimensions of the variable itself. Thus, the variable can be represented in a matrix of the form :

Sequence		Market 1				Market 2				Market 3			
Date	Day												
1	Mon.	R_{m11}				R_{m21}				R_{m31}			
2	Tue.		R_{t12}				R_{t22}				R_{t32}		
3	Wed.			R_{w13}				R_{w23}				. . .	
4	Tr.				R_{u14}				R_{u24}				. . .
5	Fri.					R_{f15}				R_{f25}			
6	Mon.	R_{m16}				R_{m26}				. . .			
7	Tue.		R_{t17}				R_{m27}				. . .		
8	Wed.			R_{w18}				R_{w28}				. . .	
9	Thr.				R_{u19}				R_{u29}				. . .

Our empirical results summarizes the row, column, or diagonal block structure of these returns, In words, the empirical results present statistics relating to :

a) The evolution of the variable over time : including analyses of changes in means, variances, and other parameters of the unconditional distribution of daily stock price changes. Also included are estimates of the serial correlation of changes in the stock price indexes, and estimates of the function (i. e. forms of random walk)

that best describes the sequence of returns. These empirics concentrate on summarizing the structure of sequential returns, with t as the key index . [Table 1]

b) The dependence of the variable on the day of the week of trading : including average returns and variances by day of the week, and tests of the equivalence of the means and the distributions themselves (Kruskal-Wallis). The statistics concentrate on the structure of returns conditioned by day of the week, d. [Tables 2, 3, and 4]

c) The correlation between the indexes under investigation : including estimation of the importance of the "world market" factor in daily data and derivative statistics (country index betas, correlations, etc.). Cross serial correlations also are investigated to search for lagged dependencies in returns. [Tables 5, 6, 7, and 8]

V. EMPIRICAL RESUITS

Serial Correlations

Table I presents serial correlation coefficients in each equity market for the entire period covered in this analysis. The serial correlation coefficients are measured on one- and two-day lag basis, unconditioned by the day of the week of trading, and lagged one week for each day of the week. Consistent with market efficiency, none of these markets shows any evidence of strong serial correlations.

Weekly Seasonal Patterns in Index Returns

Estimated means and standard deviations for each day of the week are presented in Table Ⅱ and Table Ⅲ providing t-test statistics under the null hypothesis that the mean return on a given day is equivalent to the means return generated over each of the other trading days of the week. The resuits continue to show daily patterns in the returns generated on U. S. and Japanese markets, as in other studies, but no such consistent pattern seems to exist in the four smaller markets. Indeed, the results seem to suggest a pattern of returns that is consistent with all trading days of the week being drawn from distributions that are equivalent. Negative returns do not seem to be evident for any day of the week for these four exchanges, nor is it the caes that the returns on Monday are systematically and materially lower than those on other days of the week. The only figure which is marginally siginficant is for the Korean exchange, with a lower than average return on Thursday.

In addition, higher returns are not evident on other weekdays for these smaller markets. However, while not significantly different from the returns on other days of the week in any of the individual second tier markets, Wednesday's returns are above the means of the other days for all four of the smaller markets — an empirical observation that is not consistent with other investigations of day-of-the-week phenomena.

Interestingly returns on Saturdays in Kores and Japanese stock markets are significantly greater than returns on other days of the week (since August of 1986, the Japanese market has been open on only the first and fourth Saturdays of the

month). This is a tendency that has been observed for the Japanese market by Jaffe and Westerfield (1985a, 1985b)

An F-test is conducted for each of these indexes, in the from of a regression,

$$(2)\quad R_{dit} = \sum_{j=1}^{\#\text{ of days}} a_j D_{it} + u_{it} \qquad \text{for all } i \text{ indexes}$$

which is simply the regression of sequential returns in each market on dummies for the day of the week the trading takes place. These results are presented in Table Ⅳ. Only in the case of Japan is the equation defining the pattern of daily returns siginficantly different from zero, though the F-value is close to being significant for the Korean Market (undoubtedly due to the high positive returns on average on Saturdays).

In summary, there is little evidence of strong daily effects in the set of seocnd tier markets studied here. Clearly, the tendency for return expectations to be different on some days of the week, documented so carefully for the world's major stock markets, seems sufficiently imprecise and undocumented for four of the important second tier markets.

Contemporaneous and Leading Cross Correlations Between Markets.

Tables V and VI present correlations of retudrns for each day of the week between the U. S. index and all others, and between the Japanese index and all others. Thus, the calculations are meant to summarize the contemporaneous correlations that exist between markets on a short-term basis. As is self-evident, these correlations are near zero. The highest of the values tends to be that between the two major markets. Correlations between the second tier markets and the major markets are too small to be considered to be economically important.

While it is not terribly surprising to find that this correlation is low between the U. S. and other smaller Asian markets — for no other reason than that the two markets are not open at the same on any given day — we find it interesting to note the low correlations existing between Japan and the other Asian markets.

Based on the fact that trading in New Yorkk leads trading in these other exchanges by between 14 and 16 hours, Table Ⅶ shows correlations between price changes observed at the close of trading in New York with the following close in the relevant Asian market (which would be recorded as being on the follwong business day in that Asina market). Thses numbers, while somewhat larger than those in Table V, are still near zero.

In more general terms, and beyond the particular results presented in Tables V through VIII, the contemporaneous and one day leading correlations of returns between these equity maekets are very low and certainly surprising. Correlations among these four second tier markets are as low as those presented in Tables V through Ⅶ. Seldom do the estimates provide a correlation exceeding 0. 1, implying that the variaton in one country's index is associated with only 1 percent of the variation in the other country's index. In other words, on a daily basis, while there is little comovement

among the world's major exchanges (from Tables V through VIII, and from Jaffe and Westerfield(1985a, 1985b)), there is even less between the major and second tier markets or between the second tier markets themselves.

VI. CONCLUSIONS

The evidence presented here does not tend to suggest that important well-documented day-of-the-week effects found in some major equity markets can be supported for smaller Asian stock markets. While our results continue to show such effects for the U. S. and (especially) Japanese equity markets, we are unable to document the existence of any important tendency for returns or standard deviations to differ over days of the week for the four second tier markets investigated.

Moreover, consistent with market efficiency, there is no evidence of strong serial correlation in any of these markets, whether that correlation is based on daily differencing intervals or differencing intervals that correspond to one week span.

Finally, inconsistent with the existence of a pervasive "world" market factor, the returns on these different markets seem to be generated by a process that implies a good deal of independence between the various equity markets studied.

REFERENCES

[1] CROSS F. (1973), "The Behaviour of Stock Prices on Fridays and Monday." *Financial Analysis Journal*, 29(November-December), 67-69.

[2] FRENCH K. (1980), "Stock Returns and the Weekend Effect." *Journal of Financial Economics* 8(March), 55-69.

[3] GIBBONS M. and HESS P. (1981), "Day of the Week Effects and Asset Returns", *Journal of Business*, 54(October), 579-96.

[4] HAWAWINI. G. (1988), "Market Efficiency and Equity Pricing : International Evidence and Implications for Global Investing." University of Pennsylvania Working Paper(March).

[5] JAFFE J. and WESTERFIELD R. (1985a), "The Week-end Effect in Common Stock Returns : The International Evidence." *Journal of Finance*, 40(June), 433-54.

[6] JAFFE J. and WESTERFIELD R. (1985b), "Patterns in Japanese Common Stock Returns : Day of the Week and Turn of the Year Effects." *Journal of Financial and Quantitative Analysis*, 20(June), 261-72.

[7] KEIM D. and STAMBAUGH R. (1984), "A Further Investigation of the Weekend Effect in Stock Returns." *Journal of Finance*, 39(July), 819-34.

[8] LAKONISHOK J. and LEVI M. (1982), "Weekend Effects on Stock Returns : A Note." *Journal of Finance*, 37(June), 883-89.

[9] LEVI M. (1978), "The Weekend Game : Clearing House Vs. Federal Funds." *Canadian Journal of Economics*, 11(November) 750-57.

[10] MACFARLAND J. PETTIT R. and SUNG S. (1982), "The Distribution of Foreign Exchange Price Changes : Trading Day Effects and Risk Measurement." *Journal of Finance*, 37(June), 693-715.

[11] THEOBALD M. and PRICE V. (1984), "Seasonality Estimation in the Thin Markets." *Journal of Finance*, 39(June), 377-92.

[Table 1] Serial Correlations in Each Equity Market between January, 1984 and June, 1987

	Korea	Taiwan	Singapore	HongKong	Japan	U. S. A.
1-Day Lag	0. 115	-0. 007	0. 153	-0. 004	0. 173	0. 066
2-Day Lag	-0. 011	0. 053	0. 069	0. 085	0. 020	-0. 007
1-Week Lag on :						
Monday	0. 150	0. 250	0. 028	-0. 064	0. 191	0. 008
Tuesday	-0. 152	-0. 068	0. 147	-0. 043	-0. 001	-0. 104
Wednesday	0. 032	0. 051	0. 073	-0. 043	0. 023	0. 044
Thursday	0. 061	-0. 049	0. 095	0. 024	-0. 006	-0. 021
Friday	0. 074	-0. 183	-0. 061	0. 118	0. 075	0. 012
Saturday	-0. 086	-0. 110	-	-	0. 132	-

[Table 2] Average Percent Returns on Country Common Stock Indexes by Day of Week between January, 1984 and June, 1987

	Mon	Tues	Wed	Thurs	Fri	Sat	All
Korea : The Korean Stock Exchange Index							
Mean	0. 164	0. 052	0. 192	0. 024	0. 071	0. 260	0. 130
Std. Dev.	0. 898	0. 935	0. 999	0. 944	0. 915	0. 803	0. 920
Observations	174	171	169	168	171	173	1026
Taiwan : The Taiwan Exchange Index							
Mean	0. 070	0. 093	0. 117	0. 122	0. 047	0. 046	0. 080
Std. Dev.	1. 249	1. 121	1. 025	0. 932	1. 008	0. 923	1. 050
Observations	165	171	165	166	168	166	1001
Singapore : The Straits Times Index							
Mean	0. 022	0. 005	0. 053	0. 006	0. 061	-	0. 030
Std. Dev.	1. 091	0. 901	0. 954	1. 291	0. 881	-	1. 030
Observations	181	181	178	179	178	-	897
Hong Kong : The Hang Seng Index							
Mean	0. 119	0. 044	0. 209	0. 288	0. 111	-	0. 150
Std. Dev.	1. 618	1. 351	1. 342	1. 498	1. 364	-	1. 440
Observations	181	181	178	180	178	-	898
Japan : The Nekkei Dow							
Mean	-0. 029	-0. 085	0. 233	0. 107	0. 140	0. 263	0. 100
Std. Dev.	0. 799	0. 747	0. 752	0. 886	0. 742	0. 600	0. 770
Observations	166	173	174	175	176	122	986
United States : The S & P 500 Composite Index							
Mean	-0. 028	0. 116	0. 058	0. 139	0. 079	-	0. 070
Std. Dev.	0. 839	0. 910	0. 763	0. 865	0. 806	-	0. 840
Observations	171	180	179	176	176	-	882

[Table 3] t-value for Average Returns by Day of Week for Each Market

Country	Mon	Tues	Wed	Thurs	Fri	Sat
Korea	0.570	-1.188	1.002	-1.607	-0.884	2.089
Taiwan	-0.171	0.146	0.470	0.528	-0.485	-0.485
Singapore	-0.111	-0.348	0.346	-0.338	0.455	-
Hong Kong	-0.371	-1.151	0.571	1.397	-0.442	-
Japan	-2.312	-3.437	2.538	0.166	0.797	2.526
U.S.A	-1.764	0.754	-0.269	1.153	0.100	-

[Table 4] Test for Equality of Average Returns across Days of the Week for Each Market

Country	Degress of Freedon (n1, n2)	F-statistic* (F)
Korea	5, 1020	1.748
Taiwan	5, 995	0.170
Singapore	4, 892	0.115
Hong Kong	4, 893	0.785
Japan	5, 980	5.197
U.S.A	4, 877	1.021

* Prob(F>1.94 / n1=4, n2=∞) = 0.10;
Prob(F>1.85 / n1=5, n2=∞) = 0.10;
Prob(F>3.78 / n1=4, n2=∞) = 0.01;
Prob(F>3.02 / n1=5, n2=∞) = 0.01.

[Table 5] Contemporaneous Cross-Correlations : Day-of-the-Week Effects (U.S. with Other Countries)

Day of the Week	Korea	Taiwan	Singapore	Hong Kong	Japan
Monday	-0.173	-0.113	0.023	-0.067	0.149
Tuesday	0.104	-0.008	0.027	-0.092	0.015
Wednesday	0.063	0.068	0.018	0.084	-0.014
Thursday	-0.019	0.033	-0.014	-0.012	0.223
Friday	0.055	0.045	0.126	0.097	0.128
Overall*	0.005	0.003	0.030	-0.003	0.105

* The overall correlation is computed without regard to the day of the week.

[Table 6] Contemporaneous Cross-Correlations : Day-of-the-Week Effects (Japan with Other Countries)

Day of the Week	Korea	Taiwan	Singapore	Hong Kong
Monday	-0.194	-0.126	-0.019	0.209
Tuesday	-0.124	0.096	0.085	-0.074
Wednesday	0.069	-0.067	-0.030	0.043
Thursday	0.127	-0.064	0.069	0.045
Friday	0.108	0.046	0.071	0.135
Saturday	-0.044	0.108	-	-
Overall*	0.007	-0.014	0.046	0.080

* The overall correlation is computed without regard to the day of the week.

[Table 7] One Day Lead Cross-Correlations : Day-of-the-Week Effects (U.S. with Other Countries)

Day of the Week	Korea	Taiwan	Singapore	HongKong	Japan
Monday-Tuesday	0.070	-0.091	0.023	0.210	0.109
Tuesday-Wednesday	0.022	0.037	0.200	0.012	0.298
Wednesday-Thursday	0.048	0.023	-0.031	0.109	0.232
Thursday-Friday	0.132	0.035	-0.033	0.057	-0.035
Friday-Saturday	0.048	0.026	-	-	0.300
Friday-Monday	-	-	0.227	0.164	-
Overall*	0.065	0.004	0.080	0.110	0.178

* The overall correlation is computed without regard to the day of the week.

[Table 8] One Day Lead Cross-Correlations : Day-of-the-Week Effects (Japan with Other Countries)

Day of the Week	Korea	Taiwan	Singapore	HongKong
Monday-Tuesday	-0.026	-0.012	0.048	-0.024
Tuesday-Wednesday	0.059	0.005	0.068	0.105
Wednesday-Thursday	0.222	0.024	-0.089	-0.044
Thursday-Friday	0.139	-0.027	-0.023	0.008
Friday-Saturday	-0.038	0.113	-	-
Saturday-Monday	-0.005	-0.005	-0.058	-0.058
Overall*	0.065	0.010	0.004	0.018

* The overall correlation is computed without regard to the day of the week.