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THE SECURITIES EXCHANGE OF THAILAND : TESTS OF WEAK FORM EFFICIENCY

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During the past two decades, there has been considerable interest in the relationship between investor behavior and stock market efficiency. The main thrust of this interest has been in terms of the ability of some investors to achieve "abnormal" returns, which is due to the belief that securities trading is a zero-sum game, so that the investors who obtain abnormal returns do so at the expense of others. The primary theory concluding that above average risk-adjusted returns cannot be consistently earned is the efficient markets hypothesis (EMH).

The theory of efficient markets implies that past information cannot be used by investors to generate abnormal returns. Thus, a simple buy-and-hold strategy would generate the same return as complex trading rules, and would be preferred given transactions costs. Different degrees of efficiency can be obtained through assumptions of different information subsets : weak-form efficiency, semi-strong form efficiency, and strong-form efficiency. The weak form simply states that past price and volume information cannot be used to predict future price changes. The semi-strong form considers additional publicly available information such as earnings per share, price-earnings rations, dividend announcements, etc. The strong form holds that no information (public or otherwise) can be used to generate excess returns. This paper is concerned only with tests of weak form efficiency of the Securities Exchange of Thailand.

Nature of The Market

The Securities Exchange of Thailand (SET) was established in 1974 after discontinuance of the Bangkok Stock Exchange. The SET has several characteristics in common with other thin markets in that a large number of stocks

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are very inactive. Such market thinness has several effects on efficiency. Some individual securities are very inactive, and may not react fully to changes in available information. Inactivity slows the speed of adjustment and may negate any conclusion of efficiency. Secondly, some market participants may have some degree of monopoly power in their ability to affect the stock price by manipulation of trading activity. For example, a single individual may continuously bid up the price in order to encourage speculators who believe that price increases are indications of further market increase. This leads to another effect on efficiency that of investor psychology. Relatively unsophisticated participants would be influenced by such psychological factors. Thus because of the thinness characteristics, the analysis of the SET should be consistent with other studies of thin markets.

Previous Studies on Thin Markets

Numerous studies have shown that, in general, major stock exchanges (e.g. the New York Stock Exchange, the London Stock Exchange) are weak form efficient. Similar conclusions, however, cannot be made for thinner, regional stock exchanges. Theil and Leenders[1] found evidence of positive serial correlation in the Dutch market. Solnik[2], however, found little serial correlation for eight European stocks markets and the coefficients were more significant for daily price changes than for longer time intervals and were fairly stable over different sample periods. Jennergren and Korsvold[3] concluded that the Oslo and Stockholm exchanges did not follow a random walk. Hong[4] used runs, serial correlation, and the "Theil-Leenders" tests for four Far Eastern stock exchanges : Japan, Hong Kong, Singapore, and Australia. He found Japan to be the most efficient market, but not as efficient as the New York Stock Exchange or the London Stock Exchange. For the Stock Exchange of Singapore, D'Ambrosio[5] again employed runs and serial correlation tests over one day, one week, and two week data, to conclude that the six indices studied did not behave in a manner consistent with the random walk. In a recent study of the Hong Kong Stock Exchange, Law[6], in addition to the runs and serial correlation tests, also tested for a simple linear relationship between the natural log of prices and found that thirty-two of fifty-six individual securities exhibited nonrandom behavior. In general, it appears that thinner markets are less efficient than the EMH implies.

Methodology

Two tests, the runs and the serial correlation tests, are usually employed in the analysis of weak form efficiency. The runs test is a nonparametric method of evaluating the randomness of price changes.[7] A run is defined as a sequence of price changes of the same sign and can take three forms : consecutive increases, consecutive decreases, or no change in price.

For example, the series

$$+ + / - / + / 0 / + + +$$
$$1 \quad 2 \quad 3 \quad 4 \quad 5$$

where +, −, and 0 stand for price increase, decrease and no change, respectively, consists of 5 runs. The null hypothesis of randomness is tested by comparing the actual number of runs with the expected number of random runs. If the difference is significant, the null hypothesis of market efficiency can be rejected. The expected number of runs, M, is given by

$$M = \left[N(N+1) - \sum_{i=1}^{3} n_i^2 \right] / N$$

Where N is the total number of price changes, and n_i is the total number of price changes for each sign.

and the standard error of the expected number of runs is

$$\sigma_M = \left(\frac{\sum_{i=1}^{3} n_i^2 \left(\sum_{i=1}^{3} n_i^2 + N(N+1) \right) - 2N \sum_{i=1}^{3} n_i^3 - N^3}{N^2 (N-1)} \right)$$

The test-statistic, K, is given by

$$K = \frac{R + \frac{1}{2} - M}{\sigma m}$$

Where R is the actual number of price changes.

Significance of the test statistic K implies that prices changes are not influenced by chance alone and that price changes do not behave independently. Another relevant measure of dependency is the percentage difference between the actual and the expected numbers of runs (R–M)/M. If the difference is relatively large, the hypothesis of dependency may be concluded.

The serial correlation test is used to detect the possibility of dependency in price changes. By regressing the natural log of consecutive price differences, that is,

$$Y_t = a + bY_{t-1} \qquad (1)$$

where $Y_t = \ln(P_t) - \ln(P_{t-1})$ and P_t is price level at time t,

the serial correlation coefficient b, can be obtained :

$$b = \frac{\text{cov}(Y_t \quad Y_{t+1})}{\text{var} \quad (Y_{t+1})}$$

The natural log of price, ln (P_t), is used to correct for the natural heteroscedasticity caused by differences in the variances of the P_t. Significance of the serial correlation coefficient would indicate that there is some systematic relationship between consecutive price changes, meaning that conclusion of efficiency cannot be supported.

The Data

The data used in this study were taken from the Book Club, a security and finance corporation. Five indices were obtained, each from different groups of securities defined below.

BCIA : an index of all types of industrial securities except warehouse and hotel securities. Twenty five securities are included.

BCBA : an index of nine commercial bank securities.

BCFA : an index of ten finance and investment company securities.

BCLA : an index of eight low-priced srcurities. This index contains securities whose market prices are less than Baht 100.

BCMIN : an index of two mining securities.

All of these indices are market-value weighted averages of daily closing indices covering the period January, 1981, to June, 1982, providing a total of 366 observations for each index.

The Analysis

The runs test was performed for each index over one-day, two-day, five-day, and ten-day intervals. Different intervals are used to yield information on the time the market uses to absorb available information. Table 1 reports the expected number of runs, the standard error, the actual number of runs, the test-statistic K, and the percentage difference between the actual and expected number of runs (R-M/M). With the exception of BCFA, each index has at least one significant K-statistic. The result on time interval of price adjustment is mixed, however. While for BCIA and BCMIN the level of significance tends to decreasc as the interval increases, the opposite is true for BCLA. The results in the difference between the actual and the expected numbers of runs also appears to be mixed. (R-M)/M increases as the interval lengthens for BCFA and BCLA, is inconsistent for BCBA and BCMIN and decreases as the interval increases for BCIA. Also note that as, the time interval increases, there is a tendency for the sign of the difference between the actual and expected number of runs to change from positive to negative except for BCIA. This is due to the downward trend that occurs throughout the sample period. Thus, longer intervals provide more price changes of the same sign (negative), and consequently the actual number of runs is more likely to be less than the expected number of runs.

To support this observation, a simple time-series regression for each index was performed as follows :

$$P_t = a + bt$$

As shown in Table 2, the trend is indeed significantfor each index.

Next, the serial correlation test is performed on the same data over one-day, two-day, five-day, and ten-day lags. Table 3 presents the regression coefficients and t-statistics. For the one-day lag all coefficients (but BCFA) are insignificant at the .10 level, but as the lag increases (for all indices), so does the level of significance. In fact, all the coefficients are significant at the .001 level in the remaining lag periods. This may be caused by the significant trend noted above, in which case the series are nonstationary. Tests of serial correlation cannot be made on nonstationary series, for the coefficient may be significant even when serial correlation is non-existent. Thus, the implication of time in price adjustment cannot be made from the results. While Law[8] maintains that identification of a trend is sufficient to reject the hypothesis of weak-form efficiency, such short term trends can be generated by a random walk process. It can be argued that the trend would not persist over a longer period of time.

To remove the effect of the trend in the serial correlation test, we employ the common detrending technique of taking first differences of equation (1) above. The model becomes

$$Y_t^* = c + dY_{t+1}^* \qquad (2)$$

where

$$Y_t^* = Y_t - Y_{t-1}.$$

Differencing removes the trend but not the serial correlation. Note that equation (1) is actually a first-difference of log price, which partiauly detrends the data, and equation (2) is actually second-differencing. Taking second differences is usually sufficient in removing all the time trend[9]. Indeed, Table 4 shows that after taking the first difference, the trend line has a zero slope for all lag periods over all indices. The results of the serial correlation test using detrended data are reported in Table 5, showing that for the one-day interval the serial correlation coefficients for all indices are significant, but as the lag increases the coefficients become less significant. The results show that price changes have a significant correlation with price changes in the previous period, but, not with the price changes in the two, five, or ten day intervals. Thus, in a restricted sense, the hypothesis of weak form efficiency can be rejected. However, all serial correlation coefficients (but BCMIN) are insignificant for the two or more day intervals. It is worth noting that the significance of BCMIN for a two day interval may result from inactive trading on the two securities included in the index·

Conclusions

The conclusion of this paper is that the SET may be in general weak form inefficient, implying that some form of market analysis may consistently generate abnormal returns. In addition, there may be a continuous transfer of wealth from unsophisticated to sophisticated investors, resulting in an undesirable increase in income inequality. Currently there are efforts to improve the efficiency of the SET through structural changes (eg, requiring all financial institutions to be publicly held and thus listed on the exchange, provision of incentives by changing tax laws which would increase returns, and an effort to gain public confidence by education and wider publication of financial information. Furthermore, it may be argued that allowing the formation of open-end mutual funds will increase the willingness and ability of small investors to participate in the market.

However, there are limitations to this analysis. First, the sample covers a short time period, which may have caused the trend observed in the data. Secondly, indices are used instead of individual securities, which may bias the results because an index may not reflect certain characteristics of individual securities. However, one would expect the individual securities from these indices to also be inefficient since the index is a weighted average of the individual securities. Finally. transactions costs are not included which may make any market application unprofitable.

NOTES

1. Henri Theil and C. Leenders, "Tomorrow on the Amsterdam Stock Exchange," *Journal of Business* (July 1965) : 277–284.
2. B. Solink, "Note on the Validity of the Random Walk for European Stock Prices," *Journal of Finance* (December 1973) : 1151 – 1159.
3. L.P. Jennergren and P.E. Korsvold, "The Non–Randon Character of Norwegian and Swedish Stock Market Prices," in *International Capital Markets*, ed. J. Elton and M.J. Gruber (Amsterdam : North Holland, 1975).
4. Hai Hong, "Predictability of Price Trends on Stock Exchanges : A Study of Some Far Eastern Countries," *The Review of Economics and Statistics* (November 1978) : 619–621.
5. Charles A. D'Ambrosio, "Random Walk and the Stock Exchange of Singapore," *Financial Review* (Spring 1980) : 1 – 12.
6. Cheung – Kwok Law, "A Test of the Efficient Market Hypothesis with Respect to the Recent Behavior of the Hong Kong Stock Market," *Developing Economies* (March 1982) : 61–72.
7. Statistical properies of the runs test can be found in P.G. Hoel, *Introduction to Mathematical Statistics*, Wiley, New York, 1962, P. 335. Literature on runs test's application to the weak–form test can be found in E.F. Fama, "The Behavior of Stock Market Prices, "*Journal of Business* (January 1965) : 34 – 105.
8. ibid, p. 68.
9. Robert S. Pindyck and Deniul L. Rubinfeld, *Econometric Models and Economic Forecasts* (New York : McGraw–Hill, 1981) : 502.

Table 1
Results From Runs Test

		one-day interval	two-day interval	five-day interval	ten-day interval
BCIA	M	181.62	91.51	35.22	18.11
	σ_m	9.26	6.47	3.38	10.03
	R	155	75	32	19
	K	-282***	-2.48**	-0.81	0.14
	$\frac{R-M}{M}$	-0.1466	-0.1804	-0.914	0.0491
BCBA	M	183.86	95.51	35.03	17.00
	σ_m	9.78	6.41	32.98	2.62
	R	207	79	32	12
	K	2.42**	-1.88**	-0.77	-1.72**
	$\frac{R-M}{M}$	0.1259	-0.1367	-0.0865	-0.2941
BCFA	M	181.36	91.71	35.52	16.28
	σ_m	8.77	6.27	4.09	2.84
	R	227	112	32	15
	K	0.09	0.91	-1.09	-1.614*
	$\frac{R-M}{M}$	0.0015	0.0486	-0.1349	-0.2530
BCLA	M	185.26	94.18	36.92	17.19
	σ_m	11.22	7.59	4.52	1.92
	R	176	87	26	11
	K	-.78	-.88	-2.30	-2.96
	$\frac{R-M}{M}$	-.0499	-.0763	-.2958	-.3583
BCMIN	M	242.17	115.93	40.97	17.69
	σ_m	9.24	6.19	3.72	2.08
	R	223	83	20	16
	K	-2.02**	-5.24***	-1.79**	-0.58
	$\frac{R-M}{M}$	-0.0792	-0.2841	-0.5118	-0.0955

* significant at .2 level
** significant at .1 level
*** significant at .01 level

Table 2

Time Series Regressions

	Coefficient	t-statistic	R^2
BCIA	0.0315	16.239*	0.4208
BCBA	0.0525	37.797*	0.7969
BCFA	0.1258	38.635*	0.8040
BCLA	0.0587	44.157*	0.8427
BCMIN	0.1582	56.799*	0.8986

*significant at .001 level

Table 3

Serial Correlation Coefficients

	one-day lag		two-day lag		five-day lag		ten-day lag	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
BCIA	-0.4016	-7.857**	0.1615	2.931*	0.4307	8.594**	0.6289	14.466**
BCBA	-0.0911	-1.694*	0.4536	9.427**	0.7939	24.187**	0.8960	37.380**
BCFA	0.0144	0.267	0.5034	10.791**	0.8043	25.073**	0.9065	39.786**
BCLA	-0.2092	-3.962**	0.3565	7.066**	0.7016	18.245**	0.8454	29.335**
BCMIN	-0.0991	-1.843*	0.5215	11.320**	0.8082	25.247**	0.9120	41.180**

*significant at .1 level
**significant at .001 level

Table 4

Time Series Regressions (Detrended Series)

	one-day lag		two-day lag		five-day lag		ten-day lag	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
BCIA	-.0004	-.4492	-.0002	-.2618	-.00013	-.0797	-.00006	-.3667
BCBA	-.00007	-.0702	-.00006	-.0615	-.0001	-.1082	-.00001	-.0195
BCFA	-.00006	-.0822	-.00005	-.0770	-.0002	-.2670	-.000000	-.0002
BCLA	-.0002	-.1172	-.0002	-.1182	-.0003	-.1641	-.00007	-.0386
MIN	.00005	.0305	.00002	.0134	.0005	.2653	.0004	.2120

Table 5

Serial Correlation Coefficients (Detrended Series)

	one-day lag		two-day lag		five-day lag		ten-day lag	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
BCIA	-.0410	-9.4098**	-.0395	-.7149	-.0178	-.3219	.0672	1.2206
BCBA	-.5451	-12.0237**	-.0241	-.4467	.1137	8.1199**	.0462	.8559
BCFA	-.4886	-10.3668**	-.0044	-.0813	.0197	.3645	.0536	.9870
BCIA	-.5797	13.1577**	.0572	1.0603	-.0310	-.5717	-.0608	-1.1194
MIN	-.6077	-14.1537**	.2012	8.7978**	-.0182	-.3367	.0860	1.6224

**significant at .001 level
*significant at .1 level