An Examination of the Random Walk Model and Technical Trading Rules in the Malaysian Stock Market

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This paper examines the predictability of technical trading rules on the daily returns of the Kuala Lumpur Stock Exchange Composite Index for the full sample period from January 1977 to December 1999, which includes both bull and bear periods. The methodology employed includes both the variance ratio test and moving average rules. The results indicate non-randomness of successive price changes. The degree of predictability is supported, as the trading rules examined indicate technical attractiveness with the presence of transaction costs.

Introduction

The possibilities of market inefficiencies and subsequent profit opportunities that arise after controlling for risk in international and local stock markets are appealing to portfolio managers and investors. If the market is not fully efficient, then there are possibilities for investors to find good value stocks at low prices. Investors can buy these low value stocks, wait for their prices to rise, and then sell

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the stocks and make abnormal profits. Hence, whatever the investment strategy, investors first need to know whether the stock market is efficient. In more technical terms, do stock prices follow a random walk? Lo and MacKinlay (1988, 1999) report that stock prices do not completely follow the random walk and that some predictable components do exist in stock returns. They provide techniques for detecting forecast ability as well as its statistical and economic significance.

Ariff, Shamsher, and Annuar (1998) observe that emerging markets display variations in behavior that are not correlated with that of the developed markets. Ratner and Leal (1999) report that emerging equity markets are significantly inefficient. This has given rise to renewed interest in technical analysis that relies on past prices to predict future prices. This paper contributes to technical analysis research by supplementing the existing literature with insights where associated issues of forecast ability, profitability, and random walk movement of the Kuala Lumpur Stock Exchange Composite Index are integrated and examined. Findings from this study also may advance our understanding and practice of technical trading rules in bull and bear markets and their implications on profit potential.

Literature Review

The random walk model first developed by Bachelier (1900) states that changes in stock price between period t + k and period t are independent with zero mean and proportional variance; that is, the variance of monthly changes are four times the variance of the weekly changes. Lo and MacKinlay (1988) propose the variance ratio test for the random walk hypothesis. They apply the test on weekly returns in the New York Stock Exchange and American Stock Exchange and find evidence to reject the random walk model for the entire sample period of 1962 to 1985. According to the variance ratio test, the ratio of the variance of the q period returns to the variance of the one period returns divided by q must be equal to unity under the random walk hypothesis.

Lo and MacKinlay (1989) indicate that the variance ratio test is more powerful than the well-known Dickey-Fuller unit root or the Box-Pierce Q tests. Ayadi and Pyun (1994) also acknowledge that the variance ratio test is more appealing than other traditional tests for random walk. Furthermore, it would be better if the variance ratio tests could be complemented with the multiple variance ratio test that was extended by Chow and Denning (1993). The multiple variance ratio test simply compares the maximum absolute value of the Lo and MacKinlay test statistics [namely $Z_j^*(q) = \max |Zj(q)|$ (j = 1 and/or 2)] with the studentized maximum modulus (SMM) critical values. The SMM table can be found in Hahn and Hendrickson (1971) and Stoline and Ury (1979).

Pan, Chiou, Hocking, and Rim (1991) apply the variance ratio test on daily and weekly returns of five Asian stock markets: Hong Kong, Japan, Singapore, South Korea, and Taiwan from January 1982 to June 1987. The random walk hypothesis is

rejected in all the sample countries except Japan. In addition, the variance ratios also indicate evidence of positive autocorrelation for all sample countries except Japan.

Though much empirical research indicates the weak form of efficiency in Malaysia's Kuala Lumpur Stock Market, the results so far have been inconclusive and thus demand investigation. It is worth noting that Joy and Jones (1986, pp. 51-53) state that weak form tests are not direct tests of technical analysis.

Despite the views on market efficiency, technical analysis is still considered to be a viable and efficient approach to individual stock selection and market analysis. Brock, Lakonishok, and Lebaron (1992) examined the predictability of technical trading rules such as the moving average rule and trading range breakout rule in the United States stock market from 1897 to 1986. They find that the buy (sell) signals generate returns that are higher (or lower) than normal returns. In addition, they also find that for both the variable length moving average (VMA) and fixed length moving average (FMA) rules, the conditional mean buy returns are significantly higher than the conditional mean sell returns prior to taking transaction costs. Hudson, Dempsey, and Keasey (1996) who apply the technical trading rules of Brock et al. (1992) in the United Kingdom (U.K.) stock market from July 1935 to January 1994, however, find that the technical trading rules did not generate excess returns after taking transaction costs of 1 percent per round trip.

Bessembinder and Chan (1995) investigate the trading rules of Brock et al. (1992) in Hong Kong, Japan, Korea, Malaysia, Thailand, and Taiwan from 1975 to 1991. The results indicate strong forecast ability for the emerging markets of Malaysia, Thailand, and Taiwan. This is consistent with Dawson (1991) and Yong (1991) who find some price patterns in the Malaysian stock market.

Data and Method

The random walk hypothesis and the predictability of technical trading rules in the Malaysian stock market are examined by analyzing the daily data of the Kuala Lumpur Stock Exchange Composite Index (KLSE CI) from January 3, 1977 to December 31, 1999.

The random walk model is tested by applying the variance ratio and the multiple variance ratio tests on the market returns. Thus, the random walk hypothesis can be tested by statistically examining if the variance ratio at lag q

$$VR(q) = \frac{\sigma_c^2(q)}{\sigma_a^2(q)} = 1 \qquad (1)$$

where

$\sigma_c^2(q)$ = An unbiased estimator of 1/q of the variance of the q-period returns; and

$\sigma_a^2(q)$ = An unbiased estimator of the variance of the single period returns.

The variance ratio at lag q is then tested for unit value by using two Z-statistics, namely Z(q) and Z*(q) based on the assumptions of homoskedasticity and heteroskedasticity, respectively, of the error terms.

After testing for random walk in the Malaysian stock market, the predictability of two technical trading rules [namely, the variable length moving average (VMA) rule and the fixed-length moving average (FMA) rule] is examined. In both the VMA and FMA rules, a buy (sell) signal is generated when a short-term moving average exceeds (falls below) the long-term moving average (Figure 1). In this paper, the short-term moving average is represented by the five-day moving average to reflect the five (5) trading days per week and T + 5 rolling settlement system in Malaysia. This average is then compared with the long-term moving averages of 60-days (3 months), 120-days (6 months), and 180-days (9 months). In addition, a one percent band[1] around the long-term moving average is used to generate six variations of each rule, namely (5,60,0), (5,120,0), (5,180,0), (5,60,0.01)[2], (5,120, 0.01), and (5,180,0.01).

In the VMA rule, a buy or sell signal will be generated each day and the buy (sell) signal will be executed on day (t) when the short-term moving average on day (t - 1) exceeds (falls below) the long-term moving average on day (t - 1). When a one percent band is introduced, however, a buy (sell) signals is initiated only when a short-term moving average exceeds (falls below) the long-term moving average by at least one percent. If the short-term moving average falls between the upper and lower band of the long-term moving average, no signal or a neutral signal will be generated.

The FMA rules used in this study are similar to the VMA rules. For the FMA rules, however, once a signal is generated, it will be held for a certain period to estimate the holding period returns. The selection of the holding period is arbitrary, and we choose the same 10-day holding period of Brock et al (1992) to reflect ten (10) trading days. Any signals within these holding periods will be ignored. After the 10-day period, the FMA rule will generate new signals. The same 10-day holding period rule will be followed, and the cumulative returns of 10-day will be calculated.

In measuring the profit resulting from the application of the technical trading rules and the buy-and-hold strategy, the double-or-out framework used by Brock et al. (1992) and Bessembinder and Chan (1998) is applied. In this framework an investor is assumed to borrow at the risk-free interest rate and double the equity investment when a buy signal is generated. On the other hand, the investor will sell the shares and invest in the risk free interest rate when a sell signal is generated. The

[1] The band by percentage eliminates whiplash signals [as highlighted by Brock et al (1992)], particularly when short-term and long-term moving averages are close.

[2] The first term within the parentheses represents the short-term moving average, the second term the long-term moving average, and the last term the percentage band around the long-term moving average.

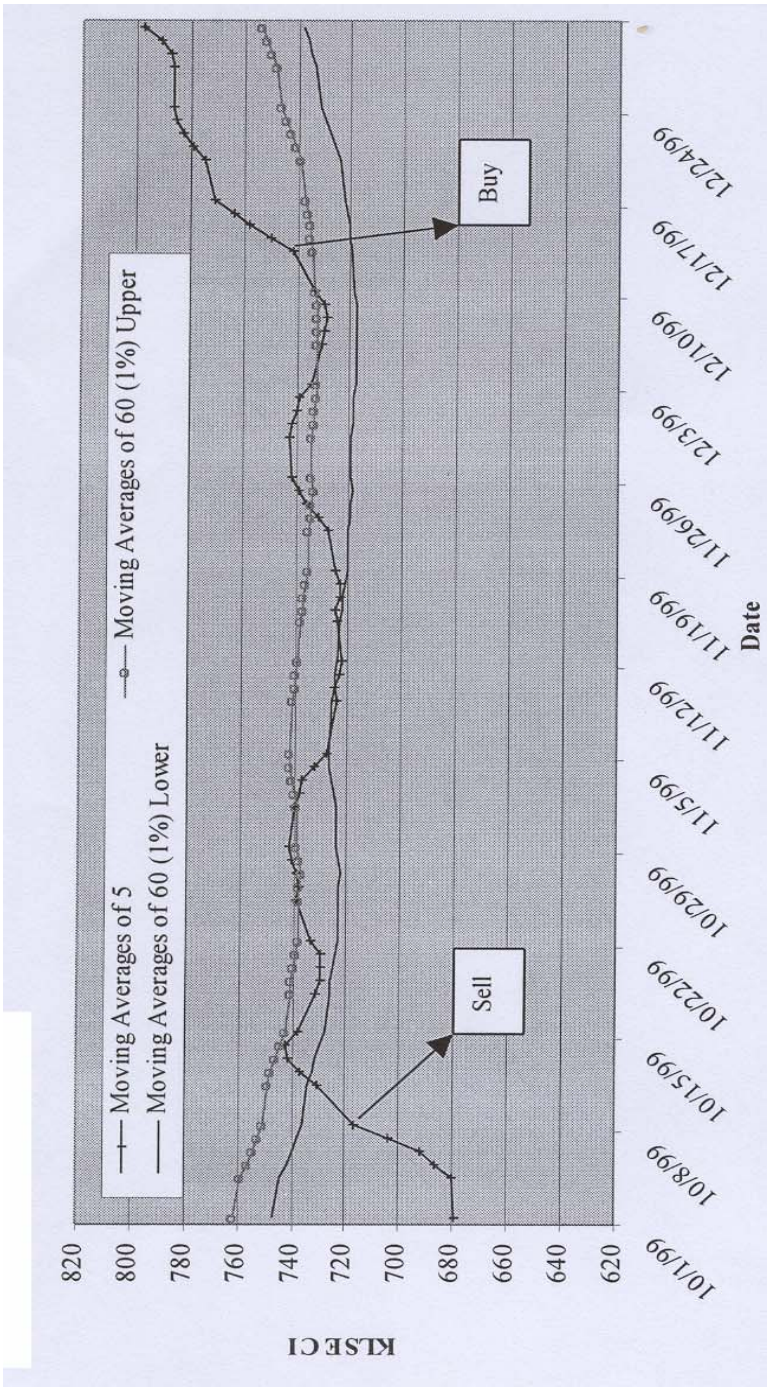

Figure 1—The Short- and Long-Term Fixed Moving Averages (5, 60, 0.01) of KLSE CI from October to December 1999

average yield of the 3-month Malaysian treasury bill is used as proxy for the risk-free interest rate. In addition, the borrowing and lending rates are assumed to be equal, and the risk during the buy and sell periods are assumed to be the same. Thus, the profit generated as a result of the buy signals would be computed as follows:

$$\text{Profit } (\pi) = [(\text{mean return}^3 \times \text{trade per year}^4) - (\text{risk free interest rate}^5)] \quad (2)$$

The profit or cost savings earned for not being in the market when a sell signal is generated is computed as follows:

$$\text{Profit } (\pi) = [(\text{risk free interest rate}) - (\text{mean return} \times \text{trade per year})] \quad (3)$$

Hence, the profits or extra returns earned by using the technical trading rules before accounting for transaction cost is the combination of the profits from the buy signals and the cost savings of the sell signals. In an environment with transaction costs, however, the concept of the breakeven transaction costs is used to calculate the profits earned as follows in line with Bessembinder and Chan (1995):

$$\pi \text{ (After transaction cost)} = \pi \text{ (Before transaction cost)} - C * (Nb + Ns) \quad (4)$$

where:

Nb and Ns = The number of buy and sell signals generated in a year; and

C = The percentage round trip transaction cost.

The viability of the moving average rules are first evaluated by testing to determine if the mean returns generated are significantly different from zero. The returns generated by the moving average technical trading rules are then compared with the mean returns derived from the buy and hold strategy.

Both the random walk model and the technical trading rules are investigated over the full sample period and four non-overlapping sub-periods. The four sub-periods are selected to reflect political and economic developments in Malaysia.

The first sample period from January 3, 1977 to December 31, 1981 reflects the early period of the security industry in Malaysia after the separation of the Stock Exchange of Malaysia and Singapore and the establishment of the Securities Industry Act (1973). The second sub-period from January 4, 1982 to December 30, 1987 represents the period when the National Unit Trust fund was established as well as the growth period of the Malaysian Securities industry.[6] The third sub-period from

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[3] *Mean return* refers to the return earned for each rule in the sample period.

[4] *Trade per year* refers to average buy or sell signals generated per year. It is computed as the total buy (sell) signals divided by the number of years involved, i.e., 23 years in this study.

[5] The risk free interest rate is measured by

$$= 2 \times \left(\left[1 + \frac{(\text{Face Value} / \text{Price})^{365/90} - 1)}{100} \right]^{1/2} - 1 \right) \times 100\%$$

the respective 3-month Malaysian treasury bill in full-period sample and four sub-periods samples.

[6] "The collapse of a big Singapore company, Pan-El, forced the Kuala Lumpur Stock Exchange (KLSE) to suspend trading between December 2, 1985 and December 4, 1985. The

Table 1—Summary Statistics of the Kuala Lumpur Stock Exchange Composite Index (KLSE CI) from January 1977 to December 1999

	Daily Returns	Weekly Returns	Monthly Returns
Mean	0.0378	0.1802	0.7945
Standard Deviation	1.5959	3.4978	8.8205
Skewness	-0.3206	-0.6808	-0.6232
Kurtosis	31.2302	8.5146	2.9286
Jacque-Bera Normality Test	229439**	3679.95**	110.93**
ARCH Test	1413.26**	20.018*	4.788**
Number of Observations	5656	1200	276

Lag	Autocorrelation	T-stat	Autocorrelation	T-stat	Autocorrelation	T-stat
1	0.0950	7.3077**	0.1060	3.6552**	0.1120	1.8667
2	0.0310	2.3846*	0.0950	3.2759**	0.1500	2.5000*
3	0.0260	2.0000*	0.0750	2.5862**	-0.1180	-1.9667*
4	-0.0450	-3.4615**	0.0110	0.3793	-0.0570	-0.9500
5	0.0630	4.8462**	0.0660	2.2759*	-0.0290	-0.4833
6	-0.0320	-2.4615*	0.0040	0.1379	-0.0830	-1.3833
7	-0.0050	-0.3846	0.0970	3.3448**	0.0890	1.4833
8	0.0050	0.3846	0.0190	0.6552	-0.0080	-0.1333
9	0.0300	2.3077	0.0730	2.5172*	0.0600	1.0169
10	0.0330	2.5385*	0.0200	0.6897	0.0690	1.1696
11	0.0370	2.8462**	-0.0710	-2.4483*	0.0340	0.5769
12	0.0030	0.2308	0.0240	0.8276	-0.0460	-0.7797
13	-0.0050	-0.3846	-0.0640	-2.2069*	-0.0390	-0.6610
14	0.0430	3.3077**	-0.0320	-1.1034	-0.0580	-0.9831
15	0.0010	0.0769	-0.0050	-0.1724	-0.0330	-0.5690
16	-0.0100	-0.7692	-0.0100	-0.3448	-0.0530	-0.9138

* $p < 0.05$
** $p < 0.01$

January 4, 1988 to December 31, 1993 represents a period of major restructuring and liberalization[7] of the securities industry as well as the bull period in the Malaysian stock market (Tan, 1997, p. 154). Finally, the fourth sub-period from January 3, 1994 to December 30, 1999 starts with the removal of the restrictive registration concerning institutional investors and the continuation of the consolidation and development of the security industry.[8] This period also encompasses the Asian financial crisis and reflects a bear period in the Malaysian stock market.

Pan El crisis was an important event because it prompted the government to step in to restructure the stockbroking industry" (Tan, 1997, p. 114).

[7] See Dobson and Jacquet (1998).

[8] Tan (1997, p. 161) indicates that "in 1995, major liberalization measures for the financial market were trading in 200 units was instituted; broking houses were allowed to operate Unit Trust Schemes; regulated short selling, and securities borrowing and lending were allowed.

Analysis and Discussion

Variance Ratio Test Results

The summary statistics of market index returns reported in Table 1 indicate non-normality of returns computed on a weekly and monthly basis. The results of Jacque-Bera normality test reject the null hypothesis of normality for the changes in the log price indices on a daily, weekly, and monthly basis. The values of skewness and kur-

Table 2—Variance Ratios of KLSE CI Returns From 1977 to 1999

	Lag	Variance Ratio	Homoskedasticity Z (q)	Heteroskedasticity Z*(q)
Daily	2	1.0948	7.1334**	1.7005
	4	1.1862	7.4877**	1.7830
	6	1.2168	6.5958**	1.5724
	8	1.2307	5.8667**	1.3986
	10	1.2464	5.4886**	1.3084
	12	1.2792	5.6013**	1.3353
	14	1.3085	8.1787**	1.3529
	16	1.3407	5.8212**	1.3877
	18	1.3637	5.8272**	1.3891
	20	1.3836	5.8058**	1.3841
	22	1.3311	4.7612**	1.1350
	24	1.3541	4.9127**	1.1587
Weekly	2	1.1297	4.4897**	3.0973**+
	4	1.2922	5.4086**	3.5253**
	8	1.5218	6.1078**	3.9811**
	12	1.7114	6.5701**	4.2824**
	16	1.7776	6.1250**	3.9873**
	24	1.7912	4.9996**	3.2587**+
	32	1.7717	4.1944**	2.7304**+
	52	1.8921	3.7640**	2.4535*+
Monthly	2	1.1182	1.9605* +	1.5305
	4	1.2827	2.5059* +	1.9562
	6	1.2645	1.7742	1.3851
	8	1.2350	1.3174	1.0285
	10	1.2442	1.1995	0.9365
	12	1.2995	1.3247	1.0342
	18	1.2604	0.9198	0.7181
	24	1.1331	0.4029	0.3148

Z(q) and Z*(q) denotes the homoskedasticity and heteroskedasticity test statistics. The variance ratios are statistics different from 1

* $p < 0.05$

** $p < 0.01$

+ denotes an inference error in which variance ratio is statistical significant from 1.0 according to the standard normal distribution but is insignificantly different from 1.0 under the studentized maximum modulus (SMM) distribution as indicated in Stoline and Ury (1979) critical value of 3.031 and 3.493 at the 5 percent and 1 percent level

tosis indicate that the distributions are not normal. The distribution of the weekly and monthly index returns are characterized by leptokurtosis. Furthermore, the ARCH (autoregressive conditional heteroskedasticity) test detects successive periods of volatility followed by successive periods of stability.

The autocorrelation of market index returns exhibits significant positive dependency of log price changes on a weekly basis. The serial correlation tests, however, fail to produce significant negative autocorrelation on monthly basis.

Table 2 reports the variance ratios and the Z-statistics for lags of two days to 24 days, two weeks to 52 weeks, and two months to 24 months on the daily, weekly, and monthly returns, respectively. The variance ratios are all greater than one, indicating positive serial correlation in daily, weekly, and monthly market returns. Furthermore, the variance ratios increase with an increase in the number of lags, but the Z-statistic declines with an increasing number of lags. Overall, the random walk hypothesis is rejected under the assumption of homoskedasticity, particularly on daily and weekly returns. This is consistent with the results of Richardson and Stock (1989) and Chow and Denning (1993) who also fail to reject the random walk hypothesis for monthly market index returns.

The variance ratio test of the weekly market index returns[9] for the four non-overlapping periods as shown in Table 3 are all greater than one, thus exhibiting positive serial correlation. The results document deviations from random walk in all the four sub-periods except the third sub-period from January 8, 1988 to December 31, 1993 The randomness may be due to financial services liberalization efforts[10] that had transformed the market into weak form efficient. Nonetheless, the randomness was not sustainable and subsequently partially disappeared indicating by the high critical value of multiple variance ratio in the fourth sub-period.[11]

[9] The variance ratio test requires a sample size of at least 256 observations to have reasonable power against other alternative tools; the weekly market returns are appropriate in this case.

[10] The financial services liberalization included introduction of the Banking and Financial Institutions Act in 1989 which provided the main features of the laws governing the financial institutions, large inflows of foreign direct investment, the introduction of computerized trading system in 1992, and the deregulation of interest rates that promoted the efficiency of the domestic capital market (Dobson and Jacquet, 1998).

[11] Malaysian has implemented the capital control measures since September 1, 1998 that aim to end speculation on the Ringgit. This is an important step toward the revitalization of the economy. The Ringgit controls involve: 1) restrictions on external account transactions by nonresidents; 2) tightening of rules on overseas investments by Malaysians; 3) trade settlements by Malaysian exporters and importers; and 4) export and import of the Ringgit by the travelers (Yap, 1999).

Table 3—Variance Ratios of Weekly KLSE CI Returns From 1977 to 1999

Ranking Period	Lag	Variance Ratio	Homoskedasticity Z(q)	Heteroskedasticity Z*(q)
1/7/77 to 12/31/81	2	1.1407	2.2694**+	1.5736
	4	1.4125	3.5553**	2.4653*+
	8	1.7143	3.8936**	2.6999**+
	12	1.9729	4.1845**	2.9017**+
	16	2.0555	3.8665**	2.6812**+
	32	1.6105	1.5434	1.0703
	52	1.2165	0.4255	0.2952
	104	0.8196	-0.2489	-0.1728
1/7/82 to 12/31/87	2	1.2612	4.6141**	2.4936*+
	4	1.5216	4.9250**	2.6617**+
	8	1.7718	4.6087**	2.4910*+
	12	1.8996	4.2386**	2.2915*+
	16	1.9618	3.8598**	2.0871*+
	32	2.1012	3.0493**+	1.6497
	52	2.2768	2.7483**+	1.4895
	104	1.3886	0.5872	0.3203
1/8/88 to 12/31/93	2	1.0367	0.6477	0.4342
	4	1.1232	1.1636	0.7807
	8	1.1543	0.9214	0.6188
	12	1.2485	1.1707	0.7866
	16	1.2665	1.0693	0.7187
	32	1.1161	0.3214	0.2162
	52	1.0903	0.1944	0.1310
	104	1.8936	1.3502	0.9146
12/7/94 to 12/30/99	2	1.2105	3.7188**	2.9381**+
	4	1.1444	1.3638	1.1947
	8	1.4019	2.3996*+	2.1051*+
	12	1.6305	2.9705**+	2.6082**+
	16	1.6793	2.7259**+	2.3951*+
	32	1.5790	1.6034	1.4112
	52	1.9582	2.0624*+	1.8176
	104	1.5581	0.8432	0.7458

Z(q) and Z*(q) denotes the homoskedasticity and heteroskedasticity test statistics. The variance ratios are statistics different from 1

* $p < 0.05$

** $p < 0.01$

+ denotes an inference error in which variance ratio is statistical significant from 1.0 according to the standard normal distribution but is insignificantly different from 1.0 under the studentized maximum modulus (SMM) distribution as indicated in Stoline and Ury (1979) critical value of 3.031 and 3.493 at the 5 percent and 1 percent level

Table 4—Variance Ratios of KLSE CI Daily Returns During Bull and Bear Periods

	Lag	Variance Ratio	Homoskedasticity Z (q)	Heteroskedasticity Z*(q)
Bull Period	2	1.2571	5.7200**	4.3519**
1/2/92 to 12/31/93	4	1.3782	4.4981**	3.4223**$^{+}$
	6	1.3936	3.5423**$^{+}$	2.6952**$^{+}$
	8	1.3979	2.9929**$^{+}$	2.2772*$^{+}$
	10	1.4103	2.7035**$^{+}$	2.0571*$^{+}$
	12	1.4167	2.4729*$^{+}$	1.8817
	14	1.4376	2.3815*$^{+}$	1.8125
	16	1.4705	2.3783*$^{+}$	1.8105
	18	1.5072	2.4040*$^{+}$	1.8305
	20	1.5325	2.3836*$^{+}$	1.8154
	22	1.5336	2.2693*$^{+}$	1.7288
	24	1.5320	2.1599*$^{+}$	1.6458
Bear Period	2	1.0108	0.2408	0.0824
7/1/97 to 7/2/99	4	1.0557	0.6622	0.2267
	6	1.0064	0.0577	0.0198
	8	0.9864	-0.1025	-0.0351
	10	0.9655	-0.2274	-0.0779
	12	0.9764	-0.1400	-0.0479
	14	0.9889	-0.0602	-0.0206
	16	1.0188	0.0952	0.0326
	18	1.0576	0.2729	0.0934
	20	1.0890	0.3985	0.1364
	22	1.1265	0.5379	0.1841
	24	1.1616	0.6562	0.2247

Z(q) and Z*(q) denotes the homoskedasticity and heteroskedasticity test statistics. The variance ratios are statistics different from 1

* $p < 0.05$

** $p < 0.01$

$^{+}$ denotes an inference error in which variance ratio is statistical significant from 1.0 according to the standard normal distribution but is insignificantly different from 1.0 under the studentized maximum modulus (SMM) distribution as indicated in Stoline and Ury (1979) critical value of 3.031 and 3.493 at the 5% and 1% level

The random walk hypothesis was further examined during the bull and bear periods in the history of the Malaysian stock market. The bull[12] period spanned from

[12] The year "1993 was an outstanding year on many counts. The year exhibited a bullishness never before experienced in the history of the Kuala Lumpur Stock Exchange. Sixty-eight Malaysian stocks were included in the Morgan Stanley's Europe, Australia-Asia, and Far East (EAFE) Index and in the world index in May 1993 helped attract foreign funds and provided further impetus to the local market" (Tan, 1997 p. 154). Furthermore, in his commemorative book of KLSE, Tan (1997) indicates that the January to July 1993 was noted as "Bull Run" and August to December 1993 was viewed as "Super Bull Run" of Kuala Lumpur Stock Exchange.

January 2, 1992 to December 31, 1993, whereas the bear period[13] was from July 1, 1997 to July 2, 1999. The results of the bull and bear periods are presented in Table 4.

The random walk hypothesis is rejected during the bull period, while the Kuala Lumpur Stock Exchange Composite Index does follow a random walk during the bear period. This is consistent with Mansor and Lim (1995) who report that investors in the Malaysian stock market resort to fundamental analysis and long-term investment strategies during bear periods and speculative activities during bull periods with the aim of making short-term capital gains.

Predictability of the Moving Average Rules

The results reported in Table 5 provide evidence to reject the hypothesis that the VMA rules generate zero returns. Over the full sample period from 1977 to 1999, the VMA rules generate more buy than sell signals. In addition, the average returns of the buy signals are significantly positive. The VMA rules, particularly the 60-days VMA rule, are found to earn significantly higher returns compared to the buy-and-hold strategy.

Overall, the predictability of the variable moving averages appears to be pervasive, with the 60-days rule generating the highest returns.

The results reported in Table 6 provide some evidence to reject the hypothesis that the FMA rules generate zero returns. Similar to the VMA rules, the buy signals generate positive returns, whereas the sell signals generate negative returns. In addition, the FMA rules also generate more buy than sell signals. Furthermore, the FMA rules also are found to generate significantly higher returns compared to the buy-and-hold strategy at the 5 percent level. Once again, the 60-day FMA rule is found to generate significantly higher profits compared to the buy-and-hold strategy.

Based on the VMA and FMA test results for the four non-overlapping sub-periods are presented in Tables 7 and 8. Both these technical trading rules are found to generate significantly positive returns only in sub-period 1 (year 1977-1981) and sub-period 3 (year 1988-1993). The results provide evidence to reject the hypothesis of mean equality between the technical trading rules and the buy-and-hold strategy in all four sub-periods, however. The overall test results are in line with Brock et al. (1992) and Bessembinder and Chan (1995 and 1998) in which the technical trading rules generate abnormal profits.

[13] "Since July 1997, the currencies of all three second tier Southeast Asian newly industrialized countries had fallen precipitously, with the stock markets responding in tandem" (Jomo, 1998, p. 1). The period in the mid 1997 to mid 1999 were considered as financial crisis period and economic downturn in Malaysia.

Table 5—Test Results of Variable Length Moving Averages (VMA) Rules, 1977 to 1999

			VMA -Full Sample						
Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
5,60,0	3445	2152	0.1226	-0.0945	0.5628	0.4740	0.2171	13.20461[B]	11.9888
			(6.1391)[1]**	(-2.0760)[1]*			(4.9504)[3]**	-3.6803[S]	
			(2.459)[2]*	(-3.2722)[2]**				16.8849[T]	
5,60,0.01	3109	1848	0.1311	-0.1187	0.5664	0.4637	0.2498	12.5620	12.6046
			(6.1590)**	(-2.2778)*			(5.3290)**	-4.3789	
			(2.6188)**	(-3.6600)**				16.9409	
5,120,0	3469	2068	0.1012	-0.0477	0.5624	0.4734	0.1489	10.1026	4.3896
			(4.9563)**	(-1.0400)			(3.3585)**	0.8693	
			1.8422	(-2.0849)*				9.2333	
5,120,0.01	3320	1908	0.1050	-0.0728	0.5636	0.4680	0.1778	9.9908	6.2957
			(5.1250)**	(-1.4541)			(3.8767)**	-0.8782	
			(1.9250)	(-2.6170)**				10.8690	
5,180,0	3470	2007	0.0811	2.1262	0.5591	0.4723	-2.0451	7.0723	-188.4134
			(3.8876)**	(44.8000)**			(-45.6916)**	190.6945	
			(1.2579)	(50.3611)**				-183.6223	
5,180,0.01	3367	1879	0.0856	-0.0508	0.5601	0.4667	0.1364	7.3652	1.7678
			(4.0245)**	(-1.0151)			(2.9675)**	1.0083	
			(1.3751)	(-2.0850)*				6.3569	
Average			0.1044	0.2903					

[1]The student t-statistic ratio tests the hypothesis that the mean returns generated by technical trading rules is zero. The second row of the each test present t-statistic values in parentheses. [2]The t-statistic ratio that tests the mean returns generated by technical trading rules equal to the returns derived by the buy-and-hold strategy. The third row of the each test present t-statistic values in parentheses. [3]The t-statistic ratio of the difference between the returns of the buy and sell signals. N(Buy) refers to the number of buy signals generated during the sample period. N(Sell) refers to the number of sell signals generated during the sample period. Buy>0 is the fraction of returns of the buy which are more than zero. Sell>0 is the fraction of returns of the sell signal which are more than zero. Profit(b) refers to the average annual profit before transaction cost. Profit(a) refers to the average annual profit after transaction cost. B denotes profit for buy signals, S denotes profit for sell signals. T denotes total profit for buy and sell signals

* $p < 0.05$, ** $p < 0.01$

Table 6—Test Results of Fixed Moving Average (FMA) Rules, 1977 to 1999

			FMA -Full Sample						
Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
5,60,0	348	212	1.2044	-0.9437	0.6006	0.4340	2.1480	13.0621[B]	16.1101
			(5.3819)[1]**	(-1.8936)[1]			(4.5044)[3]**	-3.5378[S]	
			(2.7348)[2]**	(-3.4507)[2]**			16.6000[T]		
5,60,0.01	311	184	1.1745	-1.0525	0.5981	0.4402	2.2270	10.7216	13.5483
			(4.9192)**	(-1.8943)			(4.3747)**	-3.2597	
			(2.4998)*	(-3.4879)**				13.9813	
5,120,0	350	204	0.8512	-0.4209	0.5686	0.4755	1.2721	7.7934	5.8814
			(3.2172)**	(-0.9035)			(2.6385)**	1.4274	
			(1.5709)	(-2.047)*				6.3660	
5,120,0.01	333	188	0.9074	-0.4042	0.5706	0.4787	1.3116	7.9776	5.6652
			(3.3565)**	(-0.8089)			(2.6267)**	1.8566	
			(1.7165)	(-1.9267)				6.1210	
5,180,0	347	201	0.8141	-0.3974	0.5735	0.4677	1.2115	7.1219	4.9556
			(3.1412)**	(-0.8210)			(2.4971)*	1.6870	
			(1.4419)	(-1.9728)*				5.4349	
5,180,0.01	337	187	0.8141	-0.6534	0.5697	0.4492	1.4676	6.7684	6.4624
			(3.0584)**	(-1.2773)			(2.9403)**	-0.1524	
			(1.4222)	(-2.5344)*				6.9207	
Average			0.9610	-0.6453			1.6063		

Table 7—Test Results of Variable Moving Average Rules

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel A: 1977 to 1981									
5,60,0	913	246	0.1740	-0.0633	0.6024	0.5691	0.2373	27.8509	22.3784
			(5.1058)[1**]	(-0.5236)[1]			(2.6565)[3**]	0.8087	
			(1.1156)[2]	(-2.0314)[2*]				27.0422	
5,60,0.01	851	182	0.1767	-0.1207	0.6075	0.5659	0.2974	26.1542	22.4683
			(5.0212)**	(-0.7502)			(2.9286)**	-0.4709	
			(1.1418)	(-2.3677)*				26.6251	
5,120,0	933	933	0.1547	-0.0483	0.6013	0.1018	0.2030	24.9420	22.5149
			(4.4822)**	(-0.6724)**			(3.5247)**	-5.0816	
			(0.7654)	(-2.9855)**				30.0236	
5,120,0.01	916	154	0.1572	-0.0263	0.6004	0.5844	0.1835	24.8777	17.4578
			(4.5215)**	(-0.1450)			(1.6941)	3.1142	
			(0.8078)	(-1.3121)				21.7635	
5,180,0	897	142	0.1270	0.0907	0.5953	0.5986	0.0363	18.8681	8.1864
			(3.4247)**	(0.4878)			(0.3231)	6.5008	
			(0.2516)	(-0.2043)				12.3673	
5,180,0.01	889	133	0.1349	0.1185	0.5973	0.6015	0.0164	20.0622	8.8736
			(3.6229)**	(0.6288)			(0.1417)	7.0761	
			(0.3942)	(0.0461)*				12.9861	
Average			0.1541	-0.0082					

Table 7—Test Results of Variable Moving Average Rules (continued)

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel B: 1982 to 1987									
5,60,0	694	722	0.1082	-0.1274	0.5375	0.4501	0.2356	7.9894	14.0395
			(2.4362)[1*]	(-1.8528)[1]			(2.8648)[3**]	-10.7984	
			(1.8729)[2]	(-1.4552)[2]				18.7878	
5,60,0.01	634	644	0.1332	-0.1430	0.5426	0.4472	0.2762	9.5459	16.0776
			(2.8620)**	(-1.8891)			(3.1908)**	-10.8173	
			(2.1553)*	(-1.6130)				20.3631	
5,120,0	694	662	0.0844	-0.1027	0.5432	0.4396	0.1870	5.2272	7.4780
			(1.7440)	(-1.4347)			(2.2251)*	-6.7979	
			(1.5376)	(-1.0714)				12.0251	
5,120,0.01	659	610	0.1124	-0.1291	0.5493	0.4279	0.2415	7.8120	12.1540
			(2.4385)*	(-1.6906)			(2.7781)**	-8.5974	
			(1.8970)	(-1.3964)				16.4094	
5,180,0	644	652	0.0673	-0.0670	0.5528	0.4417	0.1343	2.6924	1.0921
			(1.1836)	(-1.0146)			(1.5618)	-2.7456	
			(1.2650)	(-0.5748)				5.4381	
5,180,0.01	617	611	0.0758	-0.0781	0.5592	0.4304	0.1538	3.2602	2.5605
			(1.2867)	(-1.1206)			(1.7419)	-3.4182	
			(1.3603)	(-0.711)				6.6784	
Average			0.0969	-0.1079					

* denotes $p < 0.05$, ** denotes $p < 0.01$

Table 7—Test Results of Variable Moving Average Rules (continued)

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel C: 1988 to 1993									
5,60,0	1048	371	0.1380	0.0130	0.5763	0.5337	0.1250	17.9065	6.1456
			(4.3485)[1]**	(0.1848)[1]			(1.7940)[3]	7.0025	
			(0.6612)[2]	(-1.4068)[2]				10.9040	
5,60,0.01	918	298	0.1395	-0.0104	0.5806	0.5034	0.1499	16.8059	8.7155
			(3.9815)**	(-0.1263)			(1.9490)	4.0127	
			(0.6652)	(-1.6063)				12.7932	
5,120,0	1031	328	0.1126	0.0275	0.5664	0.5305	0.0851	14.8203	4.2311
			(3.4622)**	(0.3650)			(1.1645)	6.0320	
			(0.1154)	(-1.1329)				8.7883	
5,120,0.01	968	277	0.1130	0.0069	0.5661	0.5054	0.1061	13.7036	4.6808
			(3.3100)**	(0.07983)			(1.3506)	4.8479	
			(0.1218)	(-1.3288)				8.8557	
5,180,0	1033	266	0.1175	0.0460	0.5721	0.5113	0.0715	15.6983	4.7736
			(3.6355)**	(0.5259)			(0.9018)	6.5687	
			(0.2198)	(-0.7972)				9.1296	
5,180,0.01	1020	249	0.1162	0.0520	0.5696	0.5141	0.0642	15.2319	4.2874
			(3.6000)**	(0.5701)			(0.7878)	6.6892	
			(0.1925)	(-0.6986)				8.5428	
Average			0.1228	0.0225					

Table 7—Test Results of Variable Moving Average Rules (continued)

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel D: 1994 to 1999									
5,60,0	694	728	0.1196	-0.1339	0.5274	0.4354	0.2535	7.9235	13.4992
			(2.3811)[1*]	(-1.3385)[1]			(2.1981)[3*]	-10.3442	
			(1.5002)[2]	(-1.0520)[2]				18.2677	
5,60,0.01	622	647	0.1275	-0.1604	0.5289	0.4297	0.2878	8.6829	17.1906
			(2.3644)*	(-1.4387)			(2.3578)*	-12.7630	
			(1.5203)	(-1.2685)				21.4459	
5,120,0	672	690	0.0752	-0.1051	0.5223	0.4362	0.1803	3.8953	6.8795
			(1.4651)	(-1.002)			(1.5302)	-7.5514	
			(1.0451)	(-0.7448)				11.4467	
5,120,0.01	642	650	0.0497	-0.0989	0.5202	0.4446	0.1486	0.7881	2.6371
			(0.9661)	(-0.8923)			(1.2283)	-6.1815	
			(0.7802)	(-0.6692)				6.9697	
5,180,0	683	619	0.0321	-0.0944	0.4978	0.4410	0.1265	-0.8755	-0.0315
			(0.6783)	(-0.8008)			(1.0487)	-5.2100	
			(0.6220)	(-0.6149)				4.3345	
5,180,0.01	637	574	0.0308	-0.1350	0.4945	0.4303	0.1659	-1.2563	3.0698
			(0.6198)	(-1.0692)			(1.3257)	-8.3870	
			(0.5949)	(-0.9786)				7.1307	
Average			0.0725	-0.1213					

* denotes $p < 0.05$, ** denotes $p < 0.01$

Table 8—Test Results of Fixed Length Moving Average Rules

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel A: 1977 to 1981									
5,60,0	94	22	1.5657	-0.1763	0.7447	0.6818	1.7420	25.5119	21.8973
			(4.0078)[1**]	(-0.1337)[1]			(1.6801)[3]	3.1477	
			(0.9278)[2]	(-1.3881)[2]				22.3641	
5,60,0.01	85	20	1.5639	-0.1802	0.7294	0.7000	1.7440	22.6620	19.0366
			(3.6600)**	(-0.1245)			(-2.3261)*	3.2029	
			(0.8815)	(5.4101)**				19.4591	
5,120,0	94	16	1.4034	0.2746	0.7340	0.6875	1.1289	22.4612	17.2164
			(3.4233)**	(0.1620)			(0.9535)	4.8021	
			(0.5815)	(-0.7773)				17.6591	
5,120,0.01	91	15	1.5951	0.4957	0.0659	0.7333	1.0993	25.1065	19.2692
			(4.0399)**	(0.2760)			(-2.6131)**	5.4107	
			(0.9756)	(5.1205)**				19.6958	
5,180,0	90	14	1.3720	0.2403	0.7444	0.7143	1.1317	20.7725	15.7576
			(3.2471)**	(0.1258)			(0.8998)	4.5964	
			(0.5041)	(-0.7568)				16.1761	
5,180,0.01	90	13	1.3766	0.1915	0.7444	0.6923	1.1851	20.8560	16.0201
			(3.2567)**	(0.0928)			(-2.6349)*	4.4214	
			(0.5138)	(5.1627)**				16.4346	
Average			1.4794	0.1409					

Table 8—Test Results of Fixed Length Moving Average Rules (continued)

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel B: 1982 to 1987									
5,60,0	71	71	0.9388	-1.1762	0.5211	0.3944	2.1151	6.5792	15.4912
			(1.6794)[1]	(-1.4053)[1]			(2.0228)[3*]	-9.3882	
			(1.5666)[2]	(-1.2276)[2]				15.9674	
5,60,0.01	62	64	1.4112	-1.1558	0.5806	0.4063	2.5670	10.0522	17.4279
			(2.4135)*	(-1.2646)			(-2.4391)*	-7.7983	
			(2.0532)*	(9.5031)**				17.8505	
5,120,0	69	67	0.5726	-0.7303	0.5362	0.3731	1.3029	2.0544	5.2234
			(0.7649)	(-0.9810)			(1.2193)	-3.6251	
			(1.0681)	(-0.6211)				5.6795	
5,120,0.01	68	61	0.6991	-0.6796	0.5441	0.3934	1.3787	3.3933	5.3390
			(0.9298)	(-0.8494)			(-0.0433)	-2.3783	
			(1.2245)	(7.9796)**				5.7716	
5,180,0	65	65	0.6580	-0.6630	0.5538	0.3538	1.3210	2.5984	4.8140
			(0.8515)	(-0.9015)			(1.2088)	-2.6516	
			(1.1463)	(-0.5268)				5.2500	
5,180,0.01	61	62	0.6470	-0.7770	0.5410	0.3548	1.4240	2.0472	5.1333
			(0.7883)	(-1.0204)			(0.3683)	-3.4985	
			(1.0983)	(7.7297)**				5.5458	
Average			0.8211	-0.8636					

* denotes $p < 0.05$, ** denotes $p < 0.01$

Table 8—Test Results of Fixed Length Moving Average Rules (continued)

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel C: 1988 to 1993									
5,60,0	102	40	1.2544	0.5377	0.6275	0.6250	0.7167	15.1259	4.8666
			(3.1665)[1**]	(0.6359)[1]			(0.9074)[3]	9.7831	
			(0.4180)[2]	(-0.7893)[2]				5.3427	
5,60,0.01	92	31	1.3246	0.0524	0.6304	0.6129	1.2723	14.1126	7.2310
			(3.0852)**	(0.0523)			(-1.6524)	6.4692	
			(0.5527)	(5.8540)**				7.6434	
5,120,0	103	33	1.0608	0.4802	0.6214	0.6061	0.5806	12.0125	2.7166
			(2.5031)*	(0.5724)			(0.6856)	8.8398	
			(-0.0286)	(-0.7957)				3.1726	
5,120,0.01	96	28	0.9991	0.5593	0.6042	0.5714	0.4399	9.7876	0.5634
			(2.2536)*	(0.5647)			(-0.9854)	8.8085	
			(-0.1660)	(5.1594)**				0.9792	
5,180,0	102	28	1.0756	0.8533	0.6373	0.5714	0.2223	12.0864	1.4699
			(2.5914)**	(0.8814)			(0.2461)	10.1805	
			(0.0055)	(-0.2722)				1.9059	
5,180,0.01	102	27	1.0798	0.9236	0.6373	0.5926	0.1562	12.1587	1.3713
			(2.6011)**	(0.9212)			(-1.1094)	10.3548	
			(0.0153)	(5.0306)**				1.8038	
Average			1.1324	0.5677					

Table 8—Test Results of Fixed Length Moving Average Rules (continued)

Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit(b)	Profit(a)
Panel D: 1994 to 1999									
5,60,0	70	73	0.8664	-1.0298	0.5857	0.4247	1.8962	4.2013	10.3437
			(1.5223)[1]	(-1.0862)[1]			(1.7065)	-6.6219	
			(1.4390)[2]	(-0.9130)[2]				10.8232	
5,60,0.01	65	66	1.0103	-1.3018	0.6000	0.4091	2.3121	5.0381	13.0111
			(1.7196)	(-1.2573)			(1.9919)*	-8.4123	
			(1.5598)	(-1.1955)				13.4504	
5,120,0	66	71	0.2971	-0.5852	0.5152	0.5070	0.8823	-2.6384	-2.0801
			(0.5063)	(-0.6007)			(0.7768)	-1.0177	
			(0.7178)	(-0.3500)				-1.6207	
5,120,0.01	64	66	0.4346	-0.6462	0.5313	0.5000	1.0809	-1.2709	-0.5054
			(0.7248)	(-0.6256)			(0.9275)	-1.2015	
			(0.8694)	(-0.4110)				-0.0694	
5,180,0	70	61	0.2921	-0.9338	0.5429	0.4590	1.2259	-2.4992	0.6477
			(0.5323)	(-0.8308)			(1.0536)	-3.5862	
			(0.7321)	(-0.7271)				1.0870	
5,180,0.01	67	56	0.4054	-1.1686	0.0448	0.4464	1.5740	-1.3800	3.2079
			(0.7243)	(-0.9650)			(1.3088)	-5.0003	
			(0.8535)	(-0.9576)				3.6204	
Average			0.5510	-0.9442					

* denotes $p < 0.05$, ** denotes $p < 0.01$

Notes: The (mean and standard deviation) of 10-day returns of the KLSE CI for full sample period and four sub-period 1977-1981, 1982-1987, 1988-1993, 1994-1999 under the buy-and-hold strategy are (0.3776, 5.4734); (1.1309, 4.3776); (-0.2470, 6.2298); (1.0732, 4.2337); and (-0.3027, 6.6423), respectively

Conclusions

The behavior of stock market index and dependency of successive price changes are of considerable interest for investors. Our findings indicate no random walk in the KLSE and imply a potential for technical trading rules to generate above average returns. This is verified by the predictability of the FMA and VMA rules examined in this study and the significantly positive returns generated by these rules even in the presence of trading costs. In addition, both these rules generate returns that are significantly higher than the unconditional mean return of the buy-and-hold strategy. In this context, the 60-day VMA and FMA rules are found to be the most profitable.

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