

## **Technical Analysis in the Malaysian Stock Market: An Empirical Evidence**

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### **Abstract**

This paper examines moving averages and trading range breakout rules on Malaysian stock market by replicating the framework of Brock et al. (1992). The study is based on the Kuala Lumpur Composite Index over the period of January 1977 to December 1999. The findings reveal the predictive ability and returns of moving average rules even in the presence of transaction costs. Results show that both variable and fixed moving average rules generate extra returns as compared to the buy-and-hold strategy. We find that moving average length of sixty days outperformed the other levels of length studied.

## **1. Introduction**

The re-emergence of technical analysis as a viable and efficient approach to individual stock selection and market analysis has drawn a great deal of interest among practitioners and academicians.

Technical analysis, or the use of past prices to predict future prices, have been popular among investors and financial analysts despite its criticisms levelled at it. All stockbroking firms and major daily newspaper analyse and publish technical commentary on the performance of the market as a whole and selected stocks on a daily basis. Public seminar and consulting firms that solely based on technical analysis are even formed.

The emergence of equity markets in Asia provides great opportunities for local and global investors. This paper examines two popular and simple technical trading rules, namely the moving average and the trading range breakout by using different levels of length which are considered to be appropriate in the local trading environment. The Kuala Lumpur Stock Exchange Composite Index (KLCI) which is the most popular market barometer of the Kuala Lumpur Stock Exchange (KLSE) is used in this study. The index is influenced more by local factors and forces rather than global information variables.

This paper contributes to a more comprehensive understanding of the predictive ability and technical analysis in the KLSE, an emerging market in which the degree of market efficiency are

still hotly debated and is still inconclusive. The sample period offers a long and comprehensive coverage over the period of 1977 to 1999.

The section two presents a review of previous empirical research in this area. The section 3 focuses on a discussion on the data and the methodology employed in this study. The results of the study are presented and discussed in section 4. Finally the conclusions of this study are presented in section 5.

## **2. Literature Review**

Brock et al. (1992) used 90 years of daily Industrial Average of Dow Jones Index from 1897 to 1986 to examine the predictive ability of simple and popular technical trading rules, moving average and trading range break. The findings support for technical strategies. The buy (sell) signals generate returns, which are higher (or lower) than 'normal' returns. 10-day holding period between buy and sell returns is about 0.8 percent as compared to a 'normal' 10-day holding returns of 0.17 percent. T-statistics are used and the Variable length moving average (VMA) and Fixed length moving average (FMA) results demonstrate that conditional mean buy returns are significantly higher than the conditional mean sell returns prior to taking transaction costs over the full sample period as well as four non-overlapping sub-periods.

Hudson et al. (1996) also adopted the technical trading rules of Brock et al. (1992) and applied it on United Kingdom (UK) stock prices to examine whether trading result is replicable or not in

the presence of costly trading environment. They used the daily Financial Times Industrial Ordinary Index from July 1935 to January 1994. The study indicated the predictive ability of technical trading rules but the use of these technical trading rules do not allow investors to make excess returns after taking the transaction costs of 1% per round trip transaction. This is to compare with the average excess returns per round trip transaction of 0.8% from the application of technical trading rules. Ratner and Leal (1999) tested ten variable length moving average in the emerging markets of Latin America and Asia. The results showed that average returns of the difference in buy and sell signals may be profitable in Taiwan, Thailand, and Mexico. Other markets do not indicate strong support of these ten technical trading strategies.

Bessembinder and Chan (1995) investigated the same trading rules of Brock et al. by using daily equity market indices of six Asian countries (Hong Kong, Japan, Korea, Malaysia, Thailand and Taiwan) over the period 1975-1991. The results indicated the strongest forecast ability for the emerging markets of Malaysia, Thailand, and Taiwan.

In 1998, they further investigated the technical forecast power identified by Brock et al. They confirmed that the basic Brock et al. results and concluded that the forecast power is not solely attributable to returns measurement error arising from non-synchronous trading. They highlight evidence supporting the hypothesis that predictive power of technical trading rules need not be consistent with market efficiency. The study also reported that buy signals generated positive returns, whereas sell signals offer negative returns and have more significant predictive ability.

Alexander (1964), Fama and Blume (1966) tested the application of various filter rules ranging from 5 to 50 percent on Dow Jones and Standard and Poor's Industrial Average from 1897 through 1959. They found that filter rules generally could not generate trading profits. In general, the results uniformly favour the smaller filter over the buy-and-hold strategy. But, the profits would be substantially reduced by the payment of commissions. Filters of all different size generated profits.

The technical analysis had also been examined in Malaysia. Dawson (1991) found some price patterns but he noted investors often ended up making less returns than the market after deducting transaction costs. Thus, despite the existence of patterns of price movements, no super-normal profits can be gained consistently from technical analysis. Yong (1991) responded to Dawson (1991) work and commented that investors can not rely solely on any set of technical tools to help them in their stock investment. There was no consistency in the results of the tests that Yong (1991) has carried out both on market indices and individual stocks. Some patterns of prices do exist and the level of randomness is lower than in developed markets. Neoh (1990) had found some pattern of movements of shares and he cautioned investors against using solely technical analysis which was based on naïve analysis of historical prices. Yong (1991) also mentioned that the technical analysis tools are used to improve the chances of making accurate prediction. Successful investors require attributes like patience and discipline in stock investment.

### **3. Data**

This study uses Kuala Lumpur Stock Exchange Composite Index (KLSE CI) which is the main and most popular market barometer in Malaysia from January 3, 1977, the first trading day of KLCI to December 31, 1999. This index reflects the sectoral contribution to the Gross Domestic Product. The correlation between these development and the component stocks in the KLSE CI is closely monitored. The index started with a sample of 67 component stocks and was gradually increased by the KLSE index sub-committee. Up to date, there are 100 stocks in the composition of KLSE CI (refer Appendix 1).

The construction of KLSE CI was based on the market value. Market value of each stock in the index are used to determine the weightage. The greater the market value of a stock, the greater the importance of the component stock in the KLSE CI. The index will be automatically adjusted for stock splits and other capital changes as the decrease in stock price is offset by an increase in the number of shares outstanding, thus causing the total market value to remain unchanged.

In addition to the full sample, the overall sample period is broken down into four non-overlapping sub-periods. The four sub-periods are January 1977 to December 1981, January 1982 to December 1987, January 1988 to December 1993, and January 1994 to December 1999. The sub-samples will be able to reflect the political and economic development of Malaysia. The first sample reflects the early period of the security industry in Malaysia

especially when the split of Stock Exchange of Malaysia and Singapore after the termination of currency interchangeability with Singapore in May 1973. The Securities Industry Act (1973) was enforced and Permodalan Nasional Berhad (PNB) was established. The second sub-sample captures the establishment of Amanah Saham Nasional in 1981 and the growth period of the Malaysian Securities industry. The third sub-sample is to capture the major restructuring and liberalisation of the security industry as well as the booming period of the stock market. “Sixty eight Malaysia stocks that 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 provide further impetus to the local market in 1993” (Tan, 1997 pp.154). The fourth sub-sample starts with the removed restrictive registration concerning institutional investors and continuation of the consolidation and development of the security industry. Employees Provident Fund (EPF) and other unit funds actively participate in the stock market Kuala Lumpur Stock Exchange (Tan 1997).

### **3.1 Technical Trading Rules**

This study examines the technical trading rules used by Brock et al (1992). They are Variable length moving average (VMA) rules, Fixed-length moving average (FMA) rules, and trading range breakout (TRB) rules. We used different periods of short term and long term moving averages in this study to reflect the local trading environment in Malaysia.

For both VMA and FMA rules, a signal is generated by comparing a short-term moving average of price to a long-term moving average. We used 5-days as the short-term moving average. This is to compare with the long-term moving averages of 60 days (3 months), 120 days (6 months), and 180 days (9 months). We used 5 days as short term in view that there are 5 trading days in a week in Malaysia and T+5 rolling settlement system. We also employed a one percent band around the long-term moving average. This study examines six variation of rules as (5,60,0), (5,120,0), (5, 180,0), (5,60,0.01), (5,120, 0.01), and (5,180, 0.01). 5 denotes to short-term moving average, 60 denotes to long-term moving average, 0.01 refer to one percent band around the long-term moving average. A buy (sell) signals is generated when a short-term moving average exceeds (fall below) long-term moving average. In this case, each day is considered either buy or sell signals. However, when a one percent band is introduced, a buy (sell) signals is initiated only when a short-term moving average exceeds (falls below) long-term moving average by at least one percent band. If the short-term moving average fall in between the upper and lower band of the long-term moving average, no signal or a neutral signal will be generated. It is noted that the introduction of a band by percentage is to eliminate 'whiplash' signals as highlighted by Brock et al (1992), particularly when short-term and long-term moving averages are very close.

As the rule implies, a buy (sell) signal will be executed on day (t) when day (t-1) moving average exceeds (fall below) long-term moving average on day (t-1). The return on day t is computed as the differences of the logarithm of closing price on day (t) and closing price day (t-1). The return formula ( $R_{i,t}$ ) is :  $R_{i,t} = \text{LN} (P_{i,t}/P_{i,t-1})$ .

The similar VMA rules will be used for FMA rules except that for FMA rules, once a signal is generated, it will be held for a certain period, 10 days or 14-days and the selection of number of days is arbitrary. Ten days of holding period is chosen for this study. Any signals within these holding period will be ignored. After the 10 days, FMA will generate new signal. Thus, the same rules of 10 days holding will be held and the cumulative returns of 10-days are calculated.

The third trading technical trading rule is trading range breakout (TRB). The rules are (1,60,0), (1,120,0), (1,180,0), (1,60,0.01), (1,120,0.01), and (1,180,0.01). The (1,60,0.01) rule works in the following manner:

A buy signal is generated in TRB rule when the closing price on day  $t-1$  exceed the maximum (resistant level) of previous 60 days by at least one percent. The buy signal will start next day, day  $t$ . On the other hand, a sell signal is initiated when the closing price on day  $t-1$  falls below the minimum (support level) of the previous 60 days by at least one percent. If the closing price on day  $t-1$  does not meet the above two criteria, no signal will be generated. Similar to FMA rules, the TRB rules require investors to stay in the same position for 10 days, hence, cumulative of the 10 days holding period will be computed. In this study, a zero and one percent band will be applied.

The conditional mean return and standard deviation of each buy, sell signals of each technical trading rules are computed as:

The conditional mean return:

$$R_b = \frac{1}{N_b} \sum_{t=1}^N R_t I_{t-1}^b$$

$N_b$  = Number of days for buy signals

$R_t$  = Daily index return

$I_{t-1}^b$  = Indicator function taking a value equal to one for a buy signal observed on day t-1 and zero otherwise.

On the other hand, the conditional mean return for a buy signal is computed as the mean of the daily return over the period that includes all the days in which buy signals are generated. The sell signals are calculated in a similar manner.

Two null hypotheses tested in this study are:

**Null hypothesis 1:**

Ho: The returns generated by technical trading rules are zero.

H1: The returns generated by technical trading rules are not equal to zero.

**Null hypothesis 2:**

Ho: The mean returns generated by technical trading rules equals the returns derived by the buy-and-hold strategy

H1: The mean returns generated by technical trading rules is not equal to the returns derived by the buy-and-hold strategy

The t-statistics used in the study are the student t-statistic in which it tests the null hypothesis that the returns generated by technical trading rules are equal to zero.

The student t-statistic tests the first null hypothesis that the returns generated by technical trading rules are zero is employed in this study. T-statistic is calculated as follows:

$$T = \frac{(N)^{1/2} \bar{R}}{\sigma_R}$$

$\bar{R}$  denotes the average daily rule returns

$\sigma_R$  denotes the standard deviation of daily rule returns

$N$  is the number of daily observations

Appendix 2 contains a summary of the daily returns and 10-day returns as well as its standard deviation for buy-and-hold strategy for the entire full sample and the four non-overlapping sub-periods in this study. We also adopt another t-statistic which had been also used by Brock et al. (1992) to examine mean differences between each technical trading rule with the strategy of buy-and-hold. We assume that the two populations have the equal variances. The t-statistics for the buys (sells) are:

$$\frac{\mu_r - \mu}{(\sigma^2/N + \sigma^2/N_r)^{1/2}}$$

Where  $\mu_r$  and  $N_r$  are the mean return and number of signals for the buys and sells, and  $\mu$  and  $N$  are the unconditional mean and number of observations.  $\sigma^2$  is the estimated variance for the entire sample. For the returns difference between buy-sell, the statistic is,

$$\frac{\mu_b - \mu_s}{(\sigma^2/N_b + \sigma^2/N_s)^{1/2}}$$

where  $\mu_b$  and  $N_b$  are the mean return and number of signals for the buys and  $\mu_s$  and  $N_s$  are the mean return and number of signals for the sells.

### 3.2 Profits Measurement

To measure the profit from applying technical trading rules and the buy-and-hold strategy, the framework of “double or out” strategy is adopted. This framework has been used by Brock et al. (1992) and Bessembinder and Chan (1998). “Double or out” strategy means that when a buy signal is generated, an investor will borrow at the risk free interest rate and double the equity investment in the market. In response to sell signals, the investor will sell the shares and invest in the risk free interest rate. The strategy is also in line with government restriction of short selling practices in Malaysia. Two assumptions will be made in the computation of the profits. First, the borrowing and lending rates are the same. Secondly, the risk during buy and sell periods are the same. The profit or extra return is denoted by  $\pi$  from employing technical trading rules as compared to buy-and-hold strategy.  $R_t$  denotes the daily return from the buy-and-hold strategy on day  $t$ ,  $i_t$  refers to the risk free interest rate. The average yield of the 3-months Malaysian treasury bill will be used as proxy for the risk free interest rate. Hence, by using the “double or out” strategy, the profit will be  $R_t - i_t$  in response to buy signals. In the case of sell signals, we sell the shares at the return of  $R_t$  and then invest in risk free asset and earn  $i_t$ . Hence, the profit will be  $i_t - R_t$ . Using the example of (5,60,0) rule, the profits of the buy signals are computed as follows:

$$\begin{aligned}
\text{Profit } (\pi) &= ((\text{mean return} \times \text{trade per year}) - (\text{risk free interest rate})) \\
&= (0.122611 \times 3445/23) - 5.1603\% \\
&= 18.365\% - 5.1603\% \\
&= 13.2047\%
\end{aligned}$$

Whereas, in a sell signal, the profit for not being in the market are illustrated as follows:

$$\begin{aligned}
\text{Profit } (\pi) &= ((\text{risk free interest rate}) - (\text{mean return} \times \text{trade per year})) \\
&= 5.1603\% - (0.1094486\% \times 2152/23) \\
&= 5.1603\% - 8.8406\% \\
&= -3.6803\%
\end{aligned}$$

The profit or extra return before transaction cost earned from employing technical trading rules are the combination of the profit of the buy and sell signals. Hence, based on the above calculation of the (5,60,0) rule, the profit is 16.88%. It is worth noting that the mean significant difference of the profits generated from the technical trading rules can be tested against the value of zero.

The technical trading rules are also examined in trading cost environment. The method of computation of breakeven transaction costs are used by Bessembinder and Chan (1995). The percentage round trip transaction cost is denoted as C. When a buy or sell signal is emitted, the C/2 transaction cost will be deducted from the return. Another C/2 will be charged when the position is closed out. Consequently, the breakeven transaction costs are:

$$C = \frac{\pi}{(N_b + N_s)}$$

$N_b$  = Number of days in which a buy signal is generated in a year

$N_s$  = Number of days in which a sell signal is generated in a year

C = Percentage round trip transaction costs

$\pi$  = Profit generated from technical trading rules as compared to buy-and-hold strategy

Rearranging the above equation, the profit derived from applying the technical trading rules is given as follows:  $\pi$  (before transaction cost) -  $C * (N_b + N_s)$ .

In addition to the cost of the shares bought or sold, the investor will have to pay the transaction costs in Malaysia. The round-trip percentage transaction cost will be about 2.102%. The cost comprises of the brokerage fee, clearing fee and stamp duty for both buy and sell transaction.

The details can be obtained from the KLSE website and are illustrated below:

i. Brokerage fee

1.00% - For transaction value up to RM500,000

0.75% - For transaction value of RM500,001-RM2 million

0.50% - For transaction value exceeding RM2 million

ii. Clearing fee

0.05% of transaction value

iii. Stamp duty

RM1.00 for RM1,000 or fractional part of value of securities (payable by both buyer and seller)

By using the example of (5,60,0) rule, the profit after transaction costs will be:

$$\text{Profit } (\pi) = \pi \text{ (before transaction cost) } - C * (N_b + N_s).$$

$$= 16.885\% - 0.02012 (3445/23 + 2152/23)$$

$$= 11.9888\%$$

#### **4. Results and Analyses**

Table 1 reports the test results of the six variable length moving average rules at different length and with zero and one percent band for the full sample period from 1977-1999. All the daily one-day average return of buy signals are significantly positive, thus providing evidence to reject the null hypothesis that the VMA rules generate zero returns. Number of buy signal as indicated in column 7 is greater than sell signals.

The test results also reject the null hypothesis in which the VMA rules gained the same returns as the buy-and-hold strategy. This is indicated in the column 9 that returns of buy-sell difference are positive and highly significant at the level of 5%. The last two columns, columns 10 and 11 demonstrate the positive profits before and after transaction costs earned based on the “double or out” strategy. This implies that the forecast ability of variable moving averages and the length of 60 days appears to generate the highest returns among the rules in this study.

#### **Table 1: Test Results of Variable Length Moving Averages (VMA) Rules**

Vma-Full Sample										
Period	Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit <sup>(b)</sup>	Profit <sup>(a)</sup>
1977-1999	5,60,0	3445	2152	0.1226	-0.0945	0.5628	0.4740	0.2171	13.20461 <sup>B</sup>	11.9888
				(6.1391) <sup>1**</sup>	(-2.0760) <sup>*</sup>			(4.9504) <sup>3**</sup>	-3.6803 <sup>S</sup>	
				(2.459) <sup>2**</sup>	(-3.2722) <sup>2**</sup>				16.8849 <sup>T</sup>	
	5,60,0.01	3109	1848	0.1311	-0.1187	0.5664	0.4637	0.2498	12.5620	12.6046
				(6.1590) <sup>**</sup>	(-2.2778) <sup>*</sup>			(5.3290) <sup>**</sup>	-4.3789	
				(2.6188) <sup>**</sup>	(-3.6600) <sup>**</sup>				16.9409	
	5,120,0	3469	2068	0.1012	-0.0477	0.5624	0.4734	0.1489	10.1026	4.3896
				(4.9563) <sup>**</sup>	(-1.0400)			(3.3585) <sup>**</sup>	0.8693	
				1.8422	(-2.0849) <sup>*</sup>				9.2333	
	5,120,0.01	3320	1908	0.1050	-0.0728	0.5636	0.4680	0.1778	9.9908	6.2957
				(5.1250) <sup>**</sup>	(-1.4541)			(3.8767) <sup>**</sup>	-0.8782	
				(1.9250)	(-2.6170) <sup>**</sup>				10.8690	
	5,180,0	3470	2007	0.0811	2.1262	0.5591	0.4723	-2.0451	7.0723	-188.4134
				(3.8876) <sup>**</sup>	(44.8000) <sup>**</sup>			(-45.6916) <sup>**</sup>	190.6945	
				(1.2579)	(50.3611) <sup>**</sup>				-183.6223	
	5,180,0.01	3367	1879	0.0856	-0.0508	0.5601	0.4667	0.1364	7.3652	1.7678
				(4.0245) <sup>**</sup>	(-1.0151)			(2.9675) <sup>**</sup>	1.0083	
				(1.3751)	(-2.0850) <sup>*</sup>				6.3569	
	<b>Average</b>			0.1044	0.2903			-1.1151		

Notes:

<sup>1</sup> The student t-statistic ratio which tests the hypothesis that the returns generated by technical trading rules are zero. All the second rows of the each test present t-statistic ratios in parentheses.

<sup>2</sup> 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. All the third rows of the each test present t-statistic ratios in parentheses

<sup>3</sup> The t-statistic ratio of return buy-sell differences.

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.

\* denotes  $p < 0.05$ , \*\* denotes  $p < 0.01$ . Buy>0 is the fraction of return of the buy signal is more than zero, Sell>0 is the fraction of return of the sell signal is more than zero.

Profit<sup>(b)</sup> refers to the average annual profit before transaction cost, Profit<sup>(a)</sup> refers to the average annual profit after transaction cost

<sup>B</sup> denotes profit for buy signals, <sup>S</sup> denotes profit for sell signals, <sup>T</sup> denotes total profit for buy and sell signals

**Table 2: Test Results of Fixed Moving Average (FMA) Rules**

Period	Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit <sup>(b)</sup>	Profit <sup>(a)</sup>
1977-1999	5,60,0	348	212	1.2044	-0.9437	0.6006	0.4340	2.1481	13.0621 <sup>B</sup>	16.1101
				(5.3819) <sup>1**</sup>	(-1.8936) <sup>1</sup>			(4.5044) <sup>3**</sup>	-3.5378 <sup>S</sup>	
				(2.7348) <sup>2**</sup>	(-3.4507) <sup>2**</sup>				16.6000 <sup>T</sup>	
	5,60,0.01	311	184	1.1745	-1.0525	0.5981	0.4402	2.2270	10.7216	13.5483
				(4.9192) <sup>**</sup>	(-1.8943)			(4.3747) <sup>**</sup>	-3.2597	
				(2.4998) <sup>*</sup>	(-3.4879) <sup>**</sup>				13.9813	
	5,120,0	350	204	0.8512	-0.4209	0.5686	0.4755	1.2721	7.7934	5.8814
				(3.2172) <sup>**</sup>	(-0.9035)			(2.6385) <sup>**</sup>	1.4274	
				(1.5709)	(-2.047) <sup>*</sup>				6.3660	
	5,120,0.01	333	188	0.9074	-0.4042	0.5706	0.4787	1.3116	7.9776	5.6652
				(3.3565) <sup>**</sup>	(-0.8089)			(2.6267) <sup>**</sup>	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) <sup>**</sup>	(-0.8210)			(2.4971) <sup>*</sup>	1.6870	
				(1.4419)	(-1.9728) <sup>*</sup>				5.4349	
	5,180,0.01	337	187	0.8141	-0.6534	0.5697	0.4492	1.4675	6.7684	6.4624
				(3.0584) <sup>**</sup>	(-1.2773)			(2.9403) <sup>**</sup>	-0.1524	
				(1.4222)	(-2.5344) <sup>*</sup>				6.9207	
	<b>Average</b>			0.9610	-0.6453			1.6063		

Notes:

<sup>1</sup> The student t-statistic ratio which tests the hypothesis that the returns generated by technical trading rules are zero. All the second rows of the each test present t-statistic ratios in parentheses.

<sup>2</sup> 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. All the third rows of the each test present t-statistic ratios in parentheses

<sup>3</sup> The t-statistic ratio of return buy-sell differences.

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.

\* denotes  $p < 0.05$ , \*\* denotes  $p < 0.01$ . Buy>0 is the fraction of return of the buy signal is more than zero, Sell>0 is the fraction of return of the sell signal is more than zero.

Profit<sup>(b)</sup> refers to the average annual profit before transaction cost, Profit<sup>(a)</sup> refers to the average annual profit after transaction cost

<sup>B</sup> denotes profit for buy signals, <sup>S</sup> denotes profit for sell signals, <sup>T</sup> denotes total profit for buy and sell signals

Results of the six fixed moving average rules are presented in Table 2. Ten-day cumulative returns for buy signals are positive with an overall average across all six rules of 0.9610% whereas sell signals generate negative returns. Similar to VMA rules, positive buy signals are at higher percentage as compared to sell signals as indicated in columns 7 and 8. Meanwhile the number of buy signals generated is about 40-50% more than sell signals. This is consistent with upward trend in the market and the rising market index during the sample period.

All the buy signals rejected the null hypothesis that the FMA rules gained zero returns. In contrast, sell signals at the confidence level 95% and 99% rejected the second null hypothesis in the study that returns earned from FMA rules are equal to the buy-and-hold strategy. The columns 10 and 11 indicate that positive profits before and after transaction costs generated FMA rules. Once again, the length of 60 days with and without one percent band showed the highest profits among the rules. Column 9 indicates the returns of buy-sell difference at highly confidence level as well.

### **Table 3: Test Results of Trading Range Breakout (TRB) Rules**

TRB-Full Sample										
Period	Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit <sup>(b)</sup>	Profit <sup>(a)</sup>
1977-1999	1,60,0	80	31	1.2584	-0.8811	0.6875	0.5161	2.1395	-0.7832	-4.8530
				(3.0662) <sup>1**</sup>	(-0.8562) <sup>1</sup>					
	1,60,0.01	18	14	1.4366	-2.3523	0.7778	0.5000	3.7889	-4.0360	-7.7925
				(1.5311)	(-1.4170)			(1.9425)	3.7285	
				(0.8195)	(-1.8638)				-7.7645	
	1,120,0	68	21	1.2591	-0.9585	0.6618	0.5238	2.2177	-1.4377	-5.8007
				(2.8253) <sup>**</sup>	(-0.6533)			(1.6229)	4.2851	
				(1.3201)	(-1.1166)				-5.7228	
	1,120,0.01	16	10	1.2185	-2.3990	0.7500	0.5000	3.6174	-4.3127	-8.4527
				(1.1675)	(-1.0596)			(1.6395)	4.1173	
				(0.6136)	(-1.6027)				-8.4300	
	1,180,0	56	21	1.3179	-0.9585	0.6964	0.5238	2.2765	-1.9514	-6.3039
				(2.6716) <sup>**</sup>	(-0.6533)			(1.6254)	4.2851	
				(1.2792)	(-1.1166)				-6.2366	
	1,180,0.01	15	10	1.5196	-2.3990	0.8000	0.5000	3.9186	-4.1692	-8.3084
				(1.4226)	(-1.0596)			(1.7536)	4.1173	
				(0.8070)	(-1.6027)				-8.2865	
	Average			1.3350	-1.6581			2.9931		

Notes:

<sup>1</sup> The student t-statistic ratio which tests the hypothesis that the returns generated by technical trading rules are zero. All the second rows of the each test present t-statistic ratios in parentheses.

<sup>2</sup> 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. All the third rows of the each test present t-statistic ratios in parentheses

<sup>3</sup> The t-statistic ratio of return buy-sell differences.

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.

\* denotes  $p < 0.05$ , \*\* denotes  $p < 0.01$ . Buy>0 is the fraction of return of the buy signal is more than zero, Sell>0 is the fraction of return of the sell signal is more than zero.

Profit<sup>(b)</sup> refers to the average annual profit before transaction cost, Profit<sup>(a)</sup> refers to the average annual profit after transaction cost

<sup>B</sup> denotes profit for buy signals, <sup>S</sup> denotes profit for sell signals, <sup>T</sup> denotes total profit for buy and sell signals

To further investigate the predictive ability of technical trading rules, the trading range breakout will be examined by using the earlier chosen length at zero and one percent band. The results as illustrated in Table 3 seem to fail to reject the null hypotheses. The profits before and after the transaction costs generated as shown in columns 10 and 11 are negative. It is noted that the number of buy and sell signals is very few during the sample period. Possible explanations are resulted from the length selected and nature of the TRB rules. For example ((1,60,0) rule, to generate a buy (sell) signal, the current closing price has to

be greater than the maximum of the previous 60 days. It implies that if the current closing price is not higher (lower) than maximum (minimum) of previous 60 days, no signal will be generated. Hence, not many signals were generated during the study period and on average, there are about zero to two signals per year.

Appendices 4, 5, and 6 contain the test results of VMA, FMA, and TRB for four non overlapping periods, respectively. The period for the year 1977-1981 appear to produce the highest profits among the technical trading rules tested. All returns of buy signals for the sub-period 1 (year 1977-1981) and sub-period 3 (year 1988-1993) in VMA and FMA generate positive returns, hence, rejecting the null hypothesis that technical trading rules are equal to zero. All the four sub-periods fail to reject the null hypothesis of mean equality between the technical trading rules and buy-and-hold strategy.

#### **4.1 Implications**

This study offers predictive ability of technical trading rules with and without trading costs environment in an emerging market. The findings support the work done by Brock et al. (1992) and Bessembinder and Chan (1995 and 1998). The use of historical price information together with the current prices allow extra returns to be generated. Based on the efficient market hypothesis, when technical analysis does have values, it reflects that market is not weak-form efficient. Nonetheless, the findings do not provide sufficient evidence to conclude that KLSE is

inefficiency as a whole. There may be not a one-to-one relationship between the market efficiency and technical analysis as highlighted in the study of Joy and Jones (1986).

Future research should explore on the stochastic properties of stock returns to provide further evidence of the market inefficiency. The length chosen for trading range breakout rule is recommended to be shortened in view of shorter investment horizon in the KLSE as whole. Retail investors are still the dominant players in the KLSE in which they usually have a shorter investment horizon. The technical trading rules tested in the study should be conducted on individual stocks as well.

## **5. Conclusions**

The findings confirm the predictive ability of moving averages even in the presence of cost trading. It implies that Kuala Lumpur Stock Exchange is in the weak-form inefficient.

Overall, the most profitable length of VMA and FMA rules examined is sixty days as compared to a buy-and-hold strategy. It is indicated by the extra returns generated if the rules are applied under the “double and out” strategy.

The results reveal that one-day returns for all buy signals and difference between buy and sell signals for VMA are higher than unconditional daily returns that based on buy-and-hold

strategy. The same result also appears in the FMA 10-day returns for both buy signals and difference between buy and sell signals.

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**Appendix 1: KLSE Composite Index Components  
(as at 5 July 1999)**

	<b>STOCK CODE</b>	<b>COMPANY</b>
1	5185	AFFIN HOLDINGS BHD
2	2674	ALUMINIUM COMPANY OF MALAYSIA BHD
3	1015	AMMB HOLDINGS BHD
4	2712	AMSTEEL CORPORATION BHD
5	6351	AMWAY (M) HOLDINGS BHD
6	1007	ARAB-MALAYSIAN DEVELOPMENT BHD
7	1473	BANDAR RAYA DEVELOPMENTS BHD
8	1562	BERJAYA SPORTS TOTO BHD
9	2771	BOUSTEAD HOLDINGS BHD
10	2879	CHEMICAL COMPANY OF MALAYSIA BHD
11	2909	COLD STORAGE (M) BHD
12	1023	COMMERCE ASSET -HOLDING BHD
13	5738	COUNTRY HEIGHTS HOLDINGS BHD
14	5355	DAIMAN DEVEOPMENT BHD
15	2976	DNP HOLDINGS BHD
16	1368	FABER GROUP BHD
17	6041	FARLIM GROUP (MALAYSIA) BHD
18	5398	GAMUDA BHD
19	3182	GENTING BHD
20	1953	GOLDEN HOPE PLANTATIONS BHD
21	2968	GOLDEN PLUS HOLDINGS BHD
22	3247	GRAND UNITED HOLDINGS BHD
23	3255	GUINNESS ANCHOR BHD
24	3034	HAP SENG CONSOLIDATED BHD
25	2526	HICOM HOLDINGS BHD
26	5819	HONG LEONG BANK BHD
27	1503	HONG LEONG PROPERTIES BHD
28	3328	HUME INDUSTRIES (M) BHD
29	1597	IGB CORPORATION BHD
30	3336	IJM CORPORATION BHD
31	1961	IOI CORPORATION BHD
32	4383	JAYA TIASA HOLDINGS BHD
33	1058	JOHN HANCOCK LIFE INSURANCE (M) BHD
34	6416	JOHOR PORT BHD
35	5509	KELANG CONTAINER TERMINAL BHD

36	3522	KIAN JOO CAN FACTORY BHD
37	5371	KIM HIN INDUSTRY BHD
38	2445	KUALA LUMPUR KEPONG BHD
39	2003	KULIM (M) BHD
40	3557	KUMPULAN EMAS BHD
41	3131	KUMPULAN GUTHRIE BHD
42	3174	LAND & GENERAL BHD
43	3565	LARUT CONSOLIDATED BHD
44	4529	LEADER UNIVERSAL HOLDINGS BHD
45	2011	LINGUI DEVELOPMENTS BHD
46	3735	MAGNUM CORPORATION BHD
47	1155	MALAYAN BANKING BHD
48	3794	MALAYAN CEMENT BHD
49	3891	MALAYAN UNITED INDUSTRIES BHD
50	3816	MALAYSIA INTERNATIONAL SHIPPING CORP BHD
51	2194	MALAYSIA MINING CORPORATION BHD
52	3786	MALAYSIAN AIRLINE SYSTEM BHD
53	1198	MALAYSIAN ASSURANCE ALLIANCE BHD
54	5525	MALAYSIAN INDUSTRIAL DEVELOPMENT FINANCE BHD
55	6459	MALAYSIAN NATIONAL REINSURANCE BHD
56	3832	MALAYSIAN OXYGEN BHD
57	3867	MALAYSIAN PACIFIC INDUSTRIES BHD
58	1228	MBF CAPITAL BHD
59	1708	METROPLEX BHD
60	2275	MNI HOLDINGS BHD
61	3905	MULPHA INTERNATIONAL BHD
62	4707	NESTLE (M) BHD
63	3999	NEW STRAITS TIMES PRESS (M) BHD, THE
64	4944	NYLEX (M) BHD
65	4006	ORIENTAL HOLDINGS BHD
66	6866	PADIBERAS NASIONAL BHD
67	4049	PALMCO HOLDINGS BHD
68	1759	PELANGI BHD
69	4065	PERLIS PLANTATIONS BHD
70	5304	PERUSAHAAN OTOMOBIL NASIONAL BHD
71	5681	PETRONAS DAGANGAN BHD
72	6033	PETRONAS GAS BHD
73	4073	PILECON ENGINEERING BHD
74	1295	PUBLIC BANK BHD
75	6807	PUNCAK NIAGA HOLDINGS BHD

76	6475	RAMATEX BHD
77	1066	RHB CAPITAL BHD
78	4162	ROTHMANS OF PALL MALL (M) BHD
79	2224	SELANGOR DREDGING BHD
80	1783	SELANGOR PROPERTIES BHD
81	5517	SHANGRI-LA HOTELS (M) BHD
82	4324	SHELL REFINING CO (FOM) BHD
83	4197	SIME DARBY BHD
84	4502	SISTEM TELEVISYEN MALAYSIA BHD
85	6084	STAR PUBLICATIONS (M) BHD
86	4308	SUNGEI WAY HOLDINGS BHD
87	4898	TA ENTERPRISE BHD
88	5606	TAN & TAN DEVELOPMENTS BHD
89	4405	TAN CHONG MOTOR HOLDINGS BHD
90	2267	TANJONG PLC
91	4189	TECHNOLOGY RESOURCES INDUSTRIES BHD
92	4863	TELEKOM MALAYSIA BHD
93	5347	TENAGA NASIONAL BHD
94	4456	TIME ENGINEERING BHD
95	4421	TRADEWINDS (M) BHD
96	4588	UMW HOLDINGS BHD
97	4596	UNIPHONE TELECOMMUNICATIONS BHD
98	4545	UNITED ENGINEERS (M) BHD
99	4642	YEO HIAP SENG (M) BHD
100	4677	YTL CORPORATION BHD

**Appendix 2: Daily and 10-day Returns under the Buy-and-hold Strategy**

<b>Daily Returns</b>					
	<b>Full Sample</b>	<b>77-81</b>	<b>82-87</b>	<b>88-93</b>	<b>94-99</b>
Mean	0.0378	0.1133	-0.0251	0.1072	-0.0304
Std	1.5961	1.2436	1.5472	1.1534	2.1739
<b>10-day Returns</b>					
	<b>Full Sample</b>	<b>77-81</b>	<b>82-87</b>	<b>88-93</b>	<b>94-99</b>
Mean	0.3776	1.1309	-0.2470	1.0732	-0.3027
Std	5.4734	4.3776	6.2298	4.2337	6.6423

Appendix 3: Test Results of Variable Length Moving Average Rules

Period	Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell	Profit <sup>(a)</sup>	Profit <sup>(b)</sup>
1977-1981	5,60,0	913	246	0.1740 (5.1058) <sup>***</sup> (1.1156) <sup>z</sup>	-0.0633 (-0.5236) <sup>1</sup> (-2.0314) <sup>z</sup>	0.6024	0.5691	0.2373 (2.6565) <sup>***</sup>	27.8509 0.8087 27.0422	22.3784
	5,60,0.01	851	182	0.1767 (5.0212) <sup>**</sup> (1.1418)	-0.1207 (-0.7502) (-2.3677) <sup>*</sup>	0.6075	0.5659	0.2974 (2.9286) <sup>**</sup>	26.1542 -0.4709 26.6251	22.4683
	5,120,0	933	933	0.1547 (4.4822) <sup>**</sup> (0.7654)	-0.0483 (-0.6724) <sup>**</sup> (-2.9855) <sup>**</sup>	0.6013	0.1018	0.2030 (3.5247) <sup>**</sup>	24.9420 -5.0816 30.0236	22.5149
	5,120,0.01	916	154	0.1572 (4.5215) <sup>**</sup> (0.8078)	-0.0263 (-0.1450) (-1.3121)	0.6004	0.5844	0.1835 (1.6941)	24.8777 3.1142 21.7635	17.4578
	5,180,0	897	142	0.1270 (3.4247) <sup>**</sup> (0.2516)	0.0907 (0.4878) (-0.2043)	0.5953	0.5986	0.0363 (0.3231)	18.8681 6.5008 12.3673	8.1864
	5,180,0.01	889	133	0.1349 (3.6229) <sup>**</sup> (0.3942)	0.1185 (0.6288) (0.0461) <sup>*</sup>	0.5973	0.6015	0.0164 (0.1417)	20.0622 7.0761 12.9861	8.8736
	Average			0.1541	-0.0082					
	1982-1987	5,60,0	694	722	0.1082 (2.4362) <sup>1*</sup> (1.8729) <sup>z</sup>	-0.1274 (-1.8528) <sup>1</sup> (-1.4552) <sup>z</sup>	0.5375	0.4501	0.2356 (2.8648) <sup>***</sup>	7.9894 -10.7984 18.7878
5,60,0.01		634	644	0.1332 (2.8620) <sup>**</sup> (2.1553) <sup>*</sup>	-0.1430 (-1.8891) (-1.6130)	0.5426	0.4472	0.2762 (3.1908) <sup>**</sup>	9.5459 -10.8173 20.3631	16.0776
5,120,0		694	662	0.0844 (1.7440) (1.5376)	-0.1027 (-1.4347) (-1.0714)	0.5432	0.4396	0.1870 (2.2251) <sup>*</sup>	5.2272 -6.7979 12.0251	7.4780
5,120,0.01		659	610	0.1124 (2.4385) <sup>*</sup> (1.8970)	-0.1291 (-1.6906) (-1.3964)	0.5493	0.4279	0.2415 (2.7781) <sup>**</sup>	7.8120 -8.5974 16.4094	12.1540
5,180,0		644	652	0.0673 (1.1836) (1.2650)	-0.0670 (-1.0146) (-0.5748)	0.5528	0.4417	0.1343 (1.5618)	2.6924 -2.7456 5.4381	1.0921
5,180,0.01		617	611	0.0758 (1.2867) (1.3603)	-0.0781 (-1.1206) (-0.711)	0.5592	0.4304	0.1538 (1.7419)	3.2602 -3.4182 6.6784	2.5605
Average				0.0969	-0.1079					
1988-1993		5,60,0	1048	371	0.1380 (4.3485) <sup>1**</sup> (0.6612) <sup>z</sup>	0.0130 (0.1848) <sup>1</sup> (-1.4068) <sup>z</sup>	0.5763	0.5337	0.1250 (1.7940) <sup>z</sup>	17.9065 7.0025 10.9040
	5,60,0.01	918	298	0.1395 (3.9815) <sup>**</sup> (0.6652)	-0.0104 (-0.1263) (-1.6063)	0.5806	0.5034	0.1499 (1.9490)	16.8059 4.0127 12.7932	8.7155
	5,120,0	1031	328	0.1126 (3.4622) <sup>**</sup> (0.1154)	0.0275 (0.3650) (-1.1329)	0.5664	0.5305	0.0851 (1.1645)	14.8203 6.0320 8.7883	4.2311
	5,120,0.01	968	277	0.1130 (3.3100) <sup>**</sup> (0.1218)	0.0069 (0.07983) (-1.3288)	0.5661	0.5054	0.1061 (1.3506)	13.7036 4.8479 8.8557	4.6808
	5,180,0	1033	266	0.1175 (3.6355) <sup>**</sup> (0.2198)	0.0460 (0.5259) (-0.7972)	0.5721	0.5113	0.0715 (0.9018)	15.6983 6.5687 9.1296	4.7736
	5,180,0.01	1020	249	0.1162 (3.6000) <sup>**</sup> (0.1925)	0.0520 (0.5701) (-0.6986)	0.5696	0.5141	0.0642 (0.7878)	15.2319 6.6892 8.5428	4.2874
	Average			0.1228	0.0225					
	1994-1999	5,60,0	694	728	0.1196 (2.3811) <sup>1</sup> (1.5002) <sup>z</sup>	-0.1339 (-1.3385) <sup>1</sup> (-1.0520) <sup>z</sup>	0.5274	0.4354	0.2535 (2.1981) <sup>z</sup>	7.9235 -10.3442 18.2677
5,60,0.01		622	647	0.1275 (2.3644) <sup>*</sup> (1.5203)	-0.1604 (-1.4387) (-1.2685)	0.5289	0.4297	0.2878 (2.3578) <sup>*</sup>	8.6829 -12.7630 21.4459	17.1906
5,120,0		672	690	0.0752 (1.4651) (1.0451)	-0.1051 (-1.002) (-0.7448)	0.5223	0.4362	0.1803 (1.5302)	3.8953 -7.5514 11.4467	6.8795
5,120,0.01		642	650	0.0497 (0.9661) (0.7802)	-0.0989 (-0.8923) (-0.6692)	0.5202	0.4446	0.1486 (1.2283)	0.7881 -6.1815 6.9697	2.6371
5,180,0		683	619	0.0321 (0.6783) (0.6220)	-0.0944 (-0.8008) (-0.6149)	0.4978	0.4410	0.1265 (1.0487)	-0.8755 -5.2100 4.3345	-0.0315
5,180,0.01		637	574	0.0308 (0.6198) (0.5949)	-0.1350 (-1.0692) (-0.9786)	0.4945	0.4303	0.1659 (1.3257)	-1.2563 -8.3870 7.1307	3.0698
Average				0.0725	-0.1213					

**Appendix 4: Test Results of Fixed Length Moving Average Rules**

Period	Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-sell	Profit <sup>(b)</sup>	Profit <sup>(a)</sup>
1977-1981	5,60,0	94	22	1.5657 (4.0078) <sup>***</sup> (0.9278) <sup>2</sup>	-0.1763 (-0.1337) <sup>1</sup> (-1.3881) <sup>2</sup>	0.7447	0.6818	1.7420 (1.6801) <sup>3</sup>	25.5119 3.1477 22.3641	21.8973
	5,60,0.01	85	20	1.5639 (3.6600) <sup>**</sup> (0.8815)	-0.1802 (-0.1245) (5.4101) <sup>**</sup>	0.7294	0.7000	1.7440 (-2.3261) <sup>*</sup>	22.6620 3.2029 19.4591	19.0366
	5,120,0	94	16	1.4034 (3.4233) <sup>**</sup> (0.5815)	0.2746 (0.1620) (-0.7773)	0.7340	0.6875	1.1289 (0.9535)	22.4612 4.8021 17.6591	17.2164
	5,120,0.01	91	15	1.5951 (4.0399) <sup>**</sup> (0.9756)	0.4957 (0.2760) (5.1205) <sup>**</sup>	0.0659	0.7333	1.0993 (-2.6131) <sup>**</sup>	25.1065 5.4107 19.6958	19.2692
	5,180,0	90	14	1.3720 (3.2471) <sup>**</sup> (0.5041)	0.2403 (0.1258) (-0.7568)	0.7444	0.7143	1.1317 (0.8998)	20.7725 4.5964 16.1761	15.7576
	5,180,0.01	90	13	1.3766 (3.2567) <sup>**</sup> (0.5138)	0.1915 (0.0928) (5.1627) <sup>**</sup>	0.7444	0.6923	1.1851 (-2.6349) <sup>*</sup>	20.8560 4.4214 16.4346	16.0201
	Average			1.4794	0.1409					
1982-1987	5,60,0	71	71	0.9388 (1.6794) <sup>1</sup> (1.5666) <sup>2</sup>	-1.1762 (-1.4053) <sup>1</sup> (-1.2276) <sup>2</sup>	0.5211	0.3944	2.1151 (2.0228) <sup>3</sup>	6.5792 -9.3882 15.9674	15.4912
	5,60,0.01	62	64	1.4112 (2.4135) <sup>*</sup> (2.0532) <sup>*</sup>	-1.1558 (-1.2646) (9.5031) <sup>**</sup>	0.5806	0.4063	2.5670 (-2.4391) <sup>*</sup>	10.0522 -7.7983 17.8505	17.4279
	5,120,0	69	67	0.5726 (0.7649) (1.0681)	-0.7303 (-0.9810) (-0.6211)	0.5362	0.3731	1.3029 (1.2193)	2.0544 -3.6251 5.6795	5.2234
	5,120,0.01	68	61	0.6991 (0.9298) (1.2245)	-0.6796 (-0.8494) (7.9796) <sup>**</sup>	0.5441	0.3934	1.3787 (-0.0433)	3.3933 -2.3783 5.7716	5.3390
	5,180,0	65	65	0.6580 (0.8515) (1.1463)	-0.6630 (-0.9015) (-0.5268)	0.5538	0.3538	1.3210 (1.2088)	2.5984 -2.6516 5.2500	4.8140
	5,180,0.01	61	62	0.6470 (0.7883) (1.0983)	-0.7770 (-1.0204) (7.7297) <sup>**</sup>	0.5410	0.3548	1.4240 (0.3683)	2.0472 -3.4985 5.5458	5.1333
	Average			0.8211	-0.8636					
1988-1993	5,60,0	102	40	1.2544 (3.1665) <sup>***</sup> (0.4180) <sup>2</sup>	0.5377 (0.6359) <sup>1</sup> (-0.7893) <sup>2</sup>	0.6275	0.6250	0.7167 (0.9074) <sup>3</sup>	15.1259 9.7831 5.3427	4.8666
	5,60,0.01	92	31	1.3246 (3.0852) <sup>**</sup> (0.5527)	0.0524 (0.0523) (5.8540) <sup>**</sup>	0.6304	0.6129	1.2723 (-1.6524)	14.1126 6.4692 7.6434	7.2310
	5,120,0	103	33	1.0608 (2.5031) <sup>*</sup> (-0.0286)	0.4802 (0.5724) (-0.7957)	0.6214	0.6061	0.5806 (0.6856)	12.0125 8.8398 3.1726	2.7166
	5,120,0.01	96	28	0.9991 (2.2536) <sup>*</sup> (-0.1660)	0.5593 (0.5647) (5.1594) <sup>**</sup>	0.6042	0.5714	0.4399 (-0.9854)	9.7876 8.8085 0.9792	0.5634
	5,180,0	102	28	1.0756 (2.5914) <sup>**</sup> (0.0055)	0.8533 (0.8814) (-0.2722)	0.6373	0.5714	0.2223 (0.2461)	12.0864 10.1805 1.9059	1.4699
	5,180,0.01	102	27	1.0798 (2.6011) <sup>**</sup> (0.0153)	0.9236 (0.9212) (5.0306) <sup>**</sup>	0.6373	0.5926	0.1562 (-1.1094)	12.1587 10.3548 1.8038	1.3713
	Average			1.1324	0.5677					
1994-1999	5,60,0	70	73	0.8664 (1.5223) <sup>1</sup> (1.4390) <sup>2</sup>	-1.0298 (-1.0862) <sup>1</sup> (-0.9130) <sup>2</sup>	0.5857	0.4247	1.8962 (1.7065)	4.2013 -6.6219 10.8232	10.3437
	5,60,0.01	65	66	1.0103 (1.7196) (1.5598)	-1.3018 (-1.2573) (-1.1955)	0.6000	0.4091	2.3121 (1.9919) <sup>*</sup>	5.0381 -8.4123 13.4504	13.0111
	5,120,0	66	71	0.2971 (0.5063) (0.7178)	-0.5852 (-0.6007) (-0.3500)	0.5152	0.5070	0.8823 (0.7768)	-2.6384 -1.0177 -1.6207	-2.0801
	5,120,0.01	64	66	0.4346 (0.7248) (0.8694)	-0.6462 (-0.6256) (-0.4110)	0.5313	0.5000	1.0809 (0.9275)	-1.2709 -1.2015 -0.0694	-0.5054
	5,180,0	70	61	0.2921 (0.5323) (0.7321)	-0.9338 (-0.8308) (-0.7271)	0.5429	0.4590	1.2259 (1.0536)	-2.4992 -3.5862 1.0870	0.6477
	5,180,0.01	67	56	0.4054 (0.7243) (0.8535)	-1.1686 (-0.9650) (-0.9576)	0.0448	0.4464	1.5740 (1.3088)	-1.3800 -5.0003 3.6204	3.2079
	Average			0.5510	-0.9442					

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

Appendix 5: Test Results of Trading Range Breakout Rules

Period	Test	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-sell	Profit <sup>(a)</sup>	Profit <sup>(a)</sup>
1977-1981	1,60,0	27	1	1.0509 (1.6280) <sup>1</sup>	-7.1073 n/a	0.7407	0.0000	8.1583 (1.8300) <sup>3</sup>	1.7515 2.5020	-0.8632
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,60,0.01	8	1	0.2042 (0.1341) (-0.5967)	-7.1073 n/a (-1.8811)	0.7500	0.0000	7.3115 (1.5746)	-3.5967 2.5020 -6.0988	-6.1350
				(-0.0919)	n/a			n/a	n/a	
	1,120,0	25	0	1.0496 (1.5058)	n/a n/a	0.7200	n/a	n/a n/a	1.3247 n/a	n/a
				(-0.0919)	n/a			n/a	n/a	
	1,120,0.01	8	0	0.2042 (0.1341) (-0.5967)	n/a n/a n/a	0.7500	n/a	n/a n/a n/a	-3.5967 n/a n/a	n/a
				(-0.0919)	n/a			n/a	n/a	
	1,180,0	23	0	1.0751 (1.4250)	n/a n/a	0.7391	n/a	n/a n/a	1.0218 n/a	n/a
				(-0.0606)	n/a			n/a	n/a	
	1,180,0.01	8	0	0.2042 (0.1341) (-0.5967)	n/a n/a n/a	0.7500	n/a	n/a n/a n/a	-3.5967 n/a n/a	n/a
				(-0.0919)	n/a			n/a	n/a	
	Average			0.6314	n/a					
1982-1987	1,60,0	16	15	1.0097 (0.9647) <sup>1</sup> (0.8071) <sup>2</sup>	-2.6112 (-1.4711) <sup>1</sup> (-1.4569) <sup>2</sup>	0.4375	0.3333	3.6209 (1.6165) <sup>3</sup>	-1.8378 -1.9975 0.1597	0.0558
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,60,0.01	3	5	1.0228 (0.3785) (0.3546)	-6.4529 (-1.5821) (-2.2199)*	0.3333	0.2000	7.4757 (1.6424)	-4.0190 -0.8470 -3.1720	-3.1988
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,120,0	14	13	1.4600 (1.2766) (1.0245)	-2.2952 (-1.1668) (-1.1752)	0.5000	0.3077	3.7552 (1.5642)	-1.1239 -0.4425 -0.6813	-0.7719
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,120,0.01	3	5	1.0228 (0.3785) (0.3546)	-6.4529 (-1.5821) (-2.2199)*	0.3333	0.2000	7.4757 (1.6424)	-4.0190 -0.8470 -3.1720	-3.1988
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,180,0	12	11	1.5849 (1.1995) (1.0183)	-1.0606 (-0.5228) (-0.4272)	0.5000	0.3636	2.6455 (1.0168)	-1.3606 2.5860 -3.9466	-4.0237
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,180,0.01	3	3	1.0228 (0.3785) (0.3546)	-4.6979 (-0.7033) (-1.2335)	0.3333	0.3333	5.7207 (1.1241)	-4.0190 2.1815 -6.2005	-6.2206
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	Average			1.1872	-3.9285					
1988-1993	1,60,0	28	1	1.3692 (1.8205) <sup>1</sup> (0.3664) <sup>2</sup>	0.2933 n/a (-0.1841) <sup>2</sup>	0.6071	1.0000	1.0759 (0.2497) <sup>3</sup>	0.1908 6.2475 -6.0567	-6.1539
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,60,0.01	6	0	1.9501 (1.9435) (0.5077)	n/a n/a n/a	0.6667	n/a	n/a n/a n/a	-4.2485 n/a n/a	n/a
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,120,0	20	1	1.0221 (1.1142) (-0.0517)	0.2933 n/a (-0.1838)	0.6000	1.0000	0.7288 (0.1681)	-2.7915 6.2475 -9.0390	-9.1094
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,120,0.01	6	0	1.9501 (1.9435) (0.5077)	n/a n/a n/a	0.6667	n/a	n/a n/a n/a	-4.2485 n/a n/a	n/a
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,180,0	17	1	0.9412 (0.9196) (-0.1261)	0.2933 n/a (-0.1838)	0.6471	1.0000	0.6479 (0.1488)	-3.5318 6.2475 -9.7793	-9.8396
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,180,0.01	6	0	1.9501 (1.9435) (0.5063)	n/a n/a n/a	0.6667	n/a	n/a n/a n/a	-4.2485 n/a n/a	n/a
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	Average			1.5305	n/a					
1994-1999	1,60,0	14	13	2.4023 (2.4400) <sup>1*</sup> (1.5165) <sup>2</sup>	0.6873 (0.3485) <sup>1</sup> (0.5350) <sup>2</sup>	0.7143	0.4615	1.7150 (0.6703) <sup>3</sup>	-0.3017 7.3961 -7.6978	-7.7883
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,60,0.01	5	8	1.9813 (1.2997) (0.7675)	0.5763 (0.2190) (0.3732)	0.6000	0.3750	1.4050 (0.3710)	-4.2559 6.6754 -10.9313	-10.9749
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,120,0	10	7	3.0989 (2.5743)* (1.6140)	0.8077 (0.3061) (0.4412)	0.7000	0.5714	2.2912 (0.6999)	-0.7422 6.8494 -7.5915	-7.6485
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,120,0.01	4	4	3.2168 (2.7910)** (1.058)	-2.2618 (-0.7245) (-0.5890)	0.7500	0.2500	5.4786 (1.1664)	-3.7625 4.3992 -8.1616	-8.1885
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,180,0	7	6	3.1580 (1.9281) (1.3752)	0.7252 (0.2324) (0.3782)	0.7143	0.5000	2.4328 (0.6583)	-2.2227 6.6322 -8.8548	-8.8984
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	1,180,0.01	2	3	1.7581 (0.9139) (0.4384)	-1.9343 (-0.4405) (-0.4250)	0.5000	0.3333	3.6924 (0.6089)	-5.3210 4.9399 -10.2608	-10.2776
				(-0.0939) <sup>2</sup>	(-1.8811) <sup>2</sup>				-0.7505	
	Average			2.6026	-0.2333					