EFFECTIVENESS OF INVESTMENT STRATEGIES BASED ON MACD INDICATOR: EVIDENCE FROM THE STOCK EXCHANGE OF THAILAND

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ABSTRACT

This paper identifies the most effective investment strategies applying the MACD indicator in the Stock Exchange of Thailand (SET). Among technical analysis indicator, it is known that MACD is the most effective momentum indicator. The data cover a period from January 2007- December 2015. Four investment strategies investigated include the main trend-following momentum indicator (or called main system); the main system with fund flows; main system with relative strength to SET; and main system with both fund flows and relative strength to SET. This paper found that all four strategies being tested, all perform better than "buy and hold" strategy or investing SET index. Among the four strategies tested, Strategy 4 yields the most effective results in higher annual return, but at the same time, it shows the highest average percentage loss.

Keywords: Technical analysis, MACD indicator, investment strategy, Stock Exchange of Thailand (SET)

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Introduction

Two types of analyses investors often use to analyze any particular security; the fundamental analysis and technical analysis. Investors apply fundamental analysis to observe how the economic conditions, the industry and the company's performance may affect the firm's future stock price. While investors apply technical analysis to observe historical data, trends, identify the patterns of stock price, and on proxies for buy or sell signal in the market (Bodie, Kane, & Marcus, 2009; Meissner, Alex, & Nolte, 2001; Vasiliou, Eriotis, & Papahanasiou, 2006).

Moving Average Convergence Divergence (MACD), developed by Gerald Appel during the late 1970s, is currently one of the most well-known technical indicators, used by investors globally due to its predictive power and are easy to interpret (Appel, 2005). By comparing the exponential moving average (EMA) of different periods, MACD can indicate changes in the trend of stock prices.

The objective of this research is to identify the most effective investment strategies with MACD indicator in the Stock Exchange of Thailand (SET). This research aim to apply MACD indicator to identify a strategic portfolio, on all the stocks within the SET market. This research apply MACD with four strategies; first, this study observes how well the strategy with MACD application performs by itself. Second, the strategy adds another condition into it, the fund flows effect. Third strategy adds the relative strength to the SET index effect condition; we investigate the effects of the performance of the portfolio. Fourth and last strategy combines both conditions, the fund flows and the relative strength to the SET index.

Literature Review

Among the investment theories, which lay the ground of technical analysis, this research emphasizes on the two most well-known theories in the market. These are the Dow Theory, and the Efficient Market Hypotheses (EMH).

The Dow Theory: Most of investors and researchers know the Dow Theory, which tracks stock market movements, from Dow's successor, William Peter Hamilton. According to Brown, Goetzmann, and Kumar (1998), six principles in the Dow Theory were summarized as follows:

1. The market has three movements. First, the main movement is the primary or the main trend. Second, medium swing is the intermediate reaction, which may retrace about 33% to 66% of the main movement. Third, short swing movements or the daily fluctuations, which are the minor movements.

2. Market trend has three phases; these are, an accumulation phase, a public participation phase, and a distribution phase. The first phase, accumulation phase begins when investors are actively buying stock against the general opinion of the market. During this phase, stock price is mostly unchanged, since these investors are in the minority demanding (absorbing) stock that the market at large is supplying (Releasing). Eventually, when the market catches on the price of the stock change very rapidly into the next phase, public distribution phase. Last, when market reaches the distribution phase, it is the time when investors sell their stocks.

3. The stock market discounts all news, once news enters the market, stock price will adjust to reflect this new information.

4. The stock market averages must confirmed each other. This means that the averages have to move in the same direction in order to confirm the information. When the moving average are not moving in the same direction, it implies that some changes may occurred.

5. Trends are confirmed by volume. Price movements are always confirmed by high volume, which represents the true market view.

6. Trends exist until definite signals prove that they have ended.

Efficient Market Hypothesis (EMH): EMH made two important predictions (Bodie et al., 2009; Fama, 1970). First, EMH implies that stock prices fully reflect the information that is available to investors. Second, because prices adjust rapidly, therefore active investors will find it uneasy to outperform the passive strategies (buy and hold of market indexes). Market participants distinguish among three forms of the EMH, which are; weak form,

semi-strong form and strong form. Weak-form states that all historical information is fully reflected in stock prices. The semi-strong form states that prices adjust rapidly according to all publicly available information. The strong form states that all information sources including public and inside information is reflected in the stock price (Fama, 1970). If the EMH holds true, fundamental and technical analyses are unable to beat the market, as information must have already been reflected in stock prices. In such condition, investors should buy and hold to get capital gain through the actual growth of the company. In fact, an absolute strong form of EMH does not exist, and information technology has allowed investors to have an access to information quickly and at insignificant cost, thus when the market prices adjust to new information, investors may have chance to derive abnormal profits from adjustment errors.

Previous studies in related to the application of technical analysis are active globally (Bessembinder & Chan, 1995; Brock, Lakonishok, & LeBaron, 1992; Fama & Blume, 1966; Hejase, Srour, Hejase, & Younis, 2017; Ling & Abdul-Rahim, 2017; Tam & Cuong, 2018; Tharavanij, Siriprapasiri, & Rajchamaha, 2015). Most studies came across the important implication of an efficient market in the weak form that the technical analysis will no longer relevant in stock trading (Hejase et al., 2017; Ling & Abdul-Rahim, 2017; Vasiliou et al., 2006). Brock et al. (1992) tested the daily data of Dow Jones Industrial Average (DJIA) Index using two simple technical analysis tools, which are the moving averages and trading-range breaks; they claimed that the results obtained from using the two techniques support the use of technical analysis in the market. Hudson, Dempsey, and Keasey (1996), replicated the process using the United Kingdom data and found that there is a weak form efficiency of financial market. Alexeev and Tapon (2011) also found that Toronto Stock exchange is another evidence of weak-form efficiency. Further, evidences of technical trading rules from Southeast Asian markets found that with technical trading rules suggested that Singapore, Indonesian, Thailand, the Philippines, and Malaysian stock markets are efficient in weak form but to a varying degree. (Ling & Abdul-Rahim, 2017; Tharavanij et al., 2015; Yu, Nartea, Gan, & Yao, 2013). Ratner and Leal (1999) tested the potential profit of technical trading strategies in ten emerging markets of Latin American and Asia and found that there are three countries; namely, Taiwan, Thailand, and Mexico, where technical trading strategies may be profitable. Moving Average Convergence Divergence (MACD) indicator is a trend-following momentum indicator, which shows the difference between two movements of the exponential moving average (EMA), the 26-day EMA and the 12-day EMA; where another line called signal line is a 9-day EMA. Investors use MACD look for crossover of these two lines. Generally speaking, the crossover signal, centerline crossovers, and divergences to generate signal to buy and sell. Anghel (2015) evaluated stock markets of 75 countries of the world with MACD indicator; he found that 34 inefficient markets are detected with MACD, and evidenced that EMH cannot be rejected. Kulkarni and More (2014) analyze whether investors can make an abnormal return on selected stocks from the Bombay Stock Exchange on the application of MACD indicator. They proved that MACD is extremely useful for trading decisions with precautionary vision to minimize loss. Meissner et al. (2001), tested MACD indicator and derived to one new version of MACD, called MACDR2 of which they extended the number of days applied in EMA calculation. Their results showed that both traditional MACD and MACDR2 may outperform the market, although with low success rate. As such, MACD works best when markets have strong trends, but are not effective when markets are sideways or has unpredictable path.

Methodology and Data

This study gathered data from Stock Exchange of Thailand. This research tested for all stocks in the SET market, from January 2007 through December 2015. We assumed an initial investment in our portfolio was THB 1,000,000. We collected the daily closing price; as a result, there was only one signal at the end of the day.

Further, this study assumed the commission expense fee for 0.16% for each transaction, thus round-trip transaction was 0.32%. The transacted price is the opening price for the next day once there is the buy or sell signal. We only bought in 100 round lots, and we did not buy fractions of shares. We added a random number for each transacted transaction between 0% to 5% on top of the transacted price. This accounts for the slippage that could occur in the real market. If it is the buy transaction, the buy price transacted could be as high as 5% more than the next day opening price after the buy signal is triggered at the end of the previous day. If it is the sell transaction, the sell price transacted could be as low as 5% less than the next day opening price after the sell signal is triggered at the end of the previous day.

In term of position sizing, this study decided to invest only in 20 securities at a time in the research's portfolio. In other words, for each buy signal, we bought only up to 5% of the portfolio.

For controlling liquidity, although our investable universe is the SET market, we decided to invest only in the stock that has the 5-day average trading volume greater than THB 3,000,000. The rationale is to control liquidity problem that may cause slippage when getting in and out of the security. Additionally, we controlled for our position sizing by buying up to only 3% of the stock's daily trading volume on the signaled day for any transacted position. That is, if on the day that the buy-signal is called at the end of the day, we tested to see first if our buy position, which is 5% of our portfolio is greater than 3% of the trading volume on that day or not. If it is, then, we will only buy up to 3% of the trading volume as calculated on the signaled day. Since this research focuses on identifying the effectiveness of strategy with MACD to create a portfolio, four strategies are examined as follows:

Strategy 1: Main System
Our first strategy uses the Moving Average Convergence Divergence (MACD) signal, which is a trend-following momentum indicator. This MACD indicator is calculated from the difference between the two Exponential Moving Averages (EMA), one is the short-12 days, and the other one, the long-26 days. Then, the signal is calculated from the EMA of the MACD itself. Both the signal and MACD can be in negative or positive number. Once the signal crosses above the zero line, it signals a buy. Once the signal crosses below the zero line, it signals a sell.

Strategy 2: Main System with Fund Flows
This study decided to use fund flows effect incorporated in our main system. In the commodities futures market, fund flows are one of the important condition to look for when trading. It is observed through the open interest. As the trend begins and open interest rises, this signals a commitment from investors, which indicates that the trend should continue (Murphey, 1999). For stocks, there are no open interests, however, the rising in volume during the beginning of any trend, either uptrend or downtrend, confirms a beginning of a trend (Pring, 2014). As a result, we decided to compare the 20-day simple moving average of the volume with the 60-day simple moving average of the volume of our interested stock. If the 20-day volume is greater than the 60-day, while our main system signals the buy, then this system will signal a buy.

Strategy 3: Main System with Relative Strength to the SET Market
Third strategy is to test stock's relative strength to the SET market. The famous cup and handle pattern strategy is also another variant of this strategy. O'Neil (2009) stated that the winning stock should display the correction less than the market and rises faster and higher than the market. In other words, it should have the relative strength better than the market during both the rising market and the correction market. Correspondingly, we incorporate this idea by calculating the rate of change for the stock and the SET market for the past 10 days, then compare it with each other. This study called for Relative Strength Comparison (RSC) to the SET market. If RSC is positive, it means that the stock has relative strength better than the market's. If RSC is negative, it means that the stock has relative strength worse than that of the market. For the third strategy, if our main system signals a buy while

the RSC is positive, then this third strategy will signal a buy. To signal a buy, both the condition must be present at the same time.

Strategy 4: Main System with Both of the Conditions, Fund Flows and Relative Strength to the SET Market

This study tested for another strategy where this strategy will incorporate the fund flows signal and the RSC signal at the same time. Under this strategy, for this system to signal a buy, the main system and the other two conditions, fund flows and RSC must also be presented at the same time. For sell and exist strategy, this research only deployed the sell signal for stocks in all strategies once the MACD signal crosses below the zero line.

The Simulation Set Up

Once we run each strategy testing, each buy signal from the strategy will cause us to buy the particular stock the next opening day. Our system will only buy up to 20 securities at a time, holding each position about 5% of the portfolio. With this limitation, we expect that there should be several buy signals occurring during the last round of buy; where there is not enough money left to buy. As a result, we used the ranking strategy to rank all the buy signaled stocks in the last round. We ranked it according to liquidity. The ranking is calculated by using the trading value of the signaled day to the 20-day simple moving average of the trading value for each signaled stock. The ones with the higher rank should signifies higher current liquidity. For this reason, it will be chosen.

Monte Carlo Simulation

The research ran Monte Carlo simulation on all the buy-signals, which means in each run of our tested portfolio, the stocks that we hold can be different because for each buy-signals that is generated, were randomly choose to invest in the stock. The missing trade factor is 10% applied in the Monte Carlo. This indicates that at minimum, the portfolio run in the simulation will be different from each other by more than 10% because once the bought securities differs among the portfolios, the timing of each sell of the stock. Then we buy again once any new buy signal is called for will shift the portfolio away from each other. In this study, we ran 300 runs of Monte Carlo simulation.

Holding Period of the Simulation

Since the study observed the performance for each year, thus, we decided to run the simulation from the beginning of each year then liquidate the portfolio at the end of every year to see the annual performance for each of the strategies. We run this simulation for each year from year 2007 until year 2014.

Empirical Results and Discussion

We analyzed the following parameters in our simulation for each strategy, Annual Return (AR), Maximum Draw-Down (MDD), number of trades, percentage of the winning trades, average percentage profit of the winning trades, average percentage loss of the losing trades, and the AR/MDD. The annual return is the performance of the portfolio calculated annually. The maximum drawdown is the maximum loss from peak to trough of a portfolio in a given year. This is an indication of the downside risk. We calculated the risk to reward ratio, which is AR/MDD (Faith, 2007). We compare each strategy by each of the parameters. The results for are shown in the following tables. We also show the box plot for each of the strategy's annual return to see the distribution of the return for the tested years.

Table 1   Percentage Annual Return (AR) of the Portfolio

% Annual Return (AR)					
Year	SET Market	Strategy 1	Strategy 2	Strategy 3	Strategy 4
2007	26.22	17.13	19.83	20.44	28.79
2008	-47.56	(16.50)	(4.20)	(16.87)	(2.30)
2009	63.25	64.58	78.69	73.19	80.30
2010	40.60	37.84	44.38	32.90	35.65
2011	-0.72	7.58	10.39	6.25	11.09
2012	35.76	60.19	67.35	61.58	73.54
2013	-6.70	(20.27)	(12.96)	(26.02)	(14.00)
2014	15.32	9.96	0.36	14.30	3.41
Average	15.77	20.07	25.48	20.72	27.06

Table 2   Percentage Maximum Drawdown of the Portfolio

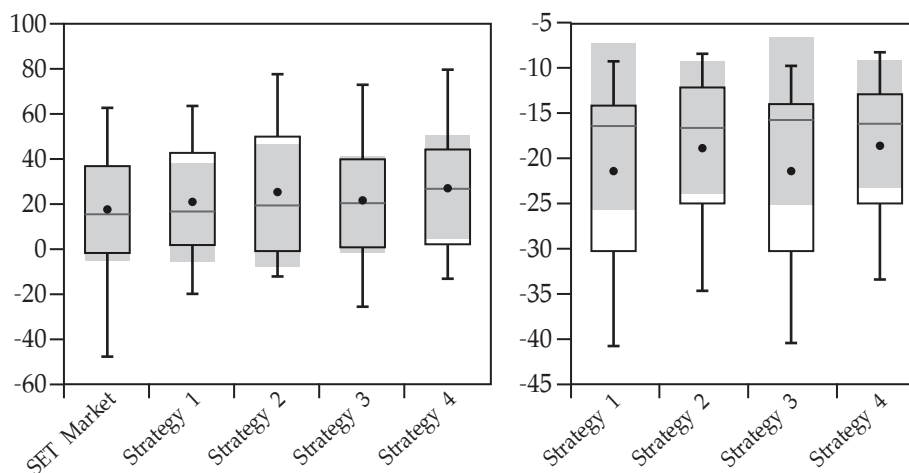| % Maximum Drawdown (MDD)				
Year	Strategy 1	Strategy 2	Strategy 3	Strategy 4
2007	(14.13)	(15.59)	(13.58)	(15.24)
2008	(40.23)	(34.79)	(40.60)	(33.42)
2009	(15.66)	(12.31)	(14.23)	(12.05)
2010	(13.93)	(11.82)	(15.24)	(13.43)
2011	(17.06)	(17.77)	(16.11)	(16.77)
2012	(9.04)	(8.28)	(9.52)	(8.00)
2013	(40.81)	(32.46)	(40.21)	(32.38)
2014	(20.61)	(17.64)	(20.23)	(17.84)
Average	(21.44)	(18.83)	(21.22)	(18.64)

Figure 1   Percentage Annual Return (AR) Box Plot (Left), and Maximum Draw Down Box Plot (Right)

From the Table 1 and 2, and Figure 1, they showed combining both the conditions, fund flows and RSC into our main strategy, which indicates that "Strategy 4" yields the best results almost every year compared to other strategies. Besides having the lowest MDD on average and higher annual return on average, the distribution of the returns and MDDs for "Strategy 4" are skewed towards the positive side, which indicates a higher possibility for a better performance than other strategies tested in this research. All strategies have a higher annual return on average compared to the SET market's annual return. Moreover, all four strategies possess a positively skewed annual return, while the SET market possess a negatively skewed annual return distribution over the sample years. This shows that the strategies tested in this research help reduce the downside risk of the portfolio compared to just investing in the SET market index.

Table 3   Total Number of Trades in 1 Year

Number of Trades in 1 Year				
Year	Strategy 1	Strategy 2	Strategy 3	Strategy 4
2007	151.39	119.84	142.48	104.57
2008	168.94	128.58	165.22	120.99
2009	120.26	87.48	113.87	77.20
2010	144.03	114.21	141.70	105.91
2011	153.25	117.04	150.92	111.93
2012	125.99	107.30	117.16	95.05
2013	175.30	139.52	173.55	130.73
2014	152.86	137.08	147.13	122.57
Average	**149.00**	**118.88**	**144.00**	**108.62**

Table 4   Percentage of Winners within the Total Buys

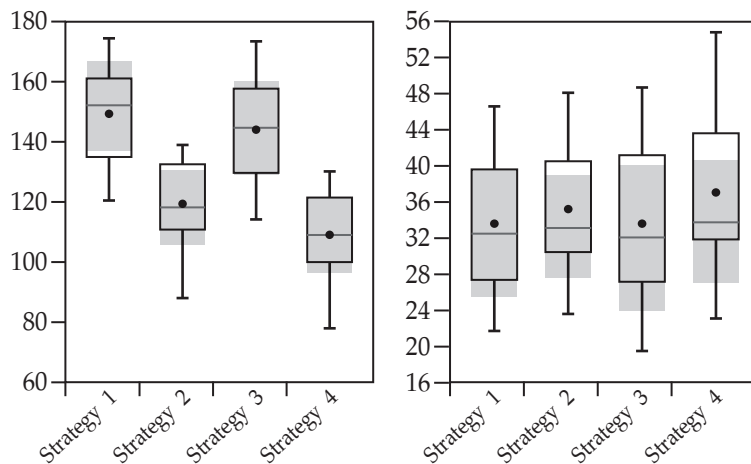| % of Winners in the Total Buys				
Year	Strategy 1	Strategy 2	Strategy 3	Strategy 4
2007	35.68	33.99	37.36	34.34
2008	26.04	30.85	25.70	32.06
2009	46.63	48.15	48.86	54.91
2010	35.62	39.21	33.80	41.29
2011	28.53	32.35	28.13	33.22
2012	43.94	41.93	45.05	45.97
2013	21.66	23.24	19.22	23.01
2014	29.19	29.87	30.22	31.31
Average	**33.41**	**34.95**	**33.54**	**37.02**

Figure 2 Number of Trades in one Year Box Plot (Left) and Percentage of Winners in the Total Buys Box Plot (Right)

Table 3 until 7 show the different measurements we analyze for each strategies for each year. The measurements we analyze for each strategy are the number of trades, the percentage of winners, average percent profit, average percent loss, and reward to risk ratio. We did not show these measurements for SET because the assumption for investing in the SET market is buy and hold. So, we always buy the January 1st SET index and hold it until December 31st of the year and sell it. As a result, these measurements are inapplicable for the SET index.

From Table 3 and 4, and Figure 2, we can conclude that the best strategy, "Strategy 4", has the lowest number of trades and the highest percentage of winners to the total buys. This is due to the filtering of the buy signal by adding the condition for the fund flows and for the relative strength to the SET market. As expected, the percent win hoovers around 30% to 40% for trend following strategies. Interestingly, Strategy 2 and Strategy 3, where we add just one filtering condition to each strategy, do not perform as well as we expected them to be. Especially for Strategy 3, having the relative strength higher than that of SET market performs similar to our main strategy, Strategy 1, which leaves us to question the market manipulation by some local players. In other words, the local players can manipulate the stock they control to make it

seem that this stock should be a buy because it fits every signal of the traders. However, if there is no real money supporting real fundamentals flow in, this stock will not soar and will come back to the price where it belongs. As a result, Strategy 3 will have the performance that is very close to Strategy 1, which is our main strategy without any filtering condition.

For strategy 4, we are incorporating the filtering of the buy signal by adding the fund flows condition, which is strategy 2, and adding the relative strength to the SET market, which is strategy 3. With these two additional filtering conditions, the false signals can be eliminated. Strategy 2 alone can results in false signals because at certain times the whole market is quite and has little activity. However, once the market starts to have activities, it will be for almost all of the stocks. With this situation, strategy 2 will be triggered for several stocks, but that doesn't mean that these stocks will perform well. As a result, applying only strategy 2 can be misleading.

Applying only strategy 3 can also be misleading as mentioned earlier. Hence, combining strategy 2 and strategy 3, into strategy 4, can help exclude the stocks that are manipulated by local traders and also exclude the stocks that are only triggered by the market movement but are not true winners.

Table 5   Average Percentage Profits for Winning Trades

Average % Profit for Winning Trades				
Year	Strategy 1	Strategy 2	Strategy 3	Strategy 4
2007	16.64	24.10	17.90	30.14
2008	18.26	17.88	19.39	18.37
2009	34.92	55.23	37.46	53.16
2010	27.42	31.42	29.48	29.35
2011	19.20	18.84	19.23	19.11
2012	27.13	35.39	28.22	37.80
2013	17.31	18.76	14.15	18.95
2014	22.78	17.21	24.07	19.29
Average	**22.96**	**27.35**	**23.74**	**28.27**

Table 6   Average Percentage Profits (Loss) for Losing Trades

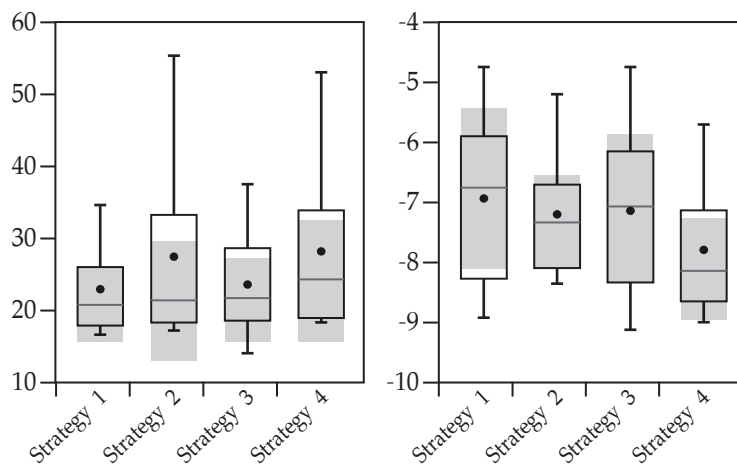| Average % Profit (Loss) for Losing Trades				
Year	Strategy 1	Strategy 2	Strategy 3	Strategy 4
2007	(5.57)	(7.37)	(5.93)	(7.76)
2008	(8.80)	(8.36)	(9.05)	(8.61)
2009	(8.92)	(8.14)	(9.13)	(8.99)
2010	(6.72)	(7.27)	(7.20)	(8.68)
2011	(6.19)	(6.21)	(6.29)	(6.56)
2012	(4.73)	(5.15)	(4.74)	(5.68)
2013	(7.73)	(8.02)	(7.61)	(8.47)
2014	(6.76)	(7.11)	(6.94)	(7.66)
Average	**(6.93)**	**(7.20)**	**(7.11)**	**(7.80)**

Figure 3   Average Percentage Profit for the Winning Trades Box Plot (Left) and Average Percentage Profit (Loss) for the Losing Trades Box Plot (Right)

From Table 5 and 6, and Figure 3 show the results for the average percentage of profits for the winning trades and the average percentage of profits (loss) for the losing trades. The average percentage of profits are as we expected it. Our best strategy, Strategy 4, has the highest and positively skewed.

These new findings shows that the average percentage loss for the losing trades are not what we expected it to be. Although positively skewed, the distribution of the loss for Strategy 4 is concentrated to be lower than that of other three strategies.

Table 7   Reward to Risk Ratio (AR/MDD)

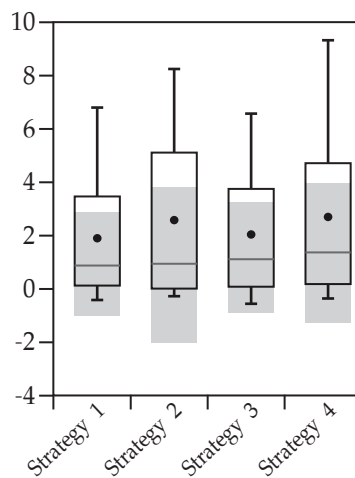| Reward to Risk Ratio (AR/MDD)			
Year	Strategy 1	Strategy 2	Strategy 3	Strategy 4
2007	1.22	1.28	1.52	1.91
2008	(0.41)	(0.12)	(0.41)	(0.07)
2009	4.17	6.40	5.16	6.68
2010	2.75	3.80	2.20	2.67
2011	0.46	0.59	0.40	0.67
2012	6.78	8.24	6.55	9.29
2013	(0.50)	(0.40)	(0.65)	(0.43)
2014	0.49	0.03	0.71	0.20
Average	1.87	2.48	1.93	2.62

Figure 4   Reward to Risk Ratio (AR/MDD) Box Plot

Table 7   and Figure 4 display the reward to risk ratio results for every strategy. The results are as expected. Our best strategy, Strategy 4, gives the highest ratio, 2.62.

Conclusion

According to our results within the sample testing period, it seems that we should use at least one of the four strategies instead of just investing in the SET market index, with buy and hold strategies. The annual return of all the strategies are higher than that of the SET market index. Moreover, we saw that the returns of all the strategies are positively skewed, while the SET market is negatively skewed. This is due to the exit strategies on all of our

trading systems.

Among all the four different systems we tested, the one with both of the filtering conditions, fund flows and higher relative strength to the SET market, performs the best. The second best is our Strategy 2, where it has only one filtering condition, the fund flows. Amazingly, Strategy 3, which has just one condition, the higher relative strength to the SET market, performs similarly to Strategy 1, which has no filtering at all. After all, if there is any market manipulation by local traders to provide the buy signal to all traders, that would be similar to having no filtering condition at all, which is Strategy 1. However, for Strategy 2, the money flowing into a stock is real. One cannot manipulate that. Unless, one has enough money to manipulate at a larger scale, which is not common to see in the Emerging Market stocks.

We reached the new finding, that although Strategy 4 is the best strategy, however, with the highest average percentage loss for the losing trades among all strategies. Despite all the rest of the parameters, Strategy 4 excel among the strategies. We believe that further studies need to examine more closely at this effect. As an example, instead of investing in only one-year period, researchers can simulate for a longer term, such as 2-year period, and begin the test every January of each year to see the results. Further studies should focus in implementing different exit strategies, such as ATR trailing stop, break low pattern, and MACD divergence system. Additionally, position sizing can be explore further through either Monte Carlo simulation or through the application of market volatility and Kelly's criterion for the best money management.

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