ISBN 978-1-84626-026-1
Proceedings of 2010 International Conference on Business, Economics and Tourism Management (CBETM 2010)
Singapore, 26-28 February, 2010

The Day-of-the-Week Effect in the Stock Exchange of Thailand (SET)

Phaisarn Sutheebanjard and Wichian Premchaiswadi [+]

Graduate School of Information Technology
Siam University
Bangkok 10163, Thailand

Abstract. This paper presents the results of a project that systematically investigated the effect of day-of-the-week on the Stock Exchange of Thailand (SET) index. The experiment was conducted by using daily SET Index data of 1,040 days from 4 January 2005 to 31 March 2009. The data on each single day of the week was tested by applying the same prediction function. The prediction function incorporates important economic factors such as the Dow Jones index, the Nikkei index, the Hang Seng index and the domestic Minimum Loan Rate (MLR). The tuning coefficients of each factor in this research were calculated by using the *two-membered* Evolution Strategies (ES) technique. The results provide empirical evidence that day-of-the-week has a significant effect on the SET index with the highest percent of prediction error on Monday and the lowest percent of prediction error on Friday.

Keywords: Calendar effects, Day-of-the-week effect, Stock Exchange of Thailand, Evolution Strategies

1. Introduction

An interesting area of research related to stock market returns is the presence of calendar anomalies. In recent years the testing for market anomalies in stock returns has become an active field of research in empirical finance. Among the most well-known anomalies are the January Effect and the day-of-the-week effect.

The studies on day-of-the-week effect have been ongoing since 1930 when Kelly [1] revealed the existence of a Monday effect on the US markets where the returns turned out to be negative. The day of the week patterns have been investigated extensively in different markets [2-7]. The average daily return of the market is not the same for each day of the week. The day of the week effect phenomenon resulted in a different return for each day of a week. This phenomenon of return can affect investors in deciding investment strategy, portfolio selection, and profit management.

There are some research works on the day-of-the-week effects for the Stock Exchange of Thailand. Their findings support the notion that stock returns depend on the day of the week. But there are different day of the week patterns. Some research results indicated that the returns are negative, on average, on Monday [4, 5], and other indicated that Monday has a significant positive return on average [6]. The purpose of this research is to present evidence on the day-of-the-week effects for the Stock Exchange of Thailand by applying the prediction function to each day in a week and evaluating the percent of error.

The remainder of this paper is organized as follows. Section 2 provides a brief description on the Stock Exchange of Thailand. Section 3 explains the data collected and the methodology utilized. The empirical findings are reported in Section 4. The final section provides a summary of the paper.

2. Background on The Stock Exchange of Thailand

[+] Corresponding author. *E-mail address*: mr.phaisarn@gmail.com, wichian@siam.edu.

Thai stock market in Th ailand officially started trading on Ap ril 30, 19 75. The index of the Stock Exchange of Thailand is called the SET Index. The SET Index is a composite market capitalization-weighted price index which com pares the current m arket value (CMV) of all listed common stocks with its m arket value on the base date of April 30, 1975 (Base Market Value or BMV), which was when the stock m arket was established. The initial value of the SET index on the base date was set at 100 points. The formula of the SET index calculation is as follows:

$$\text{SET Index} = \frac{\text{Current Market Value x 100}}{\text{Base Market Value}} \quad (1)$$

The SET index m ovement is depende nt on bot h gl obal and domestic economic factors [8-15]. The factors that i nfluence the SET index are the Dow Jo nes index, the Nikkei Index, the Hang Seng index, the Straits Times Industrial in dex, the ex change rate of the US dollar and th e Thai baht, the exchange rate o f Japanese yen and the Thai baht, the price of oil, the price of gold, the Minimum Loan Rate (MLR) and many others.

In 2005, Rimcharoen, et al. [12] us ed A daptive Evol ution Strategi es to predict the Stock Ex change of Thailand ind ex for the p eriod of January 2003 to D ecember 2 004. T he econom ic factors used in th eir experiment were the Do w Jones index, the Nik kei index, the H ang Seng i ndex, the price of gol d and t he MLR. The e xperimental results show that their m ethod can be used to forecast the Stock Exchange of Thailand index with an error less than 3%. The Function used by Rimcharoen et al. is shown in (2).

$$\begin{aligned} SET_{(t)} = {} & 2.3645 + 5.5208\sin^3[0.3138_{(t-1)}] - \\ & 1.5430 hangseng_{(t-1)} / -5.2054 mlr_{(t-1)} + \\ & 2.8360\cos^2[0.6246_{(t-1)}] * 4.6811\sin[0.3651_{(t-1)}] - \\ & 1.5380\cos^3[0.7522_{(t-1)}] - 1.1618\cos^3[0.7724_{(t-1)}] + \\ & 3.3228\sin^3[1.5317_{(t-1)}] - 2.4620\cos[0.6676_{(t-1)}] * \\ & 2.3144 mlr_{(t-1)} \end{aligned} \quad (2)$$

where (t) is today and (t-1) is yesterday.

They have eventually found that the SET index can be adequately explained by onl y two m ajor factors, the Hang Seng index and the MLR as (3) and the graph is shown in figure 1.

$$SET_{(t)} = \frac{-1.5430\, hangseng_{(t-1)}}{-5.2054\, mlr_{(t-1)}} \quad (3)$$

In 2009, Phai sarn and Wichian [15] applied (1+1) E volution Strategies to predict the SET index in the period of January 2003 to December 2004. There are four factors used in the prediction function; namely the Dow Jones index, the Nikkei Index, the Hang Seng index and the MLR. The prediction error is less than 2%. The prediction function of Phaisarn and Wichian is shown in (4) and the graph is shown in figure 2.

$$\begin{aligned} SET_{(t)} = {} & 0.86 SET_{(t-1)} + 0.021008 \times ((0.632529 DJ_{(t-1)} + \\ & 0.317615 NK_{(t-1)} + 0.156434 HS_{(t-1)}) / \\ & 0.509522 MLR_{(t-1)}) \end{aligned} \quad (4)$$

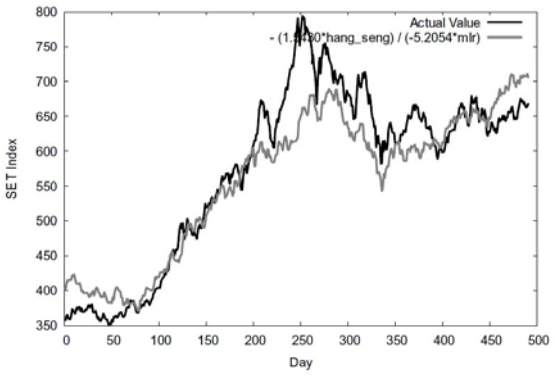

Figure 1. The graph of SET Index movement from 2003-2004 against equation (3) [12]

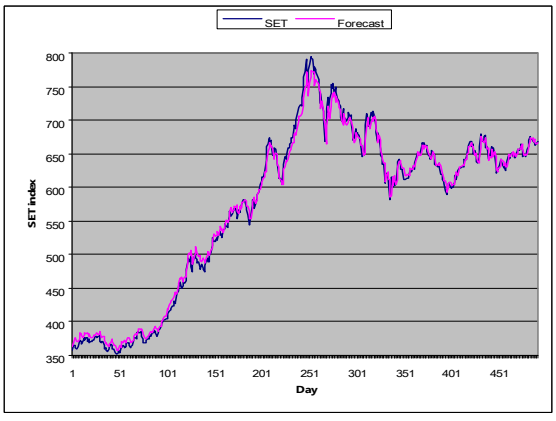

Figure 2. The graph of SET Index movement from 2003-2004 against equation (4) [15]

3. Data and Methodology

In predicting the SET index, the research used the function of Phaisarn and Wichian [15] as shown in (5) that is com posed of global and domestic factors, namely; Do w Jones inde x (New York), Nikkei in dex (Japan), Han g Seng index (Hong Kong), dom estic Minimum Loan Rate (MLR) and SET index (Thailand) itself. The ex perimental data were obtai ned from th e Bank of Thailand. Daily data on the SET index from January 2004 to December 2004 were used for the training phase and data from January 2005 to March 2009 was used for the testing phase.

$$SET_{(t)} = a_0 SET_{(t-1)} + a_1 \left(\frac{a_2 DJ_{(t-1)} + a_3 NK_{(t-1)} + a_4 HS_{(t-1)}}{a_5 MLR_{(t-1)}} \right) \tag{5}$$

where a_0-a_5 denote coefficients.

SET is SET index (Thailand)
DJ is Dow Jones index (New York)
NK is Nikkei index (Japan)
HS is Hang Seng index (Hong Kong)
MLR is Minimum Loan Rate (MLR)

The proposed m ethod appl ied the (1+1) Evol ution Strategies [16, 17] in the coefficient tuni ng process, and training and testing the data we re done on each individual day of the week. The intention of the resear ch was to find patterns of the SET index movement that was possibly influenced by the day of the week.

Evolution Strategies (ES) was introduc ed by Rechenberg [18]. Similar to Genetic Algorithm s, Evolution Strategies (ES) are algorithms which im itate the p rinciples of natural evolu tion as a method t o solv e parameter optimization problems. The concept is to use the princi ples of organic evolution processes as t he rules for optim um se eking procedures. The (1+1)-ES is a si mple mutation-selection sche me c alled *two-membered* ES. It is based upon a "population" consisting of one parent individual (a real val ued vector), and one descendant, created by m eans of adding normally distributed random nu mbers with identical standar d deviations. The resulting individual was evaluated by a fitness function and com pared to its parent, and the better of bot h indi viduals survives to become the parent of the next generation, while th e other one i s discarded.

This research used Mean Squared Error (MSE) as a fi tness function in order to minimize error of fitness between the prediction function and actual value as shown in (6).

$$MSE = \frac{1}{n} \sum_{t=1}^{n} \left(g_{(t)} - f_{(t)} \right)^2 \tag{6}$$

where $g_{(t)}$ is an actual value.
$f_{(t)}$ is a forecasted value
n is the number of data points.

In controlling the search strategy, an adjustment of standard deviation was considered and taken from the ratio of the better individual during th e evolution process, referred to as the 1/5 success rule [18] as shown in (7).

$$\sigma' = \begin{cases} \sigma / 0.817 & if\,(p > 1/5) \\ \sigma \cdot 0.817 & if\,(p < 1/5) \\ \sigma & if\,(p = 1/5) \end{cases} \tag{7}$$

This research used the Mean Absolu te Percentage Error (MAPE) to m easure the error, which is the difference between the forecasted value and actual value. MAPE expresses the error as a percentage. MAPE is commonly used i n quantitative forecasting m ethods because it produces a m easure of relative overall fi t. The absolute values of all the pe rcentage errors are su mmed up a nd the average is com puted. The MA PE function is shown in (8).

$$MAPE = \frac{\sum_{t=1}^{n} \left| \frac{g_{(t)} - f_{(t)}}{g_{(t)}} \right|}{n} \times 100 \tag{8}$$

where $g_{(t)}$ is an actual value.
$f_{(t)}$ is a forecasted value
n is the number of data points.

4. Experimental Results

In this experiment, the coefficients of (5) were computed using Evolution Strategies for 34,000 times on each individual day in the week. The lowest MAPE at each level of a_0 (weight of $SET\ index_{(t-1)}$) from 0.01 to 1.06 were selected as shown in figure 3. And at each level of a_0 from 0.91 to 1.04 were selected as shown in figure 4.

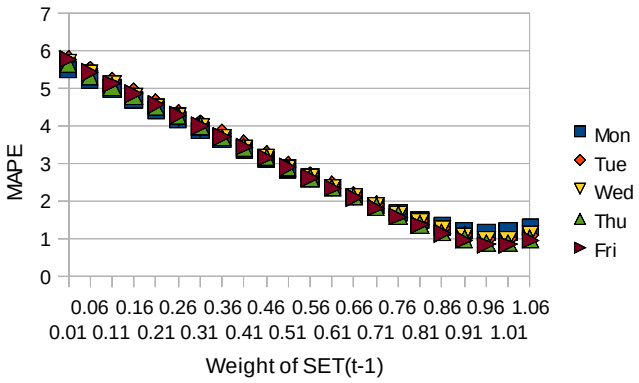

Figure 3. The lowest MAPE of each single day from equation (5) at different weight of SET $index_{(t-1)}$ scale from 0.01-1.06

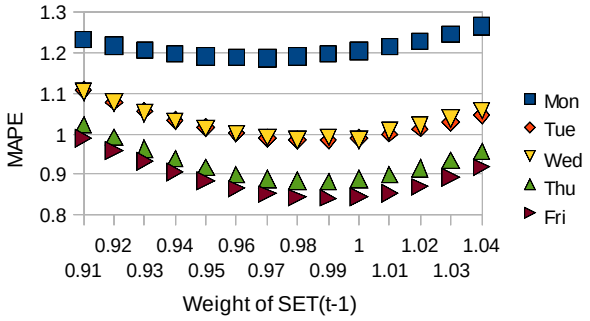

Figure 4. The lowest MAPE of each single day from equation (5) at different weight of SET $index_{(t-1)}$ scale from 0.91-1.04

In Figure 3, the MAPE of each single day is nearly the same for almost every level of a_0 from 0.01-1.06. But Figure 4 shows that at the finer scale of a_0 from 0.91-1.04, Monday has the highest MAPE and Friday has the lowest MAPE.

This study also tested the prediction function on all days in a week (Monday through Friday denoted as "Mon-Fri" in the figure). The result was compared to each individual day of the week as illustrated in figure 5. The MAPE from the test on all days in a week is in the middle of the graph, which indicates the average error. Therefore, it can be concluded that the prediction error on Monday is higher than average, on Tuesday and Wednesday the prediction errors are almost equal to the average and on Friday and Thursday the prediction errors are lower than the average.

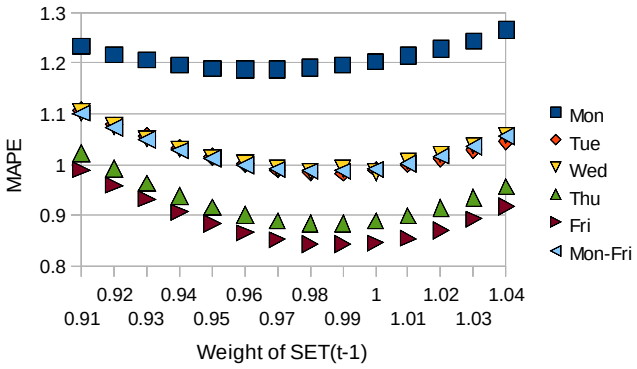

Figure 5. The lowest MAPE of each single day compare to everyday (denote as "Mon-Fri") from equation 5 at different weight of SET index(t-1) scale from 0.91-1.04

5. Conclusion

The primary objective of this paper was to investigate the day-of-the-week effect on an emerging stock market of Thailand. The results provide empirical evidence that the day-of-the-week effect is present in the Stock Exchange of Thailand (SET) returns data for the period of January 2005 to March 2009. The analysis was conducted by applying Evolution Strategies method to analyze the daily data from 4 January 2005 to 31 March 2009, 1040 days in total.

In this research, the prediction functions were employed to predict the SET index on Monday, Tuesday, Wednesday, Thursday and Friday. The results show that the percent of error is highest on Monday and

lowest on Friday. Thus, it can be concluded that the Day-of-the-Week had a significant effect on the Stock Exchange of Thailand index during the period of January 2005 to March 2009.

6. References

[1] Kelly, F., "Why You Win or Lose: The Psychology of Speculation," Boston: Houghton Mifflin, 1930.

[2] Christos S. Savva, Denise R. Osborn and Len Gill, "The Day of the Week Effect in Fifteen European Stock Markets," *Conference on High Frequency Finance*. University of Konstanz paper, available at http://www.uni-konstanz.de/micfinma/conference/Files/papers/Savva_Osborn_Gill.pdf

[3] Chiaku Chukwuogor-Ndu, "Stock Market Returns Analysis, Day-of-the-Week Effect, Volatility of Returns: Evidence from European Financial Markets 1997-2004," *International Research Journal of Finance and Economics*. 112-124, 2006

[4] Ravindra R. Kamath, Rinjai Chakornpipat and Arjun Chatrath, "Return distributions and the day-of-the-week effects in the stock exchange of Thailand," *Journal of Economics and Finance*. Volume 22, Numbers 2-3, June, 1998

[5] Hooi Hooi Lean, Russell Smyth and Wing-Keung Wong, "Revising Calendar Anomalies in ASIAN Stock Markets using A Stochastic Dominance Approach," *Journal of Multinational Financial Management*. Volume 17, April, 125-141, 2007

[6] Chris Brooks and Gita Persand, "Seasonality in Southeast Asian Stock Markets Some New Evidence on day-of-the-week Effects," *Journal Applied Economics Letters*, Volume 8, March, 2001

[7] Anwar, Yunita & Mulyadi, Martin Surya, "The day of the week effects in Indonesia, Singapore, and Malaysia stock market," *MPRA Paper, University Library of Munich*, Germany, 2009

[8] Tantinakom, T. "Economic Factors Affecting Stock Exchange of Thailand Index," *Master Thesis in Economics, Chiang Mai University*, Chiang Mai, Thailand, 1996

[9] Khumyoo, C. "The Determinants of Securities Price in the Stock Exchange of Thailand," *Master Thesis in Economics, Ramkhamhaeng University*, Bangkok, Thailand, 2000

[10] Chotasiri, S. "The Economic Factors Affecting the Fluctuation of The Stock Exchange of Thailand Index," *Master Thesis in Economics, Chiang Mai University*, Chiang Mai, Thailand, 2004

[11] Chaereonkithuttakorn, K. "The Relationship between the Stock Exchange of Thailand Index and the Stock Indexes in the United States of America," *Master Thesis in Economics, Chiang Mai University*, Chiang Mai, Thailand, 2005

[12] Rimcharoen, S., Sutivong, D. & Chongstitvatana, P. "Prediction of the Stock Exchange of Thailand Using Adaptive Evolution Strategies," *Tools with Artificial Intelligence, 2005*. ICTAI 05. 17th, 2005

[13] Worasucheep, Chukiat. "A New Self Adaptive Differential Evolution: Its Application in Forecasting the Index of Stock Exchange of Thailand," *Evolutionary Computation, 2007*. CEC 2007, 2007

[14] Chaigusin, S., Chirathamjaree, C. & Clayden, J. "Soft computing in the forecasting of the stock exchange of Thailand (SET). Management of Innovation and Technology," *ICMIT 2008*. 4th, 2008

[15] Phaisarn Sutheebanjard and Wichian Premchaiswadi, "Factors Analysis on Stock Exchange of Thailand (SET) Index Movement," *The 7th International Conference on ICT and Knowledge Engineering, ICTKE2009*, Bangkok, Thailand, December 1-2, 2009. In press.

[16] Back, T., Hoffmeister, F. and Schwefel, H.P. "A Survey of Evolution Strategies," *Proceeding of the Fourth Conference on Genetic Algorithm*, 1991

[17] Beyer, H.G. and Schwefel, H.P. "Evolution Strategies-A Comprehensive Introduction," *Natural Computing*. Vol. 1, Issue 1, 2002

[18] Rechenberg, I. "Evolutionsstrategie: Optimierung technischer Systeme nach Prinzipien der biologischen Evolution." *Stuttgart: Frommann-Holzboog Verlag*. 1973.