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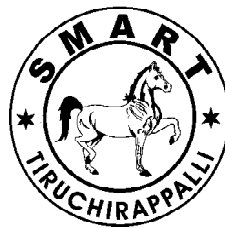
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Professor MURUGESAN SELVAM, M.Com, MBA, Ph.D, D.Litt
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STOCK MARKET RETURNS AND THE WEATHER EFFECT IN SRILANKA

Chinnadurai Kathiravan*

*Ph.D Research Scholar, Bharathidasan University, Tiruchirappalli.
kathirba@gmail.com*

Marriappan Raja

*Assistant Professor of Commerce
Bharathidasan University Constituent College, Lalgudi, Tamil Nadu, India.
rajacommerce@gmail.com*

and

Chinnadorai. K.M.

Principal, Kamban College of Arts & Science, Coimbatore.

Abstract

This study investigated the effect of three weather factors (temperature, humidity and wind speed), on the returns of the Sri Lanka stock index (CSE - Colombo Stock Exchange). The study used the daily weather data of Sri Lanka capital city, namely, Colombo. Econometric models like Descriptive Statistics, ADF Test and OLS regression Test were used for the analysis. This paper provides significant evidences for correlation between weather factor and stock market returns in Sri Lanka. The findings of this study will be useful for the investing community, Government and Policy Regulators in the sample country. The study results indicate that only one weather factor, namely, wind speed influenced the Colombo stock market index.

Keywords: *Weather Effect, Investor Sentiments, Behavioural Finance, Stock Market, Trading Activity, Colombo Stock Exchange.*

JEL Code: *G10, G11, G12, G14*

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*** Corresponding Author**

1. Introduction

Many previous studies in the field of behavioral finance had examined the association between investor sentiments and stock market returns and proved that weather conditions did have a significant impact on human behavior, mood, thinking and judgment (**Pardo and Valor; 2003 and Loughran and Schultz, 2004**). Weather influences the moods and risk preferences of investors (**Mehra & Sah, 2002 and Howarth & Hoffman 1984**). Since moods could not be observed while weather conditions could be identified, tests for the effects of moods on stock returns and the volatility, used observed weather variables, such as ground visibility, rainfall, and wind speed. The psychology literature clearly shows that investors' moods and emotions significantly affected their memory, judgment, and evaluation processes (**Kahneman and Riepe 1998**). In other words, economic agents tend to make positive judgments or evaluations when they are in a good mood, in an effort to maintain their induced moods (**Bagozzi et al. , 1999**). Investors' moods at the time that they make decisions, influence their behaviors and therefore, investors' moods can influence stock returns, to deviate from their fundamental values (**Loewenstein, 2000**).

Weather Condition Sri Lankan perspective

Sri Lanka has three main climatic zones, namely, Wet Zone, Intermediate Zone and Dry Zone (**Panabokke, 1996**). The two most important climatic factors, that influence that the Sri Lankan economy, are temperature and rainfall. Colombo Stock Exchange (CSE) is one of the most modern stock exchanges in South Asia, with a fully automated trading platform. Moreover, it has been one of the best performing stock markets in the world, with market capitalization of over US\$23 billion and average daily turnover at over US\$18 billion (**Rathnayaka 2014**).

2. Review of Literature

Many studies have been conducted to analyze the weather effect on global capital market. The reviews of previous studies are given below.

Angel Pardo and Enric Valor (2003) investigated the possible relation between weather and market index returns in the context of the Spanish market. The study found that there was no influence of weather on stock prices. Thus, these findings do not contest the notion of efficient markets. **Stephen P. Keef and Melvin L. Roush (2005)** investigated the influence of four independent facets of the local weather in the two major cities of New Zealand on the interest rates of bank bills and government bonds and the returns of stock indices. It showed that the prices of bank bills were positively influenced by the level of the sunshine factor. The prices of stock indices were negatively influenced by the level of the Wellington wind factor. **Seong-Min Yoona and Sang Hoon Kang (2009)** analysed the relationship between stock returns and the weather variables of temperature, humidity, and cloud cover in the Korean stock market. The study results indicated that the weather effect was weakened as the result of heightened market efficiency. **Sang Hoon Kanga et.al (2010)** investigated the weather effects on returns as well as volatility in the Shanghai stock market. The study provides two key results regarding weather effects. First, the weather effect existed in the A-share returns, but did not exist in the B-share returns over the whole period. Second, the weather effect exercised a strong influence on the volatility of both A- and B-share returns. **Yi-Hsien Wang et al (2012)** investigated the impact of weather effect on stock market in Taiwan. The study results indicate that precipitation did not significantly influence stock return and risk and

likewise, sunshine hours and temperature insignificantly influenced stock return but exercised significant impact on stock risk. **Guangxi Cao et al (2015)** conducted the event analysis on 21 indices, from the stock market of SZSE, to investigate the effects of climatic events on the Chinese stock market. The result showed that unexpected domestic climatic events did have greater effect on the volatility of the Chinese stock market than those that occurred in the USA. **Hyein Shim et al (2015)** investigated how weather affected the stock market volatilities of a leading emerging market. The study revealed that historical volatility better captured the weather effect than the implied volatility. It was found that volatilities tended to increase in cloudy, wet and windless weather. **Nikolaos Sariannidis et al (2016)** wanted to find out whether weather variables can explain the stock return reaction on the Dow Jones Sustainability Europe Index. The study found that not only changes in humidity and wind levels seemed to affect positively the European stock market but also changes in returns of oil and gold prices. **Chinnadurai Kathiravan et al (2017)** analyzed the effect of weather (temperature) factor, on the returns and volatility of the Indian stock indices (BSE Sensex and S&P CNX Nifty). The study found that the returns of stock indices were not influenced by the temperature in Delhi City. **Jae H. Kim (2017)** studied the weather effect on stock return, reported in two seminal studies of investors' mood on stock market. It was found that research designs, adopted by past studies, that maximized the statistical power by pooling large or massive samples, led to serious imbalance between Type I and II error probabilities. **Chinnadurai Kathiravan et al (2018)** investigated the effect of three weather factors (temperature, humidity and wind speed), on the returns of the Indian stock indices (BSE

Sensex and S&P CNX Nifty). The study found that temperature influenced the investors' mood in Bangalore, in respect of BSE Sensex and Kolkata & Mumbai, in respect of CNX Nifty and Humidity influenced Mumbai, in respect of CNX Nifty. The review of previous studies clearly indicated that there was no comprehensive study, exclusively covering the Sri Lanka region. This research, on this subject, could help the policy makers and the investors, to easily identify the riskless weather condition and their diversification strategy for investments. It is an attempt to fill the gap in research on the Stock Returns and the Weather Conditions.

3. Statement of the Problem

It is well-known that investors always examine a portfolio, by evaluating its maxim return with Efficient Market Hypothesis (EMH) and Capital Asset Pricing Model-CAPM (**Sharpe, 1964**). According to these two theories, stock market information should be fully available for the investors and should be considered by them directly and sensibly (**Chang et al. 2008**). Now a days, investors' mood and psychological condition have received importance. Among the different psychological factors, weather condition plays a vital role in investor decision-making and risk taking attitude in stock market return. Obviously, weather factors affects investors' emotional states and moods. Subsequently, it will affect investors' risk evaluation and investment strategy (**Haward and Hoffman 1984; Symeonidis 2010**). It is understandable that investors' beliefs towards their future predictions on stock market returns would be positive at the time they enjoy a good mood as a result of good weather conditions. According to the significance of seasonal affective disorder (SAD), people adopt a more risk taking attitude during winter time (**Kamstra et al, 2003**). Against this background, the effect

of weather factor on stock market return is a topic worth analyzing. Based on this, an attempt has been made in this study to examine the inter linkage and relationship among the weather factor and stock market.

4. Need of the Study

Based on the previous studies, the weather factors could influence investors' psychological conditions and the investors' moods affect their behaviour and their behaviour may affect the stock market investment decisions. Hence it is worth finding out the weather effects on the Asian stock markets. While many researchers have studied weather effects on the stock market in different countries (Cao & Wei, 2005), this study focuses on the relation between weather factors and stock movement in Sri Lankan equity markets.

5. Objectives of the Study

The main objective of this study was to examine the relationship between CSE - COLOMBO STOCK EXCHANGE and weather factors (Temperature, Humidity and Wind speed), in the capital city of Colombo, over the sample period.

6. Hypotheses of the Study

- **NH1:** There is no normal distribution among the sample index and weather factors in sample cities.
- **NH2:** There is no stationarity among the sample index and weather factors in sample cities
- **NH3:** There is no correlation between the sample index and weather factors in sample city.

7. Research Methodology

7.1 Sample Selection

For the purpose of attaining the above objectives, this study covered the top stock

market from Sri Lanka, namely, Colombo Stock Exchange and three weather factors (Temperature, Humidity and Wind speed) from Sri Lankan capital city, namely, Colombo.

7.2 Source of Data

The study used daily equity returns data of the Colombo stock market index and it was collected from Yahoo finance database (<https://finance.yahoo.com/>) and Colombo weather data collected from Department of Meteorology - Sri Lanka from the respective website <http://www.meteo.gov.lk/index.php?lang=ta>.

7.3 Period of the Study

The present study covered a period of ten years from 1st April 2008 to 31st March 2017.

7.4 Tools used for the study

The following tools were used for the analysis.

- Descriptive Statistics (to find out the normal distribution of weather data and Index return)
- Unit Root Test (to experiment the stationarity among the weather data and Index return)
- OLS Regression (to analyze the impact between weather data and Index return)

8. Analysis of Data

For the purpose of the study, the analysis of Normality, Stationary, and OLS Regression model, for the returns of Sample index and returns of Weather factors, is presented as follows:

1. Analysis of Normality of Index return and Weather Factors in Colombo city of Sri Lanka
2. Analysis of stationarity Index return and Weather Factors in Colombo city of Sri Lanka
3. Impact of Weather Factors on the index return in Sri Lanka

Analysis of Normality of Index return and Weather Factors in Colombo cities in Sri Lanka

Table-1 shows the results of descriptive statistics for three weather factors in Colombo and the returns of Colombo Stock Market Index, during the study period, from 1st April 2008 to 31st March 2017. It is to be noted that for the purpose of analyzing the normality of sample variables, mean and SD were used. The mean value reflects the average value in the set of variables and the value of SD indicates the measure of the dispersion from its mean value of variables. It is clear that the lowest mean value of 0.03 was recorded for the return index of Colombo Stock Market while the highest mean value of 172.9 was registered in Colombo City for humidity. The highest variation (SD) of Colombo City for wind speed was recorded with the value of 24.86, while the lowest value of SD was registered in Colombo City for wind speed with the value of 0.0. The analysis of skewness indicated that values for all sample variables, except Colombo City for wind speed (0.95), were negative. It is significant to note from the Table that all weather variables and stock market index return earned, values of kurtosis, larger than three. Besides, the Jarque-Bera (JB) values clearly revealed that all the sample variables were normally distributed. In other words, the sample index was less volatile during the study period. In short, the distribution of return data, for all the samples was normal. Hence the null hypothesis (**NH1**), “There is no normality in the daily return data of sample index and weather factors (temperature) in sample city over the sample period from 1st April 2008 to 31st March 2017”, is rejected.

Analysis of stationarity Index return and Weather Factors in Colombo cities in Sri Lanka

The results of ADF Test with regard to the Colombo Stock Market index returns, and temperature, humidity, and wind speed, in Colombo City from 1st April 2008 to 31st March 2017, are presented in **Table-2**. It is to be noted that test critical values, for all sample variables and index return, were analyzed at three significant levels of 1%, 5% and 10%. The analysis of the Table clearly indicated that the statistical values, for all four samples were -10.6004 for Colombo Temperature, -8.92315 for Colombo Humidity, -12.1171 for Colombo Wind speed and -12.0399 for Colombo Stock Market index. On the other hand, the statistical values, for all the four samples were less than that of test critical values, at 1%, 5% and 10% significant levels, during the study period. Besides, the returns data, for all the weather data and stock index return, attained stationarity. The overall analysis of ADF test proved that all the variables earned the value of zero (0), which implied that the study could directly use them to estimate the model analysis. Hence the null hypothesis (**NH2**), “There is no stationary in the daily return data of sample index and weather factors (temperature) in sample city over the sample period from 1st April”, is rejected.

Impact of Weather Factors on the index return in Sri Lanka

The results of the OLS regression analysis for Colombo stock market index and weather factors, for Colombo City, in Sri Lanka, during the study period from 1st April 2008 to 31st March 2017, are demonstrated in **Table-3**. The extent of relationship of each independent variable with the dependent variable was ascertained. The standard error and p-values were calculated and presented for the OLS

regression model. The analysis clearly indicated that out of three weather factors, only one weather factor, namely, wind speed recorded (0.004) conventional level of significance. It indicated the fact that one weather factor, namely, wind speed recorded statistically significant relationship with Colombo index return, during the study period. Hence the Null hypothesis (**NH3**), there is no influence among the sample stock market index and weather factors in Colombo city, is partially accepted.

9. Summary of Findings and Conclusion

Investors' mood is central to behavioral finance. Recently, there has been increasing debate regarding the role of mood in price formation for stock portfolios. It has been shown in psychological studies that some weather variables did affect human performance and mood, especially sunshine hours and air humidity levels (**Guangxi Cao et.al, 2015**). The market traders, as other professionals, can be affected by these weather conditions and some authors have suggested that stock markets could reflect that behaviour. The study established the impact of three weather factors in Colombo City, on the stock index, namely, Colombo Stock Market return from the Sri Lanka. Empirical evidence revealed that Wind Speed registered the greatest effect on stock market returns in Sri Lanka. The overall results obtained in this study led to the conclusion that Colombo stock returns were influenced by weather (wind speed), indicating an irrational behaviour of the market. The study found that stock returns tended to be lower when wind speed was too heavy. As also suggested by the psychologists, when wind speed was high, the people would be melancholic and upset (**Yoona and Sang Hoon Kang, 2009**).

10. Limitations and Scope for future Study

The study of this subject can be further extended, by analyzing the different index return, namely, Commodity index and different economic variables and different weather variables and also analyze relationship and volatility of the above mentioned variable.

The present study suffered from certain limitations. First, the present study considered only one index from Sri Lanka. The limitations associated with various statistical tools, may also apply to this study. The study period was limited to 10 years.

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Table 1 : Results of Descriptive Statistics of Colombo Stock Market Index and Weather Factors for Colombo Cities in Sri Lanka from 1st April 2008 to 31st March 2017

| Variables | Temperature (°C) | Humidity (%) | Wind speed (km/h) | Colombo Stock Market (%) |
|-------------|------------------|--------------|-------------------|--------------------------|
| Mean | 23.6 | 172.9 | 67.7 | 0.03 |
| Maximum | 31.8 | 98.0 | 100.0 | 10.18 |
| Minimum | 8.2 | 27.0 | 0.0 | -9.29 |
| Std. Dev. | 5.00 | 10.06 | 24.86 | 1.48 |
| Skew. | -0.57 | -1.05 | -0.95 | -0.20 |
| Kurt. | 2.33 | 5.18 | 2.90 | 6.85 |
| Jarque-Bera | 172.9 | 908.6 | 359.8 | 1487.1 |

Source: Compiled from Yahoo finance and meteo.gov.lk /Computed using E-Views 6 Version

Table 2 : Results of Augmented Dickey-Fuller (Adf) Test for Colombo Stock Market Index and Weather Factors for Colombo Cities in Sri Lanka from 1st April 2008 to 31st March 2017

| | | Statistical Value | Critical Value | P Value |
|-----------------------------|-----|-------------------|----------------|---------|
| Temperature | 1% | -10.6004 | -3.46898 | 0 |
| | 5% | -10.6004 | -2.87841 | 0 |
| | 10% | -10.6004 | -2.57584 | 0 |
| Humidity | 1% | -8.92315 | -3.46875 | 0 |
| | 5% | -8.92315 | -2.87831 | 0 |
| | 10% | -8.92315 | -2.57579 | 0 |
| Wind speed | 1% | -12.1171 | -3.46898 | 0 |
| | 5% | -12.1171 | -2.87841 | 0 |
| | 10% | -12.1171 | -2.57584 | 0 |
| Colombo Stock Market | 1% | -12.0399 | -3.46699 | 0 |
| | 5% | -12.0399 | -2.87754 | 0 |
| | 10% | -12.0399 | -2.57538 | 0 |

Source: Compiled from Yahoo finance and meteo.gov.lk /Computed using E-Views 6 Version
 Note: Critical Value at 1%, 5% and 10% level of significance

Table 3 : The Results of OLS Regression Model for Testing the Influence of Colombo Stock Market Index and Weather Factors for Colombo Cities in Sri Lanka from 1st April 2008 to 31st March 2017

| Model | Unstandardized Coefficients | | Standardized Coefficients | | |
|-------------|-----------------------------|------------|---------------------------|--------|--------------|
| | B | Std. Error | Beta | t | Sig. |
| (Constant) | 0.0968 | 0.0903 | | -3.727 | 0.000 |
| Temperature | 0.0036 | 0.0038 | 0.0016 | 0.0035 | 0.944 |
| Humidity | 0.0008 | 0.0008 | -0.0011 | 0.0008 | 0.254 |
| Wind Speed | -0.0002 | 0.0001 | -0.0002 | 0.0001 | 0.004 |

Dependent Variable: Colombo Stock Market

Source: Compiled from yahoo finance and meteo.gov.lk/ Computed by using SPSS.