

## **A Study of Sunshine Effect and Weighted Stock Index in Different Countries- Empirical Analysis on the Data from Taiwan**

Huang Chih-Chiang<sup>1</sup>, Wu Cheng-Chung<sup>2</sup>

<sup>1</sup>Lecturer, Department of Business Administration Cheng Shiu University, Taiwan

<sup>2</sup>Associate Professor, Department of Finance Suqian College, China

*\*Corresponding Author: Huang Chih-Chiang*

**ABSTRACT:-** This research from the sunshine effect construction target separately to Taiwan weighted index, HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times index, Nikkei 225 Index and US Internet stock index date material frequency and Taiwan Taipei's rainfall amount, the relative humidity, the accumulation sunshine hours, the temperature and average wind velocity's date weather material carries on the real diagnosis for the research sign to compare, the first regression analysis discusses Taiwan Taipei's date weather material with the various indices relations of date material frequency, next the use related analytic method discusses during various indices the relevance, finally again with Saunders (1993) proposed the sunlight effect makes the empirical analysis. The real diagnosis result showed that the Sunshine effect regarding Taiwan weighted index, HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times index, Nikkei 225 Index and US Internet stock index all has the influence relations.

**Key words:-** Sunshine Effect, Weighted Stock Index, Behavior Finance

### **I. INTRODUCTION**

Stock market has always been the favorite of domestic investors. There are numerous articles on the stock market. Behavioral finance has been prevalent in recent years, and investor sentiment has become one of the hot topics. This study takes its sunshine effect as the main axis, with rainfall, relative humidity, accumulated sunshine hours, temperature and level. The influence of average wind speed on stock price index. Saunders (1993) first published an argument in American Economic Review about investor sentiment in New York City climate (including temperature, relative humidity, rainfall, wind, sunshine, cloudiness, etc.), and then explored its impact on DJIA, NYSE, AMEX and other stock index. Empirical results show that climate and stock index have significant correlation. Supports the argument that investor sentiment affects asset prices. Therefore, with the popularity of behavioral finance, the impact of investor sentiment on capital market has been explored in the light of psychology and financial theory, which has become a feasible way to explain compensation or performance. The sunshine effect is based on the theory of investor sentiment affecting stock price index. This study wants to know the impact of climate on stock price index from the theory of sunshine effect. Researchers hold a proof-seeking mentality and use empirical research to explore the impact of climate on Taiwan's weighted stock index. Therefore, we try to use behavioral finance to understand whether investor sentiment plays an important role in Taiwan's stock market, which accounts for nearly 80% of retail investments, and whether

investor sentiment helps to explain market returns. This study focuses on the sunshine effect, and the research results will vary according to different regions and climates. In fact, in different countries, cultural differences have a greater impact than climate differences. However, because the psychological factors of human beings are too complex and undefined, the theory of sunshine effect is applicable to Taiwan. The investor influence of the Bay Weighted Index has aroused the interest of researchers, and it is not difficult to collect the data of stock price index and weather day. In this study, regression analysis was used to explore the relationship between daily weather data and the frequency of daily data of various indices in Taipei, Taiwan. Secondly, correlation analysis was used to explore the relationship between the indices, and to find out whether the sunshine effect is correlated with the investment stock market.

## **II. LITERATURE REVIEW**

The role of investors has been paid attention to since the emergence of behavioral finance. When investors form the same idea in the market, they will fluctuate in the stock market. The idea of investors is abstract and difficult to estimate and quantify. Therefore, in the academic field of investor sentiment, it is left by the behavior of investors. The information below is used as an analytic factor of investor sentiment, and the validity of the research results will be affected by whether the analytic factors are suitable for investor sentiment. Using climate as an emotional index, this paper studies the relationship between climate and stock price performance. Psychological positivism holds that people's emotions will be affected by external environment such as climate and weather, and affect human decision-making. Therefore, it affects stock market performance through attributional fallacies, such as sunny days, which will make people happy, and pay more attention to positive market information or be optimistic about negative news; that is, investors are in a good mood. Bad will affect the degree of response to information or decision-making process. Saunders (1993) empirically supports that NYSE stocks tend to suffer negative returns when the weather is cloudy in New York; Kamstra, Kramer and Levi (2000) argues that daytime length variables can explain January-month effects; Hirshleifer and Shumway (2003) discovers the daily cloud coverage and local market index of the major global exchange cities. There is a significant correlation between the number of returns, but after controlling the sunshine variables, other weather variables (whether it rains or snows) have no significant relationship with the index returns. Dichev and Janes (2001) adopted the theory of psychology that the moon would affect the climate and the full moon would be the peak of weird behavior. They believed that this behavior error would eventually affect investment decisions. When the market of the United States, G7 and other countries was taken as the research object, it was found that the stock returns during the full moon period were about half of the returns during the new moon period. However, there is no significant difference between stock trading volume (volatility) and bond returns. Hirshleifer and Shumway (2003) advocate climate as a proxy for investor sentiment. They believe that good climate makes people feel better, bad climate makes people feel bad, and directly affects the trading behavior of investors to analyze the impact on the stock market. Hirshleifer and Shumway (2003) mainly represents the visibility of sunshine by the amount of cloud, and then acts as an agent for investor sentiment, which is called the sunshine effect. Climate data is easy to obtain and observe, as well as a wide range of impacts, so climate has become one of the reasons for effective agent investor sentiment. More importantly, the argument that

climate acts as a proxy for investor sentiment has also been supported by psychological empirical evidence, such as Eagles (1994) which finds that cloudy days can make people more depressed and pessimistic; especially Hirshleifer and Shumway (2003) which studies 26 stock markets around the world, finds return on stocks is negative cloud tendencies in Taipei.

### **III. RESEARCH METHOD**

Based on daily observations and records, this study uses empirical analysis to show that there is a significant correlation between the volatility of stock price index and investor sentiment by integrating the correlation between climate and stock price index. Data sources are mainly based on the daily closing date of Taiwan Stock Exchange Corporation's weighted stock index and HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times Index, Nikkei 225 Index and US Internet Stock Index provided by the investment website. Daily closing data and daily weather observations (temperature, relative humidity, rainfall, average wind speed, cumulative sunshine hours) provided by the Central Weather Bureau were studied. During the study period, it was extracted from January 1 to April 30, 2018. Climate statistics use daily temperature as the basis of sunlight intensity. In this study, regression analysis was used to explore the relationship between the variables of rainfall, relative humidity, accumulated sunshine hours, temperature, average wind speed and Taiwan weighted index, US Dow Jones Industrial Average, German DAX, UK Financial Times Index, Nikkei 225 Index and US Internet Stock Index. Secondly, phase analysis was used. Relevance Analysis of Stock Price Index between Countries and Countries.

### **IV. THE RESULTS OF EMPIRICAL ANALYSIS**

#### **(1) Multivariate Regression Analysis of the Impact of Sunshine Effect on Taiwan Stock Price Index**

Regression analysis was used to explore the predictive power of Taiwan weighted stock price index with the result variables of rainfall, temperature, relative humidity, cumulative sunshine hours and average wind speed in Taipei, Taiwan. The predictive power of Taiwan weighted stock price index was observed to reach a significant level. The rainfall, temperature, relative humidity, cumulative sunshine hours in Taipei, Taiwan were compared with the level. The structure of the average wind speed is the prediction variable, and the Taiwan weighted stock index is the benchmark variable. Enter method is used to test the causality between the variants through the establishment and test of regression equation. The judgment coefficient  $R^2$  is used to verify the overall explanatory power of the forecasting variable to the benchmark variable. The results are as shown in Table 1.

**Table 1 Regression analysis of the influence of sunshine effect on Taiwan's weighted index**

Model	Unstandardized coefficient		t	Standardization coefficient	Sig
	Beta Estimates	Standard error		Beta distribution	
<b>constant</b>	4992.072	1055.457	4.730		<b>0.000**</b>
<b>rainfall</b>	15.600	11.074	1.409	0.129	<b>0.164</b>
<b>relative humidity</b>	-42.424	9.683	-4.381	-0.533	<b>0.000**</b>
<b>cumulative sunshine hours</b>	-88.541	24.840	-3.564	-0.442	<b>0.001**</b>
<b>temperature</b>	168.308	26.113	6.445	0.660	<b>0.000**</b>
<b>average wind speed</b>	126.482	53.494	2.364	0.221	<b>0.021**</b>
<b>F Vaule</b>	<b>17.227**</b>				
<b>R<sup>2</sup></b>	<b>0.562</b>				

**\*p<.05 \*\*p<.01**

Table 1 shows that the relative humidity, cumulative sunshine hours, temperature and average wind speed in Taipei have a R<sup>2</sup> of 0.562 for Taiwan's weighted index. It shows that the relative humidity, cumulative sunshine hours, temperature and average wind speed in Taipei have an explanatory power of 56.2% for predicting Taiwan's weighted index, with F value of 17.227 reaching a significant level (P < 0.05). In other words, the relative humidity, accumulated sunshine hours, temperature and average wind speed in Taipei have significant explanatory power for the prediction of Taiwan's weighted index.

(2) **Multivariate Regression Analysis of Sunshine Effect on Other Stock Index Configuration**

Secondly, we continue to use regression analysis to explore the other six stock price indices, HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times Index, Nikkei 225 Index and US Internet Stock Index, with the results of rainfall, relative humidity, accumulated sunshine hours, temperature and average wind speed in Taipei, Taiwan. To observe whether the predictive force reaches a significant level or not, HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times Index, Nikkei 225 Index and US Internet Stock Index are used as the predictive variables in terms of rainfall, temperature, relative humidity, cumulative sunshine hours and average wind speed in Taipei, Taiwan. Enter is used to test the causality between distortions through the establishment of regression equation. The judgment coefficient R<sup>2</sup> is used to verify the overall explanatory power of the predicted variables to the standard variables. The results are shown in tables.

**Table 2 Regression Analysis of Sunshine Effect on HSI**

Model	Unstandardized coefficient		t	Standardization coefficient	Sig
	Beta Estimates	Standard error		Beta distribution	
<b>constant</b>	4992.072	1055.457	4.730		<b>0.000**</b>
<b>rainfall</b>	11917.871	2356.071	5.058		<b>0.000**</b>
<b>relative humidity</b>	1.095	24.996	0.044	0.004	<b>0.965</b>
<b>cumulative sunshine hours</b>	-78.132	21.829	-3.579	-0.430	<b>0.001**</b>
<b>temperature</b>	-179.004	55.430	-3.229	-0.395	<b>0.002**</b>
<b>average wind speed</b>	390.001	57.535	6.779	0.672	<b>0.000**</b>
<b>F Vaule</b>	<b>17.778**</b>				
<b>R<sup>2</sup></b>	<b>0.567</b>				

\*p<.05 \*\*p<.01

Table 2 shows that the relative humidity, cumulative sunshine hours, temperature and average wind speed in Taipei, Taiwan, have a R<sup>2</sup> of 0.567 for the HSI of Hong Kong. It shows that the relative humidity, cumulative sunshine hours, temperature and average wind speed in Taipei, Taiwan can predict the weighted index of Taiwan 56.7%, and the F value of 17.778 reaches a significant level (P < 0.05). In other words, relative humidity, accumulated sunshine hours, temperature and average wind speed in Taipei, Taiwan, have significant explanatory power for the prediction of the HSI in Hong Kong.

**Table 3 Regression Analysis of Sunshine Effect on US Dow Jones Industrial Average**

Model	Unstandardized coefficient		t	Standardization coefficient	Sig
	Beta Estimates	Standard error		Beta distribution	
<b>constant</b>	7682.489	808.578	9.501		<b>0.000**</b>
<b>rainfall</b>	-9.620	8.568	-1.123	-0.123	<b>0.265</b>
<b>relative humidity</b>	-18.934	7.491	-2.527	-0.368	<b>0.014**</b>
<b>cumulative sunshine hours</b>	-33.244	19.023	-1.748	-0.258	<b>0.085</b>
<b>temperature</b>	73.313	19.745	3.713	0.445	<b>0.000**</b>
<b>average wind speed</b>	55.905	40.650	1.375	0.153	<b>0.174</b>
<b>F Vaule</b>	<b>7.825**</b>				
<b>R<sup>2</sup></b>	<b>0.365</b>				

**\*p<.05 \*\*p<.01**

Table 3 shows that the relative humidity and temperature of Taipei in Taiwan are have a R<sup>2</sup> of 0.365 for the Dow Jones Industrial Index of the United States. It shows that the relative humidity and temperature of Taipei in Taiwan can be used to predict the Dow Jones Industrial Index of the United States with 36.5% explanatory power. The F value of 7.825 reaches a significant level (P < 0.05). In other words, the relative humidity and temperature in Taipei, have significant explanatory power for the prediction of the Dow Jones Industrial Index.

**Table 4 Regression Analysis of Sunshine Effect on German DAX**

Model	Unstandardized coefficient		t	Standardization coefficient		Sig
	BetaEstimates	Standard error		Betadistribution		
<b>constant</b>	3717.231	554.024	6.710			<b>0.000**</b>
<b>rainfall</b>	-1.676	5.871	-0.286	-0.029		<b>0.776</b>
<b>relative humidity</b>	-12.700	5.133	-2.474	-0.332		<b>0.016**</b>
<b>cumulative sunshine hours</b>	-26.663	13.034	-2.046	-0.279		<b>0.045**</b>
<b>temperature</b>	74.179	13.529	5.483	0.607		<b>0.000**</b>
<b>average wind speed</b>	61.825	27.853	2.220	0.228		<b>0.030**</b>
<b>F Vaule</b>			<b>11.530**</b>			
<b>R<sup>2</sup></b>			<b>0.459</b>			

**\*p<.05 \*\*p<.01**

Table4 shows that the relative humidity, accumulated sunshine hours, temperature and average wind speed in Taipei, are have a R<sup>2</sup>of 0.459 for the DAX Index. It shows that the relative humidity, accumulated sunshine hours, temperature and average wind speed in Taipei, 45.9% explanatory power for predicting the DAX Index, and the F value is 11.530 (P <0.05). In other words, relative humidity, accumulated sunshine hours, temperature and average wind speed in Taipei,have significant explanatory power for the prediction of the DAX Index.

**Table 5 Regression Analysis of Sunshine Effect on UK Financial Times index**

Model	Unstandardized coefficient		t	Standardization	Sig
	BetaEstimates	Standard error		coefficient	
				Betadistribution	
<b>constant</b>	16150.078	7841.618	2.060		<b>0.043**</b>
<b>rainfall</b>	-68.594	83.092	-0.826	-0.109	<b>0.412</b>
<b>relative humidity</b>	-101.245	72.652	-1.394	-0.244	<b>0.168</b>
<b>cumulative sunshine hours</b>	-245.539	184.485	-1.331	-0.237	<b>0.188</b>
<b>temperature</b>	-155.874	191.490	-0.814	-0.117	<b>0.418</b>
<b>average wind speed</b>	145.593	394.230	0.369	0.050	<b>0.713</b>
<b>F Vaule</b>	<b>1.205**</b>				
<b>R<sup>2</sup></b>	<b>0.081</b>				

**\*p<.05 \*\*p<.01**

Table 5 shows that the rainfall, relative humidity, cumulative sunshine hours, temperature and average wind speed in Taipei are have a R<sup>2</sup> of 0.081 for the UK Financial Times index. It shows that the predictive power of the UK Financial Times index based on rainfall, relative humidity, cumulative sunshine hours, temperature and average wind speed in Taipei is only 8.1% and F value is 1. 205 did not reach significant level (P > 05). In other words, rainfall, relative humidity, cumulative sunshine hours, temperature and average wind speed in Taipei, have no significant explanatory power for the prediction of the UK Financial Times index.

**Table 6 Regression Analysis of Sunshine Effect on Nikkei 225 Index**

Model	Unstandardized coefficient		t	Standardization	Sig
	BetaEstimates	Standard error		coefficient	
				Betadistribution	
<b>constant</b>	8928.173	1239.669	7.202		<b>0.000**</b>
<b>rainfall</b>	6.514	13.136	0.496	0.052	<b>0.622</b>
<b>relative humidity</b>	-44.473	11.485	-3.872	-0.537	<b>0.000**</b>
<b>cumulative sunshine hours</b>	-82.427	29.165	-2.826	-0.398	<b>0.006**</b>

<b>temperature</b>	135.457	30.272	4.475	0.512	<b>0.000**</b>
<b>average wind speed</b>	60.385	62.323	0.969	0.103	<b>0.336</b>
<b>F Vaule</b>	<b>9.988**</b>				
<b>R<sup>2</sup></b>	<b>0.423</b>				

**\*p<.05 \*\*p<.01**

Table 6 shows that the R<sup>2</sup> of relative humidity, accumulated sunshine hours and temperature in Taipei is 0.423 for Nikkei 225 index. It shows that the relative humidity, accumulated sunshine hours and temperature in Taipei have 42.3% explanatory power to predict Nikkei 225 index, and the F value of 9.988 reaches a significant level (P < 0.05). In other words, relative humidity, accumulated sunshine hours and temperature in Taipei, have significant explanatory power for the prediction of Nikkei 225 index.

**Table 7Regression Analysis of Sunshine Effect on US Internet stock index**

<b>Model</b>	<b>Unstandardized coefficient</b>		<b>t</b>	<b>Standardization coefficient</b>	<b>Sig</b>
	<b>BetaEstimates</b>	<b>Standard error</b>		<b>Betadistribution</b>	
<b>constant</b>	149.789	34.835	4.300		<b>0.000**</b>
<b>rainfall</b>	-0.630	0.369	-1.706	-0.170	<b>0.093</b>
<b>relative humidity</b>	1.088	0.323	-3.370	-0.445	<b>0.001**</b>
<b>cumulative sunshine hours</b>	-2.980	0.820	-3.636	-0.489	<b>0.001**</b>
<b>temperature</b>	4.509	0.851	5.301	0.578	<b>0.000**</b>
<b>average wind speed</b>	1.571	1.751	0.897	0.091	<b>0.373</b>
<b>F Vaule</b>	<b>12.370**</b>				
<b>R<sup>2</sup></b>	<b>0.476</b>				

**\*p<.05 \*\*p<.01**

As can be seen from Table 7, the relative humidity, accumulated sunshine hours and temperature of Taipei in Taiwan are have a R<sup>2</sup> of 0.476 for the U.S. Internet Stock Index, which shows that the relative humidity, accumulated sunshine hours and temperature of Taipei in Taiwan have 47.6% explanatory power to predict the U.S. Internet Stock Index, with F value of 12.370 reaching a significant level (P<0.05). In other words, the relative humidity, accumulated sunshine hours and temperature in Taipei, have significant explanatory power for the prediction of the U.S. Internet stock index.

## V. CONCLUSION AND SUGGESTIONS

This study collects seven major global indices: Taiwan Weighted Index, HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times Index, Nikkei 225 Index and US Internet Stock Index, and five climate variables in Taipei, Taiwan, including rainfall, relative humidity, accumulated sunshine hours, temperature and average wind direction. Firstly, we use regression analysis to verify the weighted index of sunshine effect profile in Taiwan; secondly, we use correlation analysis to further analyze whether there is correlation between the indices; finally, according to the empirical results, we use regression analysis to identify the significance of weather variables and indices, and the correlation between regional indices. Check whether the weighted index of Taiwan has sunshine effect. The results of regression analysis show that when investing in Taiwan weighted index, HSI and German DAX, Taiwanese investors should pay special attention to the relative humidity, accumulated sunshine hours, temperature and average wind direction in Taipei, which have significant effects on Taiwan weighted index, HSI and German DAX; when Taiwan investors invest in US Dow Jones In, they should pay special attention to the relative humidity, accumulated sunshine hours, temperature and average wind direction. When Taiwan investors invest in the Dow Jones Industrial Index, attention should be paid to the relative humidity, temperature and average wind direction in Taipei. These variables have a significant impact on US Dow Jones Industrial Average. When Taiwanese investors invest in Nikkei 225 Index and US Internet stock index, special attention should be paid to the relative humidity, accumulated sunshine hours and temperature in Taipei, Taiwan. These variables have significant effects on Nikkei 225 Index and US Internet stock index.

From the above results, we can conclude that when the relative humidity of Taipei is low, the accumulated sunshine hours are high, the temperature is high and the average wind speed is high, the weighted index of Taiwan will show positive growth. That is to say, when the weather is good, Taiwan investors invest in the weighted index of Taiwan and other indexes to provide positive reference index, which is in line with Saunders (1993). In American Economic Review, the paper first published the argument that New York City climate (including temperature, relative humidity, rainfall, wind, sunshine, cloudiness, etc.) acts as an agent for investor sentiment, and then explores its impact on stock price indices such as DJIA, NYSE and AMEX. Empirical results show that climate has a significant correlation with stock price indices and supports investor sentiment. The argument that the preface affects asset prices. That is to say, the sunshine effect can provide Taiwan's weighted index and HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times Index, Nikkei 225 Index and US Internet Stock Index as positive reference indicators for investment.

It can be found that the weather in Taipei can indeed be used as a reference factor for Taiwan investors to invest in Taiwan's weighted index, HSI, US Dow Jones Industrial Average, German DAX, UK Financial Times Index, Nikkei 225 Index and US Internet Stock Index. When the relative humidity is low, the accumulated sunshine hours are large, the temperature is high and the average wind speed is high, the Taiwan weighted index will show positive growth, that is to say, when the weather conditions are good, the timely access investment will have a considerable opportunity to obtain positive returns. Therefore, it is particularly recommended that

Taiwan investors should refer to the weather forecast of the Meteorological Bureau when investing in the weighted index. Relative humidity, cumulative sunshine hours, temperature and average wind speed are provided.

#### **REFERENCES**

- [1]. Saunders, E. M. J., (1993) Stock prices and Wall Street weather, *The American Economic Review*, 83, 1337-1345.
- [2]. Kamstra, Mark J., Lisa A. Kramer, and Maurice D. Levi, (2000) Losing sleep at the market : The daylight saving anomaly, *American Economic Review*, 90, 1005-1011.
- [3]. Hirshleifer, David and Tyler Shumway, (2003) Good day sunshine: Stock returns and the weather, *The Journal of Finance*, 58, 1009-1032.
- [4]. Dichev, I. D. and Janes, T.D., (2001) Lunar cycle effects in stock returns, Working paper, University of Michigan.
- [5]. Eagles, J.M., (1994) The relationship between mood and daily hours of sunlight in rapid cycling bipolar illness, *Biological Psychology*, 36, 422-424.

***\*Corresponding Author: Huang Chih-Chiang***

***<sup>1</sup>Lecturer, Department of Business Administration Cheng Shiu University, Taiwan***