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Climate Change and Stock Market Returns in Selected Asean Countries

Husnizam Hosin
Department of Finance, Faculty of Business and Management, Universiti Teknologi MARA, Johor Branch, Segamat Campus, Malaysia

Mohamad Zaim Isamail
Academy of Contemporary Islamic Studies (ACIS) Universiti Teknologi MARA, Johor Branch, Segamat Campus, Malaysia

Abstract
Rational investors will make a decision based on making choices that result in the optimal level of benefits or utility for an individual. The assumption of rational investor may be deemed rational as long as it can be logically explained. When the climate change are too extreme, it can affect the investor behaviour in decision making. The objective of this study is to examine the relationship between climate change variables and stock market returns in selected ASEAN countries spanning from 2004 to 2016 using Ordinary Least Square (OLS). The major weather factors studied include temperature and rainfall. Our empirical evidence suggested that temperature and rainfall are found to have no effect on stock returns in selected ASEAN countries. For further research, more weather variables can be added into the equation such as humidity and cloud cover. With these additional indicators, we can conclude both humidity and cloud cover can affect investors' behavior hence impact stock returns in selected ASEAN countries. The findings are helpful to financial managers, investors and traders dealing with the ASEAN stock market.
Keywords: Climate Change, Market Returns, Temperature and Rainfall

Introduction

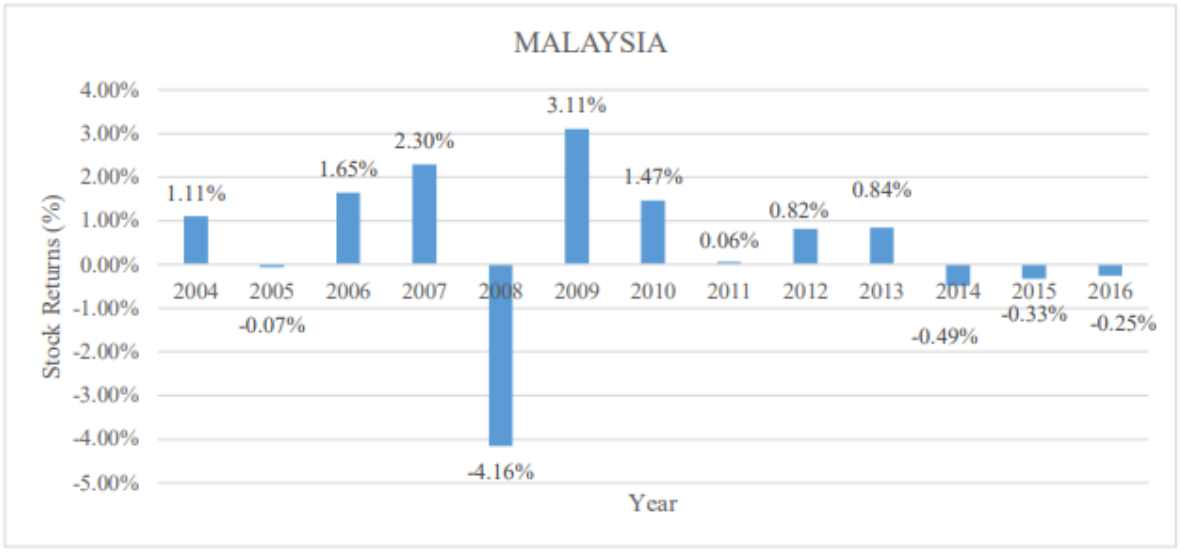
Stock market returns are the returns that the investors generate out of the stock market (Economywatch, 2010). This return could be in the form of profit through trading or in the form of dividends given by the company to its shareholders from time to time. Generally, profit making company offers a part of the kitty to the shareholders at the end of every quarter (Economywatch, 2010). Moreover, the most common form of generating stock market return is through trading in the secondary market. In the secondary market, the investor could earn stock market return by buying a stock at lower price and selling at a higher price. A rational investor will decide based on the performance of the company.

However, previous studies claimed that the climate change affects investment decision. Weather is the state of the atmosphere. For instance, describing the degree to which it is hot

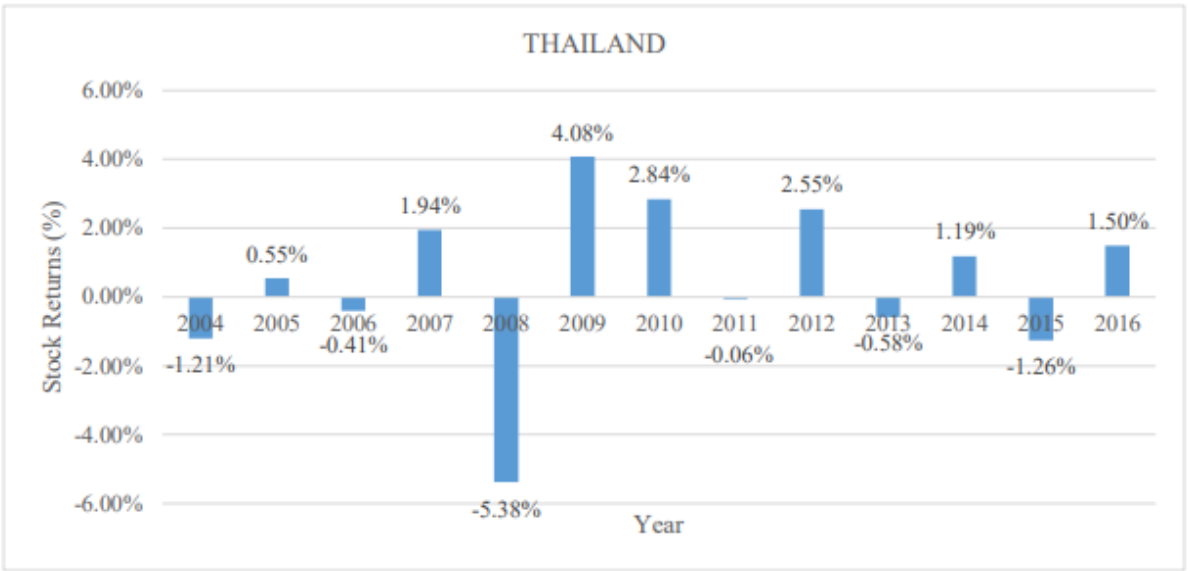
or cold, wet, or dry, calm, or stormy, clear or cloudy. Weather is driven by air pressure, temperature, and moisture differences between one place and another. These differences occur as a consequence of the sun's angle at any particular spot, which varies with latitude. Besides, rain are the natural way to boost productivity of lands (Funds, 2016). Can it affect the stock markets? Rain have a significant impact on overall economy of the country. Heavy rains tend to interrupt business processes, project installation, supply chains and consumer movement (Editing Staff in Stock & Mutual Funds, 2016). For example, it will cause water lodging or flood damage to standing crops and also cause delay in sowing of new crops until water is removed or absorbed by land. These situations can cause significant rise in rate of inflation. A rising inflation can quickly disturb the home budget of any family as well as affect the purchasing power of general public and lastly affects sales of the companies like automobile and consumer products. A stronger economic outlook can raise investor's sentiment in stock markets. Therefore, the traders and investors are advised to trade and invest in stocks during monsoon season (Funds, 2016).

Stock market is one of the main financial sources for developing countries. A well-developed stock market would stimulate the efficiencies of financing and investment in a country (Economywatch, 2010). This is due to the fact that local stock market could promote the efficiency of saving mobilization, enhancing capital market allocations and creating the employment opportunities for the nation. In the post Asian Financial Crisis (AFC) in 1997 – 1998, the well-developed stock markets are Malaysia, Singapore, and Thailand (Lee & Wang, 2011). The highest number of listed companies belongs to Malaysia but it less trading volume. Indonesia has advantage in size but less efficiency.

The stock market in Philippines has the second highest transaction costs among Asian Equities markets after South Korea. The main cost comprises of taxes and commissions (Lee & Wang, 2011). These high costs affect the trading volume or liquidity in this stock market which then makes this stock market less attractive for the investors. Malaysia, Indonesia, Thailand, Philippines, and Singapore are selected due to these countries are considered as the first five countries which collaborated to form the ASEAN in 1967. Besides, ASEAN countries have a slightly similar climate change.


MALAYSIA
Stock Returns (%)
4.00%
3.00%
2.00%
1.00%
0.00%
-1.00%
-2.00%
-3.00%
-4.00%
-5.00%
1.11%
-0.07%
1.65%
2.30%
-4.16%
3.11%
1.47%
0.06%
0.82%
0.84%
-0.49%
-0.33%
-0.25%
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year


INDONESIA
Stock Returns (%)
6.00%
4.00%
2.00%
0.00%
-2.00%
-4.00%
-6.00%
-8.00%
3.07%
1.25%
3.67%
3.49%
-5.88%
5.22%
3.16%
0.26%
1.01%
-0.08%
1.68%
-1.08%
1.19%
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year


THAILAND
Stock Returns (%)
6.00%
4.00%
2.00%
0.00%
-2.00%
-4.00%
-6.00%
-1.21%
0.55%
-0.41%
1.94%
-5.38%
4.08%
2.84%
-0.06%
2.55%
-0.58%
1.19%
-1.26%
1.50%
2004
2005
2006
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Year

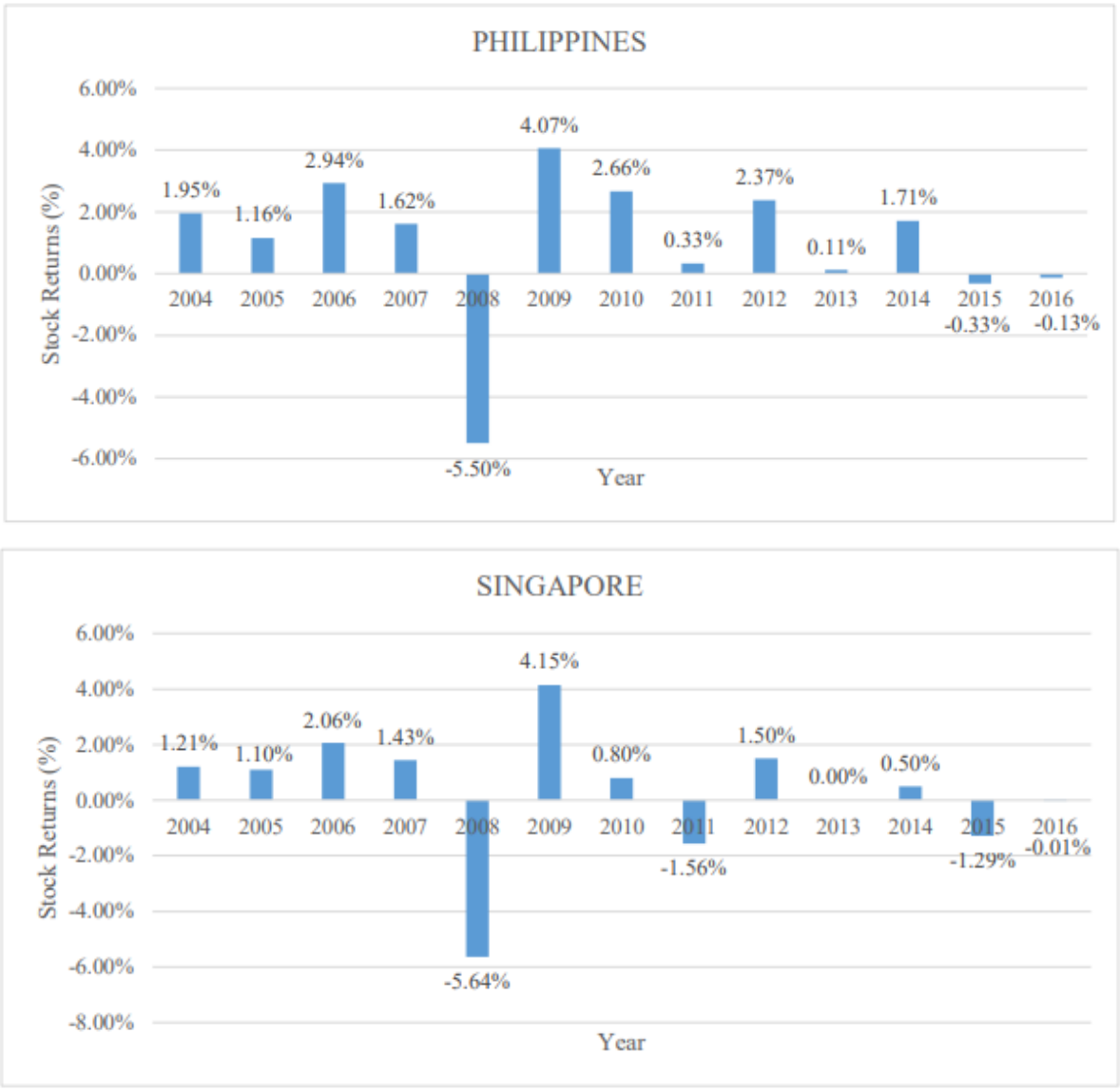


Figure 1: Average Stock Returns in Selected ASEAN Countries, 2004-2016
Source: Investing.com

As figure shows, Malaysia has recorded the highest stock returns in 2009 3.11%, while the lowest is recorded in 2008 with -4.16%. Next, the stock returns of Indonesia has the highest percent of 5.22% in 2009 and the lowest percent was -5.88% in 2008.Besides, Thailand illustrates the highest stock returns was on 2009 by 4.08% while the lowest stock returns with -5.38% on 2008. Then, 4.07% is the highest amount stock returns of Philippines and -5.50% is the lowest amount stock returns. Last but not least, Singapore stock returns have the largest amount of 4.15% on 2009 while the smallest stock returns on 2008 by -5.64%.

Table 1 shows the selected ASEAN countries ranking by market capitalization. As table shown, Singapore has the highest ranking followed by Thailand, Indonesia, Malaysia, Philippines, and Vietnam. Among the six countries, Singapore stock market has the largest market capitalization of $787.26 billion while Vietnam has recorded the smallest stock market capitalization of $51.88 billion. Nevertheless, the stock exchange of Malaysia has the highest number of companies listed and the lowest number of companies listed is Philippines stock

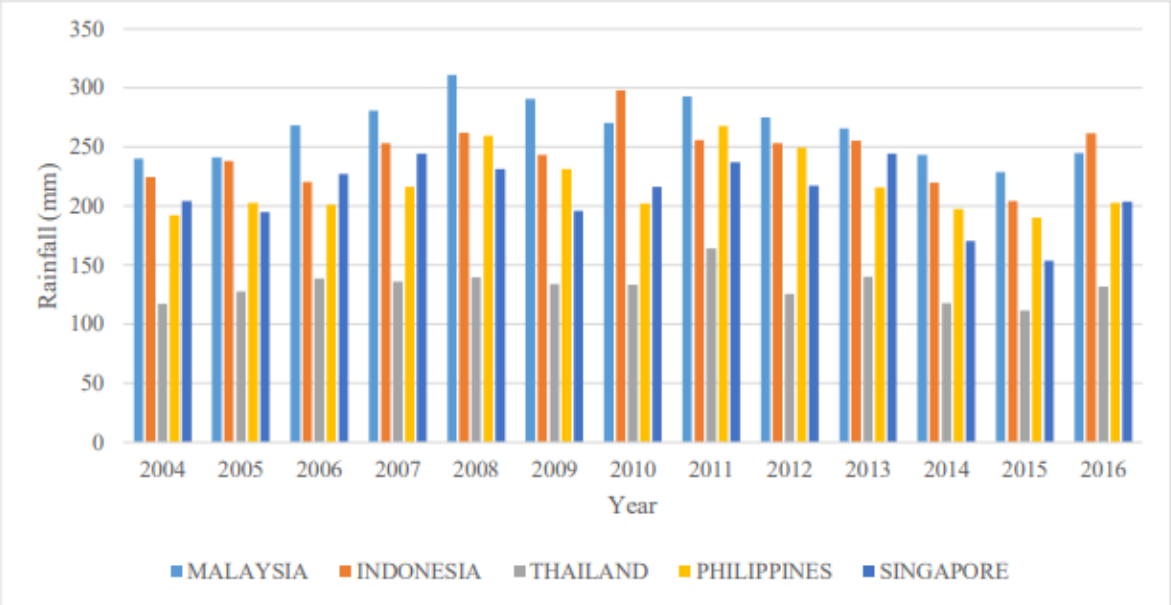
exchange. Besides, Thailand illustrates the highest average transaction cost with 16.91% while Singapore shows the lowest average transaction cost with 4.55%.

Table 1. The Stock Exchanges by Number of Companies Listed, Stock Market Capitalization and Transaction Cost.

Ranking	Country	Number of Listed Companies	Stock Market Capitalization ($USD)	Average Transaction Cost
1	Singapore	483	787.255 Billion	4.548 %
2	Thailand	688	548.795 Billion	16.910%
3	Indonesia	566	520.687 Billion	7.133%
4	Malaysia	890	455.772 Billion	4.653%
5	Philippines	264	290.401 Billion	5.463%
6	Vietnam	344	51.877 Billion	7.644%

Source: World Federation of Exchanges Database

Figure 1.2 presents the rainfall and temperature in selected ASEAN countries from period 2004 to 2016. Among the five countries, Malaysia has the highest average of rainfall while Thailand has recorded the lowest average of rainfall. Besides, Singapore illustrates the highest average of temperature whereas Thailand shows the lowest average of temperature with 1.7659 °C.



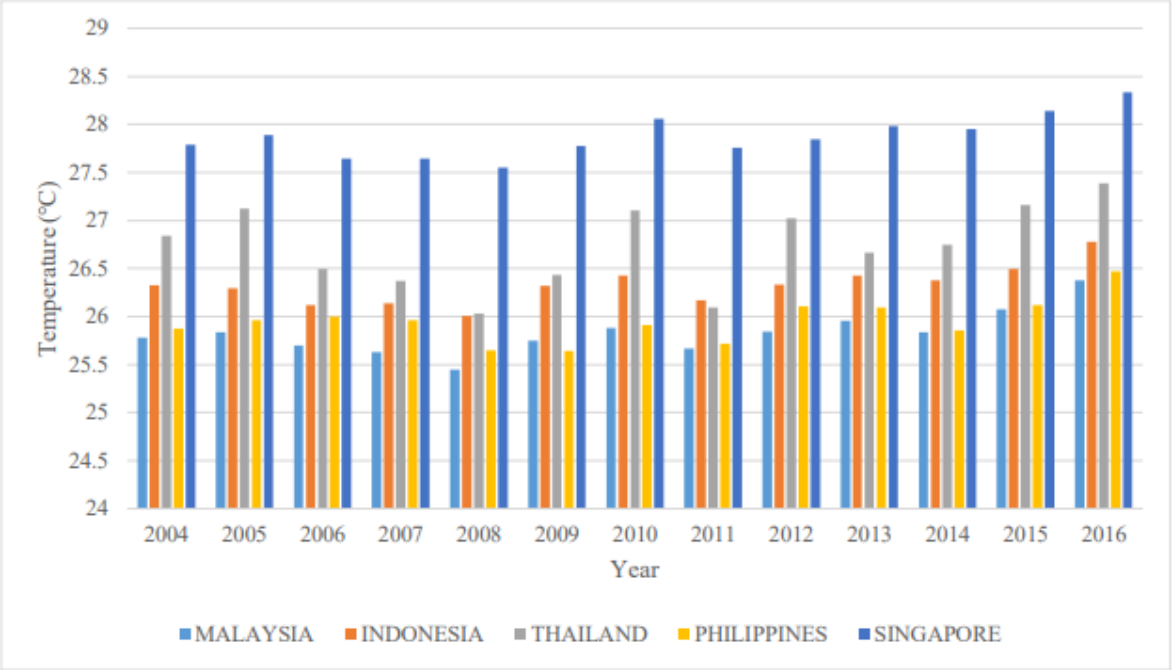


Figure 1.2: Rainfall (mm) and Temperature (°C) in Selected ASEAN Countries, 2004-2016 (Source: World Bank Group – Climate Change Knowledge Portal)

Traditional economic theory assumes that investors are rational in making decision objectively to take advantage of opportunities available (Hoon, Jiang, Lee, & Yoon, 2010). Participants in stock markets are rational before making financial and investment decisions. However, there are many factors that affecting the investment and financial decisions. That is closely related to psychological and emotional behavior which make some internal participant to behave irrationally decision-making.

Anything and everything can affect stock market if there is any public perception that would affect the underlying business of scrip traded in stock markets (Gerlach, 2007). Changes in the weather for instance, El Niño has significant effects on construction industries, agriculture, fishing, as well as on the global commodity prices (Guven & Hoxha, 2015). Weather can triggered event such as earthquake, tsunami, wildfire, storm and flood. These impact local economy and consequently markets as markets are linked with economy. For instance, oil price can up by 2% because of wildfires in Canada. Therefore, it is argued that environmental changes (rainfall and temperature) are likely to pose significant problems on stock market returns.

Literature Review

Theory of Environment Psychology

The Efficient Market Hypothesis, or EMH is an investment is an investment theory where share prices reflect all information and consistent alpha generation is impossible (Justin, 2019). According to EMH, stock always trade at their fair value on stock exchanges on the same time making it impossible for investors to purchase undervalue stocks or sell stocks for inflated price. The only way an investor can possibly obtain higher returns is by purchasing riskier investments (Justin, 2019).

In psychology, the specific area of research that investigates the relationships between changes in the environment and human behavior is called environmental psychology. It

examines how the environment affects human behavior through numerous factors, such as weather, color, and buildings. Actually, the weather can have some bizarre effects on human behavior. According to Vazquez (2016), people tend to do gambling and it is been suggested that we are more likely to gamble on days when the weather is sunny particularly if the sunshine is unexpected. The phenomenon is said to occur because good weather causes feeling of excitement which lead us to take riskier bets.

When seasonal weather, people will show seasonal affective disorder (SAD). SAD can be defined as depressive illness which is commonly attributed the lack of sunlight during winter. SAD is actually a relatively uncommon condition. Even the people do not suffer the illness, they commonly have a bad mood and low level of happiness during the winter month or colder climate (Vazquez, 2016). Besides, researchers found that when the people feel physically cold and tend to seek psychological warmth. Hence, there exist a significant correlation between being in the colder condition and choosing to watch romantic film. Alternatively, extreme weather can make people increase in empathy (Vazquez, 2016). For instance, donating the homeless shelter during the harshest day of winter and stepping out in a severe storm to rescue someone in need.

Empirical Studies

Changes in weather condition can lead to complex psychological and physical responses and reflect to the different human behavioral aspects, such as interpersonal interactions, violent behavior and performance (Lu & Chou, 2012). Psychologists found that weather has unexpected impacts on the psychological aspects of human beings, one of these is seasonal affective disorder (Lee & Wang, 2011). Similarly, bad weather has an effect on individual's mood.

Dowling & Lucey (2005) studied the weather effects in daily Irish stock returns by using four weather indicators namely cloud, rain, humidity, and geomagnetic storms. Their results are in favor the hypothesis that weather variables do, indeed, affect Irish stock returns. Moreover, Hirshleifer & Shumway (2003) suggested that there exists a significant relationship between weather effects (cloudiness, sunshine, temperature, or wind) on stock returns. Similar finding can be found in (Dowling & Lucey, 2005; Hirshleifer & Shumway, 2003; Yoon & Kang, 2009; Hoon et al., 2010; Lee & Wang, 2011; Lu & Chou, 2012; Keef & Roush, 2013).

Alternatively, several studies have considered the influence of temperature on stock returns. Cao, M., & Wei (2005) also reported that a negative correlation between temperature and stock returns, implying that stock market returns are depending on temperature effects. For instance, when the temperature is low, the stock returns will be higher but when the temperature is high, the stock returns will be lower. Using five European stock market returns (Austria, Belgium, France, Greece and United Kingdom) spanning from 1995-2006 temperature data, Floros (2008) found that there exist a negative relationship between temperature and stock market returns for Austria, Belgium and France, while a non-significant correlation between temperature and stock market returns in Greece and United Kingdom. Rational investors will make a decision based on making choices that result in the optimal level of benefits or utility for an individual (Adam, 2019b).

On the other hand, Floros (2011) examined the linkages between temperature and stock market returns in Portugal for the period 1995-2007. At that time, Portugal faces low levels of humidity and cloudiness compared to other European country like United Kingdom. Goetzmann & Zhu (2005) used a database of individual investor accounts over a 6-year period to examine the effect of weather on individual trades. There is no difference in the propensity

of the average investor to buy or sell equities on cloudy days as opposed to sunny days. The observed propensities to buy and sell stocks for groups of traders can be differentiated by gender, age, and financial wealth which respond differently to changes in weather. Hirshleifer & Shumway (2003) have reported that sunshine is highly significantly correlated with daily stock returns after controlling the sunshine and other weather conditions such as rain and snow, which are unrelated to returns from 1982 – 1997.

According to Loughran & Schultz (2004), one of the limitations of their research was to measure the mood of stock market participants by cloudiness in New York City or in the cities with stock exchanges. When the investors are the one who set prices at the margin, and moods of investors are affected by sunlight, cloudiness in New York is not a good proxy for the mood of the market. Lastly, Hoon et al. (2010) found that shanghai stock market exhibits a weather effect in volatility. Therefore, it is clearly to observe that weather has an effect on stock market.

Methodology

Monthly stock prices and climate change indicators (temperature and rainfall) between 2004 and 2016. Stock market returns data were obtained from investing.com and World Bank Group Climate Change Knowledge Portal.

Descriptive Statistics

Descriptive statistics consists of the measures of central tendency and measures of dispersion. Central tendency comprises mean, maximum and minimum. Meanwhile, the measure of dispersion of variability consists of standard deviation.

Correlation Analysis

Correlation coefficient is used to examine the correlation between stock market and climate changes (Stephanie, 2013). A correlation coefficient of 0 indicates for every increase, there is not positive or negative increase. The two just not related. Correlation coefficient of 1 indicates a perfect positive linear relationship as one variable increases in its values. Correlation coefficient of 1 indicates a perfect negative linear relationship as one variable increase in its values (Stephanie, 2014).

Ordinary Least Squares (OLS)

Ordinary Least Squares (OLS) is a type of linear least squares method for estimating the unknown parameters in a linear regression model (Jim, 2019). OLS chooses the parameters of a linear function of a set of explanatory variables by the principle of least squares by minimizing the sum of the squares of the differences between the observed dependent variable (values of the variable being predicted) in the given dataset and those predicted by the linear function (Jim, 2019).

Regression Analysis

Regression analysis is a statistical technique that attends in explaining the movement in one variable which is the dependent variable. The variable function of the movement in a set of other variables is called the explanatory variables through the quantification of a single equation. The model that will be used is the simple regression model to examine the effect of independent variable on dependent variable as follows:

$$R_t = \beta_0 + \beta_1 CC_t + \beta_2 Dummyt + \varepsilon \quad (1)$$

$$R_t = \beta_0 + \beta_1 RF_t + \beta_2 Dummyt + \varepsilon \quad (2)$$
$$R_t = \beta_0 + \beta_1 CE_t + \beta_2 Dummyt + \varepsilon \quad (3)$$

Where:
t = Time Period
R = Stock Market Returns (%) when R_t = ln (Pt) - ln (Pt-1)
CC = Climate Change indicators namely rainfall (RF) and temperature (CE)
β_0 = Constant
β_1 = Slope Coefficient
ε = Error term
Dummy = Financial crisis 2007-2008

T-value

The use of the t-test for hypothesis testing has become standard practice in econometrics. The t- test is to know whether there is a significant variable between the dependent variable and independent variable. The alternative to the t-test is using p-value approach. A p-value is the probability of observing a t-score if the null hypotheses were true.
Hypothesis testing under t-test:

H_0 : There is no significant relationship between R and RF
H_1 : There is a significant relationship between R and RF

H_0 : There is no significant relationship between R and CE
H_1 : There is a significant relationship between R and CE

R-square (R^2)

Coefficient of determination R^2 is the ratio of the explained sum of squares (ESS) to the total sum of the squares (TSS). The higher the R^2 is, the closer the estimated regression equation fits the sample data. R^2 must lie in the interval $0 \leq R^2 \leq 1$. A value of R^2 close to one shows an excellent overall fit, whereas as value near zero shows a failure of estimated regression equation to explain the values of Y_i better than could explained by the $\bar{Y}$ (Adam, 2019a).

F- test

F-test is most often used when comparing statistical models that have been fitted to a data set, in order to identify the model that best fits the population from which the data were sampled. Exact "F-tests" mainly arise when the models have been fitted to the data using least squares (George W. & Ronald A., 2019). If P-value is below the level significant, α = 0.05, then the null hypothesis, H0 is rejected. If P-value is higher than the level of significant, the null hypothesis, H0 is failed to reject, the test hypothesis are stated as below:

H_0 : The overall model is not fit
H_1 : The overall model is fit

Normality of the error term

The normality test is used to determine whether the error term is normally distributed or not. Also known as the Jarque-Bera test, this test is an indicator that works to detect the error term's non- normality. This test's decision rule depends on P-value (Jarque-Bera) in the result, if the P-value is lower than significant level, α = 0.05 or 5%, so the null hypothesis, H0 will be rejected. On the other hand, the test failed to reject the null H0 when P-value is higher than the significant level.
The normality test hypothesis was set as follows:

H_0 : The error term is normally distributed
H_1 : The error term is not normally distributed

Heteroscedasticity Test

Heteroscedasticity means that there is no constant variance in error term. Heteroscedasticity occurs when the selected variable is not consistent with the line of regression. It can be traced with the Park or White test. This White test is being used in this study which constant variance of the error terms would be examined. The decision rule will reject the null hypothesis, H0 when the probability value of test (P-value) is lower than the significant level which is α = 0.05, otherwise it failed to reject the null hypothesis. This means if the H0 is rejected that the regression model faces the problem of heteroscedasticity.
The hypothesis for this test are as below:

H_0 : Error term is homoscedasticity (constant variance)
H_1 : Error term is heteroscedasticity (does not have constant variance)

Serial Correlation

Data such as the specification bias, incorrect functional form and issues with data manipulation, autocorrelation may exist when there is an error. There are two autocorrelation testing methods that are the Durbin-Watson test and BG test. These methods are responsible for the detection and accuracy of the selected data.
In this study, BG test is selected to perform the test using the EViews 10. The 'Obs. R-Squared' and 'Prob. Chi-Square' will be referred in this test. If these indicators are higher than 0.05, it means that the null hypothesis, H0 is failed to reject the vice versa. It indicates that the term of error is serially independent.

The hypothesis are as follow:

H_0 : Error term is serially independent (no autocorrelation)
H_1 : Error term is not serially independent (autocorrelation)

Model Misspecification: Ramsey's Regression Specification Error Test (RESET)

The Ramsey RESET test is a general test that determines the likelihood of an omitted variable or some other specification error. If the proxies can be shown by the f-test to have improved the overall fit of the original equation, then we have evidence of some sort of specification error. If there is no specification error, then we do expect the coefficients of the added terms to be significantly different from zero because there is nothing for them to act as a proxy for.

H_0 : There is no specification error in the model
H_1 : There is specification error in the model

Result And Discussion

Descriptive Statistics

The below table illustrates the descriptive statistics for stock returns (R), rainfall (RF), and temperature (CE) in selected ASEAN countries from 2004-2016 which consisting of 156 observations. As the table shows, mean monthly percentage stock returns range from 0.3% (Singapore) to 1.3% (Indonesia). Moreover, the standard deviation of stock returns range varies across ASEAN countries, with Indonesia the standard deviation are higher while Malaysia the standard deviation are lower.

As for weather indicators, Malaysia experiences the greater rainfall intensity with 265.8mm while Thailand being the least rainfall intensity (132.3mm). Then, the highest sample of mean temperature is Singapore (27.9 ◦C), followed by Thailand (26.7◦C), Philippines (26.0◦C), Malaysia (25.8◦C), and Indonesia (25.3◦C).

Tabel 1. Descriptive Statistic

R Value	Malaysia	Indonesia	Thailand	Philippines	Singapore
Mean	0.0047	0.013	0.0044	0.01	0.0033
Maximum	0.127	0.1834	0.1308	0.1395	0.193
Minimum	-0.1651	-0.3772	-0.3592	-0.2754	-0.2736
Std. Dev.	0.0356	0.062	0.0592	0.0539	0.051
N	156	156	156	156	156
RF Value	Malaysia	Indonesia	Thailand	Philippines	Singapore
Mean	265.7835	245.5216	132.277	217.7214	210.917
Maximum	583.791	374.936	361.291	448.089	648.535
Minimum	102.04	73.7948	2.037	17.9266	3.8254
Std. Dev.	84.8181	67.1121	99.6784	98.2856	95.4118
N	156	156	156	156	156
CE Value	Malaysia	Indonesia	Thailand	Philippines	Singapore
Mean	25.8291	25.3164	26.7284	25.9518	27.8732
Maximum	27.1446	27.4218	31.2162	27.8719	29.0864
Minimum	24.5197	25.4451	21.5601	23.6587	26.544
Std. Dev.	0.4725	0.3549	1.8314	-0.2285	0.5455
N	156	156	156	156	156

Regression Analysis

The below table presents the OLS regression results for two models' rainfall (RF) and temperature (CE). The results suggest that there is exists a negative relationship between RF and stock market returns (R) but insignificant. Further analysis found that no statistically significant relationship between CE and R. Moreover, a dummy variable (Dummy) is include in the regression to capture the impact of global financial crisis, 2007-2008. These dummies enter with statistically significant negative coefficients and is consistent with prior expectation. This implies that the stock market returns are relatively lower during the global financial crisis than other time period (Singh, 2019).

On the other hand, all estimated regression have low goodness of fit regardless R^2 or adjusted R^2. The R^2 varies between 0.0815 to 0.1425 for model of RF and between 0.0815 to 0.1541 for model of CE. This indicates that independent variables in the models explain about 8.14% to 14.25% for model of RF and about 8.14% to 15.41% for model of CE of the changes in stock market returns.

To ensure all estimated models in this study are well specified, several diagnostic checks on the residuals. The lowest panel of tables 4.2 reveal that no serial correlation is present except Indonesia and Thailand. Furthermore, the functional form or specification error of model is checked by utilizing the Ramsey RESET test, the results suggest that most models suffer from the specification errors. This study also reveal that residuals are not normally distributed as the p-value for Jacque- Bera test are smaller than 0.05, therefore the null hypothesis of

normally distributed residuals is rejected. Lastly, the results show heteroscedasticity whereby the null hypothesis of homoscedasticity is rejected.

		Dependent Variable : R									
		Malaysia		Indonesia		Thailand		Philippines		Singapore	
C	Coefficient	0.0119	0.2329	0.0007	0.3564	0.0105	0.0171	0.0199	0.0082	0.0018	0.2587
	t-stat	1.3542	1.5622	0.0389	0.9872	1.3606	0.2529	2.0117	0.0594	0.1924	1.2891
	p-value	0.1777	0.1203	0.9690	0.3251	0.1757	0.8007	0.0460**	0.9527	0.8477	0.1993
RF	Coefficient	0.0000	-	0.0001	-	0.0000	-	0.0000	-	0.0000	-
	t-stat	0.4056	-	1.0699	-	0.1956	-	4.5116	-	0.7544	-
	p-value	0.6856	-	0.2863	-	0.8452	-	0.6125	-	0.4518	-
CE	Coefficient	-	0.0087	-	-0.0128	-	-0.0003	-	0.0003	-	-0.0090
	t-stat	-	1.5053	-	0.9346	-	0.1158	-	0.0522	-	1.2483
	p-value	-	0.1343	-	0.3515	-	0.9080	-	0.9584	-	0.2138
Dummy	Coefficient	0.0495	0.0537	0.0792	0.0822	0.0630	0.0633	0.0694	0.0702	0.0653	0.0678
	t-stat	-4.9030	-5.2718	-4.4942	-4.5164	3.6753	3.6704	-4.5116	-4.5692	-4.4960	-4.6205
	p-value	0.0000***	0.0000***	0.0000***	0.0000***	0.0003***	0.0003***	0.0000***	0.0000***	0.0000***	0.0000***
R-Sq		0.1425	0.1541	0.1194	0.1179	0.0815	0.0814	0.1232	0.1217	0.1179	0.1235
Adjusted R-Sq		0.1313	0.1430	0.1079	0.1063	0.0695	0.0694	0.1117	0.1103	0.1063	0.1120
F-stat		12.7127	13.9368	10.3756	10.2228	6.7919	6.7784	10.7491	10.6040	10.2207	10.7793
P-value (F-Stat)		0.0000***	0.0000***	0.0000***	0.0000***	0.001493***	0.001511***	0.0000***	0.0000***	0.0000***	0.0000***
Diagnostic Checkings											
BG	Obs*R-sq	0.1160	0.1030	3.9975	4.6208	7.1638	7.2176	1.7222	1.7000	1.9414	2.1388
P-value (Chi-Sq)		0.9437	0.9498	0.1355	0.0992*	0.0278**	0.0271**	0.4227	0.4274	0.3788	0.3432
White	Obs*R-sq	22.2006	9.6186	19.8825	52.2652	21.9820	21.4918	18.1755	21.0587	16.6049	23.2905
P-value (Chi-Sq)		0.0002***	0.0474**	0.0005***	0.0000***	0.0002***	0.0003***	0.0011***	0.0003***	0.0023***	0.0001***
JB		20.7069	21.8255	203.0210	176.0185	174.9072	177.3788	21.3705	21.1802	80.9291	78.7730
P-value		0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
RESET	*F*-stat	2.3718	1.9977	0.2520	2.6299	6.3986	6.0496	5.2962	0.0610	0.4560	2.6741
P-value (*F*-Stat)		0.0968*	0.1392	0.6164	0.1069	0.0022***	0.0150**	0.0227**	0.8052	0.5005	0.0722*

Notes:
R - Stock returns; RF - Rainfall; CE - Temperature
VIF - Variance inflation factor, BG - The Breusch-Godfrey Lagrange Multiplier test for serial correlation, White - The White's test for heteroscedasticity,
JB - The Jarque-Bera test for normality and RESET - The Ramsey RESET Test

***, ** and * denote significant at 1%, 5%and 10% levels

Conclusions

Based on the analysis, it shows that the mean monthly percentage stock returns range from the lowest percentage (Singapore 0.3%) to highest percentage (Malaysia 1.3%). Based on the standard deviation, Indonesia was the higher while Malaysia was the lower standard deviation.

As for weather indicators, Malaysia experiences the greater rainfall intensity followed by the Thailand being the least rainfall intensity. Then, based on the mean temperature, Singapore was the highest one and followed by Thailand, Philippines, Malaysia and Indonesia.

Environmental psychology studies have documented that weather, together with the other environmental elements such a height, light, color, noise, and so on have a profound influence on human mood, behavior, and physical health. In this study, we are using Ordinary Least Square (OLS) to explore the relationship between climate change and stock market returns in selected ASEAN countries using monthly data from of January 2004 to December 2016. The results shows that climate change indicators measured by rainfall and temperature have negative impact but insignificant on stock market returns.

In sum, the study reveals that climate change indicators measured by rainfall (RF) and temperature (CE) have negative effect on stock market returns but insignificant in most cases. Alternatively, the dummy variable is still negative and significant suggesting that stock market returns between global financial crisis (2007-2008) are lower than other time period. For all models, R^2 and adjusted R^2 show weak goodness of fit. Lastly, most of the estimated equations fail to pass the diagnostic checks for serial correlation, heteroscedasticity, normality, and specification error.

Given that weather evidently affect human moods, it would play important role when investors make decision in view of the bounded rationality. But it is not applicable in ASEAN countries. This is because ASEAN countries do not have such an extreme weather like European countries. Furthermore, investors should carefully monitor their mood when making judgements and decisions to avoid mood-induced errors. Above all, this study has important implications for individual investors and financial institution planning to invest in the selected ASEAN countries stock market.

For further research, more variable can be added into the equation such as humidity and cloud cover. With this additional indicators, it can be conclude both humidity amd cloud cover can affect the investor's behaviour hence impact stock returns in selected ASEAN countries. Lastly, additional sample data can also be added in order to gain more accurate result with up to date data.

References

Adam, H. (2019a). R- Squared Definition. Retrieved from www.investopedia.com

Adam, H. (2019b). Rational Behaviour - Definition. Retrieved from www.investopedia.com

Cao, M., & Wei, J. (2005). Stock market returns : A note on temperature anomaly. *Jorunal of Banking and Finance*, *29*, 1559–1573. Retrieved from https://doi.org/10.1016/j.jbankfin.2004.06.028

Dowling, M., & Lucey, B. M. (2005). Weather, biorhythms, beliefs and stock returns—Some preliminary Irish evidence. *International Review of Financial Analysis*, *14*(3), 337–355.

Retrieved from https://doi.org/https://doi.org/10.1016/j.irfa.2004.10.003

Economywatch. (2010). What is stock market returns ? Retrieved from http://www.economywatch.com/stock-markets-in-world/returns.html

Floros, C. (2008). Stock market returns and the temperature effect: new evidence from Europe. *Applied Financial Economics Letters*, *4*(6), 461–467. Retrieved from https://doi.org/10.1080/17446540801998585%0A

Floros, C. (2011). On the relationship between weather and stock market returns. *Studies in Economics and Finance*, *28*(1), 5–13. Retrieved from https://doi.org/10.1108/10867371111110525%0A

Funds, E. S. I. S. & M. (2016). Significant ways rain affects stock market returns. Retrieved from http://getupwise.com/finance/investments/stocks-mutual-fund/6-%0Asignificant-ways-rains-can-affect-stock-markets/%0A

George W., S., & Ronald A., F. (2019). F-test. Retrieved from www.investopedia.com

Gerlach, J. R. (2007). Macroeconomic news and stock market calendar and weather anomalies. *Journal of Financial Research, 30(2), 30*(2), 283–300. Retrieved from https://doi.org/10.1111/j.1475- 6803.2007.00214.x

Goetzmann, W. N., & Zhu, N. (2005). Rain or shine: Where is the weather effect? *European Financial Management*, *11*(5), 559–578. Retrieved from https://doi.org/10.1111/j.1354-7798.2005.00298.x

Guven, C., & Hoxha, I. (2015). Rain or shine : Happiness and risk-taking. *Quarterly Review of Economics and Finance*, *57*, 1–10. Retrieved from https://doi.org/10.1016/j.qref.2014.10.004%0A

Hirshleifer, D., & Shumway, T. (2003). Good day sunshine: Stock returns and the weather. *The Journal of Finance*, *58*(3), 1009–1032. Retrieved from https://doi.org/10.1111/1540-6261.00556%0A

Hoon, S., Jiang, Z., Lee, Y., & Yoon, S. (2010). Weather effects on the returns and volatility of the Shanghai stock market. *Physica A: Statistical Mechanics and Its Applications*, *389*(1), 91–99. Retrieved from https://doi.org/10.1016/j.physa.2009.09.010

Jim, F. (2019). 7 Classical assumptions of ordinary least square (OLS). Retrieved from www.investopedia.com

Keef, S. P., & Roush, M. L. (2013). A meta-analysis of the international evidence of cloud cover on stock returns. *Review of Accounting and Finance*. Retrieved from https://doi.org/10.1108/14757700710778045

Lee, Y., & Wang, K. (2011). The effectiveness of the sunshine effect in Taiwan's stock market before and after the 1997 fi nancial crisis. *Economic Modelling*, *28*(1–2), 710–727. Retrieved from https://doi.org/10.1016/j.econmod.2010.05.008

Loughran, T., & Schultz, P. (2004). Weather , Stock Returns , and the Impact of Localized Trading Behavior. *The Journal of Financial and Quantitative Analysis*, *39*(2), 343–364.

Lu, J., & Chou, R. K. (2012). Does the weather have impacts on returns and trading activities in order-driven stock markets ? Evidence from China. *Journal of Empirical Finance*, *19*(1), 79– 93. Retrieved from https://doi.org/10.1016/j.jempfin.2011.10.001

Singh, M. (2019). The 2007-2008 Financial Crisis in Review. Retrieved from www.investopedia.com/articles/economics/09/financial-crisis-%0Areview.asp

Stephanie. (2013). R-Squared vs Adjusted R-Squared. Retrieved from https://www.statisticshowto.datasciencecentral.com/adjusted-r2

Stephanie. (2014). Correlation coefficient: Simple definition formula, easy calculation. Retrieved from https://www.statisticshowto.datasciencecentral.com

Vazquez, L. (2016). Strange effects of weather on human behaviour.

Yoon, S.-M., & Kang, S. H. (2009). Weather effects on returns: Evidence from the Korean stock market. *Physica A: Statistical Mechanics and Its Applications*, *388*(5), 682–690. Retrieved from https://doi.org/https://doi.org/10.1016/j.physa.2008.11.01