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Impact of Coronavirus Disease 2019 (COVID-19) to Equity Market and Currency Exchange Rate

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Abstract:
Background*: In year 2020, the spreading of coronavirus disease (COVID-19) has contributed to 1,056,159 confirmed cases, 57,206 deaths and involving 207 territories by 4th April 2020. The new disease is spreading human to human contact with an infected person when they cough or sneeze. It also spreads when a person touches a surface or object that has the virus on it, then touches their eyes, nose, or mouth.The disease causes respiratory illness with symptoms such as a cough, fever, and in more severe cases, difficulty breathing.The outbreak of COVID-19 creates unstable economic condition due to market sentiment that slowdown all economy activities.*
Materials and Methods*: This research selected two types of time series data namely KLSE index and currency exchange rate for USD/MYR. The daily observation periods are selected from January 2020 until March 2020 to analyze the impact of COVID-19 outbreak. Then changes for both of these variables arecalculated for detecting dynamic behavior related to period of COVID-19 outbreak. This study also performed correlation analysis to detect association between these two variable that become indicator for a financial stability situation.*
Results*: The mean for changes of KLSE index is -0.264 that indicates negative value become dominant during COVID-19 outbreak period. In the same time, changes for currency exchange rate also shows mean with negative value, -0.087. This study implemented Spearman rank correlation analysis between changes of KLSE index and currency exchange rate. Result shows there is significant, moderate and positive association between changes of KLSE index and currency exchange rate.*
Conclusion:*Coronavirus diseases (COVID-19) creates significant effect for equity market index and currency exchange rate. This pandemic creates unstable economic environment and unbalance financial situation in worldwide because many economic activities are ceased down. The important of this finding will help government body to understand the current condition during coronavirus disease 2019 (COVID-19) outbreak. In addition, the findings will assist policy makers to develop solution in stabilizing economic situation in COVID-19 outbreak. In the same time, this study helps investors to monitor the equity market to develop investment portfolio to gain better return and reducing loss.*
Key Word*:Coronavirus disease; COVID-19; Equity Market; Currency Exchange Rate.*

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I. Introduction

COVID-19 has been spread quickly worldwide. In 2019, the first case was detected in Wuhan, China than this virus was spread to all countries. According to the report from World Health Organization (WHO) mentioned that the total confirmed cases of COVID-19 worldwide was 1,133,681 cases with the report cases of deaths was 62,784 cases (5th April 2020). United States of Amerika was reported with the higher cases of COVID-19 that are 273, 808 cases (5th April 2020).

Therefore, several countries were performing a lockdown approach for movement control order (MCO). The main reason of lockdown is to prevent the spread of COVID-19 virus. This is because this virus was spread very fast and easy to transfer from persons to persons. As suggested by World Health Organization (WHO) (2020)to prevent the spread of COVID-19, people should always wash hands frequently. Regularly wash hands with an alcohol-based hand rub or wash hand with soap and water can protect people from any virus. Besides that, people must maintain social distancing at least 1 metre distance between person to person, who is coughing or sneezing. People also encouraged to avoid touching eyes, nose and mouth because hands touch many surfaces and can pick up viruses. Then, people also encouraged to practice respiratory hygiene in order to make sure people follow good respiratory hygiene. This means covering the mouth and nose with bent elbow or tissue when people cough or sneeze. Then dispose used tissue immediately.

Even there are many recommendations to avoid the spread of COVID-19, but now this virus was spread quickly worldwide and contribute to economic recession due to the lockdown approach implement in several countries. For example, early indications of COVID-19 show that the Chinese economy are worse than initially forecast. Surveys of China's manufacturing and services sector plunged to record lows in February, automobile sales dropped a record 80 percent, and China's exports fell 17.2 percent in January and February (Segal and Gerstel, 2020).

Thus, Malaysia economic also show the declining of currency exchange between Malaysia Ringgit with US Dollar. As report by Malaysian Stock Exchange, the value of KLSE on January 2020 is 1602.50 for first trading day. Then the KLSE index show decrement patent until reach minimum value at 1219.72 during outbreak of COVID-19 in Malaysia on March 2020. Therefore, government should take a serious action in order to avoid the economic recession. Thus, it is important to investigate the impact of COVID-19 into equity market and currency exchange rate between US dollar (USD) and Malaysian Ringgit (MYR).

II. Literature Review

A considerable amount of literature has been published on the financial area worldwide (Goergen, et al., 2007; Chi, et al., 2005; Drobetz, 2005) and financial area in Malaysia (Abu Bakar and Rosbi, 2017; Abu Bakar and Rosbi, 2016).Currency exchange is one of the essential requirements for funds flow across borders and for large-scale international investments (Jan and Gopalaswamy, 2019). Li, et al., (2015) examine the dynamics between exchange rate and equities in China. The findings suggest that exchange rate and stock price are related negatively. While, Sikarwar(2018)examine the presence of exchange rate exposure and its relationship with currency derivatives suggested that the firms are more exposed to the exchange rate changes since the onset of the financial crisis.

Salifu, et al., (2007) examine the foreign exchange exposure of listed companies on the Ghana Stock Exchange. 55 per cent of firms in the sample have a statistically significant exposure to the US dollar whilst 35 per cent are statistically exposed to the UK pound sterling. Sector specific exposure results show that the manufacturing and retail sectors are significantly exposed to the US dollar exchange rate risk. While, the financial sector did not show any risk exposure to any of the international currencies. The most dominant source of exchange rate risk exposure is the US dollar. El- Masry, et al., (2007) investigate the relationship between exchange rates and stock prices found that the stock return variability of US multinationals increases significantly in the aftermath of the financial turmoil. Arsyad, (2015) show that Japan is the market with most linkages in Southeast Asia, while Singapore and Vietnam are the markets with most linkages to East Asia. Furthermore, forecast variance decomposition reveals that Japan is the East Asia's most influential equity markets, while Singapore is the most influential equity market in Southeast Asia.

Study that focus on the impact of exchange rate volatility on economic growth in Malaysia from 2000-2016reports that the direct relationship between volatility and growth is insignificant, volatility significantly reduces Malaysian exports (Kaur, et al., 2019).Hong, et al., (2018) examine the depreciation of USD and crude oil price on exchange rate exposure in Malaysia show that the firms with foreign sales face most significant negative exposure of foreign exchange, followed by domestic firms and firms with foreign assets. The study concludes that there is an influence of domestic and foreign market effects on foreign currency exposure in the economy.

Embong, et al., (2012) shows that there is a significant negative relationship between disclosure and cost of equity capital for large firms and not significant for small firms. The managers of firms could strategize the firm's disclosure policy by taking into consideration that the benefit of disclosure in reducing the cost of equity may depend on the size of the firms.

Abu Bakar and Rosbi (2018) developefficient frontier for portfolio investment consists of two stocks form Kuala Lumpur Stock Exchange (KLSE). The result shows that the expected portfolio return is 0.54 percentages at global minimum portfolio risk, 2.34percentages. Abu Bakar and Rosbi (2018) also evaluate the risk reduction for portfolio inIslamic investment using Modern PortfolioTheory found that investment through diversification can reduce the risk and maximum the return. Then, Abu Bakar and Rosbi (2019) investigate the risk reduction for portfolio using fusion Modern Portfolio Theory and Genetic Algorithm method found that this hybrid methodprovides a better accuracy of prediction for return of investmentand portfolio risk.Abu Bakar and Rosbi (2019) evaluate thevolatility rate of sharia-company in Malaysia StockExchange using Monte Carlo Simulation method. The result indicates the distribution ofvolatility rate is follows normal distribution and the Monte Carlo Simulation proved the volatility rate is4.85% and standard deviation is 2.23. The result shows that the value of volatility rate is understatistical control with implementation on Monte CarloSimulation.

However, in the current economic condition due to COVID-19 disease show the recession of economic worldwide. Thus, there is still lack of study examine the impact of COVID-19 in financial area because this is a new virus found in year 2019. Therefore, this study tries to fulfill the gap by investigate the impact of COVID-19 to equity market and currency exchange rate.

III. Research Methodology

The purpose of this study is to validate data distribution during outbreak of Coronavirus disease (COVID-19) for KLSE index and currency exchange rate. Therefore, this study performed statistical test namely normality test and correlation analysis.

3.1 Normality test

In statistical test, one of the important assumption is data follow normal distribution. Normal distribution brings the meaning where mean, median and mode is in similar value. A normal distribution in a variable X where $x \in (-\infty, +\infty)$, with mean μ and variance σ^2 is a statistic distribution with probability density function as shown in Equation (1).

$$P(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

…… (1)

The normal distribution is describe using descriptive statistics using kurtosis and skewness analysis. "Skewness assesses the extent to which a variable distribution is symmetrical. If the distribution of responses for a variable stretches toward the right or left tail of the distribution, then the distribution is referred to as skewed. Kurtosis is a measure of whether the distribution is too peaked (a very narrow distribution with most of the responses in the center)." (Hair et al., 2017, p. 61).

"When both skewness and kurtosis are zero (a situation that researchers are very unlikely to ever encounter), the pattern of responses is considered a normal distribution. A general guideline for skewness is that if the number is greater than +1 or lower than –1, this is an indication of a substantially skewed distribution. For kurtosis, the general guideline is that if the number is greater than +1, the distribution is too peaked. Likewise, a kurtosis of less than –1 indicates a distribution that is too flat. Distributions exhibiting skewness and/or kurtosis that exceed these guidelines are considered non-normal." (Hair et al., 2017, p. 61).

Meanwhile the assessment of normality using statistical testing can be performed using Shapiro-Wilk normality test. The Shapiro-Wilk test the null hypothesis that a sample $x_1, x_2, x_3, ..., x_n$ come from normally distributed population. The Shapiro-Wilk statistical test is described as follow:

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

…… (2)

The variables in Equation (2) is described as follows:

$x_{(i)}$: Order statistic *i*-th for variable *x*,

x_i : Value of variable *x* at observation period *i*,

$\bar{x} = \frac{(x_1, x_2, x_3, ..., x_n)}{n}$:Sample mean for *n* observation,

a_i : Tabulated coefficients are described by Equation (3).

$$(a_1, a_2, a_3, ..., a_n) = \frac{m^{\mathrm{T}} V^{-1}}{C}$$

…… (3)

In Equation (3), the parameter are described as follows:

$C = \left\|V^{-1}m\right\| = \left(m^{\mathrm{T}} V^{-1} V^{-1} m\right)^{\frac{1}{2}}$: Vector norm in Euclidean space,

$m = (m_1, m_2, m_3, ..., m_n)^{\mathrm{T}}$: Vector m developed from the expected values of the order statistics of independent and identically distributed random variables sampled from the standard normal distribution,

V :Covariance matrix of those normal order statistics.

The null-hypothesis of this test is that the population is normally distributed. Thus, if the p value is less than the chosen alpha level, then the null hypothesis is rejected and there is evidence that the data tested are not normally distributed. On the other hand, if the p value is greater than the chosen alpha level, then the null hypothesis that the data came from a normally distributed population cannot be rejected.

3.2 Spearman rank-order correlation

In this study, non-parametric correlation analysis is selected for detecting association between two variables. The reason of selection for no-parametric statistical test is because one of the variable follow non-normal data distribution. Therefore, normality assumption is violated. The correlation test should use non-parametric method namely Spearman rank-order correlation.

The Spearman rank-order correlation coefficient is a nonparametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale. Spearman's correlation coefficient is a statistical measure of the strength of a monotonic relationship between paired data. There are two assumptions of using Spearman correlation test.

a. Two variables should be measured on an ordinal, interval or ratio scale.
b. There is a monotonic relationship between the two variables. A monotonic relationship exists when either the variables increase in value together, or as one variable value increases, the other variable value decreases.

The Spearman correlation coefficient is defined as the Pearson correlation coefficient between the rank variables.The formula for the Spearman rank correlation coefficient when there are no tied ranks is shown in Equation (4).

$$r_s = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n\left(n^2-1\right)} \quad \ldots\ldots (4)$$

In Equation (4), the parameters are described as follow:

d_i : The difference rank between variable 1 with variable 2 at observation period *i*,

n ; Number of observations

Spearman's returns a value from -1 to 1, where:

+1 = a perfect positive correlation between ranks
-1 = a perfect negative correlation between ranks
0 = no correlation between ranks.

When there is tied rank, there Spearman coefficient need to be calculated using Equation (5).

$$\tau = \frac{\frac{1}{n}\sum_{i=1}^{n}\left(R(x_i)-\bar{R}(x)\right)\cdot\left(R(y_i)-\bar{R}(y)\right)}{\sqrt{\left(\frac{1}{n}\sum_{i=1}^{n}\left(R(x_i)-\bar{R}(x)\right)^2\right)\cdot\left(\frac{1}{n}\sum_{i=1}^{n}\left(R(y_i)-\bar{R}(y)\right)^2\right)}} \quad \ldots\ldots (5)$$

The parameters in Equation (5) are described as follows:

$R(x_i)$: Rank of variable *x* at observation period *i*,

$R(y_i)$: Rank of variable *y* at observation period *i*,

$\bar{R}(x)$: Mean rank for variable *x*,

$\bar{R}(y)$: Mean rank for variable *y*.

In validating the finding of Spearman rank correlation analysis, this study supported the finding with additional test namely Kendal tau b as shown in Equation (6).

$$\tau_B = \frac{n_c - n_d}{\sqrt{(n_0-n_1)(n_0-n_2)}} \quad \ldots\ldots (6)$$

$$n_0 = n(n-1)/2$$

$$n_1 = \sum_i t_i\left(t_i-1\right)/2$$

$$n_2 = \sum_j u_j\left(u_j-1\right)/2$$

n_c =Number of concordant pairs

n_d =Number of discordant pairs

t_i =Number of tied values in *i*th group of ties for the first quantity,

u_j =Number of tied values in *j*th group of ties for the second quantity.

IV. Resultand discussion

Objective of this study is to evaluate data characteristics of KLSE Index during outbreak of coronavirus disease 2019 (COVID-19). This study performed normality test for both of data set to check data distribution in detecting outliers effect. Then, this study evaluated correlation analysis between KLSE and currency exchange rate during outbreak of COVID-19.

4.1 Data characteristics of KLSE Index

Figure 1 shows dynamic movement of KLSE Index. The observation period involving 63 trading days starting from January 2020 until end of March 2020. The starting value of KLSE is 1602.50 for first trading day. The KLSE index show decrement patent until reach minimum value at 1219.72 during outbreak of COVID-19 in Malaysia on 19th March 2020 (55th daily observation).

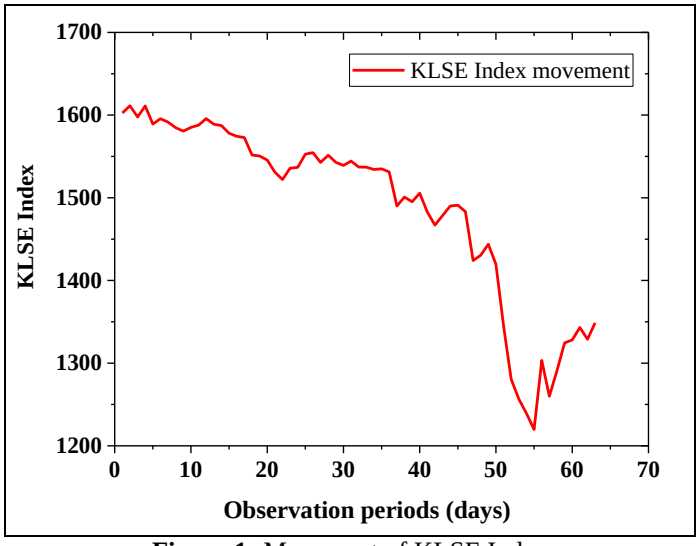

Figure 1: Movement of KLSE Index

Figure 2 shows changes of KLSE index for each of observation with previous value. Figure 2 indicates negative value is significant during peak of outbreak of COVID-19 in March 2020 (around 50th observation periods). The negative value indicates stocks in KLSE experienced decrement in stock price.

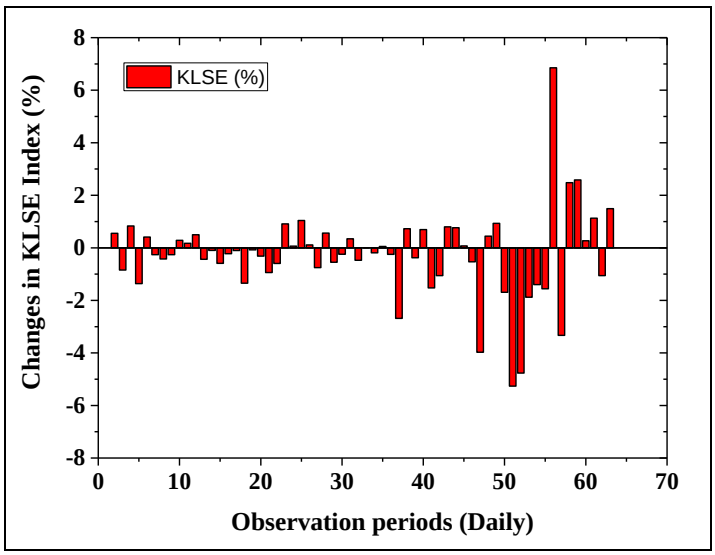

Figure 2: Dynamic movement of changes in KLSE Index

4.2 Statistical test for data normality of changes in KLSE Index data

This section describes the normality test for KLSE data. Firstly, this study calculated the changes of KLSE Index using Equation (1).

$$\Delta \text{KLSE}_t = \frac{I_t - I_{t-1}}{I_{t-1}} \times 100\% \quad \text{(1)}$$

In Equation (1), ΔKLSE_t is changes in percentages for KLSE index on period *t*, I_t is KLSE index value on observation period *t*, and I_{t-1} is KLSE Index value on observation period *t*-1.

Table 1 indicates descriptive statistics for data distribution of changes in KLSE index. Mean is -0.264, skewness is 0.345 and kurtosis is 5.880. These values indicate leptokurtic kurtosis distribution.

Next, this study validated the normality characteristics of data distribution using numerical and graphical statistical test. Table 2 shows normality test for changes in KLSE index using Shapiro-Wilk statistical test. The result indicates significant value is 0.000 that is less than alpha 0.05. Therefore, the numerical test indicates the data distribution of changes in KLSE index is not follow normal distribution. The finding is validated using graphical approach namely boxplot method. Figure 2 shows boxplot distribution range for changes in KLSE index value. The distribution of boxplot shows there are six outliers exist in the data set. The findings concluded that data distribution follows non-normal distribution because the existence of outliers.

Table 1: Descriptive statistics

Data distribution characteristic	Statistics value	Standard error
Mean	-0.264	0.215
Skewness	0.345	0.304
Kurtosis	5.880	0.599

Table 2: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
KLSE_change	.148	62	.002	.867	62	.000

a. Lilliefors Significance Correction

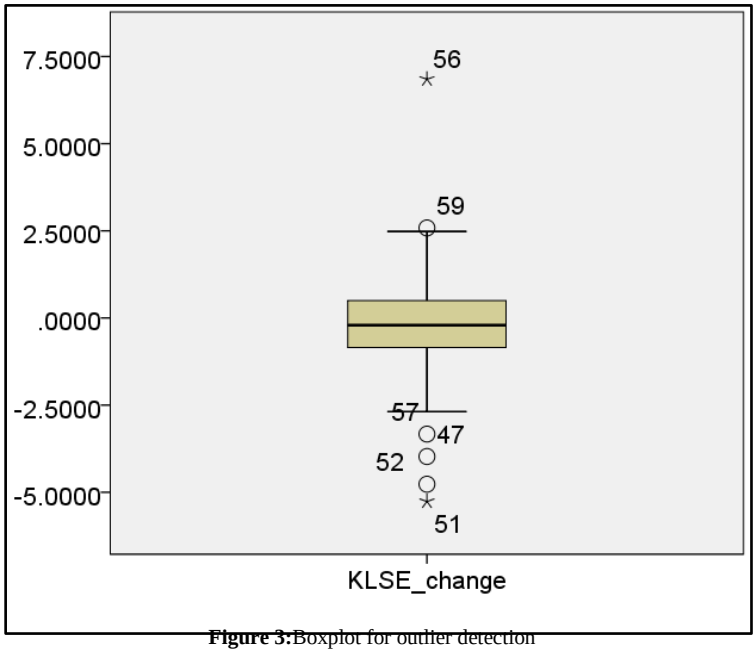

Figure 3: Boxplot for outlier detection

4.3 Data characteristics of currency exchange rate

Figure 4 shows the dynamic movement of currency exchange rate during coronavirus disease outbreak period. The sampling period is starting from January 2020 until March 2020 with total of 63 trading days. The initial value of currency exchange (USD/MYR) is 1 Malaysian Ringgit (MYR) is valued at 0.2446 United States Dollar (USD) on 2nd January 2020.The value of exchange rate keep fluctuated and reach minimum value on 23rd March 2020 (57th observation) with value of 0.2251 USD for each MYR. At minimum point, it is indicating the value of MYR is very weak in term of international currency exchange. This is one of the impact COVID-19 to economic landscape in Malaysia.

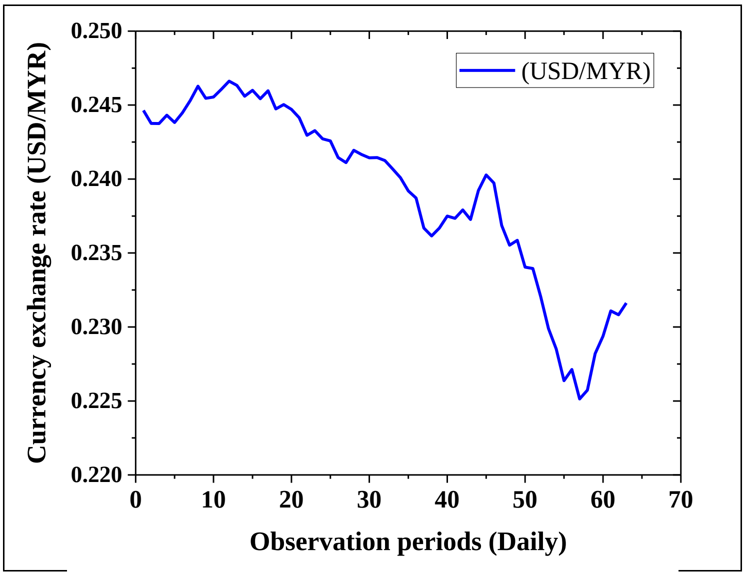

Figure 4: Dynamic movement of currency exchange rate

Next, this study analyzed the changes of currency exchange rate for one USD to MYR. Figure 5 shows the dynamic movement of changes for currency exchange rate of USD to MYR. The mean of changes is -0.087% that concluded in average the changes is in negative value because of COVID-19 disease. The outbreak of coronavirus creates unstable currency exchange that show more negative spike is shown in Figure 5.

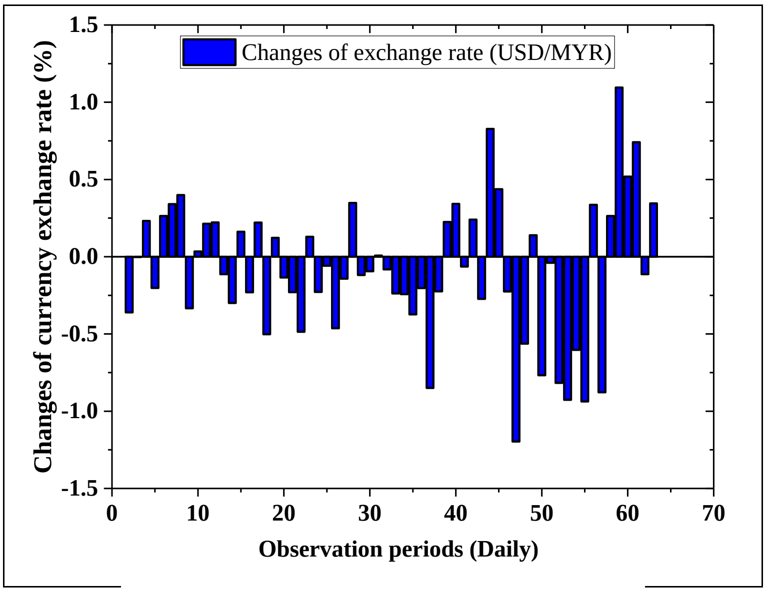

Figure 5:Changes of exchange rate (USD/MYR)

4.4 Statistical test for data normality of changes in currency exchange rate

This section describes the statistical test for changes of currency exchange rate in percentage. The calculation of changes for currency exchange rate is described in Equation (2)

$$\Delta CER_t = \frac{ER_t - ER_{t-1}}{ER_{t-1}} \times 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

In Equation (2), the parameters are described as follows:

ΔCER_t : Changes of currency exchange rate for observation period *t*,

ER_t : Exchange rate at observation period *t*, and

ER_{t-1} : Exchange rate at observation period *t*-1.

Table 3 shows the descriptive statistics that indicates the mean value is -0.087, skewness is -0.106 and kurtosis is 0.360. All three values indicate the data distribution is follow normal distribution. Then, this study performed statistical testing using Shapiro-Wilk test to prove the normality distribution. Table 4 shows the statistical normality test for data distribution of changes in currency exchange rate. From Shapiro-Wilk normality test, the probability value is 0.508 that is larger than chosen alpha 0.05. Therefore, the data distribution for changes of currency exchange rate follow normal data distribution. In addition, this study performed graphical testing using normal probability plot in Figure 6. The distribution of data is distributed near to normal distribution line. Therefore, data distribution follows normal distribution characteristics.

Table 3: Descriptive statistics for changes of currency exchange rate

Data distribution characteristic	Statistics value	Standard error
Mean	-0.087	0.057
Skewness	-0.106	0.304
Kurtosis	0.360	0.599

Table 4: Statistical normality test for changes of currency exchange rate

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Changes of currency exchange rate	.089	62	.200	.982	62	.508

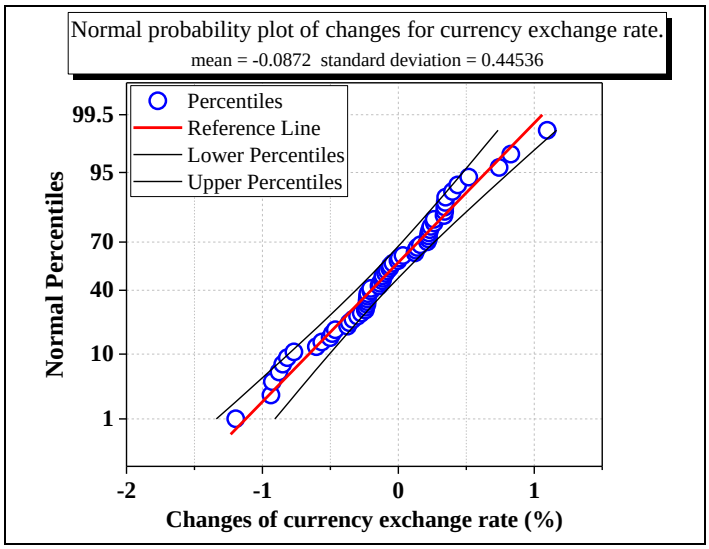

Figure 6: Normal probability plot forchanges of currency exchange rate

4.5 Statistical test of Spearman's rank-order correlation among changes in KLSE Index and currency exchange rate

This section describes correlation between changes in KLSE index and currency exchange rate. Figure 7 show the scatter plot between these two variables. Then, this study performs statistical test using Spearman's rank-order correlation to evaluate the relationship between these two variables. Spearman correlation analysis is nonparametric approach to detect relationship between two variables namely changes in KLSE Index and currency exchange rate. Table 5 shows two non-parametric correlation analyses namely Spearman rho and Kendall tau b. Both of the non-parametric analysis was selected for variables with non-normal data distribution.

Spearman correlation analysis shows the significant value is 0. 575. This indicates moderate positive relationship betweenchanges of KLSE Index and currency exchange rate. Next, the significant value is 0.000 that is less than chosen alpha 0.05. Therefore, this value rejected null hypothesis of Spearman test. As the conclusion, there is significant and moderate positive monotonic association between changes in KLSE Index and currency exchange rate.

Then, this study validated the statistical findings with performing another non-parametric correlation test namely Kendal Tau-b. Table 5 reported the value of significant is 0.000 that is less than chosen alpha 0.05. Therefore, this study rejected null hypothesis.A Kendall's tau-b correlation was run to determine the relationship between changes in KLSE Index and currency exchange rate amongst 63 observation periods. There was a moderate, positive correlation between changes in KLSE Index and currency exchange rate, which was statistically significant ($\tau b = .401$, $p = .000$).

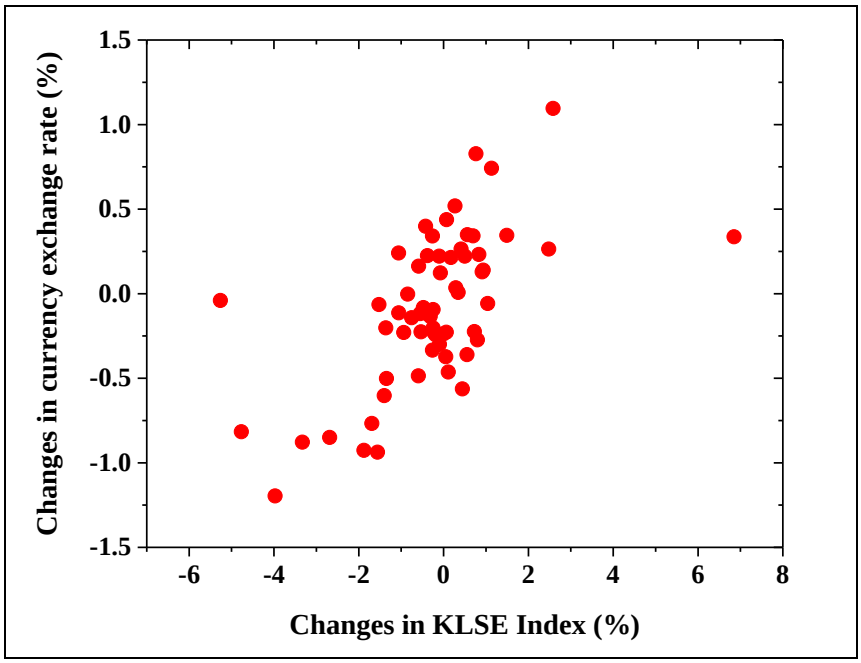

Figure 7: Normal probability plot forchanges of currency exchange rate

Table 5: Non-parametric correlation analysis

Correlation analysis			Changes in currency exchange rate
Spearman rho	KLSE Index Changes	Correlation coefficient	0.575
		Significant value (two-tailed)	0.000
		Number of observation	62
Kendall tau b	KLSE Index Changes	Correlation coefficient	0.401
		Significant value (two-tailed)	0.000
		Number of observation	62

V. Conclusion

The purpose of this paper is to evaluate impact of COVID-19 disease to dynamic behavior of equity market and currency exchange rate. Therefore, this study selected KLSE index for equity market data. Then, this study selected currency exchange rate one MYR in USD for currency exchange rate. Main objective of this study is to analyze the correlation between two data set using statistical correlation analysis to detect association of changes during outbreak of COVID-19. The finding s of this study are described as follows:

1. The selected observation periods are involving January 2020 until March 2020 because of outbreak COVID-19. There are 63 daily observation for KLSE Index and currency exchange rate of one MYR to USD.
2. The outbreak of COVID-19 creates uncomfortable feeling among investors in equity market. Therefore, KLSE index shows significant decrement of index value starting from January 2020 until March 2020. The initial value of KLSE index in January is 1602.5 decreasing to 1348.72 in March 2020. There is decrement of 253.78 point during these three months of COVID-19 outbreak.
3. In the similar manner, the currency exchange rate also shows similar pattern of decrement because of market sentiment. Market sentiment is the general feeling about the climate of the market as expressed by the direction of market prices. The initial currency exchange rate for one MYR is 0.2446 USD, the final observation in March 2020 shows currency exchange rate is 0.2316 USD for each MYR. The decrement of 0.013 USD in currency exchange rate.
4. Next, this study evaluated the associated between two variables namely changes in KLSE Index and currency exchange rate in period of COVID-19 outbreak. Both of these variables show mean of negative value of changes during outbreak of COVID-19. In addition, statistical test proved that both of the variables are affected during COVID-19 outbreak period.

The important of this finding will help government body to understand the current condition during COVID-19 outbreak. In addition, the findings will assist policy makers to develop solution in stabilizing economic situation in COVID-19 outbreak. In the same time, this study helpsinvestors to monitor the equity market to develop investment portfolio to gain better return and reducing loss.

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