MJoSHT
Malaysian Journal of Science, Health & Technology
[mjosht.usim.edu.my]

Article

The Effect of Fossil Fuels Price on Energy's Stock Returns

Nurul Syahira Che Roihan, Noor 'Adilah Ibrahim

Faculty of Science and Technology, Universiti Sains Islam Malaysia (USIM), Bandar Baru Nilai 71800, Nilai, Negeri Sembilan, Malaysia

Correspondence should be addressed to:
Noor 'Adilah Ibrahim; nooradilah.ibrahim@gmail.com

Article Info
Article history:
Received: 7 April 2021
Accepted: 23 July 2021
Published:1 October 2021

Academic Editor:
Sharifah Fairuz Syed Mohamad

Malaysian Journal of Science, Health & Technology
Vol. 7, No. 2 (2021)
eISSN: 2601-0003
https://doi.org/10.33102/mjosht.v7i2.165

Abstract— **Fossil fuels play an important role in energy systems as well as in the growth of technical, cultural and economic conditions of a country. In this study, we aim to investigate the effect of fossil fuels price towards energy's stock returns in Malaysia by using monthly fossil fuels price and energy stock price taken from Malaysian Energy Commission and investing.com, respectively. To investigate their relationship, first we test the stationarity using Augmented Dickey Fuller Test (ADF). The result shows that the data are stationary at first differences. Next, we use Pearson correlation to measure the strength of the association between two variables. To observe the effect of fossil fuels prices on energy's stock returns, we conduct a Multiple Linear Regression. We discovered that their relationships are not statistically significant. This is highly due to the competition of the use of non-renewable and renewable energy in recent years. The energy producers are adopting the renewable energy into the electricity grid which indirectly affect the utilization of fossil fuels as well as its price.**

Keywords— **Crude oil, fuel oil, diesel, gas, energy's stock return.**

I. INTRODUCTION

In this new era of technology, energy plays a significant role in our daily life which highly contribute in society's growth as well as economy. For the world economy, energy resources used for production of products, transport, computer running and other equipment. The heat energy produced by burning fuels is used in the cooking while energy derived from fuels such as petrol and diesel are used for the transmission of transports. The energy supply in factories is based on coal and natural gas. For light bulbs, running radio, home appliances and much more, electrical energy is used.

There are two types of energy resources which are non-renewable energy and renewable energy. In Malaysia, we highly depend on non-renewable energy which also called as fossil fuels. The main elements in the fossil fuels is carbon. Using renewables energy such as solar and geothermal energy is highly encouraged. However, fossil fuels continue to be the dominant source of energy worldwide due to their high energy density.

One of the ways to produce electricity is by burning the fossil fuels. The combustion of fossil fuels emits greenhouse gases such as carbon dioxide, methane and nitrous oxide. Undeniably, these gases may cause air pollution and increase the global temperature. Approximately, 21.3 billion tons per year are generated through fossil fuel combustion (Olivier et al., 2017). Natural processes are estimated to absorb only

approximately half of it, with a net increase of 10.65 billion tons of atmospheric carbon dioxide per year (Olivier et al., 2017). Currently, CO2, CH4 and N2O contribute to total worldwide greenhouse gas emissions. The direct CO2 drivers are coal, petroleum and natural gas combustion, comprising 89% of worldwide CO2 emissions, with 40%, 31% and 18% respectively (Olivier et al,. 2017).

The price of fossil fuels are determined primarily by supply level. When the supply is limited, while demand stays the same, prices will rise. Increasing in demand can lead to a cost rise for providers. However, if the demand drops, prices may also reduce.

There are few energy companies in Malaysia, specifically Peninsular, Sabah and Sarawak. However, for this study, we only use TNB to demonstrate our empirical analysis, as it is the largest electricity supplier in this country. In a nutshell, this study has three objectives, i.e (i) to examine the relationship between fossil fuels price and energy's stock returns (ii) to measure the effect of fluctuations of fossil fuels on energy's stock returns (iii) to investigate if there is correlation between variables used.

To achieve these objectives, we first investigate the previous studies related to this issue. There are numerous studies investigated on the similar issue. Jafarian and Safari (2015) did a research on market and sectoral analyses to examine the fluctuation in oil prices on Malaysian stock returns. The result on this study show that changes in oil prices have a beneficial effect on Malaysia's inventory return, for instance, on consumer staples and energy industries.

Furthermore, Sun et al,. (2019a) study the impact of fluctuations of three fossil energy prices which are coal, oil and natural gas on new energy companies stock prices. This study was carried out with data of stock price of China' new energy and technology listed companies, fossil energy prices and carbon future. This study was conducted by using variable vector autoregressive method. The outcome of this study indicates that fossil fuels account only for a small part of the stock price fluctuations of new energy company.

In addition, Lee and Baek (2018) has conducted a study on the stock prices of renewable energy firms to see if there is asymmetric response to oil prices change. The result of the study shows that the change in oil prices have a short run significant positive effect on the renewable energy stock prices in asymmetric manner. Next, a study on the effect of oil price shocks with uncertainty about oil prices on the stock returns of clean energy and technologies companies has been done by Kyritsis and Serletis (2017). Bivariate structural VAR and GARCH model has been used in this study and the result indicates that oil price uncertainty statistically insignificant effect on stock returns.

Besides that, Gormus et al., (2015) has conducted a study on the oil prices on fossil fuels stocks and alternative energy stocks, to see their inner dynamic of the sub-sector energy companies, whether they behave uniformly or do they differ in terms of their susceptibility to energy price stocks. This study proves that companies that related to fossil fuels such as coal and natural gas give a strongest response to the oil price shock, while for petroleum company did not give any response to the oil price change in the short run. Meanwhile, a study on the impact of oil price fluctuations on the return market level and sector analyses over the period from January 2000 to March 2014 has been done by Jafarian and Safari, (2015b). Multiple regression analysis shows that there is positive impact on the FTSE KLCI, consumer staples and energy sectors index return.

In addition, John and Varghese (2017) has conducted a study on the relationship of crude oil price fluctuations and stock price of energy companies in India. The results show that there is a significant relationship between crude oil fluctuations and stock price of energy companies. They also found that the energy companies seem to perform better as the crude oil prices increases. Apart from that, as in the case of Russia studied by Karacan et al. (2021), they discovered that the oil price and carbon emission negatively impacted the renewable energy consumption, while the real GDP per capita has a significant positive relationship. This indicates the importance of the use of renewable energy in Russia in order to maintain its superiority and sustainability of its energy production.

Besides that, Zhou (2020) has conducted a study on the effects of oil prices shocks and policy uncertainty on the stock return of clean energy companies. The study shows that oil supply shocks and aggregated demand shocks have a positive effect on clean energy company returns, whereas policy uncertainty shocks and oil-specific demand shocks have a negative effect. Moreover, a study on oil prices and the stock market in the four selected South Asian countries by Alamgir et al., (2021) found that there is a positive relationship between the global oil price and the stock market index, and the stock market index's response to positive and negative oil price shocks is asymmetric.

In addition, Kyritsis and Serletis (2019) have conducted a study on the effects of oil prices shocks, and also the uncertainty of oil prices on the stock returns of clean energy and technology companies. The study shows that there is no statistically significant effect of oil price uncertainty on stock returns, and that the relationship between oil prices and stock returns is symmetric. Their findings are robust to different model specifications and clean energy company stock prices. Next, a study on the effect of oil prices on Malaysian stock prices was done by Bani and Ramli (2019). They found that crude oil prices are cointegrated with both indices which are FBMKLCI and FBMEMAS, and the relationship is negative and significant in the long run. Meanwhile, Echchabi et al., (2017) has conducted a study on the possible effects of oil prices fluctuation on stock prices movements in Oman. The findings revealed that fluctuations in oil prices had a considerable impact on stock index movements. On the other hand, stock price fluctuations do not have impact on oil prices.

There are voluminous studies related to energy stock returns. Yet, there are no study has been done to investigate the relationship of fossil fuels prices on energy stock return, to the best of our knowledge. This paper is intended to fill the gap, to get a better understanding of the relationship between fossil fuels price and energy stock return for foreseeing of the development energy sector in the years to come.

II. METHODOLOGY

The fossil fuels prices data used in this study are collected from Malaysia Energy Commission, while the stock price of Tenaga Nasional is obtained from investing.com. The sample period is monthly basis from 2014 until 2018.

A. Unit Root Test

The unit root test in this study is performed using Augmented Dickey Fuller (ADF) test to check the stationarity of time series data.

B. Linear Multiple Regression Model

This method is used to estimate the coefficients of respective variables. As a predictive analysis, Linear Multiple Regression is used to explain the relationship between dependent and independent variable. Given the general regression model that relates Y to a function of X is

$$Y = f(X_{1,}X_{2,\ldots,}X_{N,}) \quad (1)$$

If the connection between parameters are estimated using a straight line, a linear regression method can be used. We suggest the regression model as follows:

$$\ln y_t = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \cdots + \beta_k \ln x_k + \varepsilon_t \quad (2)$$

where:
y_t = log return of TNB
x_1 = log price of coal
x_2 = log price of crude oil
x_3 = log price of fuel oil
x_4 = log price of diesel
x_5 = log price of gas
ε_t = error term

with hypothesis:

H_0 = There is no relationship between fossil fuels price on stock return TNB

H_a = There is relationship between fossil fuels price on stock return TNB

C. Test of Significance

Statistical hypothesis tests are used to determine if a data set has a statistically significant result. The study will reject null hypothesis if the $p < \alpha$, where p is the probability of the t test and α is the significant level, respectively. In our study, we let α to be 0.05.

D. Correlation

In addition, we also use Pearson Correlation to examine the strength of association between two variables. When the correlation coefficient is positive, it means that both variable increase and decrease together and vice versa.

E. Autocorrelation

Autocorrelation may occur in a time series data and it can be tested using Durbin Watson to measure the relationship of a variable with its previous data. An autocorrelation of +1 represents a perfect positive correlation, while an autocorrelation of negative 1 represents a perfect negative correlation with its past values. If the Durbin Watson value is around 2, no autocorrelation exist in the variable.

F. Log Return

Log return is one of the methods for calculating returns, where it assumes returns are compounded continuously rather than simple returns. The log return in this study is calculating by using log function as follows:

$$\text{Log return} = ln\frac{ending\ stock\ price}{initial\ stock\ price} \quad (3)$$

III. RESULT AND DISCUSSION

A. Unit Root Test

The results of the test do not show any stationarity at the level. Then the next step was to calculate the first difference of the time series to check for the stationarity. Result shows that the first difference appears to be stationary. Since the results indicate that the data are stationary in first difference, meaning that they are integrated of order I (1).

B. Multiple Linear Regression

Table 1 shows the result of Multiple Linear Regression to determine the relationship of independent variable (Crude Oil, Coal, Fuel Oil, Diesel, Gas prices) and dependent variable (Stock return of TNB).

TABLE 1
MULTIPLE LINEAR REGRESSION ANALYSIS OF TNB's STOCK RETURNS

Model	Coefficient	P-value	Hypothesis
β_0	0.014984	0.9062	
β_1	0.099083	0.3077	Fail to reject
β_2	0.039744	0.5345	Fail to reject
β_3	-0.109572	0.1909	Fail to reject
β_4	0.003301	0.9695	Fail to reject
β_5	-0.044756	0.5060	Fail to reject
R-squared = 0.051191			

The result of the regression analysis above is obtained using RStudio. Both coefficient of fuel oil and gas are negative which are β_3 = -0.109572 and β_5 = -0.0044756, respectively. The negative coefficient indicates that as the value of the independent variable increases, the dependent variable tends to decrease. For example, when the fuel oil increase by 1 unit, the stock return of TNB will decrease by 0.109572. Meanwhile, the coefficient of crude oil, coal and diesel are positive which are β_1 = 0.099083, β_2 = 0.039744, β_4 = 0.003301, correspondingly. A positive coefficient suggests that as the independent variable increases, the dependent variable tends to increase. As an example, when the price of crude oil increase by 1 unit, it also will increase the stock return of TNB by 0.0099083. Thus, we can say that the price of crude oil, coal and diesel have a positive relationship with the stock return of TNB, while price of fuel oil and gas have a negative relationship with the stock return of TNB.

Referring to the regression output, we can see that R^2 is 0.051191. It means that only 5.1191% of the variance in the TNB's stock returns can be predicted by fossil fuels prices. If the R^2 near to 1, it means that the suggested model predicts well and suitable to forecast the future value of dependent variable

C. Test of Significance

The result of *p*-value to test the significance of each independent variable in the model is also shown in Table 1. Based on the result, we can clearly see that the *p*-value for all variable are greater than 5% significance level, which indicates that all variables are not statistically significant to the dependent variable. This leads to weak evidence against the null hypothesis. This means that, we cannot reject the null hypothesis.

D. The Fitted Plot vs The Stock Return TNB

We plot the fitted graph which is based on our proposed model to compare with the actual value of TNB's stock returns. The purpose of doing this is to observe how far the estimated values deviates from the actual values.

Based on the plot in Figure 1, the red line is representing the stock return of TNB while the blue line is representing the fitted data. Apparently, we can see that the fitted line is not smooth, but somehow follows the trend of the actual values of the stock returns. This is highly due to lack of fuel prices data. We strongly believe that the fitted plot can be much improved if we can get access to more data.

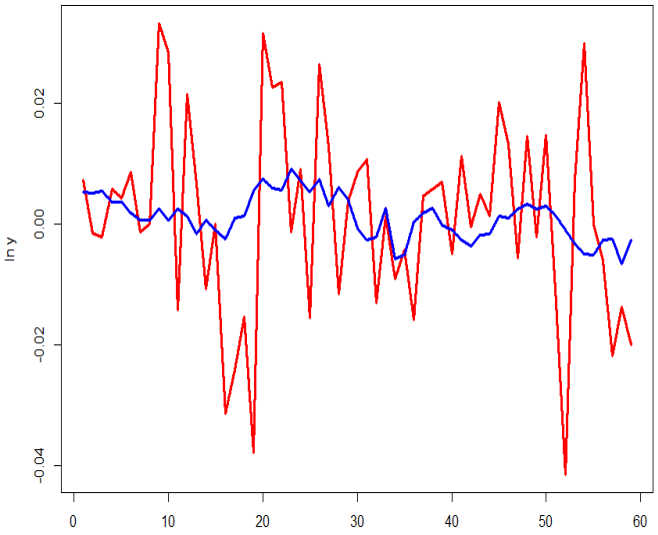

Fig. 1 Fitted Values Against the Actual Value of Stock Return

E. Residual Analysis

Apart from that, we run a residual analysis to check the validity of the regression assumption. To perform this, we find a difference value between the observed value of the dependent variable (stock return of TNB) and the predicted value (based on our proposed model). In Figure 2, it shows that there are few points that are distance from zero. However, most of the points are randomly dispersed around zero which indicates that the residuals or the error terms are following white noise processes.

Next, we plot the Q-Q plot to observe if the residuals following normal distribution. It is said to follow normal distribution if the residuals data are approximately lie on the line $y = x$.

As shown in Figure 3, the residuals seem to lie around the red line. Some of the points are outside the line but it is acceptable. Thus, we can conclude that the residuals are following normal distribution.

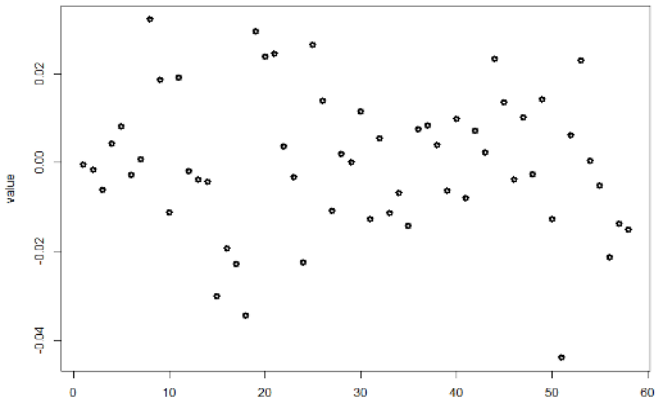

Fig. 2 Residuals Plot Against Time

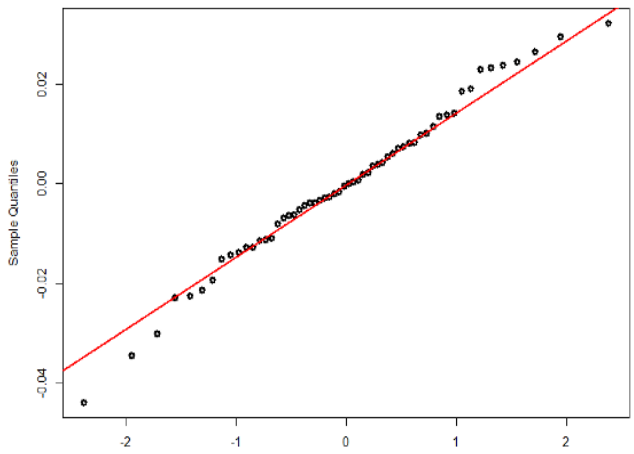

Fig. 3 Q-Q Plot

F. K-S Test

To confirm the distribution of residuals obtained above, we run a Kolmogorov-Smirnov test or known as a K-S test, which is a non-parametric test of the quality of continuous or discontinuous. In other words, the K-S test is used to test the normality of the distribution, which samples are standardized and compared with a standard normal distribution. For this test, we do not reject the null hypothesis if p-value of K-S test is greater than 5% level of significance but reject the null hypothesis if p-value of K-S test is less than 5% level of significance. The hypothesis of K-S test:

H_0 = Residuals is following normal distribution
H_a = Residuals is not following normal distribution

We discovered that the $p-$ value of K-S test is 0.9876, which is greater than 5% level of significance. This means that we do not reject the null hypothesis. Thus, this is in line with the Q-Q plot in Figure.3 which clearly shows the residuals are very close to normal distributions.

G. Correlation

Next, we measure the correlation between each independent variable with the dependent variable. Table 2 below reports the result of Pearson Correlation.

TABLE 2
PEARSON CORRELATION

Variable	y	x_1	x_2	x_3	x_4	x_5
y	1					
x_1	-0.051	1				
x_2	-0.086	0.386	1			
x_3	-0.092	0.973	0.459	1		
x_4	-0.023	0.894	0.347	0.885	1	
x_5	-0.111	-0.058	0.787	0.016	-0.184	1

Based on the Table 2, we can conclude that there is weak linear relationship between dependent variable and all independent variables since the correlation of all variables are below 0.5. Particularly, the fossil fuels prices are negatively correlated with the TNB's stock return. For instance, 1 unit increase in the crude oil price may lead to a decrease in the stock return of TNB. This indicates that the changes in the price of fossil fuels will give a negative impact on stock return of TNB. As for the correlation of independent variable, we can say that fuel oil and crude oil are mostly correlated (0.973), while gas and diesel are least correlated (-0.184).

H. Autocorrelation

In this study, we use Durbin Watson test to test the autocorrelation in the residuals. Durbin Watson test always have a value between 0 and 4, where 0 to less than 2 indicates a positive autocorrelation, while value 2 to 4 indicates a negative autocorrelation. If the value at 2, it means no autocorrelation.

The hypothesis for the Durbin Watson test is as follows:

H_0 = Residuals from a linear regression are not correlated with its previous value

H_a = Residuals from a linear regression are correlated with its previous value.

Based on the result obtained, we discovered that the value of the Durbin Watson test is equal to 1.7462. This means that there is positive autocorrelation in the model. Meanwhile, its p-value is equal to 0.06377 which means that it is statistically significant at 10% level of significant. This indicates a strong evidence against the null hypothesis. We can conclude that, residuals from a linear regression are autocorrelated.

Based on the analysis that we have done, our result show that the fossil fuels prices have insignificant effect on the stock return of TNB. This is most likely due to the use of renewable energy in recent years, where the utilization of the renewable energy is highly encouraged worldwide to reduce the greenhouse gases emission. Since Malaysia is heading towards green country in few more years, the usage of fossil fuels might be reduced and be transformed into renewable energy.

Adding to it, Anyalechi et al., (2019) also found that oil price is positively insignificant to the stock market return, while inflation rate is positively significant and real interest rate is negatively significant to the stock market return. We can say that macroeconomic factors give more contribution on the stock return compared to the fossil fuels prices. In order to make a decision to invest in a stock, the investors are focusing on the macroeconomic factors. Thus, we can say that the fluctuations of fossil fuels price are statistically insignificant on the stock return of TNB in Malaysia.

Apart from that, as we can see in Figure 1, the fitted line is not smooth with more than 50% different. This means that our proposed model is not very well explain the behaviour of the actual return. However, we believe that the findings can be improved if more data available.

IV. CONCLUSION

In this study, we investigated the effect of fluctuation of fossil fuels prices on the energy's stock return in Malaysia by using data of TNB's stock return and fossil fuel prices of crude oil, coal, fuel oil, diesel and gas. For the empirical analysis, we first run a Unit Root test to check the stationarity of the data. The results show that our proposed variables satisfy the first order stationarity. Furthermore, we found that the fossil fuels prices do not influence the stock return of TNB since all variables are not statistically significant. The Pearson correlation test shows that the fossil fuels prices are negatively correlated with the stock returns. The residuals are discovered to follow normal distribution since most of the residual's values lie within the normal distribution line. In addition, we also found that the autocorrelation exists in the residuals. For the future research we recommend to expand the model by adding some more independent variables such as macroeconomic factors. Apart from that, we also suggest to use daily data of the fossil fuels prices (if available) to get more precise results.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

ACKNOWLEDGEMENT

Faculty of Science and Technology, Universiti Sains Islam Malaysia are gratefully acknowledged.

REFERENCES

[1] Olivier, J. G. J. , Schure, K. M., and Peters, J. (2017). Trends in global CO2 and total greenhouse gas 2017 Report. PBL Netherlands Environmental Assessment Agency, (December), 5. https://doi.org/https://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2017-trends-in-global-co2-and-total-greenhouse-gas-emissons-2017-report_2674.pdf

[2] Jafarian, A. and Safari, M. (2015a). Impact of Oil Price Fluctuations on Returns of Different Sectors of Malaysian Stock Market. Journal of Modern Accounting and Auditing, 11(3), 159–167. https://doi.org/10.17265/1548-6583/2015.03.005

[3] Sun, C., Ding, D., Fang, X., Zhang, H., and Li, J. (2019a). How do fossil energy prices affect the stock prices of new energy companies? Evidence from Divisia energy price index in China's market. Energy, (December 2018), 637–645. https://doi.org/10.1016/j.energy.2018.12.032

[4] Lee, D., & Baek, J. (2018). Stock prices of renewable energy firms: Are there asymmetric responses to oil price changes? Economies, 6(4), 2–9. https://doi.org/10.3390/economies6040059

[5] Kyritsis, E., & Serletis, A. (2017). Oil Prices and the Renewable Energy Sector. SSRN Electronic Journal, (January 2017). https://doi.org/10.2139/ssrn.3070998

[6] Gormus, N. A., Soytas, U., & Diltz, J. D. (2015). Oil Prices, Fossil-Fuel Stocks and Alternative Energy Stocks. International Journal of Economics and Finance, 7(7). https://doi.org/10.5539/ijef.v7n7p43

[7] Jafarian, A. and Safari, M. (2015b). Impact of Oil Price Fluctuations on Returns of Different Sectors of Malaysian Stock Market. Journal of Modern Accounting and Auditing, 11(3). https://doi.org/10.17265/1548-6583/2015.03.005

[8] Anyalechi, K. C., Ezeaku, H. C., Onwumere, J. U. J., & Okereke, E. J. (2019). Does oil price fluctuation affect stock market returns in Nigeria? International Journal of Energy Economics and Policy, 9(1), 194–199. https://doi.org/10.32479/ijeep.7145

[9] John, T. T. & Varghese, C. M. (2019). Crude oil fluctuations in the Indian clean energy market. IJBAR, 6(1), 115-122.

[10] Karacan, R., Mukhtarov, S., Baris, I., Isleyen, A. & Yardimci, M. E. (2021). The impact of oil price on transition toward renewable energy consumption? Evidence from Russia. Energies, 14, 2947. Modern Accounting and Auditing, 11(3). https://doi.org/10.17265/1548-6583/2015.03.005

[11] Zhao, X. (2020). Do the stock returns of clean energy corporations respond to oil price shocks and policy uncertainty? Journal of Economic Structures, 9(1), pp. 1-16.

[12] Alamgir, F., & Amin, S. B. (2021). The nexus between oil price and stock market: Evidence from South Asia. Energy Reports, 7, pp. 693-703.

[13] Kyritsis, E., & Serletis, A. (2019). Oil prices and the renewable energy sector. The Energy Journal, 40.

[14] Bani, Y., & Ramli, S. N. (2019). Does Oil Price Matter for the Malaysian Stock Market?. International Journal of Economics, Management and Accounting, 27(2), pp. 315-329.

[15] Echchabi, A., & Azouzi, D. (2017). Oil price fluctuations and stock market movements: An application in Oman. The Journal of Asian Finance, Economics, and Business, 4(2), pp. 19-23.