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Causal Relationships and Short-Term Dynamics Between Oil Price and Stock Market Returns in Malaysia

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Abstract--*This study aims to corroborate the individual and institutional insights of the relationship between oil price and stock returns in Malaysia to cultivate a comprehensive policy instrument. It endeavors to analyze the causal relationships and short-term dynamics between oil price and stock return in Malaysia from 2006 to 2016. Granger Causality approach is performed to analyze the causal relationships and Impulse Response Function (IRF) within Vector Auto Regression (VAR) models are used to identify the short-run dynamic among the stock index series with oil price. The results determine that oil price movements do not Granger-cause aggregate market index. However, unidirectional and bi-directional causality exists among other selected indices and oil price. The results also show positive short-run dynamic among individual sector returns and oil price, though, Malaysian stock market index does not seem to respond immediately to oil price shocks.*

Key words--*Stock Market Return, Oil Price, Industry Analysis, Global Economy, Bursa Malaysia, Granger Causality***.**

I. INTRODUCTION

Oil is one of the largest sources of energy consumed in the world. It has a strategic position in the global economy. Oil price shocks can affect almost all the countries directly or indirectly. An increase in oil price influences the countries' economy in number of ways. Most common effect can be increasing the inflation of the economy. After 2008 financial crises the world oil price started to decrease after being at the highest level of US$114.6 [1] and the price of oil has been cut roughly half since June 2014. In January 2016, the international benchmark of oil was at around US$33.62 a barrel.

This relationship has been examined in the United States (U.S.) [2]- [5] for Gulf Corporation Council (GCC) countries [6]- [7] and for emerging economies [8]- [9]. Most of the findings on this relationship have been focusing on industrialized markets. Therefore, it is essential to carry out thorough research on emerging markets like Malaysia, a country with potential investment opportunities from major economies.

Since 1983, the Malaysian government sets the oil price in Malaysia. They also standardized the oil price for retailers and fix the margins of oil manufacturers to minimize the disruption of diesel and petrol supply. However, oil price surge in 2000 inflicted a rising fuel subsidy by the Malaysian government and in June 2008, global oil price hike

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led to increase Malaysian retail oil prices. Consequently, the price increase had a negative effect on businesses and the consumers' feared of increasing inflation in goods and services. However, recent trend indicates that the oil price has remained suppressed since the summer of 2014, dropping to the levels previously seen during the financial crises in 2007-08[10].

Over the past years many analysts have predicted that given the frequency of the oil price changes, it will affect the stock market returns. References[8], [11] studied this relationship with a different approach at the market level. In addition, the causal relationship between oil price and overall market index had been detected [12], [13]. The findings from these studies show mix results and it is worth mentioning that the current studies have not considered the individual sector level analyses.

This study follows the argument that different sector indices of the Malaysian stock exchange react differently to the oil price changes [14]. Moreover, global oil price shocks trigger mixed responses from the Malaysian stock market. However, these reactions depend intensively on the oil of the firm or a particular industry. Global oil price changes and mixed response from the equity market raised an important question on the efficiency of the Malaysian stock market, especially sector wise responses to global oil price changes. This approach may add additional weight to the argument that industries are not similar and the understanding on which the industry oil is dependent on and which industry is not sensitive to the global oil price shocks.

In light of this, this study attempts to investigate the causal relationship as well as short run dynamic relationship between oil price and stock returns at the market and industrial sector levels in Malaysia.

This study will aspire to validate the individual and institutional perception of causal relationship between oil price and stock returns in Malaysia in order to develop a comprehensive policy instrument. Furthermore,this study will attempt to analyze the short-term dynamics between the oil price and stock return. The research is expected to contribute in the following ways: first, the results of this study could be used as a preventive tool to reduce the negative impact of the global oil price changes on Malaysian stock market, especially to analyze the impact on different sectors; second, understanding this relationship would help investors both individually and institutionally to create better hedging strategies to avoid risk and maintain a healthy portfolio.

The remaining of this study is structured as follows. The next section reviews past relevant literatures, the theories and reviews of literature. Section 3 outlines research methodology, which covers data and the research model used in the study. Section 4 presents research findings of this study, whereas the summary and conclusion of the study are laid out in section 5.

II. LITERATURE REVIEW

Past researchers and economic theories have identified that there is a significant relationship between oil price and stock market return. The most influential global factors include the United States' economic policy, financial and commodity markets. Empirical study [15] identified that there is a long-term relationship between oil price and U.S. stock market and found that the oil price does not Granger-cause stock market returns, which shows one-way causal or unidirectional causal relationship from stock returns to the oil price [8]. Several theories described the impact of oil price volatility on stock price. At a microeconomic level, increase in oil price negatively affect the production cost directly or indirectly [5], [8].

Reference [16] examined both linear and nonlinear causal relationships between oil price and stock market returns in the U.S. and provides evidence of bidirectional causal relationship with the standard Granger causality tests. He identified that nonlinear causality exists from oil price movements to stock market returns, but not vice versa. Major findings ofreference [16] suggested that oil and stock markets are integrated rather than segmented and from the investment point of view, oil and stock markets' past data can be used to predict movements in each other. Similarly, reference [17] investigated the dynamic nexus between Brent oil prices and Istanbul Stock Exchange (ISE) and determined that the existence of a co-integrated relationship between two variables, which shows long-term relationship between oil price and market indices. In addition, one-way causal relationship was found on all indices to oil price, but oil price did not Granger-cause market indices.

While most of the past studies have focused on overall stock market response to oil price changes, [14] claimed that different economic sector indices react differently to the oil price fluctuations. They argued that analyzing sector indices separately leads to more conclusive results and sectors that have oil-based productions are more exposed to the oil price fluctuations. They analyzed the role of oil price in transport sector stock returns in 38 different countries. They documented that influence of oil price has a negative effect on transport sector returns in developed economies and insignificant effect on other countries.

Similarly, reference [18] investigated the sensitivity of Australian industry stock returns to oil price fluctuations by using augmented multi-factor market model using monthly data. They identified that certain industries are more significant for the oil price factor than general market index in Australia. They also found that the transport and packing industries index were negatively affected by the oil price. However, diversified resource industries such as oil and gas industries index revealed a significant positive sensitivity towards oil price fluctuations.

Despite the fact that these studies cover the importance of linkage between stock returns and the oil price in developed countries, the outcome of such studies cannot be generalized to other countries like emerging markets. An empirical study by [8] examined the dynamic linkage between oil price and stock returns in 22 emerging markets including Malaysia. Out of 22 countries only in four countries (Malaysia, Turkey, Korea and South Africa) oil price movements explained more than 2% of the forecast error variance, whereas in 15 countries oil price volatility explained less than 1% after 15 days. Results indicated countries that showed a high response had a higher level of oil consumption than other countries. The stock markets in emerging economies seem to be inefficient to transfer new information of the global oil market and stock market. Overall this study identified very weak response by emerging stock markets to oil price changes.

Reference [11] used daily data to identify the effects of oil price and stock price for 21 emerging markets including Malaysia. They found that such firms were unable to transfer the cost of fuel to the final consumer and the decline of firms' profit and dividends as the result of the increase of production costs was the main element that affected the equity price. Contrasting previous results, a study on emerging stock markets, found strong evidence that oil price movements impacted the stock market in those countries [11].

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Reference [19] employed multivariate VAR model to examine the interaction between the Chinese stock market and oil price movements. It was identified that oil price volatility did not have a significant impact on most of the industry indices in Chinese stock market and only oil company stock prices were negatively affected by oil price changes. They also found that increased oil volatility might raise the return of petrochemicals index and mining index. Reference [20] explored the dynamic relationship between Malaysian stock index and macroeconomic variables and suggested that crude oil price, industrial production, inflation rate and Treasury bills' rate have long-run relation with Financial Times Stock Exchange Bursa Malaysia Kuala Lumpur Composite Index (FBMKLCI). Their results also showed that crude oil price, industrial production index, consumer price index (CPI) and treasury bills were significantly and negatively related to FBMKLCI in the long run, except industrial product index with a positive coefficient.

Reference [12] examined the market response of the developed and emerging markets including Singapore, Japan, Korea and Malaysia; the results showed that at 10% significant level, stock market returns Granger caused oil price returns in Singapore and in Japan. However, no causal linkage was found between oil price and stock market returns in Malaysia. Furthermore, they indicated that Japanese stock market responded immediately to oil price shocks, whereas, in Singapore, Malaysia and South Korean stock market, it took longer time for the impact to occur.

Reference [9] studied 11 Asian Pacific countries to determine the linkage between oil price changes, stock returns and exchange rate. They employed Vector Auto Regression (VAR), Vector Error Correction Model (VECM) and Granger causality model, using monthly data. They found a significant short-term linkage between oil price changes and stock markets returns in Asian Pacific countries. However, Granger causality test indicated that oil price Granger-caused stock returns for only Sri Lanka and Pakistan.

Reference [21] concluded that based on the results of multiple regression analysis, the oil price has a significant negative effect on the Indian stock market. However, Granger causality test results indicated that bidirectional causality exist between stock price and crude oil price. Similarly, reference [22] employed Johansen's co-integration test and VECM on the Indian stock market and suggested that long-run co-integrations relationship exists between oil price and stock indices. In addition, they also revealed that the volatility of stock price Granger-caused the movements of oil price in the short-run.

Previous studies applied different evaluation measures to identify the relationship between oil price and stock return in Malaysia and other emerging markets. For instance, a recent study by reference [13] on stock markets of Malaysia, Singapore and Japan, used the causality methodology developed by [23] to examine the causality relationship between stock price and oil price in the short-term and long run. They indicated that there is significant difference between the reactions of the equity markets in those countries to a mutual oil price change. However, their results also showed that at 5% significant level there was no causal linkage between oil price and stock markets. In addition, they showed that in Singapore and Malaysia, the impact of oil price volatility on stock market returns were similar, because both country's stock markets had a significantly positive response to oil price movements.

From the review of the earlier literature it is observed that a large number of researches have been made to determine the relationship between crude oil price and stock market movements. There are mixed results from the past

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studies with different approaches that need further investigation. Certainly, above-mentioned studies have great contribution to the field, though the findings of the past studies are mixed and inconsistent. These results are subjective and sensitive to the choice of market, selection of methodology and the time span studied.

Yet it is more complex to generalize the findings because each market has its unique features in terms of rules and regulation and types of investors. In addition, most of the existing literature is related to the effect of oil price on aggregate stock market indices and this may hide diverse reactions at the individual sector level. To date, there are only few studies focused on the relationship between global crude oil and Malaysian financial market, especially on stock market of Malaysia. Furthermore, there is no previous study investigating the relationship between oil price and stock returns at industrial sector level in Malaysia.

III. RESEARCH METHODOLOGY

The data series and notations used in this study are as follows. Crude oil spot price is the price index in Malaysian Ringgit of West Texas Intermediate (WTI)- Cushing Oklahoma, obtained from Bloomberg data system.

$dLOLP_t$:Monthly changes of oil spot price, the conventional natural log first difference transformation of oil spot price variable

This study use FBMKLCI main market index and ten (10) sectorial indices listed on Bursa Malaysia. For modeling,all variables are expressed in natural logarithms to stabilize the variability in the data [5], [12], [18]. Data are collected from Bloomberg data system, Bursa Malaysia, on a monthly basis. The time period of this research data is from 01.01.2006 to 31.01.2016 and Eviews-9 package is used for econometric analyses. Monthly closing values and monthly returns are computed as the first difference of the log-transformed series in the following manner:

$R_{i,t} = \ln(P_t) - \ln(P_{t-1}) = \ln(\frac{P_t}{P_{t-1}})$ (1)

$DLKLCI_t$: Log of first difference FTSE Bursa Malaysia KLCI (FBMKLCI)

$DLCSU_t$: Log of first difference Consumer Product Index (KLCSU)

$DLIND_t$: Log of first difference Industrial Index (KLIND)

$DLCON_t$: Log of first difference Construction Index (KLCON)

$DLPRP_t$: Log of first difference Property Index (KLPRP)

$DLPRO_t$: Log of first difference Industrial Production Index (KLPRO)

$DLSER_t$: Log of first difference Trading/Services Index (KLSER)

$DLTIN_t$: Log of first difference Mining Index (KLTIN)

$DLTEC_t$: Log of first difference Technology Index (KLTEC)

$DLPLN_t$: Log of first difference Plantation Index (KLPLN)

$DLFIN_t$: Log of first difference Finance Index (KLFIN)

A Granger causality model is employed to identify the direction of the relationship between oil price changes and stock index returns. The Granger causality model is a statistical feedback concept that is used in the construction of forecasting models [24]. It investigates initially, if X variable causes the Y variable (X → Y) or is it the Y variable that

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causes X (Y → X), where the arrow points to the direction of causality. The Granger causality also assumes that forecast of the variables, X and Y, is comprised solely in the time series data on these variables as in Reference [24]. This model assumes that the underlying time series is stationary. Granger causality test can be meaningless if the variables are non-stationary.

Secondly, the Granger causality test is sensitive to the number of lagged terms used in the model. Therefore, the number of lagged terms needs to be introduced in the causality test. This study follows reference [25] to select different lags to run Granger causality test.

In this research, firstly, the data have been transformed into natural logarithms before conducting the main analysis. Secondly, stationarity analysis has been performed to determine the variables stationary properties and order of integration of the variables. To check the stationarity, this study employs augmented Dickey–Fuller (ADF) [26] and Phillips-Perron (PP) [27] unit root tests. In order to choose optimal lag length, Schwarz Information Criterion (SIC) is applied for ADF and PP tests. The direction of the relationship between oil price changes and stock index returns has been examined with direct Granger causality test [24]. The model used in this study is as follows:

$$(dlindex)_t = \mu_{2t} + \sum_{i=1}^{n} \lambda_i (dlindex)_{t-1} + \sum_{j=1}^{n} \delta_i \, (dlolp)_{t-i} + \varepsilon_{2t} \quad (2)$$

$dLindex$: Log of first difference of selected Index

$dlolp$:Monthly changes of oil spot price, the conventional natural log of first difference transformation of oil spot price variable

Here $dLindex$ has been taken as dependent variable and $dlolp$ has been taken as independent variable. From this model, it can be identified whether $dlolp$Granger-cause the selected stock index returns. This model also can be devised to check whether stock index returns Granger-cause the oil prices. In this case, the model is as follows:

$$(dlolp)_t = \mu_{1t} + \sum_{i=1}^{n} \alpha_i (dlindex)_{t-1} + \sum_{j=1}^{n} \beta_j \, (dlolp)_{t-i} + \varepsilon_{1t} \quad (3)$$

Empirical results based on Granger causality tests help to find the flow of influence and the directions of the variables. However, the forecasts of the impulse response function within VAR model can provide a quantitative measurement of the impacts for future periods. Therefore, in addition to Granger causality test, to establish the short-run dynamic among the stock index series and oil price, this study employs unrestricted VAR to estimate the impulse response function. Impulse response functions demonstrate the responsiveness of the endogenous variable in the VAR system and provide the time paths of the effects of each shock. In this study, Cholesky one standard deviation of innovations is used to solve this identification problem [28]. The VAR system model used in this study is as follows:

$$(dlolp) = B_1 + B_2 \, (dlindex)_{t-i} + B_3 \, (dlolp)_{t-i} + U_1 \quad (4)$$

$$(dlindex) = B_4 + B_5 \, (dlolp)_{t-i} + B_6 \, (dlindex)_{t-i} + U_2 \quad (5)$$

Where, in equation 4, (dlolp) is the dependent variable and (dlindex)t-i and (dlolp)t-i are independent variables, where t-i is the lag period and U1 is the error term. Similarly, in equation 5, (dlindex) is the dependent variable and

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(dlolp)t-i and (dlindex)t-i are independent variables, where t-i is the lag period and U1 and U2 is the error term.

U1 and U2 are also called innovations, shocks or impulses. This means when there is a shock in U1, it affects the oil price; then index and ultimately oil price during the next period. Similarly, a shock to U2 also affects the whole VAR model.

IV. FINDINGS & DISCUSSSIONS

Descriptive Statistics

Descriptive statistics of monthly returns of market and sector and monthly oil price returns from 01 January 2006 to 31 January 2016 are reported in Table I. In sector indices the average returns in oil price and Technology Index is negative. The standard deviation of the oil price exceeds the standard deviation of returns in each series, except the standard deviation of Mining Index. The return series of market, sector indices and oil price are not normally distributed. It can be said that return series are not distributed normally in full, but the series are distributed close to normal distribution as the median values of series are close to mean values.

Table I: Descriptive Statistics

	Mean	**Median**	**Maximum**	**Minimum**	**Std. Dev.**
DLOLP	-0.005	0.001	0.242	-0.366	0.090
DLKLCI	0.005	0.008	0.127	-0.165	0.037
DLCON	0.006	0.008	0.231	-0.316	0.070
DLCSU	0.008	0.011	0.108	-0.091	0.034
DLFIN	0.005	0.012	0.171	-0.156	0.049
DLIND	0.003	0.005	0.099	-0.178	0.041
DLPLN	0.008	0.010	0.225	-0.234	0.064
DLPRO	0.005	0.007	0.128	-0.131	0.048
DLPRP	0.006	0.007	0.235	-0.206	0.066
DLSER	0.004	0.009	0.124	-0.185	0.042
DLTEC	-0.001	-0.002	0.327	-0.2012	0.081
DLTIN	0.003	-0.007	1.032	-0.8546	0.153

Table II presents the ADF and PP unit root test results of the individual series in their level. The results from ADF and PP test indicate that, at 1% significant level, all the series have unit root (non-stationary) in level. However, at first difference, all of the variables show stationary properties. Table III provides the results of the unit root tests on the variables at their first difference. Based on ADF and PP test, it can be concluded that all variables are integrated of order one (I(1)) being stationary after first time differencing. Based on the unit root test results, Granger causality test can be performed on the first difference of the variables to indicate the causal relationship between them.

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Table II: Results of ADF and PP tests (Level)

	ADF test statistics		**PP test statistics**	
	Constant	**Constant and Trend**	**Constant**	**Constant and Trend**
LNOLP	-2.39 [1]	-2.40 [1]	-2.27 [4]	-2.25 [4]
	(0.14)	(0.37)	(0.18)	(0.45)
LNKLCI	-1.72 [0]	-1.52 [0]	-1.83 [6]	-2.25 [6]
	(0.41)	(0.81)	(0.36)	(0.45)
LNCON	-2.99 [0]	-2.88 [0]	-3.06 [6]	-3.12 [7]
	(0.03)	(0.17)	**(0.03)**	(0.10)
LNCSU	-1.67 [0]	-1.91 [0]	-1.68 [1]	-1.87 [2]
	(0.44)	(0.63)	(0.43)	(0.66)
LNFIN	-1.69 [0]	-1.34 [0]	-1.76 [7]	-1.89 [7]
	(0.42)	(0.87)	(0.39)	(0.65)
LNIND	-1.95 [0]	-2.88 [0]	-1.91 [2]	-3.01 [4]
	(0.30)	(0.17)	(0.32)	(0.13)
LNPLN	-2.82 [0]	-2.47 [0]	-2.77 [4]	-2.53 [4]
	(0.05)	(0.34)	(0.06)	(0.31)
LNPRO	-1.34 [0]	-2.171 [0]	-1.51 [4]	-2.57 [5]
	(0.60)	(0.50)	(0.52)	(0.29)
LNPRP	-1.847[0]	-1.90 [0]	-2.03[6]	-2.49 [6]
	(0.35)	(0.64)	(0.27)	(0.33)
LNSER	-1.51 [0]	-1.97 [0]	-1.62 [5]	-2.41 [6]
	(0.52)	(0.6096)	(0.4669)	(0.3709)
LNTEC	-1.9178 [0]	-1.47 [0]	-1.84 [2]	-1.29 [1]
	(0.32)	(0.83)	(0.35)	(0.88)
LNTIN	-3.25 [0]	-3.58 [0]	-3.11[5]	-3.53 [5]
	(0.02)	(0.03)	(0.02)	(0.04)

Notes:

1. ( ) MacKinnon (1996) one-sided p-values; [ ] optimal Lag lengths based on SIC for ADF; [ ] Bandwidth based on Newey-West automatic for PP;
2. With intercept, critical values for ADF and PP tests are respectively at 1%= -3.4860 and -3.4855, at 5%=-2.8858 and -2.8856, at 10%= -2.5798 and -2.5797;
3. With intercept and tread, critical values for ADF and PP tests are respectively at 1%= -4.0369 and -4.0363, at 5%= -3.4480 and -3.4476, at 10%= -3.1491 and -3.1489.

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Table III: Results of ADF and PP tests (First Difference)

	ADF test statistics		**PP test statistics**	
	Intercept	**Intercept and Trend**	**Intercept**	**Intercept and Trend**
LNOLP	-8.05 [0]	-8.13 [0]	-8.13 [3]	-8.20 [3]
	(0.00)	(0.00)	(0.00)	(0.00)
LNKLCI	-9.05 [0]	-9.08 [0]	-9.42 [5]	-9.44 [5]
	(0.00)	(0.00)	(0.00)	(0.00)
LNCON	-11.74 [0]	-11.81 [0]	-11.74 [6]	-11.79 [6]
	(0.00)	(0.00)	(0.00)	(0.00)
LNCSU	-11.56 [0]	-11.63 [0]	-11.56 [1]	-11.63 [0]
	(0.00)	(0.00)	(0.00)	(0.00)
LNFIN	-10.15 [0]	-10.21 [0]	-10.34 [7]	-10.37 [7]
	(0.00)	(0.00)	(0.00)	(0.00)
LNIND	-10.98 [0]	-10.95 [0]	-10.98 [1]	-10.95 [1]
	(0.00)	(0.00)	(0.00)	(0.00)
LNPLN	-9.431 [0]	-9.59 [0]	-9.60 [4]	-9.70 [3]
	(0.00)	(0.00)	(0.00)	(0.00)
LNPRO	-10.25 [0]	-10.21 [0]	-10.34 [4]	-10.29 [4]
	(0.00)	(0.00)	(0.00)	(0.00)
LNPRP	-10.04 [0]	-10.04 [0]	-10.30 [6]	-10.29 [6]
	(0.00)	(0.00)	(0.00)	(0.00)
LNSER	-10.37 [0]	-10.34 [0]	-10.45 [5]	-10.4 [5]
	(0.00)	(0.00)	(0.00)	(0.00)
LNTEC	-12.65 [0]	-12.83 [0]	-12.52 [3]	-12.77 [2]
	(0.00)	(0.00)	(0.00)	(0.00)
LNTIN	-14.38 [0]	-14.32 [0]	-14.47 [1]	-14.41 [1]
	(0.00)	(0.00)	(0.00)	(0.00)

Notes:

1. ( ) MacKinnon (1996) one-sided p-values; [ ] optimal Lag lengths based on SIC for ADF; [ ] Bandwidth based on Newey-West automatic for PP.
2. With intercept, critical values for ADF and PP tests are respectively at 1%= -3.4860 and -3.4860, at 5%=-2.8858 and -2.8858, at 10%= -2.5798 and -2.5798;
3. With intercept and tread, critical values for ADF and PP tests are respectively at 1%= -4.0369 and -4.0369, at 5%= -3.4480 and -3.4480, at 10%= -3.1491 and -3.1491

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Granger Causality Test Results

This study employs Granger causality method by using the F-test to examine the null hypothesis of no-causality. Since, oil price and stock indices are likely to have bilateral effects and that are likely to be sensitive to the selection of number of lags in the model, this study follows [25] to select different lags to run Granger causality test. Table IV to XIV reports the obtained results.

Table IV: Pairwise Granger Causality Tests of Oil Price and Market Index (FBMKLCI)

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLKLCI → DLOLP	7.21 (0.01) ***	3.63 (0.02) **	2.89 (0.03) **	2.26 (0.06) *	1.76 (0.1)	1.79 (0.1)
DLOLP → DLKLCI	0.005 (0.9)	0.12 (0.8)	0.24 (0.8)	0.77 (0.5)	1.84 (0.1)	1.51 (0.1)

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality indicate that oil price movements do not Granger-cause overall Malaysian stock market index. However, there is evidence of significant causality from stock returns to oil price changes in market index for the first four lags, since the estimated F-value is significant at the 1% level; the critical F-value is 7.21 (for lag 1), at the 5% level; the critical F-value is 3.63 (for lag 2); 2.89 (for lag 3) and at the 10% level; the critical F-value is 2.26 (for lag 4). These results are consistent with [15] and [17], which identified unidirectional causality relationship from stock returns to oil price. Furthermore, these results are also agreed by [8]. However, the results contradict with [9], [12], [13].

Table V: Pairwise Granger Causality Tests of Oil Price and Construction Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLCON → DLOLP	3.38 (0.06)*	1.61 (0.2)	1.16 (0.3)	0.98 (0.4)	0.79 (0.5)	0.86 (0.5)
DLOLP → DLCON	0.069 (0.7)	0.13 (0.8)	0.23 (0.8)	0.41 (0.8)	1.16 (0.3)	1.56 (0.1)

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality show evidence of significant causality from stock return to oil price changes in Construction Index for the first lag, since the estimated F-value is significant at the 10% level; the critical F-value is 3.38 (for lag 1).

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Table VI: Pairwise Granger Causality Tests of Oil Price and Consumer Product Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLCSU → DLOLP	**3.34 (0.06) ***	1.58 (0.2)	1.71 (0.16)	1.45 (0.22)	1.31 (0.26)	1.38 (0.22)
DLOLP → DLCSU	1.17 (0.28)	0.82 (0.4)	0.54 (0.65)	0.40 (0.80)	0.318 (0.90)	0.74 (0.61)

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality indicates evidence of significant causality from stock return to oil price changes in Consumer Product Index for the first lag, since the estimated F-value is significant at the 10% level; the critical F-value is 3.34 (for lag 1).

Table VII: Pairwise Granger Causality Tests of Oil Price and Finance Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLFIN→ DLOLP	4.54 (0.03)**	2.23 (0.1)	1.55 (0.2)	1.81 (0.1)	1.53 (0.1)	1.56 (0.1)
DLOLP → DLFIN	0.82 (0.36)	0.51 (0.5)	0.45 (0.7)	0.51 (0.7)	0.77 (0.5)	1.40 (0.2)

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality indicate evidence of significant causality from stock return to oil price changes in Finance Index for the first lag, since the estimated F-value is significant at the 5% level; the critical F-value is 4.54 (for lag 1).

Table VIII: Pairwise Granger Causality Tests of Oil Price and Industrial Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLIND → DLOLP	0.69 (0.4)	0.41 (0.6)	0.83 (0.4)	1.48 (0.2)	1.68 (0.1)	1.64 (0.1)
DLOLP → DLIND	0.00 (0.9)	0.21 (0.8)	0.10 (0.9)	0.12 (0.9)	0.20 (0.9)	0.49 (0.8)

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Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

There is no causal interaction between Industrial Index and the oil price changes.

Table IX: Pairwise Granger Causality Tests of Oil Price and Plantation Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLPLN → DLOLP	8.95 (0.00) ***	6.08 (0.00) ***	5.85 (0.00) ***	4.64 (0.00) ***	3.39 (0.00) ***	2.86 (0.01) **
DLOLP → DLPLN	2.35 (0.1)	1.62 (0.2)	1.48 (0.2)	1.33 (0.2)	1.21 (0.3)	2.15 (0.05)*

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality show that "oil price to stock return" causal direction is significant in Plantation Index for the sixth lag, since the estimated F-value is significant at the 10% level; the critical F-value is 2.15 (for lag 6). In addition, results of Granger causality indicates evidence of significant causality from stock return to oil price changes in Plantation Index at the conventional levels, whatever the lag being considered, since the estimated F-value is significant at the 1% level; the critical F-value is 8.95 (for lag 1); 6.08 (for lag 2); 5.85 (for lag 3); 4.64 (for lag 4); 3.39 (for lag 5) and at the 5% level; the critical F-value is 2.86 (for lag 6). Hence, bi-directional causality exists between oil price and stock returns in Plantation Index.

Table X: Pairwise Granger Causality Tests of Oil Price and Industrial Production Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLPRO → DLOLP	4.97 (0.02)**	2.09 (0.1)	1.57 (0.1)	1.18 (0.3)	0.80 (0.5)	0.65 (0.6)
DLOLP → DLPRO	3.23 (0.07)*	1.37 (0.2)	0.77 (0.5)	0.95 (0.4)	1.37 (0.2)	2.59 (0.02)**

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality show that "oil price to stock return" causal direction is significant in Industrial Production Index for the first and the sixth lag, since the estimated F-value is significant at the 10% level; the critical F-value is 3.23 (for lag 1) and at the 5% level; the critical F-value is 2.59 (for lag 6). In addition, there is evidence of significant causality running from stock return to oil price changes in Industrial Production Index (KLPRO) for the

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first lag, since the estimated F-value is significant at the 5% level; the critical F-value is 4.97 (for lag 1). Hence, bi-directional causality exists between oil price and stock returns in Industrial Production Index at lag 1.

Table XI: Pairwise Granger Causality Tests of Oil Price and Property Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLPRP → DLOLP	3.22 (0.07) *	1.32 (0.2)	1.02 (0.3)	0.80 (0.5)	0.67 (0.6)	0.88 (0.5)
DLOLP → DLPRP	1.90 (0.1)	0.94 (0.3)	0.69 (0.5)	0.89 (0.4)	1.55 (0.1)	2.47 (0.02) **

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality show that "oil price to stock return" causal direction is significant in Property Index for the sixth lag, since the estimated F-value is significant at the 5% level; the critical F-value is 2.47 (for lag 6). In addition, results of Granger causality indicate evidence of significant causality from stock return to oil price changes in Property Index for the first lag, since the estimated F-value is significant at the 10% level; the critical F-value is 3.22 (for lag 1). These results suggest that oil price movements can influence the performance of the companies engaged in real estate business.

Table XII: Pairwise Granger Causality Tests of Oil Price and Trading/Services Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLSER → DLOLP	3.41 (0.06)*	1.57 (0.2)	1.56 (0.2)	1.51 (0.2)	1.71 (0.1)	1.72 (0.1)
DLOLP → DLSER	1.75 (0.1)	1.02 (0.3)	0.68 (0.5)	0.73 (0.5)	0.78 (0.5)	1.26 (0.2)

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality indicate evidence of significant causality from stock return to oil price changes in Trading/Services Index for the first lag, since the estimated F-value is significant at the 10% level; the critical F-value is 3.41 (for lag 1).

Table XIII: Pairwise Granger Causality Tests of Oil Price and Technology Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLTEC → DLOLP	1.69 (0.1)	1.03 (0.3)	0.69 (0.5)	1.16 (0.3)	0.80 (0.5)	0.69 (0.6)
DLOLP → DLTEC	0.90 (0.3)	0.36 (0.6)	0.30 (0.8)	0.37 (0.8)	0.29 (0.9)	0.44 (0.8)

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Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

The above results show that there is no causal interaction between Technology Index (KLTEC) and the oil price changes.

Table XIV: Pairwise Granger Causality Tests of Oil Price and Mining Sector Index

Lags	**1**	**2**	**3**	**4**	**5**	**6**
DLTIN → DLOLP	0.26 (0.6)	0.22 (0.7)	0.55 (0.6)	0.40 (0.8)	0.25 (0.9)	0.19 (0.9)
DLOLP → DLTIN	5.10 (0.02)**	2.59 (0.07)*	1.79 (0.1)	1.29 (0.2)	1.09 (0.3)	0.77 (0.5)

Notes: table represents the results of Granger causality test applied to oil price and stock indices at different lags. The p-values are reported in parenthesis; *, **, and *** represent statistical significance at the levels of 10%, 5%, and 1%, respectively.

Results of Granger causality show that causal direction of oil price to stock return is significant in Mining Index for the first two lags, since the estimated F-value is significant at the 5% level; the critical F-value is 5.10 (for lag 1), and at the 10% level; the critical F-value is 2.59 (for lag 2). Therefore, the above results reveal that changes in oil price Granger-cause Mining sector, which includes oil and gas firms. More importantly, changes in global oil prices have a strong direct impact on stocks of oil production industries such as mining.

VAR - Impulse Response Function Analysis

Based on the results of ADF and PP unit root tests, all the series are integrated at order one, I(1). Even though it is difficult to interpret the estimated coefficient of VAR, impulse response function (IRF) within VAR model is used to analyze and draw the conclusion about the short-run dynamic among the stock index series and oil price. Moreover, IRF draws out the dynamic response path of a variable due to one standard shock to another variable. Fig. 1 to Fig. 11 present impulse response function results for the 10 months (time horizon) estimated forecasts for oil price and stock indices. They indicate that the response of stock indices returns to one standard deviation of innovation in oil price returns and the response of oil price returns to a one standard deviation of innovation in stock indices returns follow almost similar patterns with positive reactions. However, responses for overall market index, industrial sector and mining sector index vary from other stock indices.

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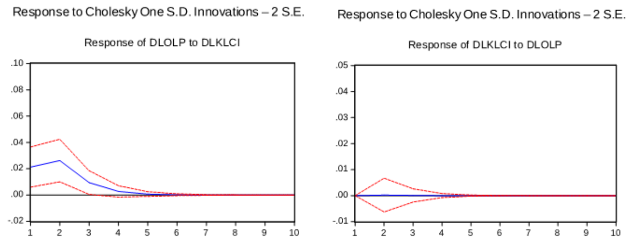

Fig.1: Impulse Response Function of Oil Price and Market Index (FBMKLCI)

The response of the market index to one standard deviation of innovation in oil price indicates that there is no reaction. However, there is a positive reaction from oil price to standardized innovation in market index, and the reaction to shock disappears from the 4th month. The results indicate that in the short term, Malaysia's overall market performance was unchanged by the global oil price movements. Fig.1 shows that Malaysian stock market index does not respond immediately to oil price shock, suggesting that Malaysian stock market is not fully efficient to the global oil price changes.

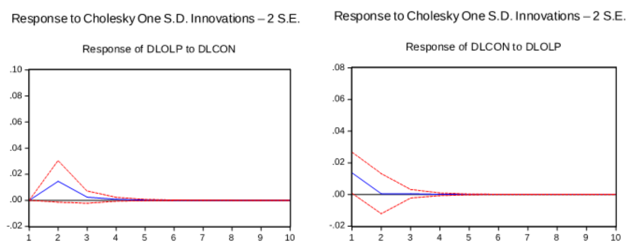

Fig.2: Impulse Response Function of Oil Price and Construction Sector Index

However, the response of construction sector index to oil price dies out after the first month, while the response of oil price to construction sector index disappears from the 3rd month. The response of construction sector index to oil price indicates that there is a short-run dynamic among the series. Construction sector index has the lowest response to its return on the innovation of the oil price, suggesting that if the oil price changes, it will affect the earnings of construction industry in the short run (Fig. 2).

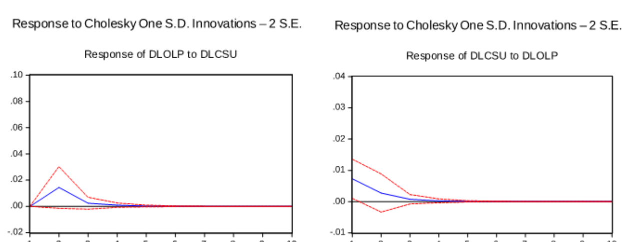

Fig.3: Impulse Response Function of Oil Price and Consumer Product Sector Index

Fig. 3 illustrates a one standard deviation shock to the oil price decreases the consumer product index and declines towards zero and dies out after 3rd month. On the other hand, one standard deviation shock to the consumer

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product index increases the response of oil price for the first month, declines thereafter and disappears after the 4th month (Fig. 3).

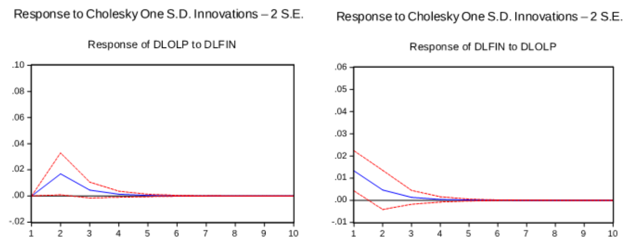

Fig.4: Impulse Response Function of Oil Price and Finance Sector Index

A one standard deviation shock to the oil price decreases the finance sector index and moves towards zero and dies out before the 4th month. On the other hand, one standard deviation shock to the finance sector index increases the response of oil price until the first month, declines thereafter and disappears from the 4th month. This suggests that in the short-run, oil price shocks can affect some non-oil intensive industrial such as financials (Fig. 4) and consumer product (Fig. 3) mainly through the demand side effects: increasing oil price affect consumer confidence and demand for most products.

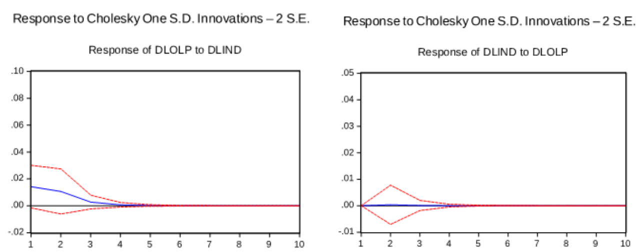

Fig.5: Impulse Response Function of Oil Price and Industrial Sector Index

The response of the industrial sector index to one standard deviation of innovation in oil price indicates that there is no reaction. However, there is a positive reaction from the oil price to standardized innovation in industrial sector index, and the reaction to shock disappears before the 4th month. The results indicate that in the short term industrial sector performance is unchanged by the global oil price movements suggesting that industrial sector takes longer period to respond to oil price changes (Fig. 5).

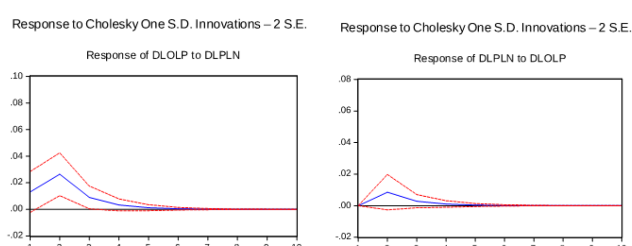

Fig.6: Impulse Response Function of Oil Price and Plantation Sector Index

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A one standard deviation shock to the oil price decreases the plantation sector index and move towards zero and dies out from the 5th month as shown in Fig. 6. On the other hand, one standard deviation shock to the plantation sector index increases the response of oil price until the first month, declines thereafter and disappears from the 4th month.

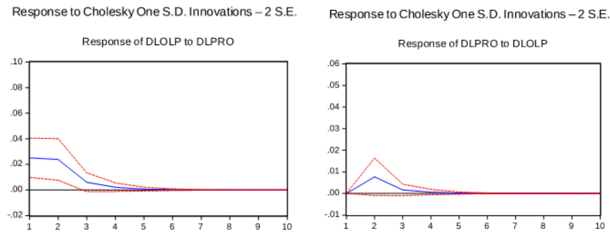

Fig.7: Impulse Response Function of Oil Price and Industrial Production Sector Index

However, Fig. 7 indicates the response of industrial production index to one standard deviation of innovation in oil price indicates an increase for the first month and a decline thereafter and being disappeared from the 4th month. It shows a positive reaction from the oil price to standardized innovation in industrial production index, and the reaction to shock disappears before the 5th month.

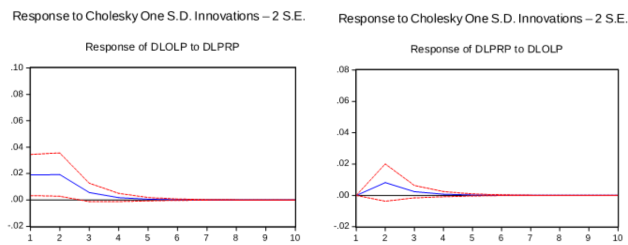

Fig.8: Impulse Response Function of Oil Price and Property Sector Index

The response of property sector index to one standard deviation of innovation in oil price indicates an increase for the first month and declines thereafter and disappears from the 4th month. And there is a positive reaction from oil price to standardized innovation in property sector index, and the reaction to shock disappears before the 5th month(Fig. 8).

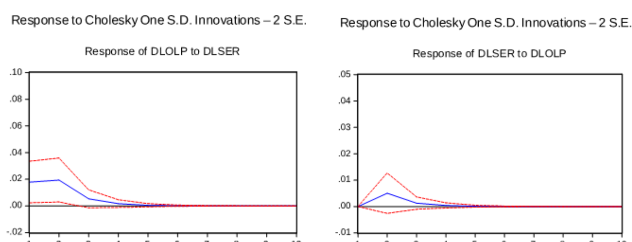

Fig.9: Impulse Response Function of Oil Price and Trading/Services Sector Index

The response of trading/service index to one standard deviation of innovation in oil price shows an increase for the first month,a decline thereafter and disappearance before the 4th month. On the other hand, the response of oil price

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to one standard deviation of innovation in trading/service index indicates a decline and reaction to shock disappearing before the 5th month according to (Fig. 9).

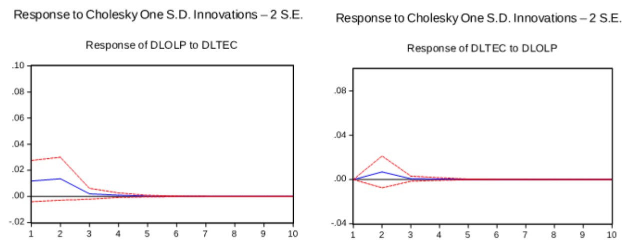

Fig.10: Impulse Response Function of Oil Price and Technology Sector Index

The response of technology sector index to one standard deviation of innovation in oil price indicates an increase for the first month, and disappearing from the 2nd month as shown in Fig. 10. On the other hand, the response of oil price to one standard deviation of innovation in technology sector index indicates a decline and reaction to shock disappearance before the 3rd month.

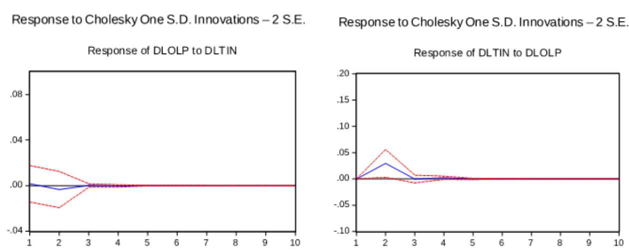

Fig.11: Impulse Response Function of Oil Price and Mining Sector Index

Fig. 11 explains the response of mining sector index to one standard deviation of innovation in oil price indicating that there is positive reaction and the reaction to shock increases for the first month, and disappears from the 2nd month. This suggests that global oil price shocks are more volatile for mining sector compared to the majority of the sectors, as firms are directly involved in oil production. However, there is a negative reaction from oil price to standardized innovation in mining sector index, and the reaction to shock disappears from the 2nd month. The response of mining sector index to oil price indicates that there is a short-run dynamic effect among the series. The possible explanation is that global oil price and Malaysian mining sector index are moving together as both are reacting to a common factor, global aggregate demand.

V. CONCLUSION

This study analyzes the causal relationships and short-term dynamics between oil price and stock return in Malaysia from 2006 to 2016. Past studies on Malaysian stock market have shown different results and further study on this issue need to be conducted for more clarification. This study argues that different sector indices of the Malaysian stock exchange react differently to the oil price changes. In order to study the causal relationship and short term dynamics, ADF and PP unit root test are conducted, in which all the data are foundto be stationary in the first difference. The results of Granger causality indicate that oil price movements do not Granger-cause overall Malaysian

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stock market index. However, this study finds evidence of unidirectional causality from stock returns to oil price changes in aggregate market index. Likewise, unidirectional causality running from oil price to stock returns exists in Mining Index, Plantation Index, Industrial Production Index and Property Index. In addition, this study finds evidence of a unidirectional causality running from stock returns to oil price in Construction Index, Consumer Product Index, Finance Index, Industrial Production Index, Property Index, Trading/Services Index and Plantation Index. Therefore, this study suggests that reverse relationship from stock price to oil price may exist.

Furthermore, bi-directional causality exists between oil price and stock returns in Plantation Index, Industrial Production Index and Property Index. This is also meaning that there is a two-way feedback relationship between oil price and stock returns in Plantation Index, Industrial Production Index and Property Index. However, over the sample period there is no causal interaction between Industrial Index and Technology Index and the oil price changes. This study concludes that changes in global oil prices have a strong direct impact on stocks of oil intensive industries such as industrial production and property sector by affecting production costs and firm's profitability. In addition, fluctuations in global oil price have a direct impact on the returns of oil production industries such as Mining Index. Therefore, it is recommended that investors who are interested in these sectors should consider the fluctuations of global oil price.

Finally, impulse response function within VAR model is used to analyze and draw the conclusion about the short-run dynamic among the stock index series with crude oil price. The responses generated from the stock indices returns to one standard deviation of innovation in oil price returns and the response of oil price returns to a one standard deviation of innovation in stock indices returns follow almost similar patterns with positive responses. However, responses for aggregate market index, Industrial sector and Mining Index vary from other stock indices. The results indicate that in the short-run, Malaysia's aggregate market performance is unchanged by the global oil price movements.

In addition, industrial sector performance is unchanged in a short-run by the global oil price movements. This result is consistent with the aggregate market results. The response of Construction sector index and Mining sector index to oil price indicates that there is a short-run dynamic among the series. Moreover, Construction sector index has the lowest response to its return on the innovation of the oil price, suggesting that if the oil price changes, it will affect the earnings of companies in construction industry in the short-run. The study concludes that existence of positive short-run dynamic among individual sector return series and oil price movements.

Evidence of this study provides comprehensive analysis on the relationship between oil price and sector indices returns in Malaysia; Furthermore, these findings suggest that portfolio diversification can be achieved across sectors in all cases of oil price changes, so that the portfolio managers and investors can rebalance their portfolios by considering future changes in oil price (rises or falls). However, it is based on investors' risk preferences and their objectives. These industries may use different derivative tools and other hedging techniques to reduce their exposure to oil price fluctuations. Finally, policy makers can use these results to formulate the measures to stabilize and avoid unnecessary turbulence in the stock market due to oil price shocks.

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In addition, these results add weight to the argument that industries are not similar and different factors can affect industry returns in different ways.The possible extension of this study is to examine the impact of oil price changes with other macroeconomic variables to determine the combined effects of the variables on Malaysian stock market.

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