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Examining Asymmetric Oil Price Exposure to Assets Return in Malaysia: A Nonlinear ARDL Approach
(Mengkaji Pendedahan Tidak Simetri Harga Minyak ke atas Pulangan Asset di Malaysia: Satu Pendekatan ARDL Tidak Linear)

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ABSTRACT

Oil is one of the most important commodities and its impact on the global economy is evident through many studies. This study is focused on examining the nine sectors of stock returns in Malaysia. The main objective is to investigate the asymmetric effects of oil price changes (oil price increases and decreases) on the sectoral stock returns in Malaysia. Besides, this study also examines the spillover effect among the sectoral stock returns in Malaysia relative to the effects of other factors. By using monthly data from 2000 to 2017, the Non-linear Autoregressive Distributed Lags (NARDL) model is applied to model the asymmetric effect of oil price changes. The study detected the asymmetric effects of oil price changes with negative effect dominant, the positive effect and oil price effect is larger in the oil intensive sectors. However, the oil price is not the main determinant factor. The main factors determining the stock returns are exchange rate, Malaysia stock market return, world stock return and sectoral spillover effect. Among these factors, the exchange rate is the main factor that influenced the stock return.

*Keywords***:** *Oil price changes; stock return; spillover effects; asymmetric effect*

ABSTRAK

Minyak merupakan salah satu komoditi penting dan kesannya terhadap ekonomi global telah dibuktikan melalui banyak kajian. Kajian ini menfokus kepada penyelidikan dalam sembilan sektor pulangan saham di Malaysia. Objektif utama adalah untuk mengkaji kesan tidak simetri perubahan harga minyak (kenaikan dan penurunan harga minyak) terhadap pulangan saham sektoral di Malaysia. Selain itu, kajian ini juga mengkaji kesan limpahan antara pulangan saham sektoral di Malaysia relatif kepada kesan faktor-faktor lain. Dengan menggunakan data bulanan dari 2000 hingga 2017, model Non-linear Autoregressive Distributed Lags (NARDL) telah digunakan untuk memodelkan kesan tidak simetri dalam perubahan harga minyak. Kajian ini mengesan kesan tidak simetri perubahan harga minyak di mana kesan negatif adalah lebih dominan berbanding dengan kesan positif dan kesan perubahan harga minyak adalah lebih tinggi di sektor yang berintensifkan minyak. Walau bagaimanapun, harga minyak bukan faktor penentu utama. Faktor utama yang mempengaruhi pulangan saham adalah kadar pertukaran asing, pulangan pasaran saham Malaysia, pulangan saham dunia dan kesan limpahan antara sektor. Antara faktor-faktor ini, kadar pertukaran asing adalah faktor utama yang mempengaruhi pulangan saham.

Kata Kunci: Perubahan harga minyak; pulangan saham; kesan limpahan; kesan tidak simetri

INTRODUCTION

Oil price movement is always the concern to the public as any change of oil price may affect each of us to be a consumer, producer or investor. From the economic perspective, oil price changes may influence inflation and economic growth through aggregate demand and aggregate supply channel by changing the production cost which may pass-through into the final good price and affect the demand on the good market. Many studies have evident on the significant impact of oil shock and oil price changes on global economic activities. A sharp increase in oil prices may trigger high inflation and economic fluctuation/instability. For instance, Hamilton (1983) revealed that oil shock attributed to the US economic recessions in the 1970s. He claimed that seven out of eight post-war economic recessions in the US were caused by the rise in oil prices

(Hamilton 2011). Apart from the US, the negative impact induced by oil price shocks also found in the empirical studies of Cunado and Perez de Gracia (2003) for European countries, and Cunado and Perez de Gracia (2005) for Asian countries. Besides, Kilian and Murphy (2014) claimed that oil price shocks are responsible for monetary policy changes, labor market adjustments, and energy technologies changes which lead to consequential effects on the global economy.

The oil price has experienced large fluctuations over time, caused by episodes of events or crises. The historical movement of oil prices associated with events was well-documented in Hamilton (2011). FIGURE 1 shows the plot of the historical oil price changes and associated events. The first oil shock (1862-64) was caused by the U.S. Civil War with a cut-off in the supply of turpentine from the South and the implementation of a tax on alcohol. This caused the closure of many operations and the decline in oil production. As a result, oil prices rose from 20 cents per gallon to $2 per gallon between 1862-1865. Between 1865 - 1899 was the evolution of industry together with the Pennsylvania oil boom. The development of new drilling areas of Pennsylvania brought to the growth in production, the low oil price gained to its stable normal level after the development. High production and the export of Russia oil together with the recession of 1890-91 finally brought oil to the lower level at 56 cents/ barrel by 1892. Between 1900-1945, the development in the automobile and motor vehicle contributed to the high demand for oil. The West Coast Gasoline Famine of 1920 in the U.S. caused the spike of energy prices. The shortage of gasoline was due to the high demand for U.S. consumption on crude oil and gasoline. The event was followed by the great depression in 1929. The drop in demand due to recession and the increase in oil supply due to the discovery of the East Texas field and its production in 1930 caused a drop in oil price. In 1931, oil prices experienced a drop of 66% from its value in 1926. The period 1946-1972 marked the early postwar era. After the end of World War II, the demand for petroleum products in the U.S. increased significantly due to the transition to the automotive industries. Oil price experienced an increase of 80% between 1947-48. However, followed by a series of supply disruption and the Korean War (1952-53) and the Suez crisis (1956-57), oil prices fall to a low level. Starting the era of the 1970s marked a highly volatile period of oil price. This was caused by episodes of crisis/ events leading to oil price shocks and supply loss (see TABLE 1). The Arab Embargo caused to 231.6% price change in one month period, while the Venezuela oil strike (2002) resulted in 117.5% price changes in 2 weeks. In recent years, the oil price is still highly fluctuating.

The price increases in 2010 were based on global demand and the Arctic blasts affecting North America and Europe. Prices rose back to $90 per barrel in December 2010 (Riley 2010). Political unrest across the Middle East and the revolt in Libya contributed to further price rises in early 2011. In late February 2011, oil prices drove to $95 per barrel (Rooney 2011). The highest price recorded in the year 2013 is $118 per barrel. However, since June 2014, prices have fallen rapidly as U.S. shale oil production increased and China and Europe's demand for oil decreased. Oil price reaching around $65 per barrel by December 2014 and it continues to fall during the beginning of 2015. Oil price started to rise again after January 15, 2015, and it continues until May 2015. Reasons were a drop in expected shale oil production in the United States and the war in Yemen (Gibbons 2015). The oil price fell again in July 2015 as the U.S. dollar was strong, supplies were high, and the Chinese stock market was down. The fell was continued until February 2016, where it reached $26 per barrel, which is the lowest price since May 2003 (Riley 2016). On the next day, oil prices started to rise again and it continues until the beginning of 2017. A strong and higher than expected U.S. dollar and world supplies led to rising prices.

The highest price recorded in 2017 is $67 per barrel (Gloystein 2017). In the first half-year of 2018 oil price was up about 23%, where it reached $79 per barrel at the end of the first-half year. Due to the lowest US inventories within three years and the cold weather decreasing US production, oil reached its highest price since December 2014 (Saefong & DeCambre 2018). For the second half-year, oil price started to decrease since September 2019 and it fell to the lowest since July 2017. At the end of 2018, the oil price marked at $57 per barrel. Higher U.S. interest rates, more active U.S. oil rigs, higher U.S. crude production and lower expected worldwide demand caused the oil price to fell during the period (Saefong & Beals 2018).

Oil price changes may also affect the financial and stock market ultimately. Economic recession induced by oil price shock may further weaken the prices of assets. This may further affect financial stability and stock performance. It is expected that higher oil price is adversely linked to lower stock return. However, previous studies reported inconclusive results (Dhaoui et al., 2018; Soyemi et al. 2017). Besides, the oil price-financial/stock market nexus study is relatively new and in smaller volume as compared to the oil price-macro study (Soyemi et al. 2017). The research is especially limited for the emerging market (Al-hajj et al. 2018).

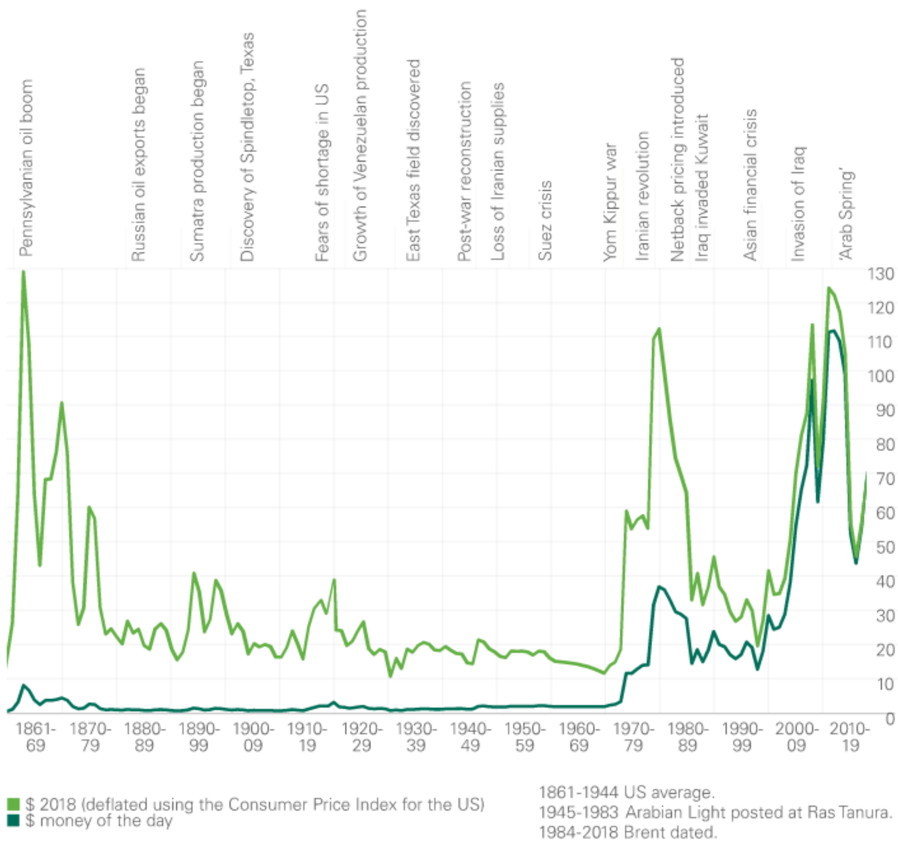


FIGURE 1. Crude oil prices, $ per barrels.
Source: BP Statistical Review of World Energy

TABLE 1. Oil price changes and the market disruptions.

Event	Start date	Duration (week)	Price change (%)	Supply loss (%)
Arab Embargo	Oct 1973	4	231.6	-3.3
Iranian oil strikes	Oct 1979	2	15.1	0.2
Saudi Arabia's refusal to increase output	Jan 1979	2	64.5	-2.5
Saudi Arabia's cut in supply to major companies	May 1979	1	30.7	-0.2
Hostage-taking at US embassy in Iran	Nov 1979	14	17.8	-0.3
Outbreak of Iran/ Iraq War	Sep 1980	2	28.4	-1.5
Iraq invasion of Kuwait	Aug 1990	6	58.4	-0.5
OPEC unilateral production cut	Jan 1999	12	43.5	0.1
Venezuela oil strike	Nov 2002	2	117.5	-5.1
Hurricanes Katrina/ Rita	Aug 2008	4	11.2	-1.2
Unexpected cut in Nigerian production	Early 2007	4	18.8	-1.1
Surge in Chinese distillate demand	Late 2007	6	31.1	0.7
EU enforcement of 10-ppm sulfur diesel	Spring 2008	6	45.2	-1.3
Collapse of Libyan production	Jan 2011	3	27.7	-0.7
Second Libyan collapse	July 2014	3	15.8	1.3
OPEC 2017 production cut	Jan 2017	Ongoing	7.8	-1.7
Hurricane Harvey	Sep 2017	3	12.7	-0.6
First Venezuelan production collapse	Nov 2017	Ongoing	12.7	0.5
Conoco attachment of Venezuelan assets	May 2018	Ongoing	-	-0.9

Source: Verleger 2019

In contributing new insights to the oil price-stock market nexus, this study aimed to examine the asymmetric effects (oil price increase in contrast to oil prices decrease) in nine sectoral stock returns in Malaysia, namely construction, consumer product, finance, industrial, industrial product, plantation, properties, tin & mining, and trade & services. The analysis is focused on Malaysia due to several reasons. The first reason is the study on the oil-stock return nexus in emerging markets, including Malaysia is limited (Al-hajj et al. 2018) and results are inconclusive. For instance, Maghyereh (2004) found a very weak impact of oil price shock in the sample of 22 emerging stock markets. In contrast, Basher and Sadorsky (2006) found a strong impact of oil price shock on stock returns in emerging markets. Therefore, continuously research is needed to explore the oil-stock return nexus for emerging markets. Secondly, emerging markets are not financially stable and are very open to external influences, they might receive a larger impact on oil price shock. For instance, Basher and Sadorsky (2006) found that emerging markets suffer more due to oil price risk as they consume a large share of oil of importing countries and they are important players in the financial market. On the other hand, Raza et al. (2016) found that oil price causes negative impacts in emerging markets as emerging markets are vulnerable to bad news effects. The same condition holds in Malaysia. According to Tuyon and Ahmad, (2016), the stock market of Malaysia is sensitive to both internal and external factors including economic crisis. As Malaysia is moving towards an industrial country, the consumption of oil in production and economic activities has increased tremendously. Hence, changes in oil prices might impact the economy of Malaysia (including stock market performance) greatly. Studying the oil-stock return nexus might lead to a better understanding of how oil price shock may affect the stock performance and earlier prevention action can be taken to reduce the negative impact. Thirdly, oil price shock may affect stock returns asymmetrically across sectors. However, the study conducted in Malaysia is lack and the study based on sectoral stock data is not yet well explored. Utilizing the sectoral data may reveal important information on the sectoral performance and reaction to oil shock which is useful to the policymaker in making policy decisions/ actions and also for the investors to make their good financial deals.

Our study also contributes to the literature on oil-stock return in several ways. First and foremost, this study applied sectoral data rather than composite stock data. Previous studies mainly used the composite stock return data which limit the analysis on the overall stock performance. Using the sectoral data permits a deeper analysis of the behaviour of each sector in response to oil price changes. Our results may provide more information to the investors in making an investment decision by looking at the performance of each sector. Secondly, this study examined the asymmetric effects of oil price increase in contrast to oil price decrease rather than the net effect of oil price changes. We demonstrated that the effects of oil price changes may differ between its increase and its decrease and that the oil price-stock market relation is nonlinear. Indeed, it is more reasonable to model the macro indicator and stock return behaviour in a nonlinear model as economic structure and movement may not remain the same but may change over time. Some studies have revealed the nonlinearity behaviour in financial and macro data, among them include Aloui et al. (2013), Jammazi et al. (2015). Jiménez-Rodríguez (2015) found that the effect of oil price increase is more significant than its decrease in the stock market in Canada, Germany, the UK, and the US. On the other hand, Narayan and Gupta (2015) reported that a decrease in oil price is a better predictor of the equity market return in the US. Jammazi et al. (2015) discussed the reasons for the asymmetric effect. According to them, the possible reason for the presence of nonlinearity is due to the economic and financial crisis, black swan events, geopolitical pressures, changes of structure in the business cycle and heterogeneous of economic agents. Asymmetries are driven by differences in the fundamental factors that determine market dynamics. Applying a linear regression in the presence of asymmetric relationships might lead to inaccurate and biased results. Thirdly, the nonlinear autoregressive distributed lags (NARDL) model is applied to capture the asymmetric effects of oil price changes. This model enables the interpretation of results on the asymmetric effects of oil price changes rather than the net effect of oil price changes. Besides, the accumulated effects of the oil price increase and decrease can be plotted which then gives an overall picture of how influential the asymmetric effects of oil on stock returns across sectors. Our result provides new information on the stock performance across sectors and the spillover linkages among sectors. The study also reveals the main factor that determines the performance of stock returns across sectors. In particular, oil price increases dominate the stock return in the construction sector. The possible explanation is, although higher oil price leads to higher production cost, the cost is covered by increasing productivity. Higher productivity also helps to increase the volume of sales and improve competitive power, hence the profit remains or even increases

The paper is organized as follows: section 2 and 3 reviewed the literature and background study; section 4 discussed the data and methodology; section 5 interpreted the results and the last section concluded the findings.

LITERATURE REVIEW

THEORETICAL FRAMEWORK

Degiannakis et al. (2017) discussed how oil price change can determine the behaviour of stock markets through five different channels. These channels are stock valuation channel, monetary channel, output channel, fiscal channel and uncertainty channel. The first channel is the stock valuation channel. Degiannakis et al. (2017) stated that the stock valuation channel is the direct channel by which oil prices influence stock markets. This channel can be clear by defining two equations. First, we define stock returns ($R_{i,t}$) as the first log-difference of stock prices.

$$R_{i,t} = \log\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \tag{1}$$

where $P_{i,t}$= stock price of firm i at time t.

Second, the current stock prices reflect the discounted future cash flows of a particular stock. This equation is suggested by economic theory and it can be shown as follows:

$$P_{i,t} = \sum_{n=t+1}^{N} \frac{E(CF_n)}{(1 + E(r))^n} \quad (2)$$

where $E(CF_n)$= expected cash flows at time n, $E(r)$= expected discount rate.

These equations show the relationship between expected cash flows, discount rate, and stock returns. The effect of oil price on stock return is indirect as oil price change may influence a firm's future cash flows in different ways, depending on whether the firm is an oil-user (oil-consumer) or oil-producer. For an oil-importing firm, higher oil prices may lead to higher production cost which will further reduce the profit and expected cash flows. However, the oil producer firm may experience higher profit margins and hence higher expected cash flows. The second channel is the monetary channel. The discount rate is at least partially composed of expected inflation and expected real interest rates (Mohanty & Nandha 2011). Thus, oil price changes impacted stock returns is through inflation and interest rates. According to Degiannakis et al. (2017), the oil price increase may result in higher production costs. Higher expected inflation occurs when these costs have transferred to consumers leading to higher retail prices. The third channel is the output channel, where the oil price increase is expected to have both an income and a production cost effect, which will lead to changes in aggregate output. Lower-income that occurred due to higher oil price leads to lower consumption and thus aggregate output, which further leads to lower labour demand. Stock markets tend to respond negatively to such developments.

Another important channel for this transmission is the fiscal channel. The increase in oil prices may cause oil-importing economies to transfer wealth to oil-exporting economies. This allows for higher government purchases and hence leads to higher household consumption. Private firms are expected to increase their cash flows and thus their profitability. Such developments will push stock prices to higher levels and the stock market will exhibit a bullish period. The final transmission channel is the uncertainty channel, where higher oil prices cause higher uncertainty in the real economy, due to the effects mentioned in the above channels. The oil price increase will reduce firms' demand for irreversible investments, which reduces the expected cash flows. Rising uncertainty about future oil costs increases the incentives of households to save rather than consume.

EMPIRICAL FINDINGS

Many studies have been conducted to reveal how oil price changes can affect the stock market. These studies reported different results. The earliest studies focused on the analysis in the US stock market, among them are Hamilton (1983) and Jones and Kaul (1996). After that, more studies have been conducted to study the oil price-stock market relationship. However, these studies mainly focused on developed economies with inconclusive results. The first strand of studies reported a negative impact of oil price on stock return. Among them are Huang et al. (1996), Sadorsky (1999), Papapetrou (2001), Li et al. (2017). The second strand of studies found no significant effect of oil prices on stock returns, for instance, Apergis and Miller (2009). Some studies compared the results between groups of countries. Some studies reported a positive impact of oil price shock on stock markets in oil-exporting countries, while the effect is negative in oil-importing countries (Park & Ratti 2008; Luo & Qin 2017; Davoudi et al. 2018). Some studies compared the results across industries and found that the oil and gas sector shows a positive reaction to oil price increase (Nandha & Faff 2008; Elyasiani et al. 2011). Other sectors, in general, show a negative response to oil price increase (examples are Elyasiani et al. (2011), Narayan and Sharma (2011). Therefore, oil price changes may have a heterogeneous effect on the stock market comparing different industries.

Zhu et al. (2016) examined the heterogeneity dependence between crude oil price changes and industry stock market returns in China. The quantile regression result showed that co-movement exists between the global crude oil and Chinese industry markets at low quantiles, while no co-movement exists at other quantiles. Also, Caporale et al. (2015) examined the oil price uncertainty and sectoral stock returns in China by using a time-varying approach. The results suggested that oil price uncertainty imposes a positive effect on sectoral stock returns with aggregate demand-side shocks in all sectors except the sectors of consumer services, the financials and oil, and gas.

The above studies were based on the net oil price effect. More recently, some studies applied nonlinear regression to capture the asymmetric effect of oil price changes. These studies detected the asymmetric effect of oil price, with a greater effect of oil price increase than oil price decrease (Jiménez-Rodríguez 2015; Broadstock et al. 2014). Some studies applied the linear autoregressive distributed lags (ARDL) model and the nonlinear ARDL model to capture the short-run against long-run effect and asymmetric effect of oil price changes. Among them include Badeeb and Lean (2016), Liew and Balasubramaniam (2017), Kisswani and Elian (2017), Raza et al. (2016) and Bala and Lee (2018). For instance, Liew and Balasubramaniam (2017) conducted a study on the effects of oil prices on Malaysia's manufacturing and industrial outputs. The results of the nonlinear co-integration test showed that the long-run relationship exists between oil prices and outputs of the manufacturing and industrial sectors. Oil price changes showed no significant effect on both manufacturing and industrial sectors based on the NARDL model. But, there are significant negative impacts of the oil price increase and oil price decrease on the manufacturing and industrial outputs. Also, Kisswani and Elian (2017) explored the nexus between oil prices and Kuwait sectoral stock prices by using nonlinear models. The results revealed a symmetric effect between Brent oil prices and the stock prices of Banks, Consumer Services, Industrials, and Real Estate sectors. However, the asymmetric effect is detected in the Consumer Goods sector with the significant oil price increase, but no effect of Brent oil price decrease. While for WTI oil price, asymmetric effect exists for both sectors; Industrials and Real Estate. Bala and Lee (2018) discovered that three types of oil prices (OPC, OPEC, and OP) have a significant asymmetric impact to the inflation in African OPEC member countries, where both oil price hike and oil price plunge were found to be inflationary. The nonlinear impact on the oil price on inflation is higher when the oil price drops.

Few studies focused on the analyses in the Malaysia stock market. Kwong et al. (2017) found that the crude oil price has no significant effect on Malaysia's stock market performance. However, inflation and US stock market performance have a significant effect on Malaysia's stock market performance. A study on the impact of international oil prices on the stock exchange of Malaysia and Turkey was conducted by Najaf (2016). The result showed that there is a positive relationship between international oil prices and the stock exchange of Malaysia and Turkey. 52.5% and 62.24% of the variation of Pakistan stock exchange and the variation of Malaysia stock index respectively are explained by the international oil price, while the other variations are explained by other factors. Liew and Balasubramaniam (2017) examined the price-output nexus in Malaysia by comparing sectoral studies (agriculture, manufacturing, industrial and service sectors). They found a nonlinear long-run relationship between oil price and output of the manufacturing and industrial sectors. Oil price increase stimulates output but oil price decrease imposes negative effect on output in these two sectors. On the other hand, Badeeb and Lean (2016) examined the effects of oil prices on Malaysia Islamic sectoral stocks. They found a weak relationship between the two variables across sectors. The results imply the composite index was oil price-resistant and follow a nonlinear pattern. Maniam and Lee (2018) found that the stock market liberalization does not have any long-run impact on the finance sector's stock returns in Malaysia and this finding contradicts the prediction of the International Asset Pricing Model (IAPM). While for the service sector, the stock market liberalization has an impact on the stock returns in the long-run and this shows that the service sector's stock market has high market efficiency where the stock market has reacted immediately to the announcement of liberalization event and it supports the prediction of IAPM.

All these studies imply that nonlinearity relationship may exist between oil price and macroeconomic factors. Nonlinear modeling can capture the asymmetric effect of oil increases and decreases. This paper utilizes the nonlinear ARDL model to study the asymmetric effect of oil price changes (increases and decreases of oil price) and the short-run versus long-run effects of oil price on conventional stock returns at disaggregated sectoral levels in Malaysia.

BACKGROUND STUDY

MALAYSIA STOCK MARKET

The Malaysian stock market is one of the most prominent emerging markets in the region. The history for the formation of the stock exchange in Malaysia was started as early as the 1930s, but it was formally set up and named as the Malaysian Stock Exchange (MSE) in March 1960, and the public trading of stocks and shares commenced in May 1960. After the formation of Malaysia in 1963, the stock exchange again changed its name to the Stock Exchange of Malaysia (SEM). The Capital Issues Committee (CIC) was established in 1968 to supervise the issue of shares and other securities by companies applying for listing or already listed on the Exchange. Following the termination of the interchangeability with Singapore and the floating of Malaysian Ringgit, the Malaysian Stock Exchange was separated into Kuala Lumpur Stock Exchange (KLSE) and Stock Exchange of Singapore (SES) in 1973.

On 14 April 2004, KLSE changed its name to Bursa Malaysia Berhad until the present day. As globalization began, many significant milestones have achieved over the age of technology. Especially in 2009, a new board structure comprising the Main and ACE Markets was officially implemented on 3 August 2009. Bursa's benchmark index, the Kuala Lumpur Composite Index (KLCI), was raised to a new level with the adoption of the financial times stock exchange (FTSE) international index methodology. After that, Bursa Malaysia has recorded a number of 1,145 listed companies with a combination of around $235.28 billion in their market capitals at the end of February 2014 (Kwong et al. 2017). Till October 2019, the market capitalization was reported as RM1691.530 billion. The all-time high was reached at RM1960.342 billion in Jan 2018 while a low record was found at RM394.486 billion in April 2001 (CEIC data: Malaysia Bursa Malaysia: Market capitalization, 2000-2019). The listed companies can be categorized according to industries/sectors: construction, consumer product, finance, industrial, industrial product, plantation, properties, tin and mining, and trade and services.

FIGURE 2 shows the plots of sectoral stock indices, KLCI, MSCI and oil price in natural log form. Compare the stock indices with LOIL, one can observe the impact of oil price movement on the stock market. LOIL shows some sudden breaks in 2002, 2009 and 2016. Majority indices also exhibit the same breaks, including LKLCI, LMSCI, LFIN, LPLANT, LTIN, LTRADE, LINDPR. The break is largely observed in 2009 in many sectors. This implies the high impact and linkage between oil prices and stock indices.

FIGURE 3 shows the plots of LOIL (net oil price), LOIL- (oil price decreases) and LOIL+ (oil price increases). As observed, the big drop in oil prices in 2009 has contributed to the sharp decline in LOIL. As LOIL- and LOIL+ are in accumulated value (base year is Jan 2000), one is not able to see how both oil price decreases and increases can affect the sectoral stock movement graphically. Both LOIL- and LOIL+ exhibit different movements over time. In the year 2008, the accumulated oil price decreases (since Jan 2000) was about 4% while LOIL+ around 6%. But in the year 2010, LOIL- accumulated to 5% while LOIL+ reached 7.5%. The plots show that the accumulated oil price increase is larger than that of oil price decrease in the period of 2000-2017.

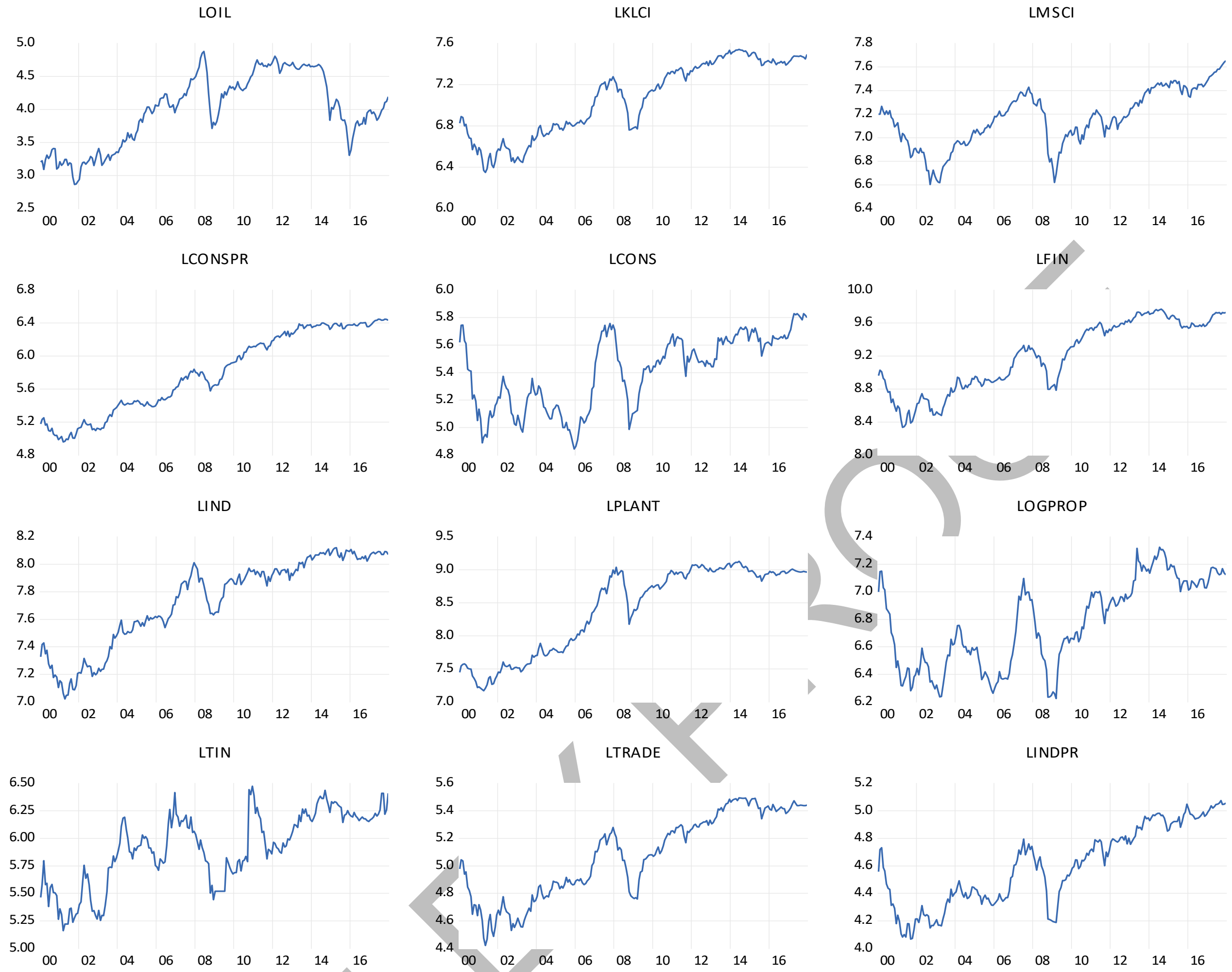


FIGURE 2. Plots of Malaysia sectoral stock indices, KLCI and MSCI and oil price in log form
Source: Sketched by author by using the data of this study

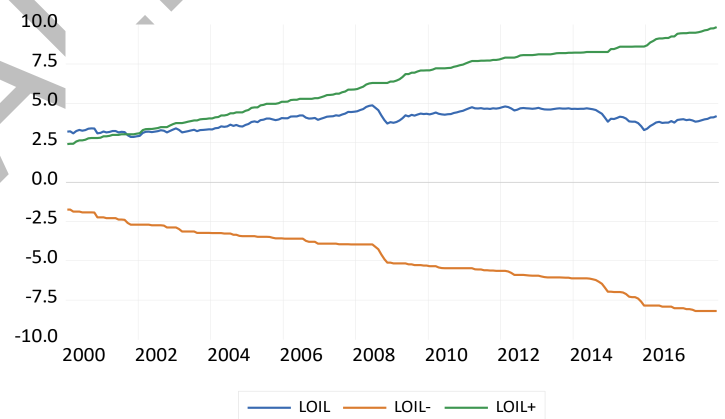


FIGURE 3. Oil price movement in log form
Source: Sketched by author by using the data of this study

DATA AND METHODOLOGY

In this study, the analyses focused on the nine major sectors of stock indices in Malaysia. The data on these stock indices were collected from the Thomson Reuters Data stream. The main independent variable of this study is oil prices. The data on oil prices (in US dollars per barrel) were collected from the Quandl Database. The other independent variables of this study are Malaysia stock market return, exchange rate, and world stock market return. Data on these variables were also collected from the Thomson Reuters Data stream. The data are presented in a monthly format, ranging from the month of January 2000 to December 2017, for a sample size of 216 months. The description of the variables is summarized in TABLE 2.

TABLE 2. Variable Descriptions

Variable	Description
LCONS	Natural log of construction stock indices
LCONSPR	Natural log of consumer product stock indices
LFIN	Natural log of finance stock indices
LIND	Natural log of industrial stock indices
LINDPR	Natural log of industrial product stock indices
LPLANT	Natural log of plantation stock indices
LPROP	Natural log of properties stock indices
LTIN	Natural log of tin and mining stock indices
LTRADE	Natural log of trade and services stock indices
LOIL	Natural log of Dubai Fateh oil prices increases (US dollar per barrel)
$LOIL^{+}$	Natural log of oil prices increases (US dollar per barrel)
$LOIL^{-}$	Natural log of oil prices decreases (US dollar per barrel)
LMSCI	Natural log of Morgan Stanley Capital International world index (MSCI)
LKLCI	Natural log of Kuala Lumpur Composite Index (KLCI)
LREER	Natural log of CPI based real effective exchange rate (REER)

METHODOLOGY – ARDL AND NARDL MODELS

The nonlinear autoregressive distributed lag (NARDL) which is the extension of the linear ARDL model is applied. The ARDL model is used to capture the symmetric net effects, but the NARDL model is used to capture the asymmetric effects between the main independent variable and the dependent variable. Both ARDL and NARDL models are valid when there is a mixture of regressors order integrated with I (0) or I (1). However, these models are not valid when there are I (2) variables.

According to Sek (2017), the conventional $ARDL(p,q)$ model can be written in the following way:

$$y_t = \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=0}^{q} \beta_i^{'} x_{t-i} + \varepsilon_t \tag{3}$$

where y_t = dependent variables.
β_i = *(k×1)* coefficient vectors of independent variables.
x = *(k×1)* vectors of independent variables.
ε_t = error term with zero mean and finite variance.

This equation can also be written in the error correction format to capture the symmetric effect:

$$\Delta y_t = \lambda(y_{t-1} + \phi_i^{'} x_t) + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \sum_{i=0}^{q} \beta_i^{'} \Delta x_{t-i} + \varepsilon_t \tag{4}$$

where ϕ_i = *(k×1)* is the coefficient vectors of the long-run independent variables and λ is the speed of adjustments. To account for asymmetries, the asymmetric expansion is made on the conventional ARDL model where the main independent variable can be expressed into its positive and negative partial sum series (Badeeb & Lean 2016; Sek 2017). The positive and negative partial sum series are shown below:

$$x_t^{+} = \sum_{j=1}^{t} \Delta x_j^{+} = \sum_{j=1}^{t} \max(\Delta x_j, 0) \tag{5}$$

$$x_t^{-} = \sum_{j=1}^{t} \Delta x_j^{-} = \sum_{j=1}^{t} \min(\Delta x_j, 0) \tag{6}$$

So, the NARDL model or asymmetric error correction model can be expressed as follows:

$$\Delta y_t = \lambda(y_{t-1} + \phi_1^{'} x_t^{+} + \phi_2^{'} x_t^{-}) + \sum_{i=1}^{p-1} \alpha_i \Delta y_{t-i} + \sum_{i=0}^{q-1} \beta_{1i}^{'} \Delta x_{t-i}^{+} + \sum_{i=0}^{q-1} \beta_{2i}^{'} \Delta x_{t-i}^{-} + \varepsilon_t \tag{7}$$

In this study, our main focus is on the asymmetric oil price effect on stock returns. To capture the asymmetric effect, we express oil price into positive and negative partial sum series. The positive and negative partial sum series of oil prices are shown below:

$$LOIL_t^{+} = \sum_{j=1}^{t} \Delta LOIL_j^{+} = \sum_{j=1}^{t} \max(\Delta LOIL_j, 0) \tag{8}$$

$$LOIL_t^{-} = \sum_{j=1}^{t} \Delta LOIL_j^{-} = \sum_{j=1}^{t} \min(\Delta LOIL_j, 0) \tag{9}$$

The NARDL models expressed in the error correction format is shown below.

$$\Delta y_t = \lambda\left(y_{t-1} + \phi_1 LOIL_t^{+} + \phi_2 LOIL_t^{-} + \phi_3 x_t + \phi_4 z_t\right) + \sum_{i=1}^{p-1} \alpha_i \Delta y_{t-i} + \sum_{i=1}^{q_1-1} \beta_{1i} \Delta LOIL_{t-i}^{+}$$
$$+ \sum_{i=1}^{q_2-1} \beta_{2i} \Delta LOIL_{t-i}^{-} + \sum_{i=1}^{q_3-1} \beta_{3i} \Delta x_{t-i} + \sum_{i=1}^{q_4-1} \beta_{4i} \Delta z_{t-i} + \varepsilon_t \tag{10}$$

where x_t is the other explanatory variables (LKLCI, LREER, LMSCI) and z_t consists of other sectoral stock price indices.

The equation above is shown without any intercept or trend terms. There exist other specifications of the equations, which are long-term intercept (restricted constant), short-term intercept (unrestricted constant) and restricted linear trend with unrestricted constant. The constant and trend terms will be added if necessary. The orders of the lags in the ARDL and NARDL models are selected by using the Akaike Information Criterion (AIC). For monthly data, Pesaran and Shin (1999) recommended choosing a maximum of 6 lags. From this, the lag length that minimizes AIC is selected.

The dynamic multiplier measures the cumulative effect of short-run and long-run effect due to a 1% increase (positive) and the 1% decrease (negative) of the nonlinear independent variable on the dependent variable. The cumulative dynamic multiplier effects of x_t^{+} and x_t^{-} on y_t can be evaluated as follows (Shin et al. 2011):

$$m_h^{+} = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{\partial x_t^{+}} \tag{11}$$

$$m_h^{-} = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{\partial x_t^{-}} \tag{12}$$

where m_h^{+}, m_h^{-} = $(k\times 1)$ vector of the cumulative effects. By construction, when $h \to \infty$, $m_h^{+} \to \phi_1$ and $m_h^{-} \to \phi_2$.

Equation (10) is estimated for each sectoral stock return, with the explanatory variables listed. Malaysia and world stock market return (LKLCI and LMSCI) are used to represent the domestic stock performance and the world stock performance respectively. Both factors are included as explanatory factors on the sectoral stock return so that comparison can be made to see either the domestic stock market or the foreign international stock market dominates the sectoral stock return in Malaysia. The results may reveal the strength of linkages between sectoral stock return with the domestic versus the international stock market. It is expected that both domestic and international returns may cause the change in sectoral stock return to move in the same direction (positive relationship).

The exchange rate is one of the predictors for stock market performance as an exchange rate may signal the economic condition. A weak currency may reflect on a weak economy (Hassan et al. 2017). Exchange rate instability may cause stock market volatility. Changes in stock prices may influence the balance sheet (profits or losses) of multinational firms and the input-output prices and demand of domestic firms, the effect depends on if the firm is exports or imports oriented (Bala Sani & Hassan 2018). Apart from this, the returns of other sectoral stocks are included as the predictor of each sectoral stock return to examine the spillover effects across sectors. The sectors that are highly interconnected tend to affect each other in the same direction (positive relationship). The oil price increase is expected to have a negative relationship with the stock return oil intensive sectors, while the oil price decline is expected to have a positive relationship. According to Liew and Balasubramaniam (2017), the oil price increases and decreases have a negative impact on the oil intensive production (industrial and manufacturing outputs). In this study, the oil intensive sectors are industrial and industrial product sectors. The oil price increase will increase the production cost of the oil intensive sectors, so the profit gained decreased and hence leads to lower stock return. For the other sectoral stock return, the oil price increase can have a mixed impact. Some of the sectors can have a negative impact because higher oil prices can lead to higher transportation costs and hence reduce the profit.

RESULTS AND DISCUSSIONS

UNIT-ROOT TESTS

Before the estimation, unit-root tests were performed and the results are shown in TABLE 3. The rejection of the null hypothesis indicates that the series is stationary. From the results, it can be observed that the unit-root tests show similar results where some variables are stationary at level (I (0)), while all variables are stationary at first-difference (I (1)). The Zivot-Andrew breakpoint unit-root tests also provide similar results and this shows that there is no breakpoint for all variables at first-difference. Since all the series are integrated less than order 2, we are eligible to apply the NARDL model.

TABLE 3. Results of unit-root tests

Variables	Conventional				Zivot-Andrews Breakpoint			
	ADF		PP		Minimize DF		Minimize Trend Break	
	Level	First-Difference	Level	First-Difference	Level	First-Difference	Level	First-Difference
LCONS	-5.7122***	-5.7527***	-177.6913***	-12.8793***	-7.7531***	-6.4634***	-5.6374***	-5.6462***
LCONSPR	-2.4543	-5.1546***	-3.2448*	-20.6094***	-5.7520***	-7.0701***	-4.7842**	-5.2046**
LFIN	-4.5368***	-5.2574***	-9.9641***	-28.0782***	-5.6717**	-6.3019***	-4.4051*	-5.3935***
LIND	-2.2131	-14.527***	-2.7714	-14.5270***	-5.7913***	-15.1788***	-5.3259***	-5.4815***
LINDPR	-5.0040***	-7.2336***	-12.5820***	-13.1296***	-5.6044**	-13.4733***	-5.2056**	-7.3416***
LPLANT	-1.4871	-11.8734***	-1.5071	-11.8734***	-4.4464	-13.8803***	-3.6753	-12.1566***
LPROP	-3.8366**	-6.3478***	-3.8896**	-12.0102***	-5.3672**	-12.6780***	-4.9521**	-6.5408***
LTIN	-3.2376*	-15.8033***	-3.2376*	-15.8033***	-4.2503	-17.4257***	-3.1023	-15.9867***
LTRADE	-4.8040***	-5.3377***	-10.6626***	-19.9159***	-5.2452**	-13.3188***	-5.2147**	-5.3145***
LOIL	-2.0270	-10.6510***	-2.0212	-10.6510***	-3.9700	-11.2878***	-3.7399	-10.6329***
LMSCI	-3.1167	-7.3284***	-3.1616*	-12.8215***	-4.5223	-8.2133***	-2.6188	-7.4369***
LKLCI	-4.2147***	-12.5752***	-8.0527***	-12.5752***	-5.2108**	-13.0479***	-5.2108**	-5.3539***
LREER	-2.5479	-14.9410***	-2.5479	-14.9410***	-4.0207	-15.6222***	-4.0207	-5.0536**

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5% and 1% level of significance respectively.

RESULTS OF NARDL MODELS

To perform the NARDL estimation, the lag selection is based on AIC suggestion and the maximum number of lags chosen is 6 because of the moderate data frequency (monthly data). Besides, we also include the highly related sectoral price index (x) in equation (10) to consider the spillover effect among sectors. We do not include all sectoral stock returns in the model as this will result in too many explanatory variables together with their lags. However, we only select the sectors with a high correlation (>0.5) into the model by checking for their correlations before estimation. The best 25 NARDL models are reported in TABLE 4 to TABLE 9. In all cases, *, **, and *** indicate the significance at 10%, 5%, and 1% level respectively. + indicates to inconclusive results of bound testing. We will start the discussion on the cointegration tests and asymmetric tests, followed by NARDL results and finally the asymmetric effect of oil price changes through the dynamic multiplier graph in FIGURE 3.

The existence of the long-run relationship is tested by two cointegration tests, namely the bounds test and the Banerjee test. The bounds testing detected the existence of the long-run relationship in 7 sectoral returns (LCONS, LCONSPR, LINDPR, LPLANT, LPROP, LTIN, and LTRADE), hence NARDL estimation is performed for these cases. There are few cases that bound testing show inconclusive or not significant results. However, since the speed of adjustments (λ) is negative and highly significant in all cases, this indicates that there is a convergence of stock returns to a long-run equilibrium level so that the model is stable. Hence, the NARDL model is valid in this study. The Banerjee test is also conducted to compare the results with the Bounds test. However, the Banerjee test shows significant at a 1% level in all models, indicating that the long-run relationship exists. Besides, the Wald test is conducted to test for the asymmetric effect of oil prices. The Wald test is significant at different significance levels for all sectors, rejecting the null hypothesis of symmetric effect. The conclusion of the asymmetric oil price effect is reached for all sectors, hence the application of the NARDL model is appropriate.

Next, we discuss the results of NARDL. TABLE 4 summarizes the results of NARDL estimates for the construction sector using different sectoral stock returns to proxy for the spillover effect. For instance, the second column "LCONS, LIND, LINDPR" indicates the names of the dependent variable (LCONS) followed by the spillover effect of included sectors (LIND, LINDPR). Here the dependent variable is the construction sector, the spillover effect included are from industrial and industrial product sectors. TABLE 5-9 are results for other sectors. The NARDL provides estimates of short-run and long-run effects. Due to the limited space, we only summarized the long-run parameter estimates. Therefore, the results of TABLE 4-9 are based on the estimates of long-run effects. Comparing the results across sectors, the main results can be summarized as follows: Oil price changes have a significant effect in majority sectors and the effects are asymmetric (the size and sign of effects differ between LOIL+, LOIL-). The effects also differ across sectors. Both LOIL+ and LOIL- lead to a negative effect on stock return in LPROP and LINDPR. LOIL+ leads to a negative effect in LTIN and LTRADE, LOIL- leads to a negative effect on LCONS, LCONSPR, but positive effect on LIND. Finance (LFIN) is not affected by oil price changes. The effects are relatively larger in construction, property, and tin and mining sectors as these sectors either use energy products or machine/ transport in their operations which are oil intensive. When oil price increases, the cost of production also increases, and the profit will be lower. When oil price declines, the cost of production is lower and profit will increase so that stock return increases. However, increasing the production will lead to an extra supply plus competition from the other firms, so that the price will drop and return is lower. The net effect is LOIL- might lead to either a positive or negative effect on stock return. In general, we observed that in most sectors, LOIL+ has a larger impact than LOIL- which are observed in property, tin and mining and trade sectors. Since LOIL+ leads to a negative outcome in majority sectors, the net effect of oil price changes (total effect of LOIL+ and LOIL-) is negative which can be observed in sectors like construction, consumer products, property, tin & mining and trade, and services with effect are more felt in oil-intensive sectors.

Exchange rate (LREER) is an important factor that determines the sectoral stock return performance in Malaysia but its effect varies across sectors. The positive relation is found in LCONS, LFIN and LPROP sectors where appreciation of Ringgit leads to higher stock return. The negative relation is found in LIND and LTIN sectors where appreciation of Ringgit leads to lower returns. The differences result depends on if the sector is dominated by imported or exported companies. Appreciation of domestic currency will benefit the importer as they can buy more goods using the same amount of money but not for exporters. Appreciation of Ringgit means the domestic price is more expensive compared to other goods and export may decline. Secondly, the international stock return (LMSCI) is influential in LCONS, LCONSPR, LIND, LTIN, and LINDPR with different effects. The effect is positive in LCONS, LTIN, and LINDPR but negative in LCONSPR and LIND. The positive effect exists as higher LMSCI which implies good international market performance, hence a good time to invest, so this will encourage more investments, the effect is spill over to domestic and sectoral market as well. However, there can be an outflow effect or shift from domestic to international stock investments due to a good expectation to invest in the international market, so that the investment on the domestic sectoral stock declines. On the other hand, LKLCI is influential in majority sectors (LCONSPR, LFIN, LPROP, LIND, LTRADE, LINDPR) and the effect is positive in these sectors. The sign is as expected as the increase in the domestic stock market return attracts more investments and positive expectation to invest in the local market including each sector, this leads to a better portfolio, inflows, and gains of each stock.

The results also reveal interconnection and linkages among sectors in which the performance of one sector may spill over to the sectors that are closely linked to this sector. The relationship can be positive or negative depending on if the sectors are complementary or competitive oriented. For instance, LTIN is positively linked with LFIN but negative with LTRADE. Our results capture spill over effects among sectors, in both short-run and long-run but TABLE 4-9 only reported the long-run estimates.

Overall, oil price changes affect stock return asymmetrically and the effects differ across sectors. However, oil is not the main determinant. Other main factors are exchange rate (LREER), domestic stock return (LKLCI), and international stock return (LMSCI). Spill over effect among sectors also affects the stock return. These factors have different explanatory effects on the stock return across sectors. LKLCI and LREER are the major determinants in LCONS, LFIN, and LPROP. On the other hand, LINDPR and LTRADE are mainly affected by LKLCI while LTIN is dominated by LREER. LMSCI also appears to be an important determinant for LCONS and LCONSPR. Sectors that are commodity-intensive like LTIN, LCONS, and LPROP also highly determined by the sectoral spill over effects.

TABLE 4. NARDL results for construction sectors.

Sectoral Indices	***LCONS***, *LIND, LINDPR*	***LCONS***, *LFIN, LTRADE*	***LCONS***, *LPROP*	***LCONS,*** *LPLANT, LTIN*	***LCONS***, *LCONSPR*
			Speed of Adjustments		
λ	-0.0788***	-0.0595***	-0.0484***	-0.1219***	-0.0841***
			Long-Run Parameter		
$LOIL^{+}$	0.3123	-0.0303	0.3394	-0.5046***	-0.1091
$LOIL^{-}$	0.1141	-0.1777	0.1092	-0.5533***	-0.3152***
LMSCI	1.0784***	1.3256*	1.5798**	0.9320***	0.7498**
LKLCI	-2.9237**	0.4036	-1.9953	-1.2418**	0.6443
LREER	4.5217***	3.8657**	2.8935*	3.3335***	3.0402***
LCONSPR	-	-	-	-	-0.7613
LFIN	-	-0.7031	-	-	-
LIND	0.4380	-	-	-	-
LINDPR	2.1053***	-	-	-	-
LPLANT	-	-	-	0.9961***	-
LPROP	-	-	0.7358	-	-
LTIN	-	-	-	0.2229*	-
LTRADE	-	-0.0611	-	-	-
C	-	-18.3661**	-	-17.1191***	-14.6674***

Bound (F-stat)	5.0222***	3.8803**	3.4188*	5.3031***	6.0191***
Banerjee (t-stat)	42.7384***	43.5120***	48.8653***	31.2047***	44.2278***
Wald (F-test)	2.5372*	2.3304***	2.5904*	2.4404**	4.1965***
LM (F-stat)	0.3341 (2)	0.3158 (2)	0.5825 (2)	0.0639 (2)	0.0158 (2)
ARCH (F-stat)	0.1424 (2)	0.1498 (2)	0.6427 (2)	0.0653 (2)	0.7518 (2)

Note: The bolded variable in the first row represents the dependent variable of the model, while the un-bold variables show the sectoral stock variables that used to examine the spillover effect with the dependent variable. The parentheses behind the LM and ARCH values show the number of lags.

TABLE 5. NARDL results for Consumer Product sectors.

Sectoral Indices	***LCONSPR,*** *LIND, LINDPR*	***LCONSPR***, *LFIN, LTRADE*	***LCONSPR,*** *LPLANT, LTIN*	***LCONSPR***, *LCONS, LPROP*
		Speed of Adjustments		
λ	-0.1530***	-0.1358***	-0.1200***	-0.1895***
		Long-Run Parameter		
LOIL⁺	0.0908**	-0.0005	-0.0251	0.1165***
LOIL⁻	-0.0223	-0.0940***	-0.1141***	-0.0050
LMSCI	-0.2831***	-0.2674***	-0.2447***	-0.2057***
LKLCI	0.5655***	1.5129***	0.7994***	0.5763***
LREER	0.3643***	0.0769	0.1466	0.0036
LCONS	-	-	-	-0.0818
LFIN	-	-0.2524	-	-
LIND	0.0299	-	-	-
LINDPR	0.3344*	-	-	-
LPLANT	-	-	0.1575	-
LPROP	-	-	-	0.2775***
LTIN	-	-	-0.0515	-
LTRADE	-	-0.2394	-	-
C	-	-	-	-
Bound (F-stat)	4.6400***	4.2674***	4.0543***	3.6487**
Banerjee (t-stat)	10.6816***	10.6797***	11.8976***	15.0567***
Wald (F-test)	3.9646***	4.0725***	4.0375***	3.9749***
LM (F-stat)	1.3483 (2)	0.6230 (2)	0.3637 (2)	0.4260 (2)
ARCH (F-stat)	0.0887 (2)	0.7612 (2)	0.2285 (2)	1.4127 (2)

Note: The bolded variable in the first row represents dependent variable of the model, while the un-bold variables shows the sectoral stock variables that used to examine the spillover effect with dependent variable. The parentheses behind the LM and ARCH values show the number of lags.

TABLE 6. NARDL results for Finance and Properties sectors.

Sectoral Indices	***LFIN,*** *LIND, LINDPR, LCONSPR*	***LFIN,*** *LCONS, LPROP*	***LPROP,*** *LIND, LINDPR, LCONSPR*	***LPROP,*** *LPLANT, LTIN*	***LPROP,*** *LFIN, LTRADE*
			Speed of Adjustments		
λ	-0.1075***	-0.1281***	-0.1926***	-0.1064***	-0.1368***
			Long-Run Parameter		
LOIL⁺	0.0855	-0.0114	-0.1482***	-0.3698***	-0.4089***
LOIL⁻	0.0659	-0.0523	-0.0409	-0.3695***	-0.3442***
LMSCI	0.0885	-0.1410*	-0.0329	0.0803	0.0136
LKLCI	-0.0933	1.0331***	0.5255	1.1114**	1.2850
LREER	0.8375***	0.5612***	0.2190	2.0817**	1.0848*
LCONS	-	0.0371	-	-	-
LCONSPR	0.4972	-	0.5497***	-	-
LFIN	-	-	-	-	0.3634
LIND	0.0045	-	-0.6311*	-	-
LINDPR	0.5083*	-	0.9589***	-	-
LPLANT	-	-	-	0.0468	-
LPROP	-	0.0053	-	-	-
LTIN	-	-	-	0.1092	-
LTRADE	-	-	-	-	-0.1825
C	-	-	-	-	-
Bound (F-stat)	2.5025+	3.4712**	4.5073***	3.2821*	3.6530**
Banerjee (t-stat)	13.8534***	28.1835***	13.1814***	14.7095***	14.1663***
Wald (F-test)	3.1025**	7.5277***	3.9544**	4.5802***	8.0447***
LM (F-stat)	1.2283 (6)	1.6878 (2)	1.4581 (2)	1.6446 (2)	0.3370 (2)
ARCH (F-stat)	0.0715 (2)	1.5511 (2)	0.9968 (6)	2.0625 (2)	1.0640 (6)

Note: The bolded variable in the first row represents dependent variable of the model, while the un-bold variables shows the sectoral stock variables that used to examine the spillover effect with dependent variable. The parentheses behind the LM and ARCH values show the number of lags.

TABLE 7. NARDL results for Industrial and Industrial Product sectors.

Sectoral Indices	***LIND,*** *LINDPR, LCONSPR*	***LIND,*** *LFIN*	***LIND,*** *LPLANT, LTIN*	***LINDPR,*** *LCONS, LPROP*
		Speed of Adjustments		
λ	-0.0573***	-0.0537***	-0.0868***	-0.1555***
		Long-Run Parameter		
$LOIL^{+}$	-0.1895	-0.3411	-0.2815*	-0.1016**
$LOIL^{-}$	0.2499**	0.2301*	0.1029	-0.1173***
LMSCI	-0.5722*	-0.6404*	-0.3585**	0.1619**
LKLCI	1.3314**	2.5454**	0.3653	0.6002***
LREER	-1.5403**	-1.2456*	-1.1937***	-0.0599
LCONS	-	-	-	0.1313
LCONSPR	0.0663	-	-	-
LFIN	-	-1.3463*	-	-
LINDPR	-0.5867	-	-	-
LPLANT	-	-	0.3436**	-
LPROP	-	-	-	0.0609
LTIN	-	-	0.1092	-
C	-	-	-	-
@TREND	0.0163**	0.0185*	0.0120*	-
Bound (F-stat)	1.6461	2.5778+	2.4867+	3.2919*
Banerjee (t-stat)	40.2749***	14.4570***	10.2810***	22.9389***
Wald (F-test)	8.2551***	5.7859***	4.0340***	9.4393***
LM (F-stat)	2.3250 (2)	0.6466 (2)	0.7688 (2)	0.0057 (2)
ARCH (F-stat)	0.1650 (2)	1.2127 (2)	0.0436 (2)	0.2541 (2)

Note: The bolded variable in the first row represents dependent variable of the model, while the un-bold variables shows the sectoral stock variables that used to examine the spillover effect with dependent variable. The parentheses behind the LM and ARCH values show the number of lags.

TABLE 8. NARDL results for Tin and Mining sectors.

Sectoral Indices	***LTIN,*** *LCONS, LPROP*	***LTIN,*** *LPLANT, LCONSPR*	***LTIN,*** *LIND, LINDPR, LCONSPR*	***LTIN,*** *LFIN, LTRADE*
		Speed of Adjustments		
λ	-0.1721***	-0.1565***	-0.1824***	-0.2072***
		Long-Run Parameter		
$LOIL^{+}$	-0.4263*	-0.2712	-0.3833**	-0.6563***
$LOIL^{-}$	0.1965	0.0844	0.0167	0.2216
LMSCI	-0.1543	0.8261**	0.7911**	0.3084
LKLCI	1.1503	-1.8986	-0.9907	2.4694
LREER	-1.9306**	-0.6503	-1.6134***	-2.1536**
LCONS	0.1000	-	-	-
LCONSPR	-	0.1482	-0.8992	-
LFIN	-	-	-	1.6189**
LIND	-	-	2.6501***	-
LINDPR	-	-	0.6361*	-
LPLANT	-	2.8315**	-	-
LPROP	-0.2341	-	-	-
LTRADE	-	-	-	-4.1978**
C	-	-	-	-
@TREND	0.0178*	-	-	0.0265***
Bound (F-stat)	2.7583+	2.9557*	2.9085*	3.6271**
Banerjee (t-stat)	23.1315***	24.7569***	22.0447***	21.1926***
Wald (F-test)	2.5127**	3.0817***	3.7641**	4.0814***
LM (F-stat)	0.1949 (2)	0.4381 (2)	0.9579 (2)	0.1817 (2)
ARCH (F-stat)	0.6124 (2)	0.1568 (2)	0.2716 (2)	0.0724 (2)

Note: The bolded variable in the first row represents dependent variable of the model, while the un-bold variables shows the sectoral stock variables that used to examine the spillover effect with dependent variable. The parentheses behind the LM and ARCH values show the number of lags.

TABLE 9. NARDL results for Trade and Services sectors.

Sectoral Indices	***LTRADE,*** *LIND, LINDPR, LCONSPR*	***LTRADE,*** *LFIN*	***LTRADE,*** *LPLANT, LTIN*
		Speed of Adjustments	

λ	-0.3416***	-0.3659***	-0.3133***
Long-Run Parameter			
$LOIL^+$	-0.0767***	-0.0972***	-0.0741***
$LOIL^-$	-0.0075	0.0105	0.0178
LMSCI	-0.0106	0.0541**	0.0021
LKLCI	0.9364***	0.6543***	0.9956***
LREER	-0.0487	-0.0662	-0.1646**
LCONSPR	0.0849	-	-
LFIN	-	0.1604**	-
LIND	-0.1552*	-	-
LINDPR	0.0125	-	-
LPLANT	-	-	-0.0743***
LPROP	-	-	-
LTIN	-	-	0.0046
C	-	-	-
@TREND	0.0027***	0.0036***	0.0029***
Bound (F-stat)	4.8010***	6.5338***	4.9440***
Banerjee (t-stat)	14.2266***	11.8801***	12.7553***
Wald (F-test)	8.1245***	8.5726***	6.4455**
LM (F-stat)	1.7135 (6)	0.8544 (2)	1.9256 (2)
ARCH (F-stat)	0.5777 (6)	2.0410 (2)	0.8146 (6)

Note: The bolded variable in the first row represents dependent variable of the model, while the un-bold variables shows the sectoral stock variables that used to examine the spillover effect with dependent variable. The parentheses behind the LM and ARCH values show the number of lags.

The diagnostics test results are shown at the bottom of each table. In this study, the serial correlation LM test and ARCH-LM test has been chosen to test the existence of serial correlation and heteroscedasticity of the models. The insignificant value of F-statistic indicates that the null hypothesis of no serial correlation or no heteroscedasticity problem will not be rejected. The number of lags used in this study is 2 and 6. Lag 2 will be chosen if the F-value is insignificant. Otherwise, lag 6 will be chosen. From the results, we observed that most of the model shows insignificant F-statistic at lag 2, while only some of the model shows insignificant F-statistic at lag 6.

ASYMMETRIC EFFECTS

Next, we examine the cumulative asymmetric impact of oil price changes to stock returns in both short-run and long-run. The asymmetric effects can be observed from the dynamic multiplier graphs and the graphs are shown in FIGURE 3. The positive (continuous black line) and negative (dashed black line) change curves indicate the adjustment of stock market returns due to the increase and decrease of oil price respectively at a given forecast horizon. The asymmetry line (broken red line) reflects the difference of cumulated effects between oil price increases and decreases effects. The 95% upper and lower confidence bands (dotted red lines) provide a measure of statistical significance of asymmetry.

The results show that consumer products, financial and trade, and services sectors receive small or limited impact from oil price changes. On the other hand, the effect of LOIL+ dominates the stock return in the construction sector. From panel (1), oil price increases lead to higher stock return in the construction sector, with the accumulated effect increasing over time. The possible explanation is, although higher oil price leads to higher production cost, the cost is covered by increasing productivity. Higher productivity also helps to increase the volume of sales and improve competitive power, hence the profit remains or even increases. On the other hand, oil price decreases impose negative effects in the first few months, and the effect started to change after that. The difference shows that the net effect of oil price changes has positive effects which accumulated over time. These results hold in four stock return models except the model includes plantation and tin & mining (panel 4). Oil price changes may induce an indirect effect on stock price changes in plantation and tin & mining sectors so that the net effect of oil price changes is negative (oil price increases dominates the net effect). This is because oil price increases lead to higher cost, so it makes the stock return lower. Here we see that the market structure determines the performance of the stock. The construction sector has more segmentation and variety of production lines, which is able to offset the higher production cost induced by higher oil prices through marketing/ promotion and increasing productivity. On the other hand, plantation and mining sectors are very specific, highly rely on non-renewable resources (include oil) and the supply or availability of the resources, hence productivity is rigid.

The negative net effect of oil is observed in industrial, industrial products, property, and tin & mining sectors. In these sectors, the net effect is negative where oil price increases are the dominance effect that leads to the drop in the stock return in these sectors. These sectors are highly oil or energy-intensive so that the stock return is sensitive to oil price changes. On the other hand, in the tin and mining sector (panel 20, 21 and 22), decrease in oil price leads to a higher stock return in the short-run (the beginning few months), but later oil price increases dominate the total effect which leads to the drop in return in the long-run.

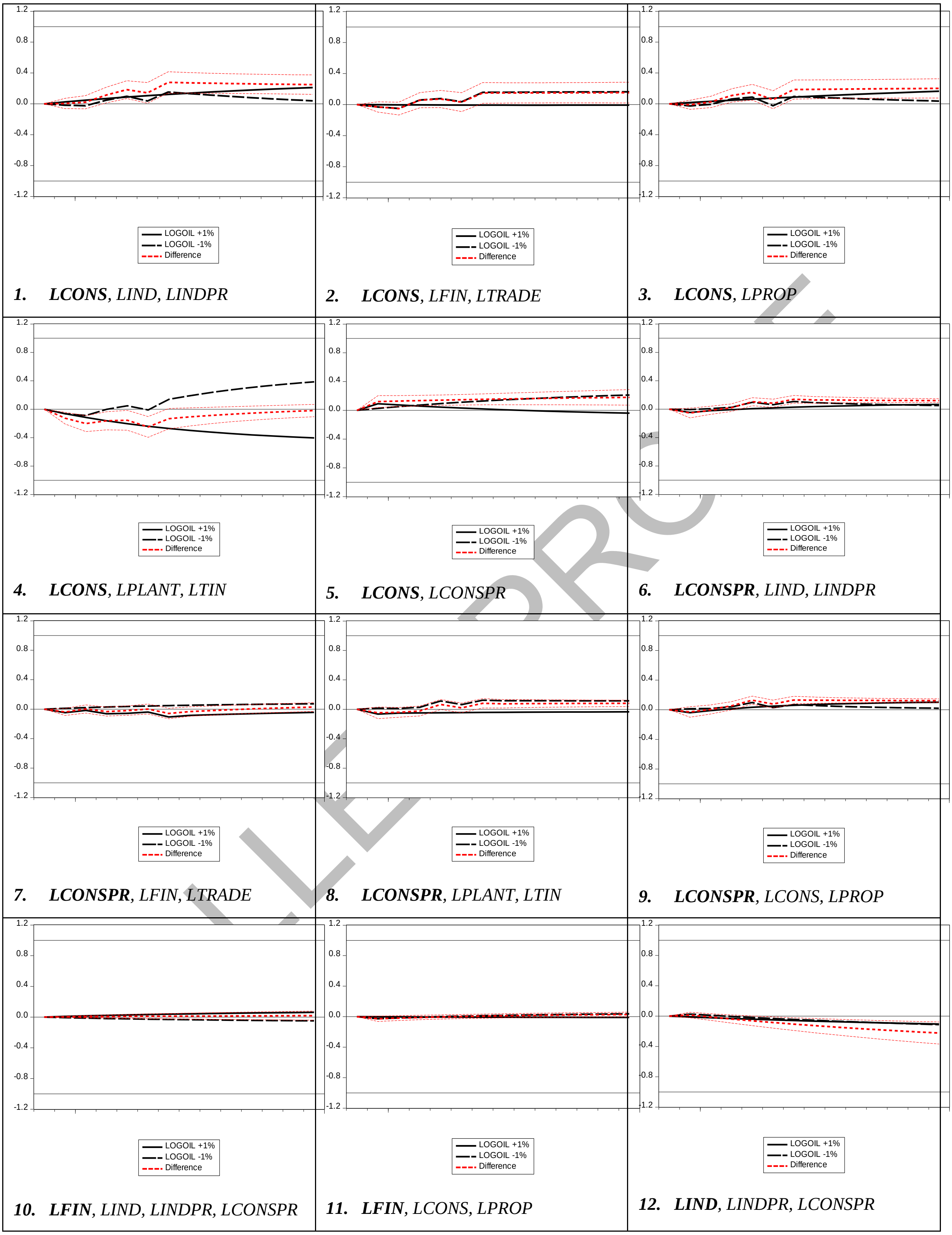
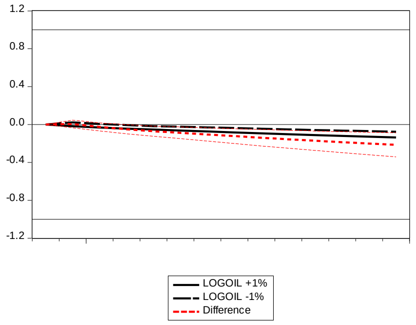
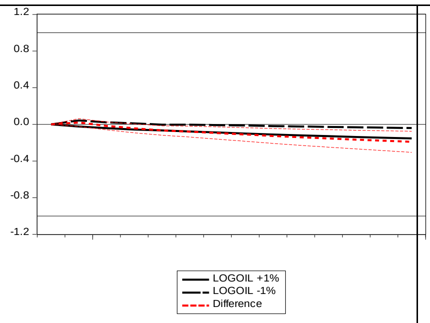


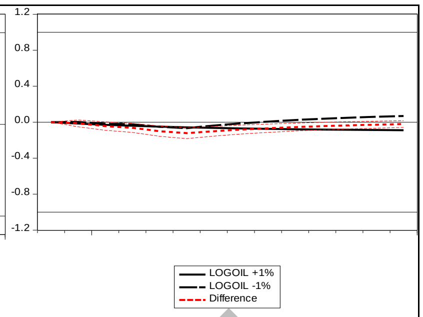
FIGURE 3. Dynamic Multiplier Graphs of the 25 estimated models



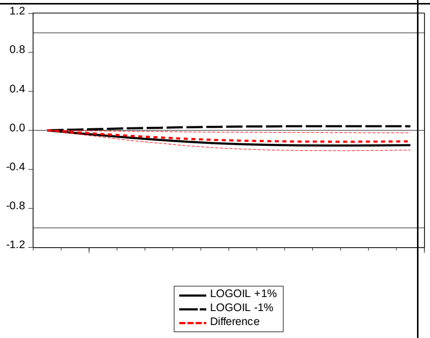
13. ***LIND***, *LFIN*



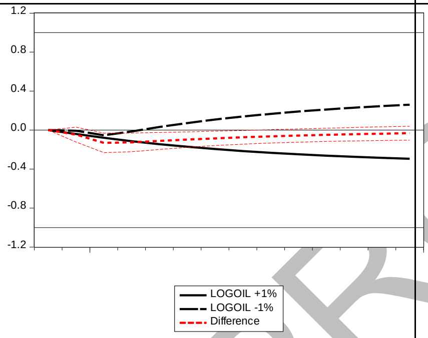
14. ***LIND***, *LPLANT*, *LTIN*



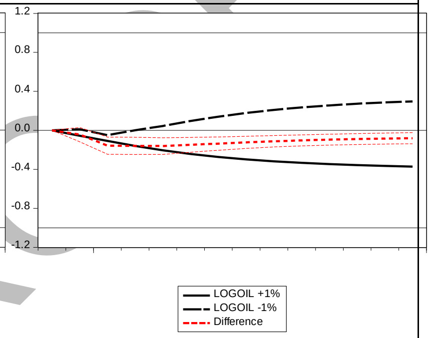
15. ***LINDPR***, *LCONS*, *LPROP*



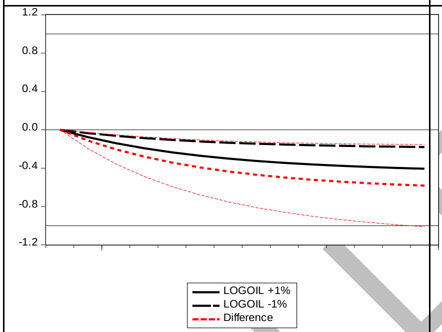
16. ***LPROP***, *LIND*, *LINDPR*, *LCONSPR*



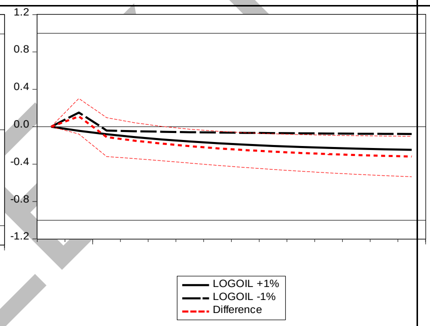
17. ***LPROP***, *LPLANT*, *LTIN*



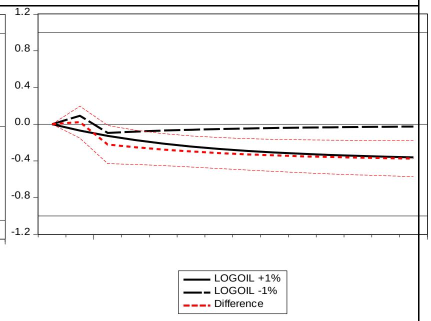
18. ***LPROP***, *LFIN*, *LTRADE*



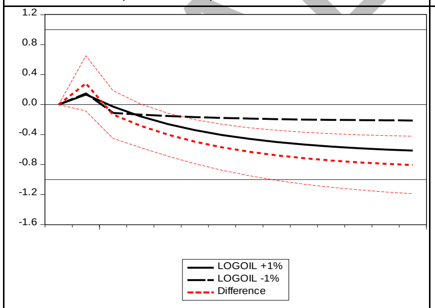
19. ***LTIN***, *LCONS*, *LPROP*



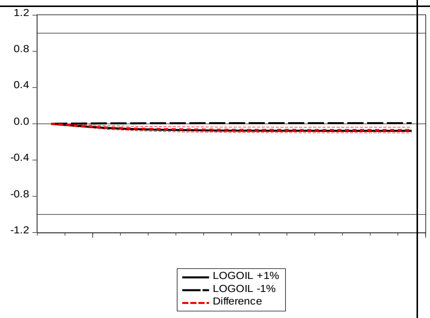
20. ***LTIN***, *LPLANT*, *LCONSPR*



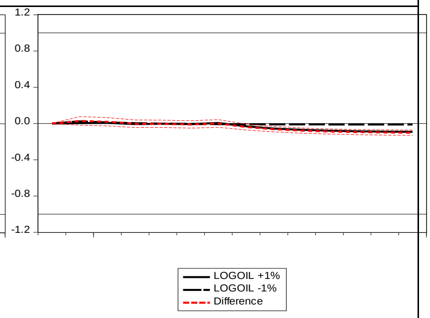
21. ***LTIN***, *LIND*, *LINDPR*, *LCONSPR*



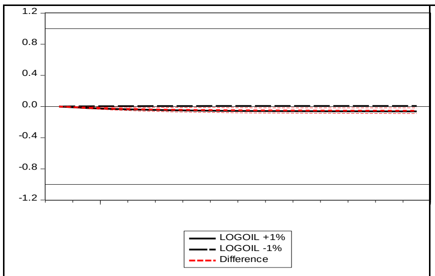
22. ***LTIN***, *LFIN*, *LTRADE*



23. ***LTRADE***, *LIND*, *LINDPR*, *LCONSPR*



24. ***LTRADE***, *LFIN*



25. LTRADE, *LPLANT*, *LTIN*		

Continues…FIGURE 3. Dynamic Multiplier Graphs of the 25 estimated models

CONCLUSION

This study applied the NARDL models to examine the asymmetric effects of oil price changes in the sectoral returns of the stock market in Malaysia. Besides, we also considered the spillover interaction effects among sectors. The results provide new insights into the stock performance analysis. Our results detected asymmetric oil price effects either in the short-run or long-run but the oil price is not the main determinant affecting the returns of the stock market. The effect of oil price increases is larger which leads to a negative effect on stock return. Hence the net effect is negative and this is consistent with the results of Kisswani and Elian (2017). The long-run significant effects of oil price changes exist in many sectoral stock returns because they are oil-intensive sectors, especially tin and mining, property, industrial and industrial products. The finance, consumer product, trade, and services are not affected much by oil price changes in the long-run because they are not an oil-intensive sector. To reduce the negative impact of oil price changes, shifting to non-oil alternative resources to reduce the dependency on oil and subsidy from the government to reduce the extra cost of oil can be a good option.

The study also captured spillover effects among sectors. Long-run spillover effects exist in 12 estimated models and the effects can be positive and negative. The most influence spillover effects are the stock returns of construction and industrial product sectors, tin and mining and plantation sectors, tin, and mining and industrial sectors and tin and mining and trade and services sectors. The three main factors that are influential to the sectoral stock returns in Malaysia are the Malaysia stock market return, exchange rate, and other sectoral spillover effects. The most influential factor that affects the sectoral stock returns is the exchange rate, where the appreciation of the exchange rate leads to the increase of sectoral stock return by at least twice. The main factors that govern the hits of external shocks and spillover effects are globalization and market integration/ high linkages. As a result of globalization, information can be shared across the globe and news is spread immediately, this leads to fast penetration of shocks into the domestic economy. Also, market integration leads to contagion/ spillover effects among markets/ sectors. To reduce the negative effects of external shocks and spillover, market diversification and cooperation through trades and regulation/ monetary policy could be helpful for both investors and policymakers. Investors should diversify their investments to more baskets of stocks in order to reduce the risk of investment. Policymakers should seek to diversify economic activities to reduce the dependency on a few main productions as the source of income. At the same time, technology transfer and knowledge sharing among trade partners are important in finding alternatives to renewable energy sources to replace the non-renewable energy sources (oil and its products). The impact of oil shock will be reduced when the dependency on oil in the production is lower. Also, an effective monetary policy should be introduced to reduce the negative impact of the exchange rate on the stock return. When the impact has reduced, the investors (local and foreign) will be more confident to invest in the desired sectors to gain profit from their investments.

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