Fluctuations of Crude Oil and the Impact on Malaysian Oil Producers

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Abstract

This study aims to investigate the impact of price fluctuations of crude oil on oil producers' companies in Malaysia. Individual stock prices of oil producers were selected instead of stock market indexes. This study employed an Autoregressive Distributed Lag Bounds (ARDL) model with weekly data spanning from January 2011 until June 2022. The empirical results found evidence of cointegration between crude oil and the stock price of PETRONAS Chemical, PETRONAS Gas, Hibiscus Petroleum and Petron Malaysia. This indicates that the stock prices move in tandem with crude oil towards long-run equilibrium. Furthermore, the study finds substantial statistical evidence of a causal impact from crude oil to the stock prices of oil producer companies, suggesting that Brent Futures significantly influences the stock price behaviour of Malaysian oil producers. The empirical results of this study will be able to assist the fund managers of these oil producer companies or individual investors in designing investment strategies based on the price movement of crude oil.

Keywords: Oil Producer, Stock Prices, Brent Futures, ARDL

1. Introduction

Malaysia is blessed with its abundance of the black gold, and since then it has become a fuel to the economy of this country. Oil exploration is a big business and requires a significant amount of capital (Weijermars, 2009), thus the Malaysian government decided to place this economic activity under its jurisdiction and protect it under the Petroleum Development Act 1974. Hence, in 1974, the government established Malaysia's national oil company, Petroliam Nasional Berhad (PETRONAS), with the responsibility of supervising oil activities both within and outside the country. It is wholly owned by the government; thus, this national oil company is not listed on any exchange, but there are several subsidiaries listed on Bursa Malaysia, namely PETRONAS Chemical, PETRONAS Dagangan and PETRONAS Gas. Listing these companies has opened an avenue for fund managers and individual investors across the globe to participate in the crude oil industry by acquiring ownership through the purchase of crude oil stocks. This, in turn, allows governments and these companies to receive more capital injection from the public to do more oil exploration and generate more revenue.

Since its establishment, PETRONAS has reliably delivered revenues to the government through dividends, which are shaped by the global oil prices (Kraal et al., 2017). This indicates that the global oil prices are able to influence the dividends the government receives. Lower oil prices result in lower dividends for the government and vice versa. Hence, the fluctuation of oil prices undoubtedly influences Malaysia's economy, an oil-rich nation and home to a multi-billion-dollar oil company. Consequently, price fluctuations of crude oil may introduce a degree of unpredictability into Malaysia's economic development, growth trajectories and the valuation of stocks. A number of researchers has engaged in investigations regarding the impact of crude oil fluctuations on the economy (Qianqian, 2011; Yoshino

& Taghizadeh, 2014; Okonkwo & Mojekwu, 2018). However, this particular study aims to investigate the impact of these fluctuations on the stock market from a different perspective.

Figure 1: Crude Oil Price Movement
Source: Author's Collection

The impact of crude oil price fluctuations on stock markets has been a topic of extensive discourse around the world due to the price movement as demonstrated in Figure 1. There are five oil producer companies listed on FTSE Bursa Malaysia, but questions arise whether their stock prices have a co-movement with crude oil and are exposed to price fluctuations. Addressing this question is crucial since the government is depending on the revenue generated from these oil-producing companies. As a result, the government must regularly monitor global oil prices, which can have a significant impact on its revenue. This allows it to develop a mitigation strategy for budget construction, which is particularly useful during periods of low oil prices. Moreover, addressing this question will assist fund managers, investors and traders in tracking the performance of oil producers' company that derive substantial revenue from activities related to crude oil. Therefore, the specific objective of this study is to investigate the impact of crude oil price fluctuations on oil producer companies listed in FTSE Bursa Malaysia. Addressing this issue will enhance both the existing knowledge, practitioners and policymaker.

This study makes two key contributions. First, while previous research has focused on the impact of crude oil price fluctuations on economy (Qianqian, 2011; Yoshino & Taghizadeh, 2014; Okonkwo & Mojekwu, 2018) and stock indexes (Imarhiagbe, 2010; Zu et al., 2011; Asaolu, & Ilo, 2012; Ghosh & Kanjilal, 2016; Mahmoudi & Ghaneei, 2022; Tursoy & Faisal, 2018), there is a significant gap in understanding of their impact on the individual stock price of oil producer companies. This study addresses this gap by examining the long-run and short-run impacts of crude oil price fluctuations on Malaysian oil producer companies listed on the FTSE Bursa Malaysia. Furthermore, if crude oil is found to have an impact on individual stock prices, it can be used as reliable proxies for forecasting the price movement of oil producer companies, as forecasting the price of individual stocks is challenging due to the variety of factors that can influence price movement. Second, from a theoretical perspective, the study expands our understanding of how external factors, such as crude oil price fluctuations, influence company's value in emerging markets. It provides new insights into the transmission mechanisms of these price changes within the crude oil industry and contributes to more robust financial models for emerging markets especially Malaysia.

The study comprises five distinct sections. Section 1 provides the background of the study, and Section 2 discusses a brief review of the literature. Next, Section 3 presents data collection and methods. Section 4 summarises the discussion of the empirical result, while Section 5 outlines the findings.

2. Brief of the Literature

Arbitrage Pricing Theory (APT) offers a robust framework for understanding how multiple macroeconomic factors influence asset returns (French, 2017). Unlike the single-factor approach of CAPM, APT considers various factors such as exchange rates and commodity prices to explain asset prices more comprehensively. In this study, APT is particularly relevant, as it helps analyse how fluctuations in crude oil prices affect the stock prices of Malaysian oil producer companies. The results are essential for understanding the complex dynamics between external economic forces and stock prices in Malaysia. The use of APT in this analysis also helps develop more robust financial models that consider the unique characteristics of emerging markets and the commodities on which they depend, thereby improving the predictive accuracy of investment strategies in the crude oil industry.

Prior researchers have conducted several studies to investigate the relationship between crude oil and the stock market. Researchers found a cointegration relationship between crude oil and the stock market in China, India, Saudi Arabia, the USA, and Russia (Imarhiagbe, 2010); OECD and non-OECD countries (Zu et al., 2011); Nigeria (Asaolu & Ilo, 2012); India (Ghosh & Kanjilal, 2016); Canada (Mahmoudi & Ghaneei, 2022); and Turkey (Tursoy & Faisal, 2018). Moreover, these countries' stock markets exhibit a positive correlation with crude oil, with the exception of Nigeria and India. Furthermore, crude oil has a long-run relationship with six stock indexes of OECD countries (Miller & Ratti, 2009), and a shock in crude oil influenced the ASE Greece Index (Filis, 2010). In China, oil shocks are able to affect the profitability of a firm due to fluctuations in output, inflation and decline in real consumption (Sim & Zhou, 2015).

Meanwhile, in close proximity to Malaysia, Narayan and Narayan (2010), using the Johansen cointegration test, discovered a positive correlation between the oil price and Vietnam's stock market. Similar to Vietnam, Hadi *et al.* (2009) and Darmawan *et al.* (2020) found a positive long-run relationship between crude oil and Indonesia’s stock market. In Malaysia itself, Hussien *et al.* (2012) found a positive relationship between crude oil price and the FBM Emas Shariah Index by employing vector autoregression (VAR) and monthly data spanning from January 2007 until December 2011. Interestingly, Bani and Ramli (2019), who employed different indices, namely FBM KLCI and FBM Emas, found a negative relationship with crude oil. However, Nordin *et al.* (2014), who used monthly data from the period of February 1997 until September 2012, found no relationship between crude oil and KLCI. These contradicting results motivate this study to further investigate the relationship between Malaysia's stock market and crude oil.

Raza et al. (2016) and Mishra et al. (2019) emphasised that every finding in previous research on the influence of crude oil on stock prices is significant and can play a vital role in investment decision-making, derivatives valuation, and hedging strategies. The approach of this study is considered novel, as the closest studies examined the relationship between crude oil and stock indexes. Unlike previous research, this study will explore the cointegration relationship between Brent Futures and selected oil producer companies listed in FTSE Bursa Malaysia. This is important since different companies have different market capitalisations and costs for production, operation and extraction. Previous studies were only conducted until 2019 and there is a need for a new investigation since crude oil went into various shocks, especially in the oil crash of 2014 to 2016, the global pandemic of COVID-19 and the latest war between Russia and Ukraine.

3. Data and Methodology

This study utilised weekly data spanning from January 2011 to June 2022 where all the stock prices (SP) of oil producer companies are obtained from FTSE Bursa Malaysia while Brent Crude Oil Futures

(OIL) and Exchange Rate (EXR) are collected from the Bloomberg terminal database. Brent Crude Oil Futures is selected as a proxy for crude oil since the government of Malaysia and PETRONAS used Brent Crude Oil Futures as a benchmark for budget construction and revenue forecasting, and EXR is included as controlled variable. PETRONAS Chemical (LnPChem), PETRONAS Dagangan (LnPDag), PETRONAS Gas (LnPGas), Hengyuan Refining (LnHeng), Hibiscus Petroleum (LnHib) and Petron Malaysia (LnPetron) represent the oil producer companies. These companies were selected based on their market capitalisation and core business of producers and refineries as stated in FTSE Bursa Malaysia. All variables are presented in natural logarithms (Ln).

In order to investigate the relationship between crude oil with stock prices of oil producer companies listed in Bursa Malaysia, this study adopted the econometric models for each stock price of oil producer companies from Narayan and Narayan (2010), Imarhiagbe (2010) and Ghosh and Kanjilal (2016) as follows:

$$LnSP_{i,t} = a_{i,1} + b_{i,1}LnOIL_{i,t} + b_2LnEXR_{i,t} + \varepsilon_{i,t} \quad (1)$$

where a_1 is a constant, ε_t is a random error term, while b_t denotes the unknown parameters to be estimated. The preliminary analysis begins with a descriptive analysis of general data, followed by a unit root test. Augmented Dickey Fuller (ADF) by Dickey and Fuller (1979) and Phillips-Perron (PP) by Phillips and Perron (1988) are employed in this study to determine the level of stationarity.

Compared to other cointegration tests, ARDL allows variables to be stationary at different levels. Thus, ARDL model is able to reduce issues of endogeneity and residual correlation (Sowah & Kirikkaleli, 2022). It is possible to perform ARDL without a preliminary test, but this study continues to conduct the unit root test to ensure that none of the variables is stationary at I(2). The long-run relationship was tested using the ARDL F-statistic bound test by Pesaran et al. (2001) within the ARDL framework to examine cointegration among the variables in alignment with the main objective. The F-statistic bound test uses two asymptotic bounds with critical values based on the I(d) regressors ($0 \leq d \leq 1$) (Pesaran et al., 2001). An F-statistic value that surpasses the upper bound [I(1)] critical value denotes cointegration. Conversely, this study will accept null hypothesis if the F-statistic value falls below I(1) which indicates that there is no cointegration found in the model. Furthermore, the error correction model (ECM) allows for the simultaneous derivation of short-run dynamics and long-run equilibrium, which preserves all relevant information (Shah et al., 2022). This study expressed the specific ARDL model as follows:

$$\Delta LnSP_{t,i} = a_{t,i} + \sum_{i=1}^{p}\beta_1\Delta LnSP_{t-i} + \sum_{i=0}^{q}\beta_2\Delta LnOIL_{t-i} + \sum_{i=0}^{q}\beta_3\Delta LnEXR_{t-i} + \varphi_1\Delta LnSP_{t-i} + \varphi_2\Delta LnOIL_{t-i} + \varphi_3\Delta LnEXR_{t-i} + \varepsilon_t \quad (2)$$

where β_i is the short-run dynamic and φ_i represent the corresponding cointegration multiplier of the underlying ARDL. The null hypothesis of this study is $H_0 : \varphi_i = 0$ indicates no cointegration, and alternative hypothesis ($H_a : \varphi_i \neq 0$) indicates of the presence of cointegration in the model. In addition to examining cointegration, this study also aims to analyse the short-run impact of crude oil on oil producer companies. The causal relationship between these variables was tested by employing the error correction model based on ARDL (ECM-ARDL) provided that $LnSP_t$ in equation (2) are cointegrated with the crude oil in the previous cointegration test. The specific ECM-ARDL model is as follows:

$$\Delta LnSP_{t,i} = a_{t,i} + \sum_{i=1}^{p}\beta_1\Delta LnSP_{t-i} + \sum_{i=0}^{q}\beta_2\Delta LnOIL_{t-i} + \sum_{i=0}^{q}\beta_3\Delta LnEXR_{t-i} + \theta ECT_{t-1} + \varepsilon_t \quad (3)$$

where ECT_{t-1} in equation (3) represents the performance of dependent variable to the lagged deviation from the long-run equilibrium, while θ denotes the coefficient of the speed of adjustment of the error correction term. ECT_{t-1} is statistically significant provided the coefficient value is less than 1 with a negative sign. In the case of no cointegration, this study employed the short-run model-based ARDL framework in the first difference form without ECT_t in determining the causality relationship between crude oil and oil producer companies. Due to concerns about the different levels of stationarity of the variables, this study opted not to employ the traditional causality test based on the Vector Autoregression (VAR) framework. Short-run causal impact is tested using the Wald test and the null hypothesis is $H_0 : \beta_i = 0$ and the alternative hypothesis is $H_a : \beta_i \neq 0$. Fail to reject null hypothesis indicates no short-run causal impact from crude oil on oil producer companies.

This study also conducted a set of diagnostic tests, specifically autocorrelation and heteroscedasticity, to evaluate the adequacy and robustness of the selected ARDL models. The study ran a further stability test by employing Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ).

4. Empirical Result

Results of descriptive statistics were presented in Table 1 for the overview of each variable. The summary of common statistics contained the mean, standard deviation, skewness, and kurtosis. For the first moment, LnOIL recorded the highest mean, followed by LnPDag, LnPGas, LnPChem, LnHeng, LnPetron, LnEXR and LnHib. In the second moment, LnHib recorded the highest standard deviation, while LnEXR recorded the lowest. The third moment's focus on skewness reveals that LnPChem, LnHeng and LnPetron display positive skewness, whereas LnPDag, LnPGas, LnHib, LnOIL, and LnEXR display negative skewness. Furthermore, LnHib displays a leptokurtic distribution, whereas the other series demonstrate a platykurtic distribution due to values falling below three. This study investigates the stationarity level of each variable, presenting the results in Table 2. The unit root test results show a mix of stationary levels, but none of the variables have an I(2) level of integration. Therefore, we should employ ARDL in this study.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Skewness	Kurtosis
LnPChem	1.952565	0.154431	0.223224	2.899162
LnPdag	3.106584	0.143844	-0.109962	2.788471
LnPGas	2.931831	0.146386	-0.084904	2.273726
LnHeng	1.716260	0.403584	0.010621	2.427287
LnHib	-0.215461	0.620897	-0.734658	3.065904
LnPetron	1.486914	0.401318	0.766003	2.781413
LnOIL	4.252316	0.367057	-0.216951	2.245109
LnEXR	1.333760	0.131036	-0.629513	1.714552

Notes: Std. Dev. is a standard deviation. Total number of observations is 565.

Table 2: Unit Root Test

Variable/Test	Augmented Dickey Fuller		Phillips-Perron	
	I(0)	I(1)	I(0)	I(1)
LnPChem	0.45340	-11.10994[a]	-1.760944	-26.13379[a]
LnPDag	-2.509753	-27.51946[a]	-2.712076	-
LnPGas	-2.289768	-12.62349[a]	-2.451909	-27.74419[a]
LnHeng	-2.431599	-11.96367[a]	-2.156240	-18.03376[a]
LnHib	-1.556024	-22.26359[a]	-1.596649	-22.27379[a]
LnPetron	-1.376182	-9.252561[a]	-1.435008	-20.74160[a]
LnOIL	-1.767090	-9.090343[a]	-1.778950	-21.69556[a]
LnEXR	-1.445183	-22.68727[a]	-1.477533	-22.77250[a]

Notes: [a] denote 1% significant level. Akaike Information Criteria was employed in determining optimal lags and the maximum lags were set to 4. I(0) is level and I(1) is first difference.

This study proceeds to the estimation of cointegration by employing the ARDL F-Bounds test approach and summary results are presented in Table 3. Based on the results obtained, LnPChem, LnHib, and LnPetron have a long-run relationship with LnOIL and LnEXR at a 5 percent level of significance, while LnPGas has a 10 percent level of significance. LnPDag and LnHeng were unable to reject the null hypothesis due to their F-statistic values being smaller than the lower critical value [I(0)], which suggests the absence of a long-term relationship. Therefore, this study continues with the error correction regression for LnPChem, LnHib, LnPetron, and LnPGas, and conducts a causality test for LnPdag and LnHeng.

Table 3: ARDL F-Bound Test

Model	F-Statistics	Null Hypothesis
LnPChem=f(LnOIL, LEXR)	4.6599[b]	Rejected
LnPDag=f(LnOIL, LEXR)	1.4970	Accepted
LnPGas=f(LnOIL, LEXR)	3.8657[c]	Rejected
LnHeng=f(LnOIL, LEXR)	1.9443	Accepted
LnHib=f(LnOIL, LEXR)	4.1599[b]	Rejected
LnPetron=f(LnOIL, LEXR)	4.1621[b]	Rejected

Notes: [b] and [c] denotes 5% and 10% significant level, respectively. Upper bound I(1) for all model is 3.87 (5%) and 3.35(10%).

Results in Table 4 indicating the coefficient of regressors in the long run. According to the probability value, PETRONAS Chemical responds to a 1 percent change in crude oil with a 0.1672 percent increase, while a 1 percent increase in the exchange rate results in a 0.6532 percent decrease. In the case of PETRONAS Gas, only the exchange rate is statistically significant at 1 percent, indicating every 1 percent increase in the exchange rate will lead to a decrease of 0.4032 percent for PETRONAS Gas's stock price.

In the case of Hibiscus Petroleum, both crude oil and exchange rates are statistically significant. Every 1 percent increase in crude oil leads to an increase of 0.603 percent in Hibiscus's stock price. Furthermore, every 1 percent increase in the exchange rate led to a 1.17 percent decrease for Hibiscus. Crude oil and exchange rates are also statistically significant for LnPetron, and the estimation result shows that every 1 percent increase in crude oil will boost the stock price by 0.1938 percent, while every 1 percent increase in exchange rates will lead to a decrease of 0.4817 percent in Petron's stock price.

This study proceeds by addressing the goodness of fit of the ARDL model. Autocorrelation based on Breusch-Godfrey Lagrange Multiplier test results indicate no serial correlation for all models, but there are heteroskedasticity problems based on the White test for LnPGas, LnHib, and LnPetron. As the financial data are exposed to the structural changes, this study also performed a cumulative sum of recursive residuals (CUSUM) and a cumulative sum of squares (CUSUMSQ) to check the stability of the model chosen. For CUSUM, all models are stable, indicating the line plotted remained within the critical bounds at the 5 percent level of significance. However, for CUSUMSQ, the plotted line for LnPChem and LnPetron touched the critical line, indicating that the variances were unstable during this period.

Table 4: Long Run Regression based on ARDL F-Bound Test

Variable	β_1	β_2	x_{sc}^2	x_{het}^2	CUSUM	CUSUMSQ
LnPCHEM	0.16721[a]	-0.65320[a]	5.38747	0.22291	Stable	Unstable
LnPDAG	-	-	1.25432	6.63321	Stable	Stable
LnPGAS	0.01595	-0.40322[a]	1.67512	60.0623[a]	Stable	Stable
LnHENG	-	-	0.39354	5.43987	Stable	Stable
LnHIB	0.60299[a]	-1.17442[a]	1.03706	5.30895[b]	Stable	Stable
LnPetron	0.19386[a]	-0.48174[b]	1.01677	24.1389[a]	Stable	Unstable

Notes: β_1 and β_2 represent the coefficient of LnBRENT and LnEXR for every model, respectively. [a] and [b] denote 1% and 5% significance level respectively. x_{sc}^2 represents autocorrelation test based on Breusch-Godfrey Serial Correlation Lagrange Multiplier test while x_{het}^2 denotes heteroscedasticity test based on White test.

Table 5 shows the results of the short-run causality test. There were short-run causalities extending from LnOIL to LnPChem, LnPDag, LnHeng, LnHib and LnPetron, but none extended to LnPGas.

Furthermore, this study identified a short-run causality impact from LnEXR to LnPdag, LnPgas, LnHib and LnPetron. This study found no causality impact for LnPChem and LnHeng.

Table 5: Short Run Causality

Alternative Hypothesis	F-Statistics	Result	θ
LnOIL→LnPChem	16.36898[a]	Accepted	-0.059533[a]
LnEXR→LnPChem	0.227167	Rejected	
LnOIL→LnPDag	4.224832[b]	Accepted	-
LnEXR→LnPDag	3.374333[a]	Accepted	
LnOIL→LnPGas	1.662801	Rejected	-0.019784[a]
LnEXR→LnPGas	11.05039[a]	Accepted	
LnOIL→LnHeng	19.56439[a]	Accepted	-
LnEXR→LnHeng	0.028264	Rejected	
LnOil→LnHib	24.80946[a]	Accepted	-0.029742[a]
LnEXR→LnHib	6.969059[a]	Accepted	
LnOIL→LnPetron	6.986405[a]	Accepted	-0.024533[a]
LnEXR→LnPetron	4.401340[a]	Accepted	

Notes: [a] and [b] denote 1% and 5% significance level respectively. → indicates there is a causality. θ denotes the coefficient of ECT.

In terms of ECT, for LnPChem, the coefficient shows a negative sign and is statistically significant, indicating 0.059 percent of disequilibrium in the next period. The correction of the disequilibrium and speed of adjustment towards long-run equilibrium for LnPGas is relatively slow at 0.01978 percent. The ECT result for LnHib is also negative and statistically significant, suggesting a correction of 0.02974 percent of the disequilibrium in the next period. As anticipated, the coefficient of ECT for LnPetron is also negative and statistically significant, suggesting a 0.0245 percent correction to the disequilibrium in the following periods.

5. Discussion and Conclusion

This study empirically investigated the impact of crude oil price fluctuation on the stock prices of oil producer companies listed in FTSE Bursa Malaysia, namely PETRONAS Chemical, PETRONAS Dagangan, PETRONAS Gas, Hengyuan Refining, Hibiscus Petroleum and Petron Malaysia. All these stocks have a market capitalisation of at least RM1 billion, with PETRONAS Chemical having the largest market capitalisation at RM75 billion (as of June 2022). The ARDL bounds test and Granger causality were employed to establish the relationship among variables with weekly data spanning from January 2011 until June 2022.

This study has made a significant contribution to the body of knowledge by examining the relationship between crude oil and the stock prices of public listed companies that primarily operate as oil producers. This is an additional contribution from the previous studies that explored the relationship between oil prices and the economy or stock indices. The results of this study have paved a new path by delving deeply into individual stocks, as opposed to general indices or at an aggregate level, given that all indices are non-tradable. Furthermore, this study is able to see the impact of oil price movements on the individual stocks of oil producer companies listed in FTSE Bursa Malaysia.

The results of this study show that there is a positive relationship between crude oil and PETRONAS Chemical, Hibiscus Petroleum, and Petron Malaysia. This empirical result was in line with the previous studies where the movement of oil prices has a positive impact on the stock market (Imarhiagbe, 2010; Narayan & Narayan, 2010; Zu *et al.,* 2011; Asaolu & Ilo, 2012; Ghosh & Kanjilal, 2016; Tursoy & Faisal, 2018; Darmawan *et al.,* 2020). Furthermore, the inclusion of weekly data and a larger sample size could potentially explain why the results of this study differ from those of Bani & Ramli (2018), who discovered a negative correlation between crude oil and KLCI and FBM Emas. Similarly, Ghosh and Kanjial (2016), who discovered a relationship with the Indian stock market only after 2012, primarily attributed their findings to structural changes and events in the oil markets. The current study recommends conducting additional research in the future, taking into account structural disruptions due to the numerous upheavals and events in the oil market.

Moreover, the results of this study may assist in investment decisions, especially for fund managers of each company or individual investors, by monitoring the price movement of crude oil. Since crude oil price is subject to price fluctuation, a fund manager can design a hedging strategy when there is uncertainty in the crude oil market by including Brent Crude Oil Futures in their trading portfolio to reduce the risk exposure. In addition, the exchange rate appeared to have a negative relationship with the stock prices of oil producer companies. Therefore, individual investors interested in investing in individual oil stocks can decide whether to invest or sell their shares based on the price movement of Brent Crude Oil Futures in a stable exchange rate environment.

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