EJEM
Econ.J.Emerg.Mark.

Economic Journal of Emerging Markets
Available at https://journal.uii.ac.id/jep

The impact of oil price shocks on macroeconomic indicators: Evidence from four ASEAN countries

Adawiya Taufani[1*], Dedi Budiman Hakim[2], Widyastutik[3]

[1]School of International IPB University, Bogor, Indonesia
[2]International Center for Applied Finance and Economics (InterCAFE) IPB University, Bogor, Indonesia
[3]Department of Economics, Faculty of Economics and Management, IPB University, Bogor, Indonesia
[*]Corresponding author: adawiyataufani@apps.ipb.ac.id

Article Info

Abstract

Purpose — This study examines the impact of oil price shocks on macroeconomic indicators, namely real GDP, real exchange rates, inflation, real interest rates, the balance of payments, and unemployment rates in four ASEAN countries, namely Brunei Darussalam, Malaysia, Indonesia, and Thailand.

Methods — This research uses a Vector Error Correction Model (VECM). The oil price variable in this study was divided into two, namely, the increase and decrease in oil prices based on the Mork transformation.

Findings — The analysis showed that the impact of price increases tended to encourage the economy of Brunei Darussalam and Malaysia. The shock of falling oil prices tended to cause a decline in the economy of Brunei Darussalam and Malaysia. The shock of rising prices tended to hamper the economies of Indonesia and Thailand. The shock of falling oil prices did not always positively impact the economy of the importing country, especially for the balance of payments.

Implication — These results show that price shocks will produce different economic responses. Understanding a country's macroeconomic framework is important before implementing effective policies.

Originality — These results expand the literature on the impact of oil price shocks on macroeconomic indicators in developing countries and small open economies, while studies related to macroeconomics generally focus on growth and inflation. This study also distinguishes oil price shocks into rising and falling oil price shocks using the Mork transformation.

Keywords: oil price shock, macroeconomics, VECM, ASEAN

Introduction

Oil plays a vital role in the modern economy of all countries (Huang, Hwang, & Peng, 2005), as fuel drives the economy. Demand and supply conditions affect the movement of oil prices. In addition, non-fundamental factors such as geopolitical conditions and weather disturbances also significantly affect fluctuations in oil prices (Feng, Xu, Failler, & Li, 2020). Oil price fluctuations affect a country's economy differently, depending on whether the country is an oil importer or exporter. Unexpected changes in oil prices significantly impact the volatility of macroeconomic and financial variables (Park & Ratti, 2008). Changes in oil prices can be an essential driver of macroeconomic uncertainty in the global economy.

ASEAN consists of oil-exporting and importing countries. For a net oil exporter country, oil is a foreign exchange earner. The oil and gas sectors are the backbone of the Brunei Darussalam economy. The energy commodity exports contributed 57.7% to Brunei's GDP, 96.35% to total exports, and 87% to government revenue in 2019 (DEPS, 2020). The surplus of export value over import value makes Malaysia a net oil exporter (Jalil, Ghani, & Duasa, 2009). Energy exports contributed 30.9% to government revenue, 28.39% of total exports, and 20% to Malaysia's GDP. When there is an increase in oil prices, oil exporters will experience an increase in foreign currency inflows, which will lead to an appreciation of the exchange rate, low inflation, and low-interest rates, which can stimulate output growth and lead to increasing demand for inputs, such as labor. In addition, significant oil exports with high prices and relatively stable long-term accumulation of foreign assets provide a safe balance of payments for exporters. However, a positive oil price shock is also expected to hamper trade growth between oil exporters and other oil importers.

The role of oil for importing countries is different from that of exporting countries. For importers, oil is not a foreign exchange earner but can reduce the country's foreign exchange. Thailand is a net oil importer, with 76.8% of its oil needs coming from imports in 2018 (IEA, 2021). Indonesia's oil needs could only be met by domestic production of 50.86%, and the rest was met through imports in 2018 (IEA, 2021).

For oil-importing countries, rising prices will be followed by increasing production input prices, pushing production costs to encourage companies to reduce output. From a macroeconomic perspective, an increase in production input prices caused by the rise in oil prices will lead to a decline in the production of various industries and economic sectors. Changes in aggregate will result in a decrease in output and encourage an increase in unemployment. The rise in oil prices also increases the demand for foreign currency, which can reduce foreign exchange and increase capital outflows, resulting in depreciation. The depreciating exchange rate makes imported products more expensive, increases domestic inflation and interest rates, and causes a trade balance deficit in a certain period. For households, this will reduce the purchasing power of the people. Consequently, the industry will be compelled to lower production volumes and rationalize employees.

For the ASEAN region, energy demand, especially oil, tends to increase yearly. It is in line with the development and industrialization process in ASEAN countries. The demand for oil that is not proportional to the energy supply can lead to vulnerabilities in energy security. British Petroleum (2020) states that in the last ten years (2008 to 2018), petroleum consumption growth in the ASEAN region has been the highest compared to other areas and the world. ASEAN's oil consumption growth is 4.4% per year.

In comparison, world oil consumption growth is 1.3% per year, and other regions such as North America is 0.2%, South and Central America is 0.6%, Europe decreases 0.9%, CIS is 1.5%, the Middle East is 2.6%, and Africa is 2.2%. Unlike consumption in the last ten years, oil production in the ASEAN region has decreased by 1.24% per year, and not all countries in the ASEAN region produce oil (British Petroleum, 2020). The growth of oil consumption that is not followed by production growth can lead to vulnerability to energy security, especially oil, an energy source that is the primary need for a country in driving its economy. Energy security occurs when a country can meet the availability of endless energy resources and the affordability of prices (IEA, 2021).

Oil prices that often experience shocks or are highly volatile are not common conditions because they can disrupt the balance of a country's economy and create vulnerabilities in the energy sector. Therefore, analyzing the economy or macroeconomics of a nation can be used as an initial signal of whether the country is sensitive to oil price shocks caused by its significant dependence on oil, which can prevent and reduce the adverse effects of oil price shocks.

Several studies have examined the effect of oil price shocks on a country's economy. Ahmed, Bhutto, and Kalhoro (2019) found that oil price shocks significantly impacted several macroeconomic indicators of the five SAARC countries in the short and long term. Kitous et al. (2016) found that the decline in oil prices has a significant and negative effect on the GDP and revenues of oil-exporting governments; this is in line with Yildirim and Arifli (2021). However, Charfeddine and Barkat (2020) found different things where the decline in oil prices has no

significant effect on real GDP. Lorusso and Pieroni (2018) found that oil price shocks have a significant effect that causes a direct decline in GDP growth, an increase in inflation, the nominal interest rate, and the unemployment rate in the importing country. On the other hand, the finding of Gershon, Ezenwa, and Osabohien (2019) was different, where the increase in oil prices causes GDP per capita to increase in oil-importing countries.

The difference between this study and previous research is the region of the ASEAN region consists of developing countries and small open economies. Most studies concerned with the oil price shocks on the economy were carried out in developed countries and countries that export and import oil in large quantities. Research related to oil price shocks in ASEAN mainly examines its effect on the stock market. There are still not many studies on oil prices with the ASEAN macroeconomics. Studies related to macroeconomics generally only focus on growth and inflation, for example, research by Kriskkumar and Naseem (2019) and Razmi, Azali, Chin, and Shah Habibullah (2016). Therefore, this study expands the empirical literature by adding macroeconomic variables such as real GDP, real exchange rates, inflation, real interest rates, the balance of payments, and unemployment rates. The selection of these variables is made to proxy the economy's performance because oil price is one of the external factors that can affect a country's economy. Leading macroeconomic indicators are used to measure this based on data availability. Real GDP describes a measure of a country's economic growth that is better than nominal GDP because real GDP is not affected by price changes, the production of goods and services is measured at fixed prices; the real exchange rate is used to proxy economic competitiveness, inflation measures the rate of price changes over time, and the availability of money, actual interest rates to proxy purchasing power, the balance of payments describes a country's economic transactions related to the ability to absorb foreign exchange and foreign debt payments and the unemployment rate represents productivity to produce output. This study also distinguishes oil price shocks into rising and falling oil price shocks using the Mork transformation (1989) to provide better explanations. Based on the description above, this study aimed to determine the impact of oil price shocks on ASEAN macroeconomic variables.

Methods

This study uses quarterly data from 1995 to 2020 consisting of real GDP, real exchange rates, inflation, real interest rates, the balance of payments, and the unemployment rate in four ASEAN countries, namely Brunei Darussalam, Malaysia, Indonesia, and Thailand. The crude oil price data used was Brent Crude Oil. In the period 1995 to 2020, because during that period there were several financial and economic crises such as in 1997, 2001, 2008, Covid-19, 2020, political and economic instability in several oil-exporting and importing countries, then shocks to the sharp rise and fall of oil prices such as in 1999, 2006, 2008, 2011, 2016, and 2020.

VAR Stability Test

The VAR estimation is stable if all the roots have a modulus smaller than one and are located within the unit circle (Enders, 2004).

Vector Error Correction Model (VECM)

VECM is a restricted VAR used for non-stationary variables but has the potential to be cointegrated (Enders, 2004). This study used VECM because the variables were non-stationary at the level and cointegrated, implying a long-term relationship. An error correction mechanism was included in the model to capture the variations associated with adjustment for the long-term relationship. The selection of VECM helps distinguish between short-term and long-term dynamics and consists of a correction aspect called the error correction term (ECT). According to Lee, Ni, and Ratti (1995), Mork (1989) and Hamilton and Lin (1996), there is a nonlinear relationship between oil prices and macroeconomics. The nonlinear specification categorizes oil price shocks into positive ones for rising oil prices and negative ones for falling oil prices using the Mork transformation. This is done

to ensure better results and explanations. According to Mork, the variables that determine changes in oil prices can be stated as follows:

op_t^+ = max $(0, (opt - opt\text{-}1))$ or $\Delta opt > 0$, for rising oil prices (lnop_positive)

op_t^- = min $(0, (opt - opt\text{-}1))$ or $\Delta opt < 0$, for falling oil price (lnop_negative)

The VECM model specifications can be estimated for positive and negative shocks or rising and falling oil prices as follows:

$$\Delta \ln rGDP_t = a_0 + \sum_{y=1}^{p} a_{1y}\Delta lnop^+{}_{t-1} + \sum_{y=1}^{p} a_{2y}\Delta lnop^-{}_{t-1} +$$
$$\sum_{y=1}^{p} a_{3y}\Delta \ln rGDP_{t-1} + \sum_{y=1}^{p} a_{4y}\Delta lnrer_{t-1} + \sum_{y=1}^{p} a_{5y}\Delta inf_{t-1} +$$
$$\sum_{y=1}^{p} a_{6y}\Delta rint_{it-1} + \sum_{y=1}^{p} a_{7y}\Delta lnbop_{it-1} + \sum_{y=1}^{p} a_{8y}\Delta un_{it-1} -$$
$$\lambda_1(\ln rGDP_{t-1} + a_{12}lnop^+{}_{t-1} + a_{22}lnop^-{}_{t-1} + a_{42}lnrer_{t-1} + a_{52}inf_{t-1} +$$
$$a_{62}rint_{t-1} + a_{72}lnbop_{t-1} + a_{82}un_{t-1}) + e_{1t} \quad\quad (3)$$

$$\Delta lnrer_t = b_0 + \sum_{y=1}^{p} b_{1y}\Delta lnop^+{}_{t-1} + \sum_{y=1}^{p} b_{2y}\Delta lnop^-{}_{t-1} + \sum_{y=1}^{p} b_{3y}\Delta \ln rGDP_{t-1} +$$
$$\sum_{y=1}^{p} b_{4y}\Delta lnrer_{t-1} + \sum_{y=1}^{p} b_{5y}\Delta inf_{t-1} + \sum_{y=1}^{p} b_{6k}\Delta rint_{t-1} +$$
$$\sum_{y=1}^{p} b_{7k}\Delta lnbop_{t-1} + \sum_{y=1}^{p} b_{8y}\Delta un_{t-1} - \lambda_2(lnrer_{t-1} + b_{12}lnop^+{}_{t-1} +$$
$$b_{22}lnop^-{}_{t-1} + b_{32}\ln rGDP_{t-1} + b_{52}inf_{t-1} + b_{62}rint_{t-1} + b_{72}lnbop_{t-1} +$$
$$b_{82}un_{t-1}) + e_{2t} \quad\quad (4)$$

$$\Delta inf_t = c_0 + \sum_{y=1}^{p} c_{1y}\Delta lnop^+{}_{t-1} + \sum_{y=1}^{p} c_{2y}\Delta lnop^-{}_{t-1} + \sum_{y=1}^{p} c_{3y}\Delta \ln rGDP_{t-1} +$$
$$\sum_{y=1}^{p} c_{4y}\Delta lnrer_{t-1} + \sum_{y=1}^{p} c_{5y}\Delta inf_{t-1} + \sum_{y=1}^{p} c_{6y}\Delta rint_{t-1} +$$
$$\sum_{y=1}^{p} c_{7y}\Delta lnbop_{t-1} + \sum_{y=1}^{p} c_{8y}\Delta un_{t-1} - \lambda_3(inf_{t-1} +$$
$$c_{12}\Delta lnop^+{}_{t-1} + c_{22}lnop^-{}_{t-1} + c_{32}\ln rGDP_{t-1} + c_{42}lnrer_{t-1} + c_{62}rint_{t-1} +$$
$$c_{72}lnbop_{t-1} + c_{82}un_{t-1}) + e_{3t} \quad\quad (5)$$

$$\Delta rint_t = d_0 + \sum_{y=1}^{p} d_{1y}\Delta lnop^+{}_{t-1} + \sum_{y=1}^{p} d_{2y}\Delta lnop^-{}_{t-1} + \sum_{y=1}^{p} d_{3y}\Delta \ln rGDP_{t-1} +$$
$$\sum_{y=1}^{p} d_{4y}\Delta lnrer_{t-1} + \sum_{y=1}^{p} d_{5y}\Delta inf_{t-1} + \sum_{k=1}^{p} d_{6y}\Delta rint_{t-1} +$$
$$\sum_{k=1}^{p} d_{7y}\Delta lnbop_{t-1} + \sum_{k=1}^{p} d_{8y}\Delta un_{t-1} - \lambda_4(rint_{t-1} +$$
$$d_{12}lnop^+{}_{t-1} + d_{22}lnop^-{}_{t-1} + d_{32}\ln rGDP_{t-1} + d_{42}lnrer_{t-1} + d_{52}inf_{t-1} +$$
$$d_{72}lnbop_{t-1} + d_{82}un_{t-1}) + e_{4t} \quad\quad (6)$$

$$\Delta lnbop_t = f_0 + \sum_{y=1}^{p} f_{1y}\Delta lnop^+{}_{t-1} + \sum_{y=1}^{p} f_{2y}\Delta lnop^-{}_{t-1} + \sum_{y=1}^{p} f_{3y}\Delta \ln rGDP_{t-1} +$$
$$\sum_{y=1}^{p} f_{4y}\Delta lnrer_{t-1} + \sum_{y=1}^{p} f_{5y}\Delta inf_{t-1} + \sum_{y=1}^{p} f_{6y}\Delta rint_{t-1} +$$
$$\sum_{y=1}^{p} f_{7y}\Delta lnbop_{t-1} + \sum_{y=1}^{p} f_{8y}\Delta un_{t-1} - \lambda_5(lnbop_{t-1} +$$
$$f_{12}lnop^+{}_{t-1} + f_{22}lnop^-{}_{t-1} + f_{32}\ln rGDP_{t-1} + f_{42}lnrer_{t-1} + f_{52}inf_{t-1} +$$
$$f_{62}rint_{t-1} + f_{82}un_{t-1}) + e_{5t} \quad\quad (7)$$

$$\Delta un_t = g_0 + \sum_{y=1}^{p} g_{1y}\Delta lnop^+{}_{t-1} + \sum_{y=1}^{p} g_{2y}\Delta lnop^-{}_{t-1} + \sum_{y=1}^{p} g_{3y}\Delta \ln rGDP_{t-1} +$$
$$\sum_{y=1}^{p} g_{4y}\Delta lnrer_{t-1} + \sum_{y=1}^{p} g_{5y}\Delta inf_{t-1} + \sum_{y=1}^{p} g_{6y}\Delta rint_{t-1} +$$
$$\sum_{y=1}^{p} g_{7y}\Delta lnbop_{t-1} + \sum_{y=1}^{p} g_{8y}\Delta un_{t-1} - \lambda_6(un_{t-1} +$$
$$g_{12}lnop^+{}_{t-1} + g_{22}lnop^-{}_{t-1} g_{32}\ln rGDP_{t-1} + g_{42}lnrer_{t-1} + g_{52}inf_{t-1} +$$
$$g_{62}rint_{t-1} + \sum_{y=1}^{p} g_{72}lnbop_{t-1}) + e_{6t} \quad\quad (8)$$

Note that op_t^+ is the transformation of the morphology of the increase in oil prices in year t, op_t^- is the transformation of the morphology of the decline in oil prices in year t, $\ln rGDP_t$ is the real GDP of the country studied in year t, $lnrer_t$ is the real exchange rate of the country studied in year t, inf_t is the rate inflation of the country studied in year t, $lnbop_t$ is the country's balance of payments studied in year t, $rint_t$ is the real interest rate of the country studied in year t, and un_t is the unemployment rate of the country studied in year t, $\lambda_1 \ldots \lambda_6$ are the short-run coefficients, $e_{1t} \ldots e_{6t}$ represents white noise.

Results and Discussion

VAR Stability Test

The results of the VAR stability test show that the VAR system was stable because all its roots had a modulus that was smaller than one (please refer to the results in Table 1)

Table 1. VAR stability test results

Country	Modulus
Brunei Darussalam	0.095122 – 0.745615
Malaysia	0.180380 – 0.745902
Indonesia	0.051953 – 0.920989
Thailand	0.496165 – 0.866404

Vector Error Correction Model (VECM)

Based on Table 2, the long-term relationship of an increase in oil prices by one percent would cause an appreciation of the BND real exchange rate by 2.727 percent and real ringgit exchange rate 2.629 percent, a decrease in Brunei's inflation by 0.557 percent, and Malaysia's inflation by 1.858 percent, a decrease real interest rate by 4.105 percent and 4.156 percent, and a decrease in Brunei's unemployment rate by 2.881 percent and Malaysia's unemployment rate by 5.609 percent. Meanwhile, the long-term relationship between the increase in oil prices and Brunei's and Malaysia's real GDP was positive and significant, when there is an increase in oil prices by one percent, it will increase Brunei Darussalam's and Malaysia's real GDP by 12.718 percent and 0.775 percent. This is in line with Alekhina and Yoshino (2018), Charfeddine and Barkat (2020), Etornam (2015), and Mendoza and Vera (2010). The long-term relationship of the increase in oil price by one percent would decline Brunei's balance of payments by 1.352 and increase Malaysia's balance of payments by 2.223 percent. These results are in line with Faheem, Azali, Chin, and Mazlan (2020), and Shangle and Solaymani (2020).

Table 2. VECM estimation results of the long-term relationship between rising and falling oil price and Brunei Darussalam's, Malaysia's, Indonesia's, and Thailand's macroeconomics

lnop_positif	BRN	MYS	IDN	THA	lnop_negatif	BRN	MYS	IDN	THA
lnrgdp	12.718*	0.775*	-0.136*	-0.620*	lnrgdp	14.207*	0.831*	-0.444*	-0.627*
	[3.291]	[5.392]	[-6.036]	[-5.121]		[4.804]	[7.179]	[-2.797]	[-4.009]
lnrer	-2.727*	-2.629*	0.379*	1.623*	lnrer	-3.171*	-2.816*	0.125*	-1.642*
	[-3.163]	[-5.369]	[6.122]	[5.005]		[4.967]	[-7.156]	[2.818]	[4.052]
inf	-0.557*	-1.858*	1.979*	2.574*	inf	-1.935*	-1.991*	3.551*	1.603
	[-2.119]	[-5.504]	[5.804]	[5.229]		[-5.282]	[-5.504]	[2.756]	[1.979]
rint	-4.105*	-4.156*	7.154*	5.534*	rint	-1.427*	4.452*	2.368*	2.599
	[-2.319]	[-5.437]	[5.894]	[4.982]		[-5.067]	[7.157]	[2.750]	[1.928]
lnbop	-1.352*	2.223*	1.151*	2.306*	lnbop	1.707*	2.382*	3.808*	2.333*
	[-2.881]	[5.680]	[6.385]	[4.114]		[5.074]	[7.337]	[2.759]	[3.113]
un	-2.881*	-5.609*	2.629*	2.248*	un	-3.351*	-6.009*	0.870*	4.298*
	[-3.272]	[-5.367]	[6.229]	[5.117]		[-4.773]	[-7.164]	[2.739]	[4.035]

Note: entries with * sign show significance at the 5% significance level.

The long-term relationship between the decline in oil prices and Brunei's and Malaysia's real GDP was positive and significant. It means that when there is a decrease in oil prices by one percent, it will cause a decrease in Brunei's real GDP by 14.207 percent and Malaysia's real GDP by 0.831 percent. On the other hand, the decline in oil prices in the long term caused the depreciation of Brunei's real exchange rate by 3.171 percent and ringgit real exchange rate by 2.816 percent, rising inflation by 1.935 and 1.991 percent, Brunei's real interest rate by 1.427 percent, Brunei Darussalam's and Malaysia's unemployment rate by 3.351 and 6.009 percent and falling the balance of payments by 1.707 and 2.382 percent. This result is in line with Bala and Chin (2018) and Yildirim and Arifli (2021). Meanwhile, the relationship between the decline in oil prices with

Malaysia's real interest rates was positive, this means that when there is a decline in oil prices, the real interest rates will decrease. These results align with Shangle and Solaymani (2020).

The long-term relationship of oil price increases based on Table 2 shows that a one percent increase in oil prices causes Indonesia's and Thailand's real GDP to decrease by 0.316 percent and 0.620 percent. Meanwhile, an increase in oil prices by one percent will have an impact on the depreciation of the rupiah real exchange rate by 0.379 percent and Thai baht by 1.623 percent, an increase in inflation by 1.979 and 2.574 percent, interest rates by 7.514 and 5.534 percent, Indonesia's and Thailand's the balance of payments by 1.151 and 2.306 percent, and the unemployment rate by 2.629 and 2.248 percent. This result is in line with the findings of Al Rasasi and Yilmaz (2016), Etornam (2015), and Jiménez-Rodríguez and Sánchez (2005), who found that rising oil prices harmed economic activity in oil-importing countries studied. These results also align with other studies which found that rising oil prices caused depreciation in the top 6 African oil-importing countries (Saidu, Naseem, Law, & Yasmin, 2021), rising inflation in South Asian countries (Zakaria, Khiam, & Mahmood, 2021), and a negative contribution to the evolution of employment or an increase of unemployment rate in Spain as an oil-importing country (Ordóñez, Monfort, & Cuestas, 2019).

However, these findings are different from Jibril, Chaudhuri, and Mohaddes (2020) and Balli, Nazif Çatık, and Nugent (2021) who found that the increase in prices negatively impacts the trade balance of importers, but the findings are in line with Varlik and Berument (2020). This may be because Indonesia not only imports but also exports oil, where the increase in world oil prices will also be followed by an increase in the Indonesia Crude Price (ICP). In addition, the increase in oil prices was also related to the increase in the prices of other commodities such as coal and palm oil, which in turn would improve Indonesia's export competitiveness so that it could lead to an improvement in the trade balance and balance of payments. The increase in oil prices did not permanently affect the current account deficit because adjustments were needed to accommodate higher oil bills.

Table 2 shows that a long-term decline in the price of oil would lead to an appreciation of the real Thai baht exchange rate and real rupiah exchange rate, a decrease Indonesia's inflation and real interest rates by 3.551 percent and 2.368 percent, Indonesia's and Thailand's balance of payments, and Indonesia's and Thailand's unemployment rate. Meanwhile, in the long term, a one percent decline in oil prices will increase Indonesia's real GDP by 0.444 percent and Thailand's real GDP by 0.627 percent. This result is in line with Al Rasasi and Yilmaz (2016). The decline in oil prices did not necessarily make Indonesia's and Thailand's balance of payments increase. This might be caused by the appreciation that occurred due to the decline in oil prices or the reverse J-curve phenomenon.

The shock of rising oil prices by one standard deviation resulted in Brunei's real GDP increasing from the 1st to the 10th quarter. When oil prices experience a positive shock, it positively impacts government revenues, encourages an increase in government spending and investment, thereby stimulating an increase in exporter GDP. The response of the real exchange rate of the Brunei Darussalam dollar was negative or appreciated from the 1st to the 10th quarter. An increase in prices will cause the amount of foreign currency or the accumulation of foreign exchange entering the country to increase. It will lead to exchange rate stability which can make the exchange rate appreciated.

The shock of rising oil price decreased the inflation from 4th to the 10th quarter but not permanent, the real interest rates decreased until the 6th quarter and then moved up again. The increase in oil prices leads to the appreciation of the exchange rate of oil-exporting countries, encouraging relatively low domestic inflation which will lead to relatively low-interest rates (Alekhina & Yoshino, 2018). The response of the balance of payments in the early quarter increased then tended to respond downwards until the 10th quarter, but the response was still positive. This may be due to Brunei's undiversified export basket. When there is an increase in oil prices, the exchange rate of oil exporters appreciated and impacted the current account surplus for several periods after the appreciation of the domestic currency. Then, after several adjustments, the appreciation decreased the current account balance, which also reduced Brunei's balance of payments. The shock of rising

oil prices can disrupt the balance of payments, especially in countries that rely heavily on inflows from oil exports and do not have a diversified export basket (Ugwuanyi, 2011).
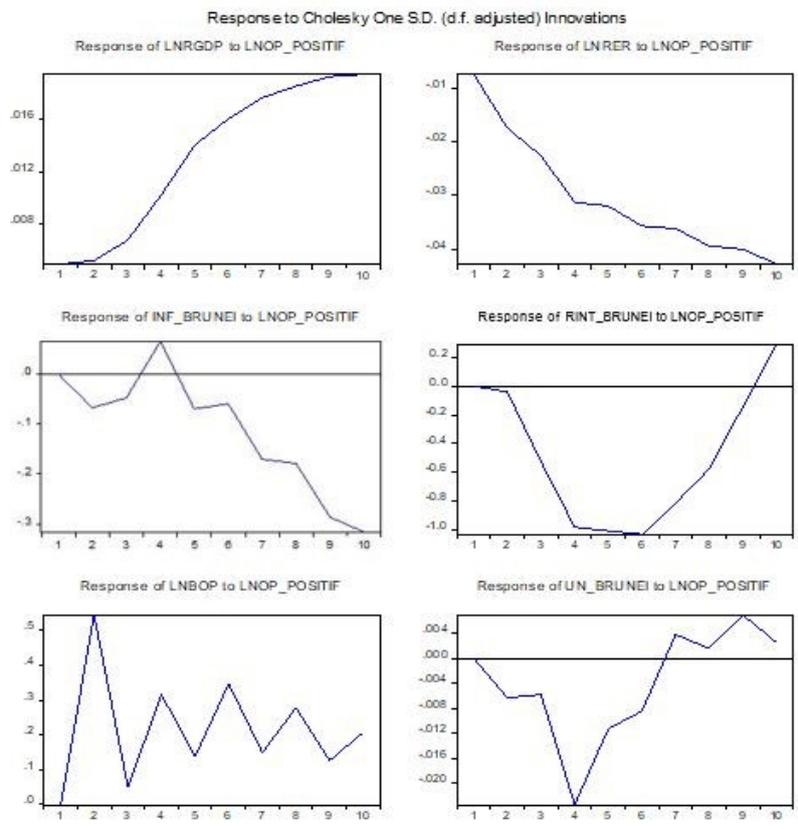
(a)
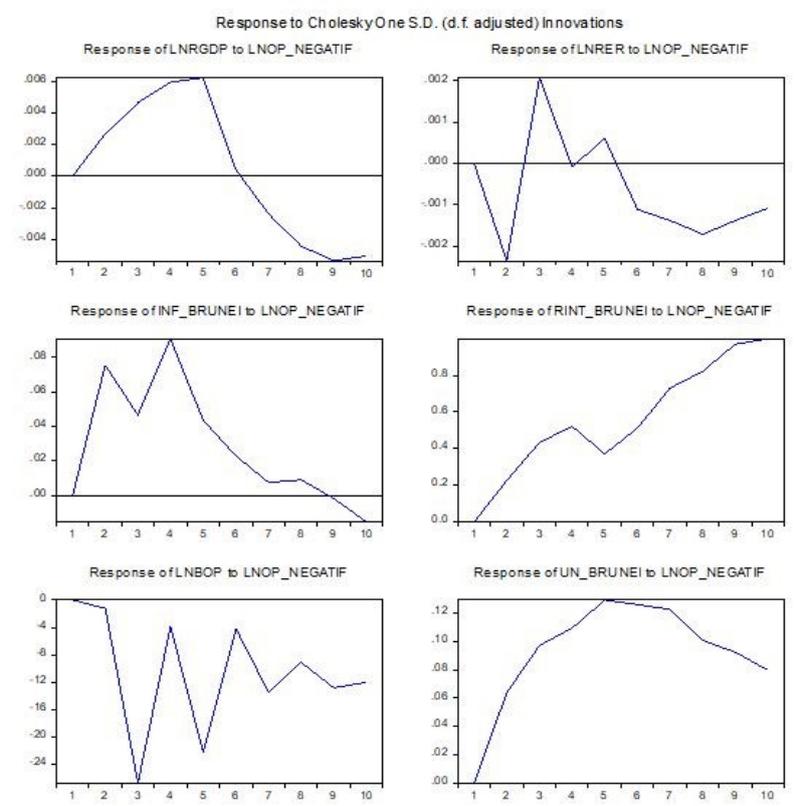
(b)

Figure 1. Brunei Darussalam IRF Results: (a) rising shock (b) falling shock
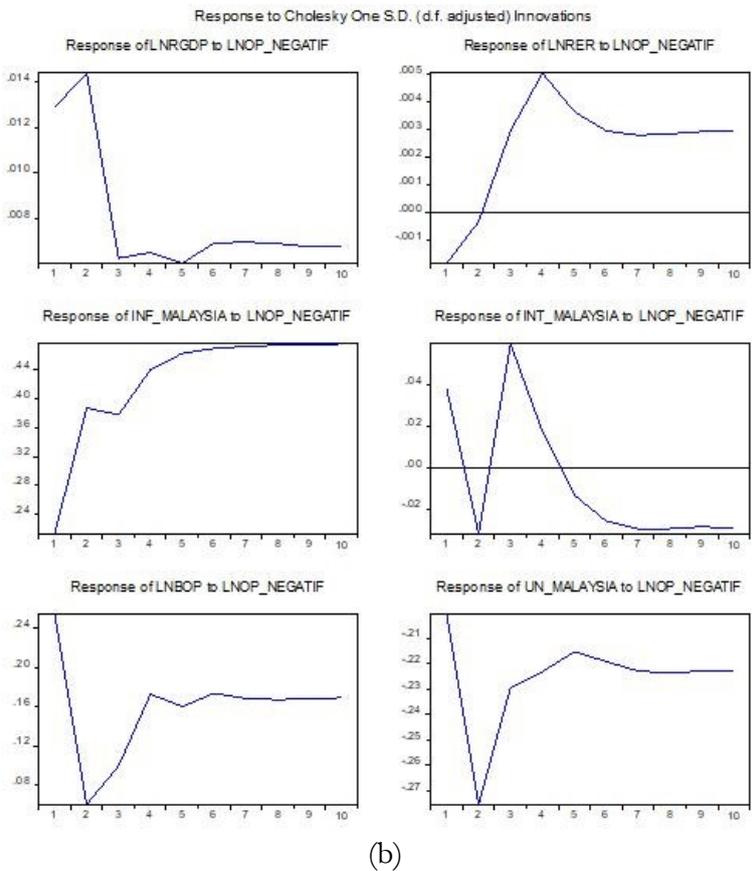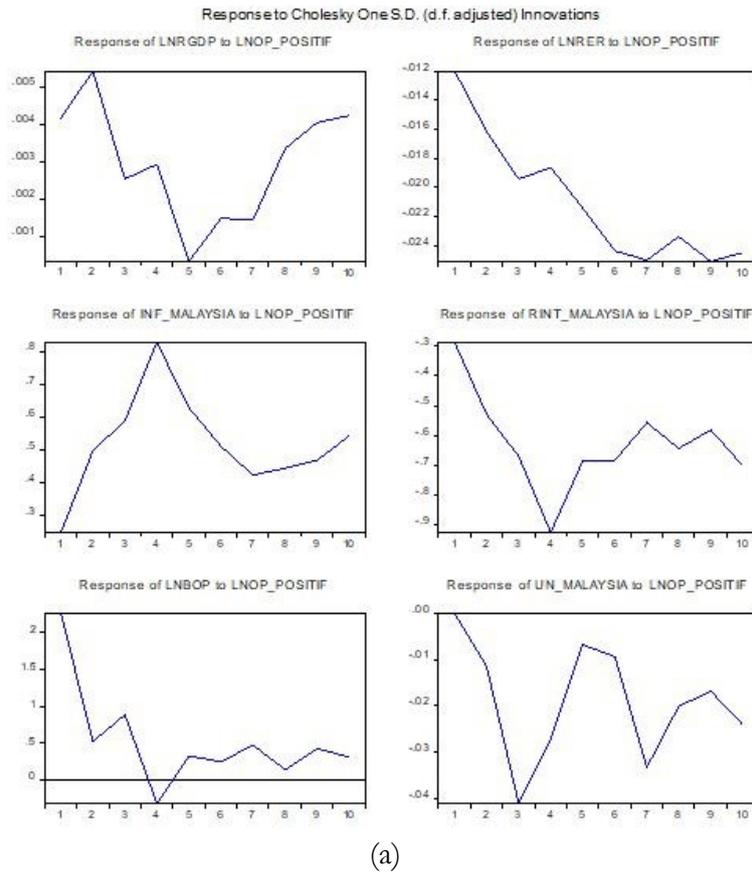
(a)

(b)

Figure 2. Malaysia IRF Results: (a) rising shock (b) falling shock

The response of Brunei's unemployment rate decreased until the 4th quarter then moved up again in the 5th quarter due to the shock of rising prices. This result is in line with the findings

of Cuestas and Gil-Alana (2018). However, Brunei's unemployment rate, which rises again after some time, was due to the mindset of young Bruneians who want jobs in the government because they are considered secure, not risky, have job security, and have attractive benefits compared to the private sector (Musa & Rozaidah, 2020), but employment opportunities in the government are limited.

The shock of falling oil prices by one standard deviation at the beginning of the quarter resulted in Brunei's real GDP increasing until the 6th quarter and then continued to decline, the real exchange rate depreciated until the 3rd quarter, then tended to appreciate again, inflation increased, and began to decline in the 6th quarter, interest rates increased, the balance of payments was negative, and the unemployment rate continued to rise until 5th quarter. The balance of payments tended to respond negatively is in line with Sakanko and David (2019).

The impact of the shock of rising and falling oil prices on Malaysia's macroeconomic indicators can be seen in Figure 2. The shock of rising oil prices was responded to positively by Malaysia's real GDP. However, Malaysia's real GDP response tended to decline until the 5th quarter, and then it rose again in the 6th to 10th quarters. The response of the Malaysian Ringgit real exchange rate to the shock of rising oil prices was negative or appreciated until the 10th quarter. Malaysia's inflation response to the shock of rising oil prices was positive and continued to increase until the 5th quarter, but after the 5th quarter, this response began to decline. This result aligns with Majuca's (2020) findings, which show that the increase in oil price positively impacts Malaysian inflation because the increase in oil prices will slowly be incorporated into the prices of other goods and services until a new equilibrium is reached. The trend of rising inflation in the first few quarters and then declining in the following quarters indicates that high oil prices was the driving force for companies to upgrade to modern manufacturing technologies that were not energy-intensive and consumers cut their consumption of energy-intensive products. This can help prevent economic indicators from being adversely affected by oil price shocks.

Malaysia's real interest rates respond negatively to the shock of rising oil prices, which was not in line with the response to inflation. This result is in line with Shangle and Solaymani's (2020) research, which found that, based on the CGE model, when the government's target is to minimize the inflation rate, the effective policy is to reduce interest rates as a response to rising oil prices, meanwhile when the government's target is to achieve the level of employment and investment, the effective policy is to reduce the reserve ratio. Oil price shocks began to be responded positively by the balance of payments in the 1st to 3rd quarters. In the 4th quarter, the balance of payments responded negatively to the shock of rising oil prices, namely -0.313721. The response was positive again in the 5th quarter to the 10th quarter. The effect of the shock of one standard deviation of the oil price on Malaysia's unemployment rate began to be responded negatively in the second quarter or tended to decline until the 10th quarter, namely 0.024053.

Malaysia's real GDP response to the shock of falling oil prices was positive but tended to move downwards until the 10th quarter. The shock of falling oil prices tended to make the real ringgit exchange rate depreciate. The shock of falling oil prices was responded to positively by inflation and continued to increase until the 10th quarter. The response of the real interest rates to the shock of the decline in oil prices tended to be negative, except in the 1st, 3rd, and 4th quarters were positive. The shock of falling oil prices was responded positively by Malaysia's balance of payments but declined until the 2nd quarter, then rose again in the 3rd quarter and was relatively stable until the 10th quarter.

Figure 3(a) shows Indonesia's and Thailand's macroeconomic response to the shock of rising oil prices. The shock of rising oil prices tends to be responded negatively and decline by the real GDP of Indonesia from the 3rd to the 10th quarter and Thailand's real GDP from the first to the 10th quarter. For oil-importing countries, an increase in oil prices would be followed by an increase in production input prices, leading to a decline in the production of various industry and economic sectors. This aggregate change would result in a decrease in output, which could encourage a decrease in government spending and investment, leading to a decrease in real GDP. In addition, rising oil prices adversely affect investment due to the increase in company costs (Jiménez-Rodríguez & Sánchez, 2005).

Response to Cholesky One S.D. (d.f. adjusted) Innovations

Response of LNRGDP to LNOP_POSITIF

Response of LNRER to LNOP_POSITIF

Response of INF_INDONESIA to LNOP_POSITIF

Response of RINT_INDONESIA to LNOP_POSITIF

Response of LNBOP to LNOP_POSITIF

Response of UN_INDONESIA to LNOP_POSITIF

Response to Cholesky One S.D. (d.f. adjusted) Innovations

Response of LNRGDP to LNOP_POSITIF

Response of LNRER to LNOP_POSITIF

Response of INF_THAILAND to LNOP_POSITIF

Response of INT_THAILAND to LNOP_POSITIF

Response of BOP_THAILAND to LNOP_POSITIF

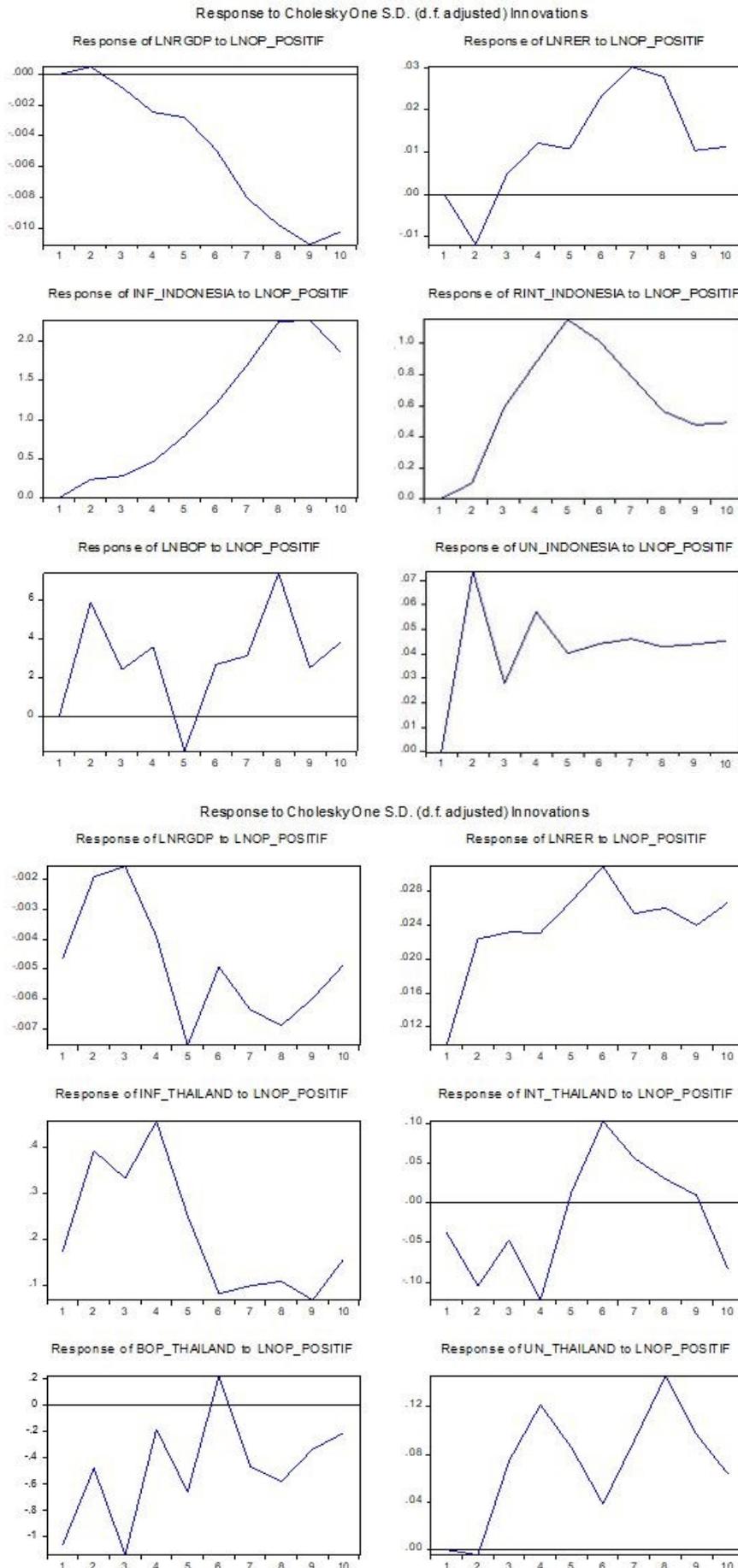Response of UN_THAILAND to LNOP_POSITIF

Figure 3a. Indonesia and Thailand IRF Results: rising shock
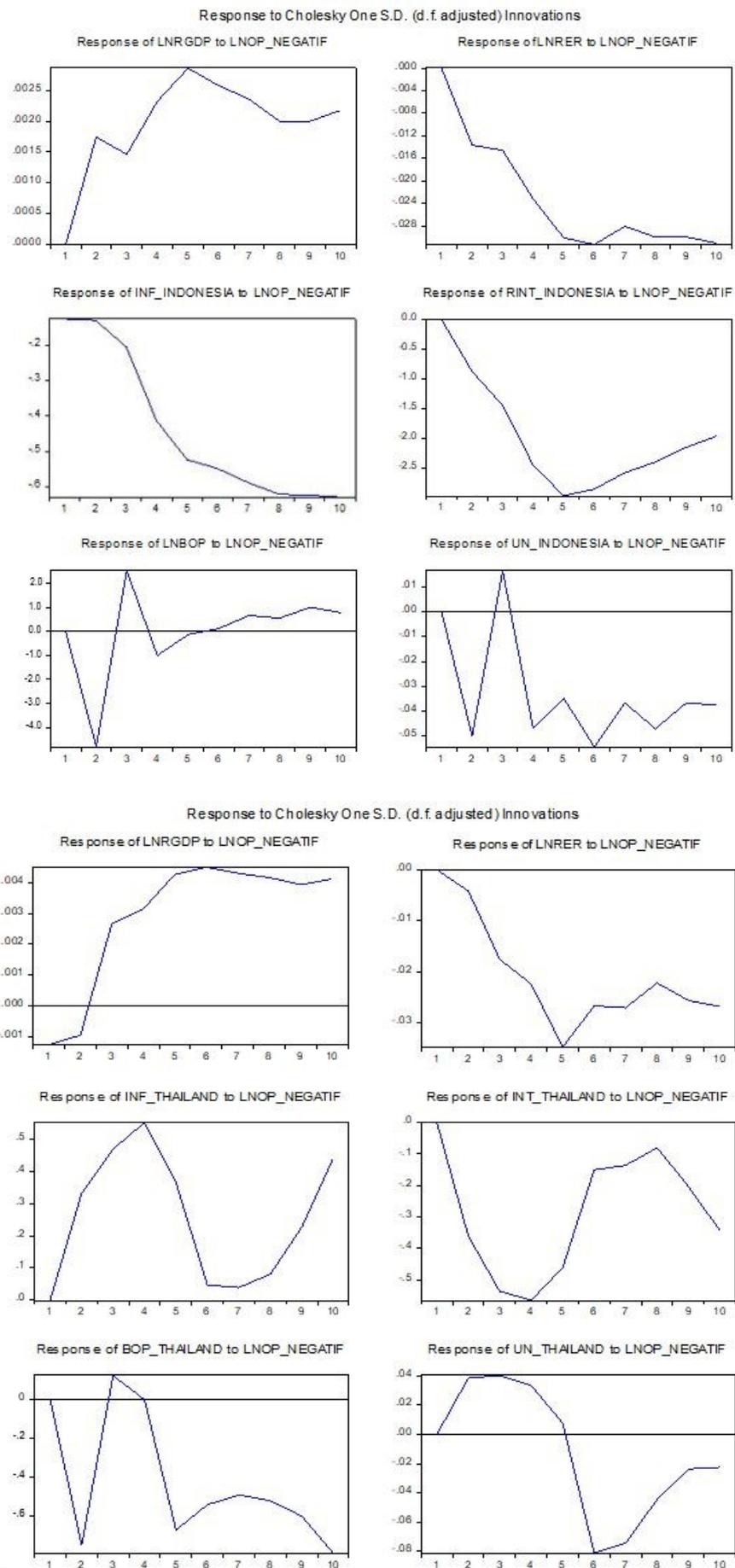
Figure 3b. Indonesia and Thailand IRF Results: falling shock

The response of the real exchange rate of the Indonesian rupiah and Thai baht to the shock of rising oil prices tended to be positive and continue to move up or depreciate. This increase in oil prices would impact the increasing demand for foreign currency, leading to a weakening or depreciation of the domestic exchange rate against the USD. The shock of rising oil prices was responded positively by Indonesia's and Thailand's inflation and continued to increase until the 9th quarter for Indonesia and tended to move up from the 1st to the 4th quarter for Thailand, then declined. The increase in oil prices causes input prices to rise, resulting in production costs and consumer prices rising.

The real interest rate response to the shock of rising oil prices was positive and continued to move up until the 5th quarter for Indonesia. The response of Thailand's real interest rates is not in line with the inflation response due to the shock of rising oil prices. For Thailand, when inflation declined, lowering interest rates was ineffective due to high household debt problems and the risk of financial instability associated with a possible increase in US interest rates. Therefore, the Bank of Thailand carried out the handling related to the decrease or increase in inflation by loosening or tightening capital controls and foreign exchange market intervention (Kumaga, 2018).

The response of Indonesia's balance of payments to the shock of rising oil prices tended to be positive and fluctuated, except in the 5th quarter, which responded to -1.793631 and increased again in the 8th quarter, namely 7.343895. The response of Thailand's balance of payments to the shock of rising oil prices was negative but tended to move up until the 6th quarter. The findings on the balance of payments align with Varlik and Berument (2020). The increase in oil prices did not permanently affect the current account deficit because adjustments were made. The increase in Thailand's balance of payments may have resulted from balancing the current account balance by an increase in exports due to depreciation or a decrease in exports in sectors that used much energy in their production. The shock of rising oil prices will increase Indonesia's and Thailand's unemployment rates.

Table 3. Variance decomposition in Brunei Darussalam, Malaysia, Indonesia, and Thailand

| Shock source | | | lnop_positive | | | | | lnop_negative | | | | |
Variance response	lnrgdp	lnrer	inf	rint	lnbop	un	lnrgdp	lnrer	inf	rint	lnbop	un
Brunei Darussalam												
Q2	27.87	38.17	3.06	0.07	20.55	23.82	1.46	7.26	1.38	3.06	3.61	2.02
Q4	37.58	33.43	16.79	0.54	10.57	25.92	1.67	4.72	0.82	3.16	3.12	1.22
Q6	50.28	24.29	25.72	0.44	6.99	21.82	2.33	4.27	0.67	3.67	2.7	2.06
Q8	51.34	17.31	30.5	0.27	4.54	14.71	1.87	4.53	0.57	3.21	2.44	2.49
Q10	46.35	12.62	32.64	0.14	2.96	9.14	2.14	4.75	3.06	2.69	2.23	2,35
Malaysia												
Q2	5.4	10.88	18.96	22.23	15.88	0.76	40.17	0.22	11.09	0.15	1.53	50.4
Q4	3.9	10.86	30.75	35.64	13.26	1.82	31.09	1.21	9.88	0.19	1.27	54
Q6	3.1	12.35	35.3	41.79	11.12	1.49	28.36	1.22	10.06	0.1	1.27	55.3
Q8	3.07	13.49	35.77	43.3	9.66	1.77	27.17	1.29	10.01	0.08	1.27	56.4
Q10	3.66	14.27	36.6	44.44	8.66	1.83	26/22	1.19	10.11	0.07	1.28	57
Indonesia												
Q2	10.16	10.48	10.18	10.12	1.86	18.01	7.84	3.98	1.94	3.52	3.68	1.43
Q4	10.97	12.73	10.7	10.53	2.55	18.19	6.73	3.79	4.9	5.98	2.95	1.06
Q6	12.81	15.95	11.89	11.47	3.33	26.85	6.4	6.14	6.38	7.2	2.57	1.01
Q8	17.04	18.43	14.24	13.28	3.93	37.35	5.95	7.15	8.99	8.6	2.25	1.16
Q10	19.29	17.5	15.27	15.92	5.88	38.37	5.72	7.73	10.58	11.7	1.99	1.09
Thailand												
Q2	5.32	10.61	7.41	7.91	6.37	2.52	1.21	0.58	2.44	2.17	7.28	1.09
Q4	3.82	14.02	7.6	9.02	9.63	8.58	1.3	3.84	2.79	3.22	6.38	1.95
Q6	6.38	18.05	8.63	9.88	9.65	8.6	1.05	8.99	3.58	4.19	9.68	1.73
Q8	7.35	18.92	10.58	10.73	9.53	11.61	1.07	9.69	3.59	4.73	11.07	1.62
Q10	7.56	19.12	14.82	11.83	9.04	11.89	1.14	10.4	4.27	6.48	14.58	1.29

The shock of falling oil prices was responded to positively by the real GDP of Indonesia and Thailand for several quarters and the response of real GDP begins to move downward differently but remains positive. The decline in oil prices would make production costs cheaper. It could stimulate an increase in production, make the prices of export products that used imported inputs more competitive and efficient, and increase the growth rate, ultimately impacting real GDP. The falling oil prices caused an appreciation of the Rupiah and Thai baht real exchange rate, decrease in inflation, and real interest rate. Indonesia's balance of payments response to the shock of falling oil prices was initially negative. However, in the third quarter, the balance of payments response moved up and was positive. The response of Thailand's balance of payments to the shock of the decline in oil prices tended to be negative. This shows that the shock of falling oil prices does not always positively impact the balance of payments of oil importers because a decline in oil prices can cause prices to decline in certain export commodities. The shock of falling oil prices tended to impact reducing unemployment rates in Indonesia and Thailand.

From Table 3, the results of the variance decomposition of the shocks of rising oil prices, in general, contributed more to explaining changes in the variance of macroeconomic indicators of ASEAN countries or macroeconomic indicators that ASEAN countries were more vulnerable to shocks to rising oil prices than shocks to falling prices. The shock of falling oil prices only contributed more than the shock of rising oil prices in explaining some changes in the variance of macroeconomic variables, namely Brunei Darussalam's real interest rate, Malaysia's real GDP and unemployment rate, and Thailand's balance of payments, or they can be said that these variables were more sensitive to the shock of falling oil prices.

Conclusion

Based on the results and discussion that have been described, it can be concluded that the increase and decrease in oil prices in the long term, in general, have a significant effect on all macroeconomic indicators analyzed in ASEAN countries, except for inflation and Thailand's real interest rate when oil prices decline. This shows that the macroeconomic indicators of the ASEAN countries studied are vulnerable to changes in oil prices. The increase in oil prices has a positive effect on the economy of Brunei and Malaysia because the increase in oil prices causes the country's real GDP to rise, the real exchange rate of the Brunei dollar and Malaysian ringgit appreciates, inflation decreases, interest rates decline, and unemployment rates decrease, but not for Brunei's balance of payments.

In the long term, the increase in oil prices impacted the decline in real GDP of Indonesia and Thailand, the depreciation of the real exchange rate of the rupiah and Thai baht, and the rise of inflation, real interest rates, the balance of payments, and unemployment rates of Indonesia and Thailand. The shock of falling oil prices does not always have a positive impact on the economy of the importing country, especially on the balance of payments, because it causes a decrease in the balance of payments in oil-importing countries

The shock of an increase and a shock of a decrease in oil prices by one standard deviation based on the results of the IRF has different impact and response to the macroeconomics of ASEAN countries. The shock of rising prices tends to boost the economy of Brunei Darussalam and Malaysia. The shock of falling oil prices tends to cause a decline in the economy of Brunei Darussalam and Malaysia. The shock of rising prices tends to hamper the economies of Indonesia and Thailand. This difference in response was caused by the dependence on oil in the energy mix, net oil imports per GDP, the efficiency of energy production, the country's export level, and income and savings from international trade.

Therefore, it is important to understand a country's macroeconomic framework before implementing policies that effectively mitigate the adverse effects of rising or falling oil prices. This study provides some policy suggestions for the four ASEAN countries. First, cooperation among ASEAN countries must be increased, for example, in terms of policies related to energy consumption, especially petroleum, energy diversification by investing in mixed substitute fuels and alternative renewable fuels, adoption of new technologies that use alternative energy, and cooperation in infrastructure development for alternative energy. ASEAN can become an exporter

of biofuels or other alternative energy because of the wealth of natural resources, especially biodiversity and agriculture. The efficiency of the use of petroleum should be carried out, especially in the transportation sector. The government, in this case, the monetary authority (central bank) in ASEAN countries, should prioritize the impact of oil prices on inflation through interest rates and maintaining exchange rate stability. The government can use a hedging strategy by using futures contracts. Brunei Darussalam can diversify its economy to reduce the adverse effects of oil price shocks.

References

Ahmed, K., Bhutto, N. A., & Kalhoro, M. R. (2019). Decomposing the links between oil price shocks and macroeconomic indicators: Evidence from SAARC region. *Resources Policy*, *61*, 423–432. https://doi.org/10.1016/j.resourpol.2018.03.001

Al Rasasi, M., & Yilmaz, M. (2016). The effects of oil shocks on Turkish macroeconomic aggregates. *International Journal of Energy Economics and Policy*, *6*(3), 471–476.

Alekhina, V., & Yoshino, N. (2018). *Impact of world oil prices on an energy-exporting economy including monetary policy* (ADBI Working Papers No. 828). Tokyo.

Bala, U., & Chin, L. (2018). Asymmetric impacts of oil price on inflation: An empirical study of African OPEC member countries. *Energies*, *11*(11), 1–22. https://doi.org/10.3390/en11113017

Balli, E., Nazif Çatık, A., & Nugent, J. B. (2021). Time-varying impact of oil shocks on trade balances: Evidence using the TVP-VAR model. *Energy*, *217*, 119377. https://doi.org/10.1016/j.energy.2020.119377

British Petroelum. (2020). *BP statistical review of world energy 2020*. London.

Charfeddine, L., & Barkat, K. (2020). Short- and long-run asymmetric effect of oil prices and oil and gas revenues on the real GDP and economic diversification in oil-dependent economy. *Energy Economics*, *86*, 104680. https://doi.org/10.1016/j.eneco.2020.104680

Cuestas, J. C., & Gil-Alana, L. A. (2018). Oil price shocks and unemployment in Central and Eastern Europe. *Economic Systems*, *42*(1), 164–173. https://doi.org/10.1016/j.ecosys.2017.05.005

DEPS. (2020). *Brunei Darussalam statitical year book 2019*. Bandar Seri Begawan.

Enders, W. (2004). *Applied econometric time series* (2nd editio). New York: John Wiley & Son.

Etornam, D. K. (2015). The impact of oil price shocks on the macroeconomic of Ghana. *Journal of Poverty, Investment and Development*, *9*, 37–54.

Faheem, M., Azali, M., Chin, L., & Mazlan, N. S. (2020). Asymmetric effect of oil price changes on trade balance in Saudi Arabia, Kuwait and United Arab Emirates. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, *14*(3), 685–714.

Feng, Y., Xu, D., Failler, P., & Li, T. (2020). Research on the time-varying impact of economic policy uncertainty on crude oil price fluctuation. *Sustainability*, *12*(16), 1–24. https://doi.org/10.3390/su12166523

Gershon, O., Ezenwa, N. E., & Osabohien, R. (2019). Implications of oil price shocks on net oil-importing African countries. *Heliyon*, *5*(8), e02208. https://doi.org/10.1016/j.heliyon.2019.e02208

Hamilton, J. D., & Lin, G. (1996). Stock market volatility and the business cycle. *Journal of Applied Econometrics*, *11*(5), 573–593. https://doi.org/10.1002/(SICI)1099-1255(199609)11:5<573::AID-JAE413>3.0.CO;2-T

Huang, B.-N., Hwang, M. J., & Peng, H.-P. (2005). The asymmetry of the impact of oil price

shocks on economic activities: An application of the multivariate threshold model. *Energy Economics*, *27*(3), 455–476. https://doi.org/10.1016/j.eneco.2005.03.001

IEA. (2021). *World energy outlook 2021: Part of world energy outlook.*

Jalil, N. E., Ghani, G. M., & Duasa, J. (2009). Oil prices and the Malaysia economy. *International Review of Business Research Paper*, *5*(4), 232–256.

Jibril, H., Chaudhuri, K., & Mohaddes, K. (2020). Asymmetric oil prices and trade imbalances: Does the source of the oil shock matter? *Energy Policy*, *137*, 1–15. https://doi.org/10.1016/j.enpol.2019.111100

Jiménez-Rodríguez, R., & Sánchez, M. (2005). Oil price shocks and real GDP growth: empirical evidence for some OECD countries. *Applied Economics*, *37*(2), 201–228. https://doi.org/10.1080/0003684042000281561

Kitous, A., Saveyn, B., Keramidas, K., Vandyck, T., Santos, L. R. L., & Wojtowicz, K. (2016). *Impact of low oil prices on oil exporting countries.* Luxembourg: European Commission, DG Joint Research Centre (JRC). https://doi.org/10.2791/718384

Kriskkumar, K., & Naseem, N. A. M. (2019). Analysis of oil price effect on economic growth of ASEAN net oil exporters. *Energies*, *12*(17), 1–19. https://doi.org/10.3390/en12173343

Kumaga, S. (2018). *Will Thailand's low inflation continue under economic expansion?* Tokyo. Retrieved from https://www.jri.co.jp/MediaLibrary/file/english/periodical/occasional/2018/05.pdf

Lee, K., Ni, S., & Ratti, R. A. (1995). Oil shocks and the macroeconomy: The role of price variability. *The Energy Journal*, *16*(4), 39–56.

Lorusso, M., & Pieroni, L. (2018). Causes and consequences of oil price shocks on the UK economy. *Economic Modelling*, *72*, 223–236. https://doi.org/10.1016/j.econmod.2018.01.018

Majuca, R. P. (2020). *Assessing the impact of oil price on the Malaysian economy* (Working Paper No. WP/20-02).

Mendoza, O., & Vera, D. (2010). The asymmetric effects of oil shocks on an oil-exporting economy. *Cuadernos de Economía*, *47*, 3–13. https://doi.org/10.4067/S0717-68212010000100001

Mork, K. A. (1989). Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton's Results. *Journal of Political Economy*, *97*(3), 740–744. Retrieved from http://www.jstor.org/stable/1830464

Musa, S. F. D., & Rozaidah, S. (2020). Addressing issues of unemployment in Brunei: The mismatch between employers expectation and employees expiration. *International Journal of Asian Business and Information Management*, *11*(2), 88–101. https://doi.org/10.4018/IJABIM.2020040106

Ordóñez, J., Monfort, M., & Cuestas, J. C. (2019). Oil prices, unemployment and the financial crisis in oil-importing countries: The case of Spain. *Energy*, *181*, 625–634. https://doi.org/10.1016/j.energy.2019.05.209

Park, J., & Ratti, R. A. (2008). Oil price shocks and stock markets in the U.S. and 13 European countries. *Energy Economics*, *30*(5), 2587–2608. https://doi.org/10.1016/j.eneco.2008.04.003

Razmi, F., Azali, M., Chin, L., & Shah Habibullah, M. (2016). The role of monetary transmission channels in transmitting oil price shocks to prices in ASEAN-4 countries during pre- and post-global financial crisis. *Energy*, *101*, 581–591. https://doi.org/10.1016/j.energy.2016.02.036

Saidu, M. T., Naseem, N. A. M., Law, S. H., & Yasmin, B. (2021). Exploring the asymmetric effect of oil price on exchange rate: Evidence from the top six African net oil importers. *Energy Reports*, *7*, 8238–8257. https://doi.org/10.1016/j.egyr.2021.07.037

Sakanko, M. A., & David, J. (2019). The effect of electronic payment systems on financial performance of microfinance banks in Niger State. *Esensi: Jurnal Bisnis Dan Manajemen*, *9*(2), 143–154. https://doi.org/10.15408/ess.v9i2.12273

Shangle, A., & Solaymani, S. (2020). Responses of monetary policies to oil price changes in Malaysia. *Energy*, *200*, 117553. https://doi.org/10.1016/j.energy.2020.117553

Ugwuanyi, C. U. (2011). *Effect of exchange rate fluctuations and oil price shocks: The Nigerian experience 1986–2008*. University of Nigeria, Nsukka.

Varlik, S., & Berument, M. H. (2020). Oil price shocks and the composition of current account balance. *Central Bank Review*, *20*(1), 1–8. https://doi.org/10.1016/j.cbrev.2020.02.002

Yildirim, Z., & Arifli, A. (2021). Oil price shocks, exchange rate and macroeconomic fluctuations in a small oil-exporting economy. *Energy*, *219*, 119527. https://doi.org/10.1016/j.energy.2020.119527

Zakaria, M., Khiam, S., & Mahmood, H. (2021). Influence of oil prices on inflation in South Asia: Some new evidence. *Resources Policy*, *71*, 102014. https://doi.org/10.1016/j.resourpol.2021.102014