Research Article

Examining the Relationship Between Oil Price Volatility and Economic Growth in Selected ASEAN Countries

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Abstract: The trade cycle and monetary policy paved the way for asymmetry in the behavior of oil prices. On the support, it can increase the rate that does not cause inflation and inflation of any requested policy stimulus. We use the Panel Vector Autoregressive (PVAR) model to analyze price dynamics on economic movements in annual data for 2008 - 2023 in four ASEAN countries. Our results show an asymmetry between oil prices and economic growth, as indicated by the PVAR and IRF test values. Our policy recommendations for these countries need to be carried out to reduce dependence on oil as a factor of production.

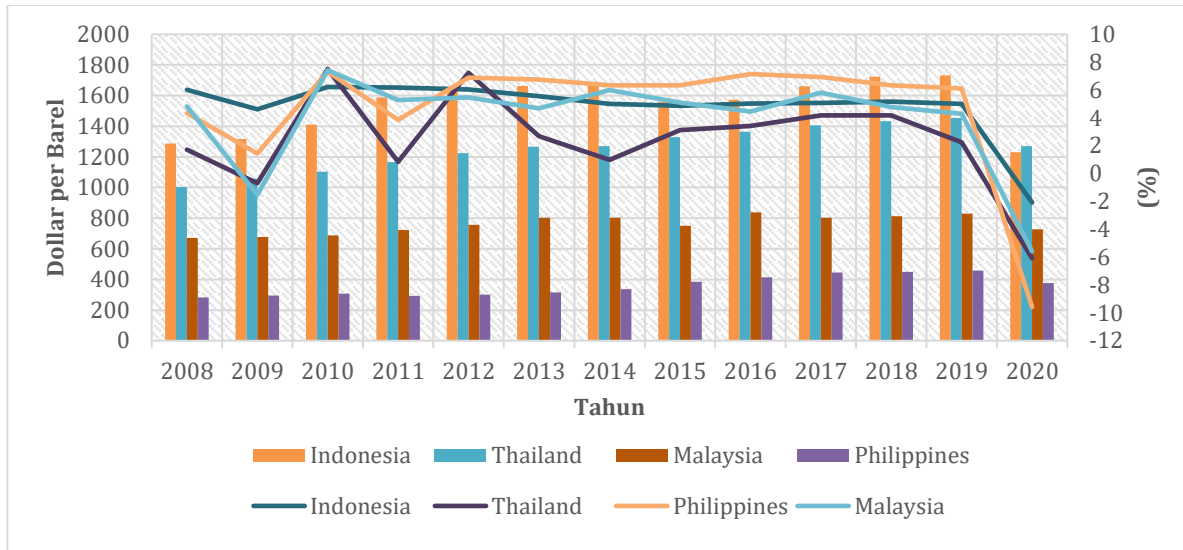*Keywords: Oil Price Volatility, Economic Growth, PVAR, ASEAN.*

I. INTRODUCTION

Energy is pivotal in fostering economic development, as rising energy consumption can reflect economic progress(Wardhono et al., 2016; Yu & Hwang, 1984). Beyond serving as a consumer good, energy is an essential input for technological advancement, which supports economic growth (Asmara et al., 2016a; Sa'adah et al., 2017a). Among various energy sources, oil stands out as a key contributor to technological development and economic advancement (Asmara et al., 2016b; Brown & Yücel, 2002; Tehranchian & Abdi Seyyedkolaee, 2017). Currently, oil is one of the most significant commodities in the production process, accounting for 33% of global energy consumption(Akinsola & Odhiambo, 2020; Ifeonyemetalu, 2020; van Eyden et al., 2019a). As a critical energy source, oil serves dual purposes as fuel and raw production material(Chang & Wong, 2003). However, increases in oil prices raise input costs, which subsequently lower economic productivity. Declines in productivity exacerbate unemployment rates and inflation in an economy.

Given its substantial impact on economic performance, oil price volatility has attracted significant attention from policymakers (Gadea et al., 2016; Kim & Lin, 2018; Pao & Tsai, 2010; Zhu & Singh, 2016a). Policies that may lead to asymmetric effects of oil price changes on economic activity are monetary policies. (Artami & Hara, 2018a). Asymmetric effects may arise when monetary policies fail to stabilize inflation. Over the long term, oil price volatility negatively affects investment levels(Alom, 2015a; Mehrara, 2007; Udemba & Yalçıntaş, 2021), leading to slower economic growth (Artami & Hara, 2018b; Sa'adah et al., 2017b). While oil price volatility is often perceived as a more critical issue for developed economies with extensive industrial sectors, developing countries are also experiencing increased oil consumption. The *Association of South East Asian Nations* (ASEAN) region stands out as one of the highest oil-consuming areas globally, characterized by rapid economic growth and rising energy demand. In 2005, 30% of ASEAN's energy consumption relied on imports, with an average Gross Domestic Product (GDP) growth of 5%. By 2010, ASEAN's GDP growth reached 18.78%, significantly exceeding the global average of 3.74%.

The selected ASEAN nations, namely Indonesia, Thailand, Malaysia, and the Philippines, are the largest oil consumers. These countries leverage oil to support economic development, as it makes substantial contributions to GDP and influences trade balances and government expenditures. However, being both major oil importers and exporters renders their economies highly vulnerable to oil price fluctuations. Figure 1 depicts oil consumption in ASEAN countries generally increased annually, followed by GDP growth. However, in 2020, oil consumption in Indonesia, Thailand, the Philippines, and Malaysia experienced a sharp decline, mirrored by a reduction in GDP. This downturn stemmed from the reciprocal relationship between demand shocks and the COVID-19 pandemic. The pandemic severely restricted human mobility, resulting in a sudden drop in demand as suppliers lost buyers. Despite these setbacks, energy consumption in ASEAN is projected to grow by 5.8% annually in 2035 (IEA *World Energy Outlook*, 2010).

Figure 1. Oil Price Trends and GDP in Selected ASEAN Countries.

Sources: *World Bank and Federal Reserve Economic Data (FRED)*

The relationship between oil price volatility and economic growth can be explained using the Solow-Swan model, which incorporates the substitution between capital (K) and labor (L). From a neoclassical perspective, energy can be a substitute for other input factors in production. As an input, oil price increases raise production costs, prompting firms to reduce output (Jiménez-Rodríguez & Sánchez, 2005a); (Alom, 2015b). The increase in production costs also leads investors to delay investments (Zhu & Singh, 2016b). Investment is a critical endogenous factor in economic development (Arsyad, 2010; Bergh dan Henrekson, 2011). In endogenous growth theory, investment contributes to both physical and human capital, fostering long-term economic growth. Moreover, investment is often accompanied by technological advancements.

The impact of oil price volatility on economic growth has been gathering attention among economists and policymakers (Nwanna & Eyedayi, 2016). (Hamilton, 2003) was among the first to investigate this relationship, examining the link between oil prices, economic growth, and inflation. He found that oil, as an input in production, significantly raises costs, leading firms to reduce output (Rahman & Serletis, 2019). An increase in oil prices adversely affects investment by driving up production costs, leading to reduced productivity (Alom, 2015b). These findings align with the previous studies (Le & Vinh, 2011), (Gollier & Treich, 2003), (Cavalcanti et al., 2015) and (van Eyden et al., 2019b) that the increased oil prices will hinder economic growth. However, some studies, such as those by (Jiménez-Rodríguez & Sánchez 2005b) and Joseph *et al.* (2020), reveal that rising oil prices can positively impact oil-exporting countries while negatively affecting oil-importing nations.

Based on empirical conditions, many studies have concentrated on the relationship between oil price fluctuations and economic growth. The findings of these studies found evidence that oil price fluctuations on economic growth are asymmetric. However, there have been no specific findings on the asymmetric effects of oil price fluctuations on economic growth. In addition, limited research explicitly examines this asymmetry in the context of selected ASEAN countries despite their heavy reliance on oil. Therefore, conducting research on this matter in selected ASEAN countries is very important. This study aims to address this gap by investigating the asymmetric effects of oil price fluctuations on economic growth in these nations, thereby contributing to the literature and providing insights for policymakers.

II. METHODOLOGY

A) Data Type and Sources

The ASEAN region is notable for its dual role as both an importer and producer of oil. Countries such as Indonesia, Malaysia, Thailand, and the Philippines exemplify this duality, serving as major oil-importing and oil-producing nations within ASEAN. Consequently, this study focuses on these selected ASEAN countries to analyze the impact of oil price volatility on economic growth. Annual data spanning from 2008 to 2023 were utilized in this research, sourced from reliable platforms such as the Federal Reserve Economic Data (FRED) and other relevant databases.

This study uses secondary data in the form of panel data in selected ASEAN from 2008 - 2023 in Indonesia, Thailand, Malaysia, and the Philippines. The starting point of 2008 was chosen to capture the effects of oil price volatility following the global financial and energy crises. GDP is the dependent variable, while the explanatory variables include oil price volatility and

inflation rates. Secondary data were obtained from official sources, including the World Bank and FRED.

B) Model Specification

The research model was adapted from Berument (2010), who examined the relationship between oil price volatility and economic growth using a Vector Autoregressive (VAR). Based on the existing parameters, The model of (Thakur et al., 2016) can be written as equation 1 and transformed into an econometric model as in equation 2.

$$GDP = f(GDP, Oil, Infl, ER) \tag{1}$$
$$GDP_t = \beta_0 + \beta_1 Oil_{it} + \beta_2 Infl_{it} + \beta_3 ER_{it} + \varepsilon_{i,t} \tag{2}$$

Where GDP is a real gross domestic product, oil is oil price volatility, Infl is the inflation rate, ER is the exchange rate, t represents the time period, i represents cross-section, and ε is an error term.

To align with the study's objectives, the model (Berument et al., 2010a) was modified by removing the exchange rate variable. Based on the results of the modification, this research model can be written as follows:

$$GDP == f(Oil, Infl) \tag{3}$$
$$GDP_{it} = \beta_0 + \beta_1 Oil_{it} + \varepsilon_{i,t} \tag{4}$$

The model was subsequently transformed into a VAR as follows:

$$GDP_t = \alpha_{10} + \alpha_{11} GDP_{it-1} + \alpha_{12} Oil_{it-1} + \varepsilon_{it} \tag{5}$$
$$Oil_t = \alpha_{20} + \alpha_{21} GDP_{it-1} + \alpha_{21} Oil_{it-1} + \varepsilon_{it} \tag{6}$$

III. RESULTS AND DISCUSSION

A) Results

The results of the PVAR analysis will show the behavior of oil price volatility variables in influencing economic growth in selected ASEAN. There are several important tests in PVAR analysis, which include stationary test, cointegration test, optimal lag selection, PVAR model estimation, Impulse Response Function (IRF) and Variance Decomposition (VD). The analysis test is carried out to implement the causal analysis method with the Vector Auto Regression (VAR) approach.

The Augmented Dickey-Fuller (ADF) test was employed to assess stationarity. If the probability value of ADF $<\alpha$, then it can be said that the data is stationary. The estimation results confirm that all variables in selected ASEAN are stationary at the first difference level indicated by the probability value of ADF $<\alpha$.

Table 1. Results of the Data Stationarity Test

ASEAN-4	Prob. Gdp	Prob. Oil	Prob. Inflasi
Level	0.2669	0.6580	0.0003
1st Difference	0.0006*	0.0205*	0.0000*
*Significant 5%. Source: Primary Data, processed (2024)			

A cointegration test examines the long-term relationship between the variables under examination. Therefore, it can be inferred that there is an ongoing connection between the data if they are cointegrated or vice versa. Additionally, a model is chosen for the PVAR analysis using the cointegration test. The data is considered cointegrated if the trace statistic value is greater than the crucial value.

Table 2. Cointegration Test Results

	A	Critical Value	Trace Statistic	Cointegration
ASEAN-4	1%	63.91969	35.45817	Not cointegrated
	5%	63.91969	29.79707	Not cointegrated
	10%	63.91969	27.06695	Not cointegrated

Source: Primary Data, processed (2024)

The best Panel Vector Autoregressive model for this study is obtained by determining the ideal lag value using the optimum lag test. The goal of figuring out the ideal lag is eliminating autocorrelation issues from the model. The optimal lag test also seeks to ascertain how long a variable has an impact on its historical variables as well as other endogenous variables. In order to prevent autocorrelation and heteroscedasticity issues in the model, the optimum lag test is utilized to determine the ideal lag duration (Wardhono et al., 2017). The Akaike Information Criteria (AIC) is utilized to determine the lag in this study since it will offer more flexible intervals to lower the degrees of freedom. Therefore, in line with this, the ideal value selected for this study is the one with the lowest value. The chosen VAR equation for ASEAN has an optimal value at lag 4, according to the results of the optimum lag estimation using the AIC approach.

Table 3. Optimum Lag Test

Lag	AIC
1.	17.26836
2.	17.42139
3.	17.12454
4.	16.96018*

Source: *Primary Data, processed (2024)*

Table 4. Empirical VAR Model

Constanta	-2.578183
GDP(-1)	-0.693433
	[1.12145]
GDP(-2)	-0.227726
	[0.33702]
GDP(-3)	0.571537
	[1.00194]
GDP(-4)	0.674226
	[1.97317]
OIL(-1)	-0.005793
	[0.10462]
OIL(-2)	-0.152305
	[-3.30002]
OIL(-3)	0.025624
	[0.54063]
OIL(-4)	0.009203
	[0.16356]
R-Squared	0.532269

Notes: [ ] t-statistics
Source: *Primary Data, processed (2024)*

Based on the PVAR estimation results above, it can be seen that the oil price variable is significant to economic growth in Selected ASEAN by -0.152305. This means that increasing oil prices by one unit will reduce economic growth by -0.152305. Furthermore, when oil prices are constant, economic growth will decrease by -2.578183. This finding indicates an asymmetry between oil prices and economic growth where the decline in oil prices will have a greater impact on the decline in economic growth.
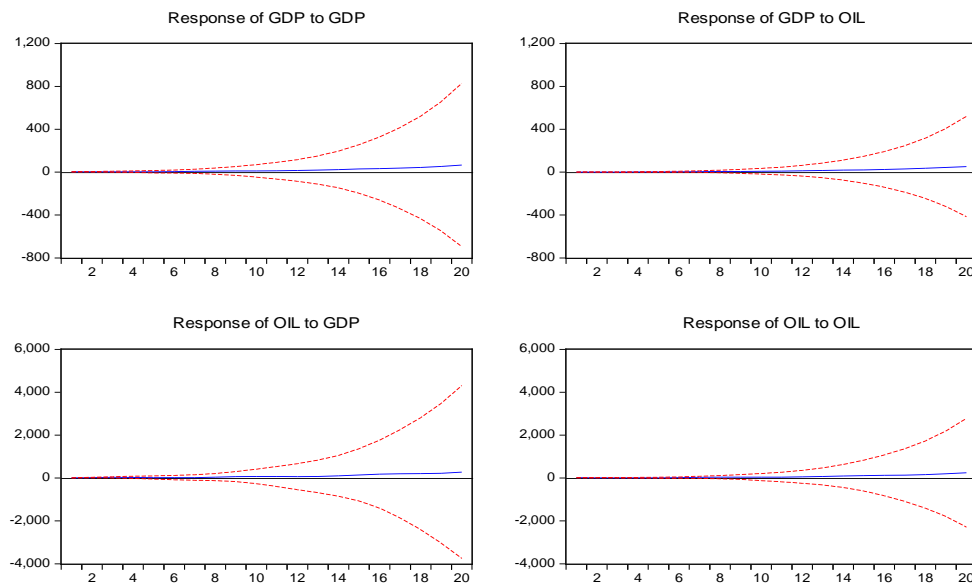
Figure 2. Impulse Response Function of Selected ASEAN Countries

Impulse Response Function (IRF) is a stage in VAR that aims to see whether there are shocks that occur from endogenous variables contained in the model (Ronayne, 2011; Wardhono et al. (2015). The impulse response function for selected ASEAN is depicted in Figure 2. Overall, the GDP variable responds to changes in oil prices. When an oil price shock occurs, it takes a

relatively long time for the GDP variable to be at equilibrium. Changes in oil prices significantly increase GDP from period 2 to period 3. Furthermore, in period 5 to period 8, the increase in oil prices decreases GDP. However, from period 9 to period 12, the increase in oil prices did not correspond to a decrease in GDP. In period 13 to period 20, oil prices and GDP are at equilibrium, and no shocks have been found.

This finding confirms that the decline in oil prices is followed by an increase in GDP. This aligns with the theory that a decline in oil prices will increase GDP. The conformity of these results shows that ASEAN's GDP depends on oil as a driver of the economy. However, in the 8th period, the increase in oil prices did not affect GDP. This shows that the GDP of the selected ASEAN region is more sensitive to the decline in oil prices. The trend of decreasing contribution is caused by government policies with subsidies and a decrease in oil production in selected ASEAN.

Table 5. Selected ASEAN Variance Decomposition

Period	S.E.	GDP	OIL
1	3.048234	100.0000	0.000000
2	4.153813	95.67087	4.113910
3	5.228948	96.30328	3.276819
4	6.380992	95.34119	4.375049
5	7.542849	86.41459	13.00738
6	9.668728	79.29560	20.33021
7	12.89240	76.21946	23.54190
8	16.81997	73.83236	25.81487
9	20.96536	73.57459	25.84038
10	25.16496	71.54777	27.61721
11	29.78755	68.25529	30.73439
12	35.71494	65.40314	33.65958
13	43.52729	63.73777	35.37936
14	53.28912	63.48974	35.62090
15	64.48122	63.82563	35.16768
16	76.75174	63.55189	35.28040
17	90.48448	62.66262	36.06082
18	106.8951	61.57772	37.14401
19	127.3303	60.88576	37.88302
20	152.6129	60.88528	37.92226

Source: Primary Data, processed (2024)

The Variance Decomposition (VD) test is used to compile estimates of a variable, namely the magnitude of the difference between before and after the shock originating from the variable itself or other variables (Wardhono et al., 2015). The VD test results in selected ASEAN show that the oil price and inflation variables contribute to GDP in selected ASEAN. The oil price variable makes a significant contribution to GDP, with a contribution of 37.92%.

B) *Discussion of VAR Analysis Results in Selected ASEAN Countries*

The work's key findings and consequences should be clearly explained in the Conclusions section, highlighting their importance and relevance.

The VAR analysis results for the selected ASEAN countries indicate that oil price volatility significantly affects GDP. Specifically, rising oil prices have a negative impact on economic growth in the region. This finding aligns with previous studies that highlight the adverse effects of global oil price volatility on economic performance (Asmara et al., 2016b); (Ito, 2012); (Bondzie et al., 2014); (Rasheed, 2023); and (Maji & Danjuma, 2023). Specifically, oil price volatility can lead to fiscal deficits and government revenue instability, resulting in inefficient public expenditure and hampering the effectiveness of fiscal policies in driving economic growth (Rasheed, 2023). Additionally, as production costs increase, oil price volatility exacerbates inflation and impedes investment, ultimately reducing gross domestic product (GDP) growth (Almasria et al., 2024). The negative impact of oil price volatility on economic growth is further attributed to a decline in the industrial sector's export performance through reduced productivity (Asmara et al., 2016b).

However, (Berument et al., 2010b) observed a positive relationship between oil prices and economic growth. The differences in the impact of global oil price volatility are often attributed to the distinct roles of oil-exporting and oil-importing countries. For oil-exporting countries, higher oil prices typically boost economic growth. Conversely, increased oil prices negatively affect economic growth in oil-importing nations, as oil serves as a crucial input in production processes. Higher oil prices elevate production costs, constrain productivity, and reduce output, ultimately leading to a decline in GDP. The empirical

findings of (Abdelsalam, 2023) conclude that oil price fluctuations significantly lead to increased economic growth in oil-exporting countries, while a negative and significant impact is observed in oil-importing nations.

Interestingly, the analysis reveals an asymmetric relationship between oil price changes and economic growth. While rising oil prices negatively affect growth, the impact of falling oil prices on output reduction is even more pronounced. This aligns with the findings of (Maalel and Mahmood, 2018), who demonstrated the asymmetric effects of oil price change dependency in oil-reliant economies. However, this finding contradicts the theoretical expectation that lower oil prices would stimulate economic growth. It underscores the continued dependence of selected ASEAN economies on oil as a primary revenue source. Enhancing oil-related efficiency and productivity is imperative to mitigate the adverse effects of oil price volatility. Measures should also aim to anticipate and cushion the impact of oil price shocks. Among the selected ASEAN countries, Indonesia's economy appears particularly vulnerable to declines in oil prices. Similarly, Malaysia's economic growth is significantly affected by falling oil prices due to its status as an oil producer, unlike the Philippines, which refines imported crude oil in Manila Bay and Batangas Bay to add value.

IV. CONCLUSION

This study analyzed the impact of oil price volatility on economic growth in selected ASEAN countries, focusing on oil price fluctuations as a determinant of GDP. Using a Panel Vector Autoregressive (PVAR) approach, the findings reveal that rising oil prices have a negative effect on economic growth in these countries, primarily because they are net oil importers. Higher oil prices increase production costs, reduced productivity, and lower economic output. Furthermore, the analysis highlights the asymmetric nature of these effects, showing that oil price declines exert a disproportionately larger negative impact on the economy than oil price increases. This underscores the critical need to reduce dependence on oil as a production input. Policymakers in the region must prioritize the utilization and diversification of alternative energy sources to minimize reliance on oil and enhance economic resilience to future shocks.)

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