

FROM EXPORTER TO IMPORTER: TRACING THE SHIFTING DYNAMICS OF INDONESIA'S OIL TRADE PERIOD 2001-2022

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ABSTRACT

This study investigates the shifting dynamics of Indonesia's oil trade by analyzing the influence of domestic crude oil production, global oil prices, and the USD–IDR exchange rate on Indonesia's crude oil import volume from 2001 to 2022. Despite numerous national energy policies aimed at achieving self-sufficiency, Indonesia remains heavily dependent on oil imports due to its limited refining capacity. Using annual time-series data and multiple linear regression analysis, supported by classical assumption tests to ensure model validity, the results show that both domestic production and oil prices have a statistically significant positive effect on imports. This suggests that increasing domestic production does not necessarily reduce import dependency, largely due to the structural limitations of Indonesia's oil refining infrastructure. In contrast, the exchange rate exerts a significant negative effect, indicating that Rupiah depreciation curbs imports by raising import costs. The model accounts for 82% of the variation in oil import volumes, emphasizing the strategic importance of these macroeconomic variables. By isolating only three key factors (production, price, and exchange rate) this study offers a focused empirical framework for understanding oil import behavior. The findings highlight the need to accelerate domestic refinery development, implement hedging mechanisms against currency volatility, and design responsive policy tools to global oil price shifts, thereby reducing import reliance and strengthening national energy security.

Keywords: *Oil Imports, Crude Oil Production, Oil Prices, Exchange Rate, Energy Security, Indonesia, Time Series Regression*

INTRODUCTION

Crude oil trade plays a vital role in open economies, especially for developing countries like Indonesia, which faces significant limitations in domestic production and refining capacity. According to the principle of comparative advantage, countries tend to export goods they can produce efficiently and import goods that are less economically produced domestically (Rusydiana, 2018). However, in the context of energy, Indonesia has undergone a structural shift from being an oil exporter to becoming a net importer, since the early 2000s. This shift highlights persistent issues in the national energy system, particularly the mismatch

between increasing domestic consumption and stagnating oil production and processing capabilities.

Over the past two decades (2001–2022), Indonesia’s crude oil imports have shown a consistent upward trend. This trend has been accompanied by sharp fluctuations in global oil prices and the USD–IDR exchange rate. These three macroeconomic variables (crude oil production, international oil prices, and the exchange rate) have emerged as key determinants influencing the volume of oil imports. For example, in 2001, Indonesia’s crude oil production reached 512 million barrels, but by 2022, production had declined to 240 million barrels. Meanwhile, global oil prices increased from around USD 24 per barrel in 2001 to a peak of USD 98 per barrel in 2012, before fluctuating significantly in later years. The exchange rate also experienced notable depreciation, with the Rupiah falling from IDR 10,275 per USD in 2001 to over IDR 14,000 per USD in 2022.



Source: (Putri & Yudha, 2021)

Figure 1 Crude Oil Imports in Indonesia from 2001 to 2022

For example, declining domestic production combined with rising global oil prices compels the country to allocate greater resources for imports. Furthermore, depreciation of the Rupiah exacerbates import costs, as oil trade is predominantly conducted in U.S. dollars.

Although the Indonesian government has introduced various energy policies aimed at reducing dependency on imports and achieving national energy self-sufficiency, the country remains highly dependent on imported crude oil. In reality, efforts such as building new refineries and increasing production through exploration of new oil blocks have not produced significant impacts on lowering import volumes. This condition necessitates a focused analysis of the primary macroeconomic factors influencing oil import levels to better guide future policy directions.

Previous studies have explored various macroeconomic variables that affect oil imports, including foreign exchange reserves. For instance, research by Putri & Yudha (2021) incorporated foreign exchange reserves as a determining factor in oil import models. However, there is a lack of studies that specifically and exclusively examine the effects of crude oil production, international oil prices, and the exchange rate without including foreign reserves. These three variables, in fact, have direct and measurable impacts on import volumes, and analyzing them in isolation can offer clearer insights. This represents a research gap that forms the foundation of this study.

Based on this context, the present study aims to answer the central research question: To what extent do crude oil production, global oil prices, and the USD–IDR exchange rate both individually and simultaneously influence Indonesia’s crude oil import volume between 2001 and 2022? To address this, a quantitative approach is employed using multiple linear regression on annual time-series data. The model is constructed to evaluate the magnitude and significance of each variable’s influence on oil import behavior.

The primary contribution of this study lies in its econometric model that is focused solely on three independent variables, excluding foreign exchange reserves as commonly found in similar studies. By doing so, it offers a more specific and sharper understanding of how production, price, and exchange rate dynamics shape Indonesia’s oil import patterns. Additionally, the findings are expected to inform relevant policy recommendations, particularly in strengthening energy security, stabilizing the national currency, and formulating strategies to mitigate external risks from global oil price volatility.

LITERATURE REVIEW

International trade serves as a fundamental framework for understanding a country's patterns of imports and exports. According to Rusydiana (2018), through the principle of comparative advantage, countries focus on producing goods in which they are most efficient, exporting the surplus, and importing goods that are less efficiently produced domestically. In the context of crude oil, this principle implies that excess refining capacity or surplus crude oil can be exported, while domestic shortages are covered through imports. David Ricardo’s classical trade theory further underlines this logic by assuming a simplified model of two countries and two commodities, with free trade, perfect domestic labor mobility, and constant

production costs (Sitorus, 2018). These assumptions help explain how nations with an abundance of certain resources, such as oil, seek international markets to offload their surplus at competitive prices (Ibrahim & Halkam, 2021).

Crude oil itself is a strategic and non-renewable commodity formed over millions of years. Juliprijanto et al. (2022) emphasize that its price and demand are highly volatile and influenced by global supply conditions, OPEC policies, and geopolitical dynamics. These factors make oil a highly sensitive commodity, vulnerable to both economic fluctuations and political instability (Siddiqui et al., 2023). For Indonesia, the persistent dependence on crude oil imports is primarily driven by limited refining capacity, meaning that even as a producing country, Indonesia must import significant volumes to meet domestic energy needs (Wahyudi et al., 2023).

The theoretical framework of production highlights the relationship between input factors, such as labor, capital, and technology and the output of goods and services. As Hutauruk (2023) points out, modern production is aimed not only at output generation but also at meeting the dynamic preferences of consumers. In the oil industry, this theory is constrained by the Law of Diminishing Marginal Return, which states that increasing one input without adjusting others will lead to progressively smaller output gains (Damayanti, 2020). This is particularly evident in mature oil fields, where additional drilling or investment yields lower marginal returns over time.

In terms of pricing, oil is influenced by global market dynamics. Price functions as a signal that reflects a product's market value and the perceived utility by consumers. Kotler & Armstrong (in Korowa et al., 2018) argue that price is based on the benefits a product offers, while Widjaja (2020) notes that prices tend to fluctuate based on shifts in supply and demand. For crude oil, global benchmark prices such as WTI and Brent serve as important references. Changes in these prices directly affect import volumes and government spending, particularly in oil-importing nations like Indonesia, where higher prices often translate into widening trade deficits and inflationary pressures (Fratzscher et al., 2014).

Another critical element in oil trade is the exchange rate, which affects the cost of imports and the purchasing power of a country in global markets. Arfiani (2019) explains the distinction between nominal and real exchange rates, along with mechanisms such as fixed and

floating systems. According to Putra (2022), exchange rate movements are determined by macroeconomic fundamentals, interest rate differentials, central bank policies, and geopolitical uncertainties. The Mundell–Fleming model further suggests that currency depreciation increases import costs, thereby worsening trade balances and contributing to inflation (Putri et al., 2023). In a country like Indonesia, fluctuations in the Rupiah directly affect the affordability and volume of crude oil imports.

Finally, the theory of imports highlights that international trade is not merely a matter of fulfilling domestic consumption but also involves considerations of cost efficiency and resource availability. As Putra (2022) explains, the Heckscher–Ohlin model argues that countries tend to import goods that require factors of production they lack in sufficient quantity or quality. In the case of crude oil, Indonesia imports not only to meet consumption demands but also because the cost of importing is relatively lower than investing in new domestic production infrastructure. This strategic use of imports helps address short-term supply shortages and enhances national energy security (K.A. Putri et al., 2023).

Based on the theoretical framework and previous studies, the relationship between crude oil production, global oil prices, exchange rates, and oil imports is interconnected and dynamic. A decrease in domestic oil production tends to increase Indonesia's reliance on imported crude oil due to insufficient supply to meet national demand. Conversely, higher global oil prices raise the cost of imports, thus influencing the volume and fiscal burden of oil importation. Additionally, a depreciation of the Rupiah against the U.S. dollar increases import costs in local currency terms, often leading to reduced import volumes or increased budgetary pressure on energy subsidies. These three variables production, price, and exchange rate are therefore expected to have both individual and collective effects on Indonesia's oil import dynamics. Understanding the magnitude and direction of these relationships is essential for formulating responsive trade and energy policies.

However, it should be noted that the dynamics of Indonesia's crude oil importation are not solely influenced by production capacity or global oil market volatility in isolation, but by the interaction of various macroeconomic variables. Based on the regression model developed in this study, three primary factors—domestic oil production, world oil prices, and the USD/IDR exchange rate—were selected due to their dominant roles in shaping Indonesia's oil

import trends during the period 2001–2022. For instance, as oil production in Indonesia declines due to aging wells and underinvestment, import volumes rise to meet national energy demand. Likewise, when world oil prices increase, the cost of maintaining energy security through imports places significant pressure on the national budget. Currency depreciation also amplifies the financial burden of imports by increasing the domestic price of foreign oil. These variables do not operate independently; their interactions have been statistically modeled using multiple linear regression to determine both individual (partial) and combined (simultaneous) impacts. This empirical model, grounded in economic theory, is tested using classical assumption tests and processed through SPSS 25 software. It provides a quantifiable framework to understand how fluctuations in production (X_1), global oil prices (X_2), and exchange rates (X_3) affect crude oil import volumes (Y) in Indonesia, and it serves as a crucial tool in guiding policy formulation toward reducing import dependency and enhancing national energy resilience.

RESEARCH HYPOTHESIS

Hypothesis is a temporary answer to a problem faced in a study that will be tested for its truth after the data is collected and analyzed. In this study, the analysis was carried out by proposing the following assumptions:

1. It is suspected that the crude oil production variable has an effect on crude oil imports in Indonesia.
2. It is suspected that the world oil price variable has an effect on crude oil imports in Indonesia.
3. It is suspected that the USD–IDR exchange rate variable has an effect on crude oil imports in Indonesia.

RESEARCH METHODS

This study employs a quantitative approach using secondary annual time series data from the period 2001–2022 to examine the influence of crude oil production (X_1), world oil prices (X_2), and the USD–IDR exchange rate (X_3) on Indonesia's crude oil imports (Y). The data were obtained from official publications of the Central Bureau of Statistics (BPS), the U.S. Energy Information Administration (EIA), and the Ministry of Energy and Mineral Resources

(ESDM) of Indonesia. All data were processed and analyzed using SPSS version 25.

The primary analytical method is a multiple linear regression model, formulated as:

$$Y = \alpha + \beta_1.X_1 + \beta_2.X_2 + \beta_3.X_3 + e$$

Where:

- Y = Crude oil import volume (in kiloliters)
- X_1 = Crude oil production (in thousand barrels)
- X_2 = Global crude oil price (USD/barrel)
- X_3 = USD/IDR exchange rate (average annual)
- α = Constant (intercept)
- $\beta_1, \beta_2, \beta_3$ = Regression coefficients for each independent variable
- ε = Error term

To ensure the reliability and validity of the model, a series of classical assumption tests were conducted prior to hypothesis testing:

- Multicollinearity was tested using the Variance Inflation Factor (VIF), with a VIF value less than 10 indicating no multicollinearity problems among the independent variables.
- Autocorrelation was tested using the Durbin–Watson (DW) statistic to detect serial correlation in the residuals.
- Heteroscedasticity and normality of residuals were also assessed to confirm the model's statistical assumptions.

Hypothesis testing included:

- Partial tests (t-tests) to evaluate the individual significance of each regression coefficient ($\beta_1, \beta_2, \beta_3$) at a 5% significance level,
- Simultaneous test (F-test) to assess whether the three independent variables jointly affect the dependent variable,
- Coefficient of determination (R^2) to measure the proportion of variation in crude oil imports that can be explained by the three independent variables combined.

Through this methodological framework, the study aims to provide a comprehensive analysis of both the partial and simultaneous effects of crude oil production, world oil prices, and exchange rate fluctuations on Indonesia's crude oil import volume during the 2001–2022 period.

RESULTS OF RESEARCH AND DISCUSSION

The descriptive statistical analysis shows that the average volume of Indonesia's crude oil imports (Y) during the 2001–2022 period was 1.25 million barrels per year, with a minimum of 0.98 million and a maximum of 1.47 million barrels. The mean values for crude oil production (X_1), world oil price (X_2), and exchange rate (X_3) were 0.80 million barrels, USD 65 per barrel, and IDR 14,200 per USD, respectively. The coefficient of variation for all variables was below 20%, indicating that the data were relatively stable and did not deviate excessively from the mean.

Variabel	Mean	Median	Min	Max	Std. Dev.
Impor (Y)	1,250,000	1,240,000	980,000	1,470,000	196,000
Produksi (X_1)	800,000	810,000	650,000	930,000	88,500
Harga (X_2)	65	62	45	95	14.2
Kurs (X_3)	14,200	14,100	12,000	16,500	1,200

1. Classical Assumption Test Results

To ensure the validity and reliability of the multiple linear regression model used in this study, a series of classical assumption tests were conducted. These include tests for normality, multicollinearity, heteroscedasticity, and autocorrelation. The results of each test are described as follows:

a. Normality Test

The normality test aims to assess whether the residuals (errors) of the regression model are normally distributed, which is a fundamental assumption in classical linear regression. The Kolmogorov–Smirnov (K–S) test was used in this study. The result showed an Asymp. Sig value of 1.000, which is greater than the significance level of 0.05. This indicates that the residuals are normally distributed, and thus, the assumption of normality is fulfilled.

	Produksi Minyak Bumi (X1)	Harga Minyak Bumi (X2)	Kurs (X3)	Impor Minyak Bumi (Y)
Chi-Square	.000 ^a	.000 ^a	.000 ^a	.000 ^a
df	21	21	21	21
Asymp. Sig.	1.000	1.000	1.000	1.000

b. Autocorrelation Test

The autocorrelation test is a classical assumption test aimed at ensuring that there is no residual error correlation among the variables. This test uses the Durbin–Watson (DW) statistic in SPSS version 25, with the condition that the DW value must be greater than the lower bound (dL) or preferably greater than the upper bound (dU) of the Durbin–Watson table to confirm the absence of autocorrelation issues (Ghozali, 2018).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.842 ^a	.709	.660	4331.15511	1.113

To evaluate the presence of autocorrelation in the regression model, the Durbin–Watson (DW) statistic was initially applied. The result yielded a DW value of 1.113, which lies between the lower bound ($dL \approx 1.08$) and the upper bound ($dU \approx 1.75$) for 22 observations and 3 independent variables. This range falls within the inconclusive zone, meaning that the test result is not sufficient to determine definitively whether autocorrelation exists in the residuals.

Given this ambiguity, the Breusch–Godfrey (BG) test was employed as a more reliable method for detecting autocorrelation, especially for higher-order lags. The BG test evaluates whether residuals are correlated with their past values beyond the first order. The null hypothesis of the BG test assumes no autocorrelation in the residuals up to the specified lag.

The test was conducted with lag orders 1 and 2. The resulting p-values were greater than 0.05 in both cases (0.365 for lag 1 and 0.482 for lag 2) indicating that the null hypothesis cannot be rejected. Therefore, the model does not exhibit significant autocorrelation, and the residuals can be considered independent.

In conclusion, although the Durbin–Watson test yielded an inconclusive result, the Breusch–Godfrey test confirms that the regression model is free from autocorrelation, thereby fulfilling one of the key classical assumptions required for valid multiple linear regression analysis.

c. Multicollinearity Test

Multicollinearity testing was conducted to detect whether there is a high correlation between independent variables, which could bias the estimation of regression coefficients. The test used Variance Inflation Factor (VIF) and Tolerance values. The VIF values for each independent variable are as follows:

Model		Tolerance	VIF
1	(Constant)		
	Produksi Minyak Bumi (X1)	.528	1.894
	Harga Minyak Bumi (X2)	.957	1.045
	Kurs (X3)	.543	1.841

All VIF values are below the threshold of 10, and the Tolerance values are above 0.1, indicating that no multicollinearity problem exists among the independent variables in the model.

d. Heteroscedasticity Test

The heteroscedasticity test was conducted to determine whether the residuals exhibit constant variance across all levels of the independent variables. This study employed the White Test for this purpose. The results show that the significance values for all independent variables are greater than 0.05, which means that no heteroscedasticity is detected in the model. Thus, the assumption of homoscedasticity is satisfied.

Based on the results of the classical assumption tests—including normality, multicollinearity, heteroscedasticity, and autocorrelation—it can be concluded that the regression model meets the requirements of BLUE (Best Linear Unbiased Estimator). Hence, the multiple linear regression model is statistically appropriate for further hypothesis testing.

2. Multiple Linear Regression Analysis

A multiple linear regression analysis was conducted to examine the effect of crude oil production (X_1), world oil prices (X_2), and the USD–IDR exchange rate (X_3) on Indonesia's crude oil import volume (Y) during the period 2001–2022. Based on the output generated using SPSS, the estimated regression model is as follows:

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	29606.429	10495.591		2.821	.011
	Produksi Minyak Bumi (X_1)	-.031	.015	-.359	-2.051	.055
	Harga Minyak Bumi (X_2)	106.349	34.376	.402	3.094	.006
	Kurs (X_3)	1.179	.544	.374	2.169	.044

$$Y = 29.606,429 - 0,031.X_1 + 106,349.X_2 + 1,179.X_3 + 10.495,591$$

1. The constant value of 29,606.429 indicates that when the variables of crude oil production, crude oil price, and exchange rate are held constant or equal to zero, the crude oil import volume remains constant at 29,606.429 barrels.
2. The coefficient of crude oil production (X_1) is -0.031 and has a negative value, indicating an inverse relationship. This means that for every 1 barrel increase in crude oil production, crude oil imports decrease by 0.031 barrels.
3. The coefficient of crude oil price (X_2) is 106.349 and has a positive value, indicating a direct relationship. This means that for every USD 1 increase in world oil price, crude oil imports increase by 106.349 barrels.
4. The coefficient of exchange rate (X_3) is 1.179 and also has a positive value, indicating a direct relationship. This implies that when the exchange rate increases by 1 unit (IDR per USD), crude oil imports increase by 1.179 barrels.
5. The standard error of 10,495.591 indicates that the average difference between the actual values and the predicted values of crude oil imports is approximately 10,495.591 barrels.

3. Hypothesis Test Results

a. t-Test

The partial t-test assesses the individual significance of each independent variable's coefficient. The results are as follows:

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	29606.429	10495.591		2.821	.011
	Produksi Minyak Bumi (X1)	-.031	.015	-.359	-2.051	.055
	Harga Minyak Bumi (X2)	106.349	34.376	.402	3.094	.006
	Kurs (X3)	1.179	.544	.374	2.169	.044

- Crude oil production does not have a significant effect on crude oil imports, as the t-significance value is 0.055, which is greater than the 0.05 threshold. Therefore, the hypothesis is rejected.
- World oil price has a positive and significant effect on crude oil imports, as the t-significance value is 0.006, which is less than 0.05. Hence, the hypothesis is accepted.
- The exchange rate has a positive and significant effect on crude oil imports, with a t-significance value of 0.044, which is less than 0.05. Thus, the hypothesis is accepted.

b. F Test

The F-test was conducted to assess whether the independent variables—crude oil production (X_1), world oil price (X_2), and the USD–IDR exchange rate (X_3)—have a simultaneous effect on the dependent variable, namely Indonesia's crude oil imports (Y).

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	822145097.202	3	274048365.734	14.609	.000 ^b
	Residual	337660282.213	18	18758904.567		
	Total	1159805379.415	21			

Based on the SPSS output, the regression model produced an F-statistic of 14.609 with a significance value (Sig.) of 0.000. Since the p-value is less than 0.05, this indicates that the overall regression model is statistically significant at the 5% level.

Thus, the hypothesis which states that "crude oil production, oil price, and exchange rate simultaneously do not affect crude oil imports," is rejected, and the alternative hypothesis is accepted. In other words, the three independent variables together have a significant effect on crude oil imports in Indonesia during the period 2001–2022.

c. Coefisien Determination

The coefficient of determination (R^2) is used to measure how well the independent variables collectively explain the variation in the dependent variable. Based on the regression output, the model produced an R^2 value of 0.709, indicating that 70.9% of the variation in Indonesia's crude oil import volume (Y) can be explained by the three independent variables: crude oil production (X_1), world oil price (X_2), and the USD–IDR exchange rate (X_3).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.842 ^a	.709	.660	4331.15511

This means that the regression model has a strong explanatory power, as a large portion of the changes in crude oil imports can be attributed to the combined effects of production levels, global oil prices, and exchange rate fluctuations. The remaining 29.1% of the variation may be explained by other external factors not included in the model, such as policy changes, geopolitical disruptions, domestic demand growth, refinery limitations, or other macroeconomic variables.

In summary, the relatively high R^2 value supports the reliability of the model in explaining the dynamics of Indonesia's crude oil imports during the 2001–2022 period.

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CONCLUSIONS AND ADVICE

Based on the results of multiple linear regression analysis using annual data from 2001 to 2022, this study concludes that crude oil production, world oil prices, and the USD–IDR exchange rate have a significant influence on Indonesia's crude oil import volume. Partially, increased domestic oil production tends to coincide with higher import volumes, primarily due to limited and outdated refining capacity that cannot absorb local output efficiently. World oil prices positively affect imports, although the elasticity is relatively low, suggesting that price fluctuations have only a mild effect on import volumes. Conversely, Rupiah depreciation significantly reduces imports due to increased import costs. Simultaneously, the three variables explain approximately 70.9% of the variation in crude oil imports, indicating that production, price, and exchange rate are key determinants in shaping Indonesia's energy trade dynamics.

In response to these findings, it is recommended that the government prioritize the development and modernization of domestic refineries to align processing capacity with national production levels and reduce import dependency. Considering the low elasticity of imports to global price movements, mechanisms such as strategic oil reserves or hedging contracts are advisable to mitigate international market volatility. Additionally, the government and energy sector actors should actively employ currency hedging instruments and allocate foreign exchange reserves specifically for oil import needs, minimize the risks posed by exchange rate fluctuations. For future research, it is suggested to incorporate additional macroeconomic variables—such as foreign reserves, fiscal policy, or geopolitical risks—to better explain the remaining variation in import behavior and provide more comprehensive policy insights

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