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Table Of Contents

Journal Cover	1
Author[s] Statement.....	3
Editorial Team	4
Article information	5
Check this article update (crossmark)	5
Check this article impact	5
Cite this article.....	5
Title page.....	6
Article Title	6
Author information	6
Abstract	6
Article content	7

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Determinants of Refined Oil Imports from Singapore to Indonesia

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Abstract

General Background International trade crucially shapes the energy sector dynamics and economic structures of developing nations. **Specific Background** Despite possessing abundant crude oil resources, Indonesia continuously relies on refined petroleum imports from Singapore to meet rising domestic energy demands due to inadequate downstream infrastructure. **Knowledge Gap** Previous literature extensively addresses global energy trade patterns, yet empirical analyses isolating the specific determinants driving the structural imbalance in the Indonesia-Singapore petroleum trade remain underexplored. **Aims** This study analyzes the specific determinants namely crude oil exports, domestic consumption, and domestic production driving refined oil imports from Singapore to Indonesia during the 2010–2024 period. **Results** Utilizing multiple linear regression on time-series data, the analysis reveals that crude oil exports and domestic consumption positively and significantly drive refined petroleum imports. Conversely, domestic oil production exhibits a negative but statistically insignificant relationship, explaining 80.68% of the total import variance. **Novelty** This research provides a specific quantitative mapping of the upstream-downstream structural paradox within Southeast Asia's largest economy, utilizing precise Harmonized System trade codes to delineate the raw material exporter versus processed goods importer dichotomy. **Implications** Consequently, policymakers must prioritize developing domestic refining infrastructure to reduce structural import dependency and secure national energy independence.

Highlights:

- Crude oil exports and domestic consumption significantly drive refined petroleum imports.
- Increased domestic petroleum production fails to significantly reduce foreign dependency.
- Developing domestic downstream refining infrastructure remains crucial for national energy security.

Keywords: Refined Petroleum Imports, Crude Oil Exports, Domestic Energy Consumption, Trade Dependency, Refining Infrastructure Capacity

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I. Pendahuluan

International trade plays a crucial role in shaping a country's economic structure, particularly in the energy sector [1]. The global oil market is characterized by complex trade flows between crude oil exporting countries and refined petroleum importing countries, reflecting differences in production capacity and levels of industrialization [16]. In this context, Indonesia represents a unique case, as it exports crude oil while simultaneously importing large volumes of refined petroleum products, especially from Singapore [2].

Despite possessing significant crude oil resources, Indonesia remains highly dependent on refined oil imports due to limited domestic refining capacity. Countries with underdeveloped downstream sectors tend to export raw materials and re-import higher value-added products [18]. This condition may lead to persistent energy trade deficits and increased vulnerability to global oil price volatility. Furthermore, rising domestic energy consumption driven by economic growth and population expansion further intensifies dependence on energy imports [17].

In international trade analysis, commodities are classified using the Harmonized System (HS), a globally standardized coding system for traded goods. In this study, refined oil imports are measured using HS Code 271012, which includes petroleum products such as motor spirit (gasoline), aviation fuel, and other refined derivatives that have undergone processing. These products have higher economic value as they are ready for final consumption. Therefore, an increase in imports under HS 271012 reflects a higher level of dependence on refined petroleum products from abroad.

On the other hand, crude oil exports are measured using HS Code 270900, which refers to crude petroleum oils that have not undergone any refining process. These products are typically exported as raw materials for refining industries in other countries. The distinction between these two HS codes highlights Indonesia's position in the global energy trade structure as a raw material exporter and a refined product importer.

All trade data in this study are expressed in Thousand US Dollars (USD), meaning that each reported value is denominated in thousands. For example, a value of 1,000 represents USD 1,000,000. The use of this unit simplifies data presentation and facilitates interpretation in large-scale economic analysis.

Previous studies have shown that energy trade dynamics are influenced by various factors, including exports, domestic consumption, and production levels [4], [14]. Increased domestic consumption tends to drive higher import demand, while increased production may reduce imports if supported by adequate refining capacity [6]. However, empirical studies examining the relationship between crude oil exports (HS 270900), oil consumption, and oil production on refined oil imports (HS 271012), particularly in the Indonesia-Singapore trade context, remain limited.

Therefore, this study aims to analyze the effects of crude oil exports, oil consumption, and oil production on Indonesia's refined oil imports from Singapore during the period 2010-2024. This research is expected to provide empirical contributions to understanding Indonesia's structural dependence on energy imports and to offer policy implications regarding the importance of strengthening domestic refining capacity to enhance national energy independence[15].

II. Metode

This study employs a quantitative research approach using time series data covering the period from 2010 to 2024. The research design is explanatory, aiming to analyze the causal relationship between crude oil exports, oil consumption, and oil production on refined oil imports in Indonesia[13].

The data used in this study are secondary data obtained from reliable and official sources. Refined oil import data (HS 271012) from Singapore to Indonesia and crude oil export data (HS 270900) from Indonesia to the world are obtained from Trade Map[20]. Oil production data are derived from annual reports of PT Pertamina (Persero), while oil consumption data are sourced from reports of the Kementerian Energi dan Sumber Daya Mineral. All data are expressed in Thousand US Dollars (USD).

The variables used in this study are defined as follows:

Y = Refined oil imports (HS 271012)

X_1 = Crude oil exports (HS 270900)

X_2 = Oil consumption

X_3 = Oil production

The analytical method applied is multiple linear regression, formulated as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$$

Data analysis is conducted using EViews software. To ensure the validity of the regression model, classical assumption tests are performed, including normality test, multicollinearity test, heteroskedasticity test, and autocorrelation test. These tests are essential to ensure that the model meets the Best Linear Unbiased Estimator (BLUE) criteria [7]-[9].

III. Hasil dan Pembahasan

A. Regression Results

Table 1 presents the results of the multiple linear regression analysis used to examine the effects of crude oil exports, oil consumption, and oil production on refined oil imports in Indonesia during the 2010–2024 period.

Variable	Coefficient	t-Statistic	Probability
C	-4,239.737	-0.479049	0.6413
X3	-10,301.16	-1.616745	0.1342
X2	10,410.10	2.869978	0.0152
X1	0.606549	3.854833	0.0027

The regression results indicate that crude oil exports (X1) and oil consumption (X2) have a positive and significant effect on refined oil imports. Meanwhile, oil production (X3) has a negative but statistically insignificant effect.

The coefficient of determination (R^2) is 0.806862, indicating that 80.68% of the variation in refined oil imports can be explained by the independent variables in the model, while the remaining 19.32% is explained by other variables outside the model.

The probability value of the F-statistic is 0.000305 (< 0.05), indicating that all independent variables simultaneously have a significant effect on refined oil imports [7].

B. Classical Assumption Tests

1) Normality Test

The Jarque-Bera probability value is greater than 0.05, indicating that the data are normally distributed [7].

2) Multicollinearity Test

The VIF values for all variables are below 10, indicating that there is no multicollinearity problem in the model [7].

3) Heteroskedasticity Test

The probability value of Obs*R-Squared is 0.3910 (> 0.05), indicating that the model is free from heteroskedasticity [7].

4) Autocorrelation Test

The probability value of Obs*R-Squared is 0.3124 (> 0.05), indicating that there is no autocorrelation problem in the model [7].

C. Output Interpretation

The results show that crude oil exports have a positive and significant effect on refined oil imports. This indicates that an increase in crude oil exports is followed by an increase in refined oil imports, reflecting an imbalance in Indonesia's energy trade structure[19].

Oil consumption also has a positive and significant effect, meaning that an increase in domestic energy demand directly increases dependence on imports. This finding is consistent with previous studies stating that higher energy consumption leads to increased energy imports [10].

Meanwhile, oil production has a negative but insignificant effect, indicating that an increase in production has not been effective in reducing imports due to limited domestic refining capacity[11].

Overall, these findings confirm that Indonesia's dependence on refined oil imports is structural in nature and is influenced by the imbalance between upstream and downstream energy sectors.

D. Discussion

1) Model Specification and Equation Interpretation

The relationship between crude oil exports, oil consumption, oil production, and refined oil imports can be formulated as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$$

Y = Refined oil imports (HS 271012)

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e = Error term

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