

Demand-side determinants of Indonesian palm oil exports to major destination countries: Evidence from India, China, and Pakistan

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Abstract

Palm oil is one of Indonesia's leading export commodities and plays an important role in supporting export revenue and international trade performance. This study aims to analyze the development of Indonesian palm oil exports and examine the influence of gross domestic product (GDP), exchange rates, and population on Indonesian palm oil exports to its three major destination countries, namely India, China, and Pakistan, during the period 2012–2022. This study employed a quantitative approach using descriptive analysis and panel data regression. The findings show that Indonesian palm oil exports to the three destination countries fluctuated during the observation period, with India recording the highest average export value and Pakistan showing a stronger upward trend toward the end of the period. The regression results indicate that GDP and exchange rates have a positive and significant effect on Indonesian palm oil exports, while population has a significant negative effect. These findings suggest that destination-country macroeconomic conditions and price competitiveness play an important role in shaping Indonesia's palm oil export performance. This study contributes to the international trade literature by providing comparative empirical evidence on the demand-side determinants of Indonesian palm oil exports across major destination countries. In addition, the findings offer practical insights for strengthening export competitiveness and developing export-oriented trade strategies in the global palm oil market.

Keywords: *Exchange rate; Gross Domestic Product (GDP); Palm oil exports; Population.*

JEL Classification: F14, Q17, C23

INTRODUCTION

Indonesia is one of the world's largest producers and exporters of palm oil, and this commodity plays a strategic role in generating foreign exchange earnings and supporting national economic growth. Palm oil and its derivative products have become major export commodities due to their extensive use in the food, cosmetics, oleochemical, and biofuel industries (Goh & Potter, 2022; Zhang et al., 2025). Over the past decade, global demand for Indonesian palm oil has continued to increase, particularly in developing countries

with large populations, expanding industrial activity, and rising consumption needs. Consequently, palm oil exports have become an important component of Indonesia's international trade performance and a significant source of export revenue.

Among the major destination countries for Indonesian palm oil exports are India, China, and Pakistan, which constitute important markets for Indonesian palm oil products. Indonesia's palm oil exports to India increased from USD 2,252 million in 2019 to USD 2,987.3 million in 2020. During the same period, exports to China declined from USD 3,019.7 million to USD 2,867.5 million, while exports to Pakistan increased from USD 1,169.1 million to USD 1,667.4 million (Badan Pusat Statistik, 2020). These fluctuations indicate that the dynamics of Indonesian palm oil exports vary across destination countries and may be influenced by differences in macroeconomic conditions, exchange rate movements, market demand, and trade characteristics.

The increasing global demand for palm oil has also raised concerns regarding domestic supply stability in Indonesia. In recent years, Indonesia experienced a cooking oil shortage that attracted widespread public attention. One factor associated with this condition was the sharp increase in global palm oil prices, which encouraged higher export activity. The global vegetable oil price index exceeded 201.7 points in early 2022, reflecting the substantial rise in international vegetable oil prices during that period (Food and Agriculture Organization, 2022). This phenomenon demonstrates the close relationship between international market demand, export orientation, and domestic palm oil availability, highlighting the importance of understanding the determinants of Indonesian palm oil exports.

Previous studies have examined various macroeconomic factors affecting export performance, including GDP, exchange rates, and population. In general, GDP in destination countries reflects purchasing power and import capacity, which may increase demand for imported commodities, including palm oil (Andreina, 2017; Hameed et al., 2016; Zakaria et al., 2024). Several studies have also found that exchange rate movements play an important role in export competitiveness, as currency depreciation may encourage exports by making exported goods relatively cheaper in international markets (Ali, 2020; Ginting, 2013; Mahendra & Kesumajaya, 2015; Nthebe & Mosikari, 2025). Meanwhile, the relationship between population and export demand remains inconclusive. Although larger populations theoretically increase consumption demand, several studies have found that population growth may negatively affect exports due to changes in consumption patterns, substitution effects, and domestic market characteristics (Ismaiel et al., 2023; Pudyastuti et al., 2018). In the context of palm oil exports, previous studies have also highlighted the importance of macroeconomic variables, international demand, and destination-country characteristics in determining export performance (Ermawati & Saptia, 2013; Karlina et al., 2022; Susilowati et al., 2025).

Although previous studies have provided important insights into export determinants, several limitations remain. First, many earlier studies have focused on aggregate Indonesian exports rather than specifically examining palm oil exports as one of Indonesia's strategic commodities. Second, previous research has generally analyzed export determinants for a single destination country without simultaneously comparing major export destinations. Third, empirical findings regarding the effects of GDP, exchange rates, and population on exports remain inconsistent across studies and contexts. Therefore, further research is needed to provide comparative empirical evidence on the determinants of Indonesian palm oil exports to its major destination countries.

This study contributes to the literature on international trade and exports by

analyzing the influence of destination-country gross domestic product (GDP), exchange rates, and population on Indonesian palm oil exports to India, China, and Pakistan using panel data. By focusing on these three major export destinations, this study extends the empirical evidence on the demand-side determinants of palm oil trade. It provides a comparative perspective on export dynamics across these markets. This comparative focus enables the study to capture differences in export responses across major destination markets rather than treating palm oil exports as a single aggregate flow. Based on this background, the objective of this study is to analyze the development of Indonesian palm oil exports and examine the influence of GDP, exchange rates, and population on Indonesian palm oil exports to India, China, and Pakistan during the period 2012–2022.

METHODS

This study employed a quantitative research approach, using panel data analysis, to examine the determinants of Indonesian palm oil exports to its three main destination countries: India, China, and Pakistan. The study analyzed the influence of destination-country gross domestic product (GDP), exchange rates, and population on Indonesian palm oil exports during 2012–2022. In addition, descriptive analysis was used to provide an overview of the development of Indonesian palm oil exports and the movement of the main research variables over the observation period.

The study used secondary data obtained from official sources, including Badan Pusat Statistik (BPS), the Asian Development Bank (ADB), and other relevant international publications. The data consisted of annual panel data covering three cross-sectional units, namely India, China, and Pakistan, and eleven years of observation from 2012 to 2022, resulting in 33 balanced panel observations. Indonesian palm oil exports were the dependent variable, while destination-country GDP, exchange rates, and population were the independent variables. Since this study used publicly available secondary data, ethical approval was not required.

To analyze the influence of independent variables on Indonesian palm oil exports, this study employed a panel-data regression model. Panel data analysis was selected because it combines cross-sectional and time-series dimensions, enabling the model to capture variations across countries and over time simultaneously. The regression model used in this study is formulated as follows:

$$\text{LogEX}_{it} = \beta_0 + \beta_1 \text{LogEXR}_{it} + \beta_2 \text{LogGDP}_{it} + \beta_3 \text{POP}_{it} + \varepsilon_{it} \dots\dots\dots (1)$$

where:

EX = Indonesian palm oil exports

EXR = exchange rate

GDP = gross domestic product

POP = population

β_0 = constant

$\beta_1, \beta_2, \beta_3$ = regression coefficients

i = cross-sectional units, namely India, China, and Pakistan

t = time period from 2012 to 2022

ε = error term

Several panel data estimation models were considered in this study, namely the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). To determine the most appropriate estimation model, panel model selection tests were conducted. The Chow test was used to compare the Common Effect Model and the

Fixed Effect Model, while the Lagrange Multiplier (LM) test was used to compare the Common Effect Model and the Random Effect Model. The Hausman test was initially used to compare the Fixed Effect Model and the Random Effect Model; however, due to the limited number of cross-sectional units, the final model selection was supported by the Chow test and the LM test, along with substantive consideration of country-specific heterogeneity across the three destination countries.

To evaluate the influence of the independent variables on Indonesian palm oil exports, this study employed both simultaneous and partial significance tests. The F-test was used to examine the joint influence of GDP, exchange rates, and population on palm oil exports. In contrast, the t-test was used to analyze the individual effect of each independent variable on the dependent variable.

RESULTS AND DISCUSSION

Dynamics of Indonesian palm oil exports to major destination countries

Indonesian palm oil exports to India, China, and Pakistan showed different patterns during the 2012–2022 period. As shown in Table 1, India recorded the highest average export value among the three destination countries, reaching USD 3,813.7 million. China recorded the highest average export value at USD 2,870.5 million, while Pakistan recorded the lowest at USD 1,564.6 million. This pattern indicates that India remained the largest market in terms of average export value, although export performance across the three countries fluctuated over time.

Table 1. Indonesian palm oil export value to India, China, and Pakistan, 2012–2022

Year	Export Value (Million USD)		
	India	China	Pakistan
2012	4846.5	2835.3	720.8
2013	4375.4	2005.7	821.7
2014	3694.3	2098.9	1366.5
2015	3224.3	2451.7	1319.9
2016	3449.5	2190.2	1301.6
2017	4901.2	2651.8	1474.7
2018	3561.5	2637.6	1445.7
2019	2252.0	3019.7	1169.1
2020	2987.3	2867.5	1667.4
2021	3337.8	4825.9	2794.3
2022	5320.6	3991.1	3129.4
Average	3813.7	2870.5	1564.6

Source: Asian Development Bank (ADB) database, processed by the authors.

Exports to India experienced considerable fluctuations during the observation period. The export value declined from USD 4,846.5 million in 2012 to USD 2,252.0 million in 2019, before increasing to USD 5,320.6 million in 2022, the highest value recorded during the study period. Exports to China also fluctuated, reaching its lowest value in 2013 at USD 2,005.7 million and its highest in 2021 at USD 4,825.9 million. Meanwhile, exports to Pakistan showed a more pronounced upward trend, increasing from USD 720.8 million in 2012 to USD 3,129.4 million in 2022.

Overall, the descriptive results suggest that the dynamics of Indonesian palm oil exports vary across destination countries. India remained dominant in terms of average export value, while Pakistan showed stronger growth momentum toward the end of the observation period. These differences provide an initial indication that destination-

country characteristics, including economic capacity, market demand, and exchange rate movements, may influence export performance.

Macroeconomic conditions of Indonesia’s major palm oil export destination countries

The macroeconomic conditions of Indonesia’s major palm oil export destination countries showed different patterns during the 2012–2022 period. As shown in Table 2, GDP generally increased in India, China, and Pakistan over the observation period. India’s GDP increased from 92,130.2 billion local currency units in 2012 to 159,710.9 billion in 2022, while China’s GDP rose from 48,698.3 billion to 113,205.4 billion. Pakistan also showed an upward trend, with GDP increasing from 27,114.7 billion in 2012 to 40,941.7 billion in 2022. However, India and Pakistan experienced declines in GDP in 2020, which may reflect the economic disruption caused by the COVID-19 pandemic.

Table 2. Macroeconomic variables of Indonesia’s major palm oil export destination countries, 2012–2022

Year	GDP (Billion Local Currency)			Population (Millions)			Exchange Rate (Local Currency/USD)		
	India	China	Pakistan	India	China	Pakistan	India	China	Pakistan
2012	92130.2	48698.3	27114.7	1236.0	1359.2	180.7	54.8	6.3	97.1
2013	98013.7	52480.3	28298.8	1252.0	1367.3	184.3	61.9	6.2	105.7
2014	105276.7	56377.4	29463.7	1268.0	1376.5	188.0	63.3	6.1	100.5
2015	113694.9	60347.1	30706.5	1284.0	1383.3	191.7	66.3	6.2	104.9
2016	123081.9	73603.7	32725.0	1299.0	1392.3	198.8	68.0	6.6	104.8
2017	131445.8	78717.1	34175.6	1314.0	1400.1	207.7	63.9	6.8	110.4
2018	139929.1	84030.3	36278.0	1328.0	1405.4	211.8	69.8	6.6	138.8
2019	145346.4	89030.5	37184.1	1343.0	1410.1	216.1	71.3	6.9	154.9
2020	136871.2	91023.6	36710.3	1357.0	1412.1	220.4	73.1	6.9	159.6
2021	149258.4	109919.8	39101.6	1370.0	1412.6	224.8	74.3	6.5	176.5
2022	159710.9	113205.4	40941.7	1383.0	1411.8	229.2	82.8	6.7	226.5
Average	126796.3	77948.5	33881.8	1312.2	1393.7	204.9	68.1	6.5	134.5

Source: Asian Development Bank (ADB) database, processed by the authors.

The population also showed an increasing trend in the three destination countries. India’s population increased from 1,236.0 million in 2012 to 1,383.0 million in 2022, while Pakistan’s population rose from 180.7 million to 229.2 million. China’s population increased gradually until 2021, then declined slightly in 2022. These patterns indicate that India, China, and Pakistan remained large potential markets for Indonesian palm oil products during the study period.

Exchange rate movements varied across the three countries. The Indian rupee and Pakistani rupee tended to depreciate against the United States dollar, with the Indian rupee moving from 54.8 per USD in 2012 to 82.8 per USD in 2022, and the Pakistani rupee from 97.1 per USD to 226.5 per USD. In contrast, the Chinese yuan remained relatively more stable, fluctuating within a narrower range during the observation period. These differences in GDP, population, and exchange rate movements provide an initial indication that destination-country macroeconomic conditions may contribute to variations in Indonesian palm oil export performance.

Determinants of Indonesian palm oil exports to India, China, and Pakistan

To determine the appropriate panel data estimation model, several model selection tests were conducted. The Chow test was used to compare the Common Effect Model (CEM) and the Fixed Effect Model (FEM). The results in Table 3 show that the probability value for the cross-section chi-square statistic was 0.0003, which is below the 5 per cent significance level. This result indicates that the Fixed Effect Model was preferred over the Common Effect Model.

Table 3. Chow test results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	8.815484	(2,27)	0.0011
Cross-section Chi-square	16.585507	2	0.0003

Furthermore, the Lagrange Multiplier (LM) test was conducted to compare the Common Effect Model and the Random Effect Model (REM). As shown in Table 4, the Breusch–Pagan probability value was greater than 0.05, indicating that the Common Effect Model could be considered preferable to the Random Effect Model.

Table 4. LM test results

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	1.527757 (0.2164)	0.002346 (0.9614)	1.530103 (0.2161)

Although the LM test indicated that the Common Effect Model could also be considered, this study employed the Fixed Effect Model as the final estimation model. The use of FEM was considered more appropriate because the analysis focused on a limited number of major destination countries—India, China, and Pakistan—which may have distinct country-specific characteristics related to economic conditions, market structures, and import demand behaviour. Therefore, FEM was used to capture heterogeneity across destination countries during the observation period.

The regression results using the Fixed Effect Model are presented in Table 5.

Table 5. Fixed effects model regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.428736	2.463143	-0.580046	0.5667
POP	-0.007665	0.002437	-3.145460	0.0040
LOG(KURS)	1.122684	0.315646	3.556782	0.0014
LOG(GDP)	1.129479	0.351934	3.209350	0.0034
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.816619	Mean dependent var		7.803435
Adjusted R-squared	0.782659	S.D. dependent var		0.516151
S.E. of regression	0.240629	Akaike info criterion		0.151843
Sum squared resid	1.563359	Schwarz criterion		0.423935
Log likelihood	3.494593	Hannan-Quinn criterion.		0.243394
F-statistic	24.04688	Durbin-Watson stat		1.554265
Prob(F-statistic)	0.000000			

The estimation results show that gross domestic product (GDP) and exchange rates have a positive and significant effect on Indonesian palm oil exports, while population has a significant negative effect. The GDP variable yielded a coefficient of

1.129 and a p-value of 0.0034, indicating that higher GDP in destination countries tends to increase Indonesian palm oil exports. The exchange rate variable also showed a positive coefficient of 1.122 (p-value = 0.0014), suggesting that depreciation of the exchange rate tends to encourage Indonesian palm oil exports.

In contrast, the population variable had a negative coefficient of -0.007 (p-value = 0.0040), indicating that higher population was associated with lower Indonesian palm oil exports during the observation period. The regression model yielded an R-squared of 0.816, indicating that approximately 81.6% of the variation in Indonesian palm oil exports to India, China, and Pakistan can be explained by GDP, exchange rates, and population. The remaining variation was influenced by other variables not included in the regression model.

In addition, the F-statistic of 24.046, with a p-value below the 5 per cent significance level, indicates that GDP, exchange rates, and population jointly have a significant effect on Indonesian palm oil exports.

Discussion

The results of this study indicate that gross domestic product (GDP) has a positive and significant effect on Indonesian palm oil exports to India, China, and Pakistan. This suggests that higher economic growth in destination countries tends to increase import demand for palm oil commodities. Countries with higher GDP generally have stronger purchasing power, greater industrial activity, and higher consumption capacity, which may encourage increased imports of palm oil products from Indonesia. This result is consistent with previous studies by Andreina (2017), Hameed et al. (2016), Risma et al. (2019), and Zakaria et al. (2024), which found that destination-country income plays an important role in influencing export demand. Similar findings were also reported by Rosyadi et al. (2021), who emphasized that GDP growth in importing countries significantly increases demand and export intensity for Indonesian and Malaysian palm oil products.

The positive effect of GDP also indicates that Indonesian palm oil exports are closely linked to economic conditions in importing countries. As the economies of India, China, and Pakistan continue to expand, demand for palm oil as a raw material for food, manufacturing, household products, oleochemicals, and biofuel industries also tends to increase (Adhikari et al., 2023). Higher GDP in destination countries generally increases purchasing power, industrial activity, and consumption capacity, thereby encouraging greater import demand for palm oil and its derivative products. This pattern reinforces the importance of external demand factors in determining Indonesia's export performance, particularly for strategic commodities such as palm oil.

Furthermore, the exchange rate variable was found to have a positive and significant effect on Indonesian palm oil exports. This indicates that exchange rate depreciation tends to improve export competitiveness by making Indonesian palm oil relatively cheaper in international markets. Consequently, destination countries may increase imports due to lower relative prices. This finding is consistent with previous studies conducted by Ginting (2013), Mahendra & Kesumajaya (2015), Lugo-Arias et al. (2024), and Tandra & Suroso (2023), which also found that exchange rates positively affect exports.

However, previous studies have reported inconsistent findings regarding the effect of exchange rates on exports. Anshari et al. (2017) and Hidayat et al. (2017), for example, found a negative relationship between exchange rates and export performance. Similar inconsistencies have also been identified in several recent studies, which show that the impact of exchange rate movements may vary across commodities, countries, and trade

structures (Adler et al., 2023; Sugiharti et al., 2020; Tarakçı et al., 2022). This variation is particularly relevant in the context of global value chains, where exchange rate movements may affect not only export prices but also production costs and trade linkages. These differences indicate that the effect of exchange rates on exports depends not only on price competitiveness but also on commodity characteristics, production costs, market structures, and macroeconomic conditions in exporting and importing countries. In the context of Indonesian palm oil exports, the positive effect of exchange rates found in this study suggests that price competitiveness remains an important factor influencing export demand in destination countries.

The findings also reveal that population has a negative and significant effect on Indonesian palm oil exports. This result is consistent with Pudyastuti et al. (2018), who also reported a negative relationship between population and trade flows. In addition, Hassan et al. (2023) showed that palm oil exports may be affected by substitution effects from other vegetable oils, suggesting that broader market characteristics shape the relationship between population and palm oil demand. Although population growth theoretically increases consumption demand, this study finds that larger populations in destination countries do not necessarily lead to higher imports of Indonesian palm oil.

This condition may reflect changes in consumption patterns, substitution toward alternative vegetable oils, or differences in domestic production capacity in destination countries. It may also be associated with sustainability concerns and changing consumer preferences in international markets (Mohamad & Ab-Rahim, 2024; Aguiar et al., 2018; Lieke et al., 2023). Previous studies have shown that palm oil increasingly faces competition from alternative vegetable oils, such as soybean and rapeseed oil, particularly in markets where environmental and sustainability issues have become more prominent (Bentivoglio et al., 2018; Chiriaco et al., 2024). In addition, sustainability standards and consumer awareness regarding deforestation and environmental impacts have influenced international demand dynamics for palm oil products. Therefore, the relationship between population growth and palm oil imports appears to be more complex than simple demand expansion.

Overall, this study's findings confirm that destination-country macroeconomic conditions play an important role in shaping Indonesian palm oil export performance. GDP growth and exchange rate movements were found to strengthen export performance, while population growth showed the opposite relationship during the observation period. These findings emphasize the importance of understanding destination-country economic characteristics in formulating export strategies and maintaining the competitiveness of Indonesian palm oil products in international markets.

From a theoretical perspective, these findings reinforce the importance of demand-side factors in international trade, particularly the role of destination-country income and price competitiveness in shaping export performance. The results support the view that macroeconomic conditions in importing countries significantly influence commodity trade flows, especially for export-oriented agricultural commodities such as palm oil. Previous studies have similarly emphasized that destination-country GDP, purchasing power, and import capacity are important determinants of agricultural export performance and international trade competitiveness (Taş & Yılmaz, 2025; Wimalasiri et al., 2025). In addition, price competitiveness and market demand in importing countries remain crucial factors influencing the export performance of primary commodities in developing countries.

From a practical perspective, the findings suggest that Indonesia's palm oil export

strategy should take into account economic conditions and exchange rate dynamics in major destination countries. In addition, the negative relationship between population and exports indicates that export performance may also be influenced by changing consumer preferences and sustainability-related concerns in international markets. Previous studies have emphasized that export competitiveness in the global palm oil market is increasingly shaped by destination-country economic conditions, market diversification strategies, and compliance with international sustainability standards (Jafari et al., 2017; Pratiwi, 2021). Sustainability standards are not only reputational issues but also increasingly function as market-access requirements in major importing regions. Furthermore, strengthening sustainable palm oil governance, improving traceability systems, and expanding exports to non-traditional markets have become increasingly important for maintaining Indonesia's competitiveness in international trade (Azahari et al., 2024; Wibawa et al., 2024). Therefore, strengthening export competitiveness, market diversification, and sustainable palm oil governance may become increasingly important for maintaining Indonesia's position in the global palm oil market.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study examined the influence of gross domestic product (GDP), exchange rates, and population on Indonesian palm oil exports to India, China, and Pakistan during 2012–2022, using panel data analysis. The findings show that Indonesian palm oil exports to these three major destination countries fluctuated during the observation period. India recorded the highest average export value, while Pakistan showed a stronger upward trend toward the end of the period. The regression results indicate that GDP and exchange rates have a positive and significant effect on Indonesian palm oil exports, while population has a significant negative effect. These findings suggest that macroeconomic conditions and price competitiveness in destination countries play a significant role in shaping the performance of Indonesian palm oil exports.

The findings also provide empirical evidence that destination-country characteristics significantly influence Indonesia's palm oil trade performance. This study contributes to the international trade and export literature by providing a comparative analysis of demand-side determinants across three major export destination countries. The results reinforce the importance of understanding external market dynamics, particularly destination-country income and exchange rate movements, in maintaining the competitiveness of Indonesian palm oil products in international markets.

Recommendations

Based on this study's findings, efforts to strengthen the competitiveness of Indonesian palm oil exports should focus on downstream industrial development, export market diversification, and sustainable palm oil governance. Policymakers should also pay greater attention to macroeconomic conditions and exchange rate dynamics in major destination countries, as these factors significantly influence export performance. In addition, strengthening the international image and sustainability standards of Indonesian palm oil products may help maintain export demand in increasingly competitive global markets.

This study is limited to three destination countries and selected macroeconomic variables. Therefore, future studies may incorporate additional determinants, such as international palm oil prices, trade policies, environmental regulations, and sustainability

indicators, as well as broader destination-country coverage and longer observation periods. Such approaches may provide a more comprehensive understanding of the dynamics of Indonesian palm oil exports in the global market.

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