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MARKET POWER OF INDONESIAN AND MALAYSIAN PALM OIL EXPORTS IN MAJOR IMPORTING MARKETS: AN ANALYSIS OF RESIDUAL DEMAND ELASTICITY

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ABSTRACT

Indonesia and Malaysia dominate global palm oil exports; however, large market shares did not necessarily imply pricing power. This study examined the extent of market power exercised by Indonesian and Malaysian crude palm oil (CPO) exports in three major importing markets—India, Pakistan, and China—by applying a structural residual demand elasticity (RDE) framework within a simultaneous equation system. Using annual data from 1994 to 2023, the analysis employed Seemingly Unrelated Regressions (SUR) and Three-Stage Least Squares (3SLS) to address endogeneity and cross-market interdependence. The results indicated that Indonesia exercised stronger market power in India and Pakistan, while market power was weaker in China due to greater substitution among vegetable oils. Malaysia exhibited statistically significant but consistently lower market power across destination markets. Export restriction policies, including export duties and related trade measures, significantly affected residual demand elasticity and export pricing behavior, particularly in markets with high import dependence. These findings provided a comparative and policy-relevant assessment of pricing power in the international palm oil trade.

Key words: export duty, oligopoly, market power

INTRODUCTION

Indonesia and Malaysia are the two largest producers and exporters of palm oil in the world. In 2023, Indonesia produced more than 50 million tons of palm oil, with export volumes reaching approximately 36 million tons and generating foreign exchange earnings of USD 25 billion. Malaysia ranked second, producing around 20 million tons and exporting 18 million tons valued at USD 16 billion (BPS-Statistics Indonesia 2024; World Bank 2024). The leading position of these two countries underscores the strategic role of palm oil in global agricultural trade. Crude palm oil (CPO) represents one of the most important plantation commodities in international markets and serves as a key input in multiple industries, including food processing, renewable energy, cosmetics, and oleochemicals. Global

demand for CPO continues to expand due to its versatility and relatively high production efficiency compared with other vegetable oils such as soybean, sunflower, and rapeseed oil.

Oil palm cultivation is widely recognized for its superior land productivity, yielding approximately 3.7 tons of oil per hectare annually, substantially higher than soybean yields of about 0.4 tons per hectare. Relatively low production costs and a long economic lifespan of 25 to 30 years further strengthen its competitiveness in international markets (Wibowo et al. 2023; Winardi et al. 2017; Singh and Zhu 2008). These structural advantages explain why palm oil remains one of the most extensively traded vegetable oils worldwide, with Indonesia and Malaysia jointly accounting for more than eighty percent of global CPO exports. Asia constitutes the principal destination region for Indonesian CPO exports. In 2023, India, Pakistan, and China emerged as the three largest importers, accounting for 16.94 percent, 13.16 percent, and 9.96 percent of Indonesia's total palm oil exports, equivalent to USD 5.335 billion, USD 4.143 billion, and USD 3.137 billion, respectively (UN Comtrade 2024).

These figures confirm the central importance of these markets for Indonesia's export performance. Demand structures differ substantially across importing countries. India imports large volumes of crude palm oil (CPO) primarily for food processing, particularly for ghee production. China places greater emphasis on refined palm oil for both food consumption and industrial applications, while Pakistan relies heavily on CPO imports to sustain its domestic cooking oil industry. These differences in demand structures reflect the diverse roles of palm oil across national food systems and industrial uses, which in turn shape import dependence and market responsiveness in each country (Lee et al. 2020; Suroso 2022; Suryana 2016). Previous studies also emphasize that global palm oil trade patterns are strongly influenced by structural demand conditions, trade policies, and the competitiveness of major exporting countries (Nugrahapsari et al. 2024). In addition, export performance is closely linked to factors such as production levels, export policies, and macroeconomic conditions that affect international market dynamics (Rifai et al. 2015).

Such heterogeneity in demand patterns implies that Indonesia's competitive position and pricing influence are unlikely to be uniform across destination markets. Despite their dominance in production and export shares, Indonesia and Malaysia do not necessarily act as price setters in the global palm oil market. International CPO prices are influenced by multiple factors, including fluctuations in substitute vegetable oil prices such as soybean and sunflower oil, macroeconomic conditions in importing countries, trade policies, and climate-related production shocks. Domestic policy instruments in exporting countries, including export duties, export levies, and downstream development strategies, further affect export supply incentives and competitiveness (Immanuel et al. 2019; Ministry of Agriculture 2024; Rifin 2010). These policies are intended to stabilize domestic supply and promote value-added processing, yet they may also influence export volumes and international price dynamics.

In economic theory, market power refers to the ability of a market participant to influence prices or quantities within a particular market. In the context of international trade, exporter market power reflects the extent to which an exporting country can affect the price of its products in destination markets. One approach widely used to analyse exporter market power is the residual demand framework (Goldberg and Knetter 1999). Residual demand refers to the demand faced by a particular exporter after the supply responses of competing exporters have been considered. In other words, it represents the portion of total market demand that remains available to a specific exporter once competitors have supplied their quantities to the market. Residual demand elasticity (RDE) differs from conventional demand elasticity. Traditional demand elasticity measures the responsiveness of total market demand to changes in price. By contrast, residual demand elasticity measures the responsiveness of the demand faced by an individual exporter after accounting for the reactions of competing suppliers (Baker and Bresnahan 1988; Knetter 1989).

This distinction is important in markets where a small number of exporters dominate global supply. In such settings, the elasticity of residual demand becomes a direct indicator of market power. When residual demand is relatively inelastic, exporters can increase prices without experiencing a proportional reduction in export quantities, implying stronger pricing power. Conversely, when residual demand is highly elastic, exporters face intense competition and behave more like price takers in the market (Carter and MacLaren 1997; Goldberg and Knetter 1999). The residual demand elasticity framework is particularly relevant for analysing international agricultural commodity markets that exhibit oligopolistic characteristics. In these markets, a limited number of large exporters interact strategically and influence price formation in destination markets. Previous studies show that such market structures can generate varying degrees of exporter market power in international trade (Go and Lau 2017; Zhu et al. 2019). The RDE approach therefore provides a useful analytical tool for measuring export competitiveness and identifying the extent to which exporters can influence prices in international markets.

Although extensive research has examined palm oil trade, most empirical studies focus on comparative advantage, export performance, or price transmission rather than directly estimating exporter market power. Rifin (2010), for example, analysed the impact of Indonesia's export duty policy on CPO exports and found that the policy tends to reduce export competitiveness. However, the study did not quantify the degree of pricing power exercised by Indonesian exporters in major destination markets. Other studies have emphasized that Indonesia exhibits stronger comparative advantage than Malaysia in markets such as India and Spain, but these analyses primarily evaluate trade performance indicators rather than directly measuring exporter market power through structural demand estimation.

Empirical studies using Granger causality analysis also indicate strong linkages between domestic and international palm oil prices. For example, Lee et al. (2020) and Rifin (2010) document price interactions between major reference markets such as Rotterdam and Bursa Malaysia, suggesting a high degree of price integration across markets. Such interdependence may reflect strategic interactions among dominant exporters and indicates the possibility of oligopolistic behaviour in the international palm oil market. Nevertheless, the magnitude of exporter market power in the global palm oil market remains largely unexplored. Several research gaps therefore remain. Empirical evidence directly estimating the market power of Indonesian and Malaysian CPO exports using a structural residual demand elasticity framework is still limited. Comparative analysis of both exporters across multiple major importing markets while accounting for cross-market interdependence is rarely conducted. Furthermore, the interaction between export restriction policies and exporter market power has not been rigorously analysed within a unified econometric framework.

Indonesia and Malaysia together account for more than eighty-five percent of global CPO exports, making the assessment of their pricing influence particularly important for understanding global vegetable oil markets. Competitive interaction between these two exporters further complicates price dynamics. Indonesia exports larger volumes, whereas Malaysia benefits from trade agreements such as the Malaysia–India Comprehensive Economic Cooperation Agreement, which facilitates preferential access to the Indian market. Non-price factors such as trade agreements, exchange rate movements, and economic diplomacy also influence export competitiveness. Substitution between palm oil and other vegetable oils is relatively high in China, which may reduce pricing power compared with India and Pakistan where import dependence is stronger. These structural differences suggest that exporter market power may vary significantly across destination markets.

This study therefore examines the extent of market power exercised by Indonesia and Malaysia in the global crude palm oil market using a structural residual demand elasticity framework. The analysis focuses on three major importing markets—India, Pakistan, and China—which together represent the largest destinations for Indonesian palm oil exports. Specifically, the study pursues two

objectives. First, it estimates and compares the degree of exporter market power of Indonesian and Malaysian CPO exports across the three major importing markets using a simultaneous equation system estimated through Seemingly Unrelated Regression (SUR) and Three-Stage Least Squares (3SLS) techniques. Second, it evaluates the impact of export restriction policies, including export duties and related policy measures, on residual demand elasticity and export pricing behaviour. By integrating exporter competition and policy variables within a unified econometric framework, this study provides a comparative and policy-relevant assessment of pricing power in the international palm oil market. The findings contribute to the literature on agricultural trade and industrial organization by offering empirical evidence on how export policy instruments interact with market structure in a highly concentrated commodity market.

RESEARCH METHODS

The Residual Demand Elasticity (RDE) model was formally introduced in the international trade literature by Goldberg and Knetter (1999) as a structural framework for measuring exporter market power using aggregate trade data. The model estimates the demand faced by an exporter after accounting for the supply responses of competing exporters in the same destination market. Within this framework, exporters face residual demand rather than total market demand. The elasticity of this residual demand reflects the degree of pricing power exercised by exporters in international markets. The RDE framework is therefore particularly appropriate for analysing the market power of Indonesia and Malaysia in the global palm oil market, where a small number of dominant exporters interact strategically and compete across major importing markets. This study uses annual data covering the period 1994 to 2023. The analysis focuses on two major exporting countries, Indonesia and Malaysia, and three principal importing markets, namely India, Pakistan, and China. These countries represent the largest destinations for Indonesian and Malaysian crude palm oil (CPO) exports and together account for the majority of global palm oil trade. Using these markets allows the analysis to capture variations in demand structures and competitive interactions across importing countries.

Export price and export volume data for CPO were obtained from the UN Comtrade database, which provides detailed bilateral trade statistics. Macroeconomic indicators for importing countries, including real GDP and the Consumer Price Index (CPI), were obtained from the World Bank World Development Indicators database. Exchange rate data were collected from the IMF International Financial Statistics database. Policy variables, including export duties, non-tariff measures (NTM), and free trade agreements (FTA), were compiled from official government publications, WTO trade policy reports, and international trade policy databases. All price variables were converted into consistent units, and yearly series were transformed into natural logarithms to ensure comparability across countries and to reduce heteroskedasticity in the estimation. Prior to estimation, the dataset was organized into a panel time-series structure by exporter–importer pairs. Export prices and quantities were matched by year for each exporting country (Indonesia and Malaysia) and each destination market (India, Pakistan, and China). Missing observations were checked and corrected using official trade records where available. Continuous variables were expressed in logarithmic form to interpret estimated coefficients as elasticities and to stabilize variance across the time series.

The empirical model is estimated separately for each importing market of Indonesian and Malaysian CPO, namely India, Pakistan, and China. To capture the strategic interaction between the two dominant exporters and the potential interdependence across destination markets, the model is specified as a system of simultaneous equations (Gafarova et al. 2023; Pall et al. 2013; Uhl 2021). The baseline estimating equation is defined as:

$$\ln P_{mt}^{n} = \gamma_{m}^{n} + \eta_{m}^{n}\ln Q_{mt}^{n} + \alpha_{m}^{n}\ln GDP_{mt} + \sigma_{m}^{n}\ln CPI_{mt} + \delta_{m}^{n}T_{mt} + \beta_{m}^{k}\ln e_{mt}^{k} + \varphi_{m}^{k}\ln PPW_{mt}^{k} + \vartheta_{mt}^{n}ER_{mt}^{n,ET} + \vartheta_{mt}^{k}ER_{mt}^{k,ET} + \vartheta_{mt}^{m}ER_{mt}^{m,NTM} + \vartheta_{mt}^{m}ER_{mt}^{m,FTA} + \varepsilon_{mt}$$

Information

n	:	Exporting countries (Indonesia/Malaysia)
m	:	Importing countries (India/Pakistan/China)
k	:	Competitor countries (Malaysia for the Indonesian equation and vice versa)
P_{mt}^{n}	:	Export price of CPO exporter to the importer market (INR/PKR/CNY per Ton)
Q_{mt}^{n}	:	Export volume of CPO exporters to importer markets (Tons)
η_{m}^{n}	:	Elasticity of Indonesia's residual demand in India, Pakistan, China at t
GDP_{mt}	:	Real GDP India, Pakistan, China at t time (USD)
CPI_{mt}	:	Consumer Price Index for Food Goods in the importer's market
T_{mt}	:	Linear time trends
e_{mt}^{k}	:	Competitor exchange rate to importer market (MYR/INR, MYR/PKR, MYR/CNY)
PPW_{mt}^{k}	:	Price of CPO producers in competing countries (MYR/Ton)
$ER^{n,ET}$	:	CPO Export Duty of Exporting Countries (US$/ton)
$ER^{k,ET}$	:	Competitor Countries' CPO Export Duties (US$/ton)
$ER^{m,NTM}$	:	Dummy of Non-Tariff Measure (NTM) in the importer's market in the period t (0 = no NTM; 1 = NTM)
$ER^{m,FTA}$	:	Dummy enforced Free Trade Area (FTA) in importer market (0 = no FTA; 1 = FTA)
ε_{t}	:	Error term

The primary parameter of interest is η_m^n, which represents the elasticity of residual demand faced by the exporter in each destination market. A statistically significant and relatively inelastic residual demand elasticity indicates that exporters can increase prices without experiencing a proportional reduction in export quantities, reflecting the presence of market power. Because export prices and quantities are jointly determined in international trade, the empirical estimation is conducted within a simultaneous equation framework to address potential endogeneity. The estimation procedure follows several steps. First, residual demand equations are specified for each exporter–importer pair, allowing the demand faced by Indonesia and Malaysia to be estimated separately for India, Pakistan, and China. Second, the system of equations is initially estimated using Seemingly Unrelated Regressions (SUR) introduced by Zellner (1962). SUR allows the disturbance terms across destination markets to be correlated, which is plausible in global commodity markets where shocks in one market may influence prices in others.

However, SUR does not correct for simultaneity bias arising from the joint determination of prices and quantities. Therefore, the final estimation employs Three-Stage Least Squares (3SLS), which combines instrumental variable estimation with system estimation. This method allows endogenous regressors to be instrumented while simultaneously accounting for cross-equation correlations. Instrumental variables are constructed using exporter-side supply shifters. Producer prices (PPW) are used as instruments because they capture domestic production conditions such as input costs, productivity, weather shocks, and domestic policy interventions. These factors affect export supply but are not directly determined by demand conditions in specific importing markets. Consequently, producer prices serve as valid instruments within the residual demand framework (Knetter 1989; Carter and MacLaren 1997; Goldberg and Knetter 1999). Similar approaches have been applied in empirical studies of agricultural commodity trade (Pall et al. 2013; Uhl 2021).

Model validity is evaluated through several diagnostic procedures. The Durbin–Wu–Hausman test is used to detect the presence of endogeneity. The Hansen–Sargan test evaluates the validity of over-identifying restrictions and confirms instrument exogeneity. Additional diagnostic tests include heteroskedasticity testing using the Breusch–Pagan or White tests, multicollinearity assessment using the Variance Inflation Factor (VIF), and serial correlation testing using the Breusch–Godfrey test. Within this framework, the magnitude and statistical significance of the estimated residual demand elasticity provide direct evidence of exporter market power. A residual demand elasticity close to zero

indicates highly elastic demand consistent with competitive market conditions, while a larger negative elasticity indicates stronger pricing power. The larger the absolute value of η_m^n, the greater the exporter's ability to influence export prices in the corresponding destination market.

RESULTS AND DISCUSSION

CPO market overview. The global crude palm oil (CPO) market is largely dominated by Indonesia and Malaysia, which together account for more than 80 percent of global production and exports. Data from the World Bank (2024) indicate that Indonesia contributes approximately 58 percent of global output, while Malaysia accounts for around 25 percent. UN Comtrade (2024) reports that Indonesia's export value in 2023 exceeded 24 billion US dollars, compared with approximately 14 billion US dollars for Malaysia. These figures confirm the central role of the two countries in shaping international CPO supply and influencing global price dynamics. Such a high level of market concentration is consistent with Winardi and co-workers (2017), who described the palm oil industry as an oligopolistic market structure in which a small number of dominant exporters influence trade flows and international prices. To provide preliminary insights into the behavior of the international palm oil market, graphical presentations of time-series export prices are presented for both Indonesia and Malaysia across the major importing markets of India, Pakistan, and China. These graphical illustrations allow an initial observation of price dynamics before the econometric analysis is conducted.

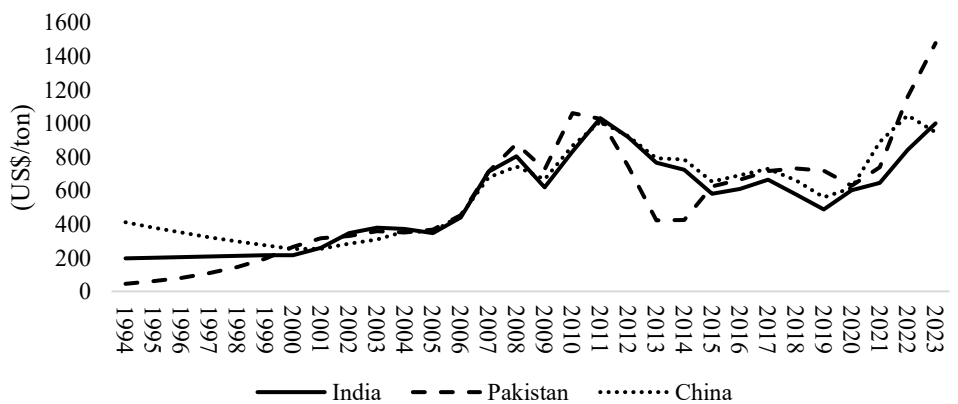

Figure 1. Trend of Indonesian CPO export prices in major import markets (1994–2023) (India, Pakistan, and China).
Source: UN Comtrade (2024)

Figure 1 presents the trend of Indonesia's CPO export prices in the three major importing markets over the period 1994–2023. The price movements across India, Pakistan, and China generally follow a similar pattern, indicating a strong degree of integration in the global palm oil market. Major price increases occurred during the global commodity boom between 2007 and 2008 and again after 2020. These periods correspond to global supply disruptions, increasing demand for vegetable oils, and shocks originating from energy markets that affected biofuel demand. Despite the broadly similar price trends, differences in the magnitude of price fluctuations are observed across markets. Pakistan shows the most pronounced price increases in recent years, which may reflect a stronger dependence on imported palm oil. In contrast, China exhibited relatively smoother price movements, suggesting the presence of broader substitution possibilities with other vegetable oils such as soybean oil and sunflower oil. These observations indicate that while global supply conditions largely determined the general direction of prices, country-specific demand structures contributed to variations in price dynamics across importing markets.

Figure 2 presents the corresponding price trends for Malaysia's CPO exports to the same importing markets. Similar to the Indonesian case, Malaysia's export prices across India, Pakistan, and China display closely related movements over time. The consistency of price trends across exporters and markets further indicates that the global palm oil market operates as an integrated commodity market where international shocks are transmitted rapidly across trading partners. Beyond price dynamics, the distribution of export market shares across importing countries also illustrates the structural position of the two exporters. Table 1 reports the average market share of Indonesian and Malaysian CPO exports in India, Pakistan, and China over the period 1994–2023. Indonesia commands a dominant share of the Indian market (55.3 percent) and the Pakistani market (64.7 percent), both considerably higher than Malaysia's shares in these markets. These findings are consistent with Suroso (2022), who highlights the strong reliance of India and Pakistan on Indonesian palm oil due to competitive pricing and established bilateral trade relationships. The prominent role of Indonesia in Pakistan is also supported by Lee et al. (2020), who note that Pakistan's refining and food processing industries depend heavily on imported crude palm oil.

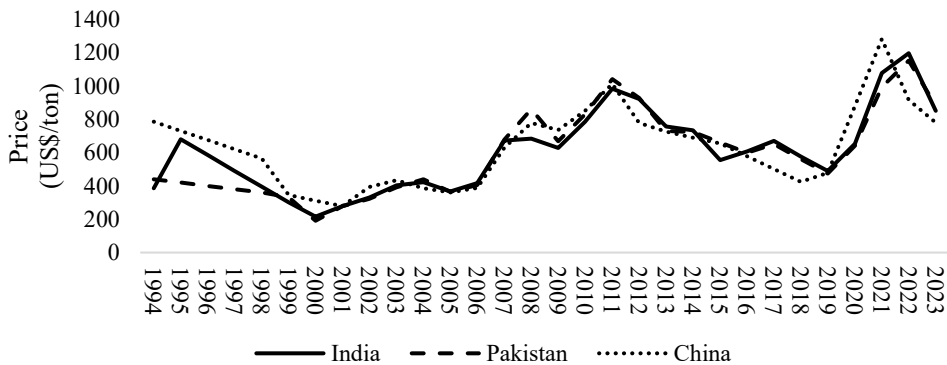

Figure 2. Trend of Malaysian CPO Export Prices in major import markets (1994–2023) (India, Pakistan, and China). Source: UN Comtrade (2024)

The Chinese market exhibits a more balanced structure, with Indonesia accounting for 48.5 percent and Malaysia 40.6 percent of imports. The relatively even distribution of market shares indicates stronger competition between the two exporters. Singh and Zhu (2008) explain that China's vegetable oil market is characterized by a high degree of substitutability among palm oil, soybean oil, and sunflower oil. Such substitution possibilities reduce the dominance of any single supplier and contribute to more elastic import demand for palm oil. As a result, Chinese buyers tend to adopt flexible procurement strategies in response to price changes.

Table 1. Average market share of Indonesian and Malaysian CPO exports in major importing markets, 1994–2023

Importing Country	Indonesia (%)	Malaysia (%)	Rest of World (%)
India	55.3	37.8	6.9
Pakistan	64.7	30.2	5.1
China	48.5	40.6	10.9

Source: UN Comtrade (2024)

These differences across importing markets highlight the heterogeneous structure of international demand for palm oil. Indonesia's dominance is strongest in India and Pakistan, where import dependence and supply chain linkages are more pronounced, whereas the Chinese market

reflects stronger competitive interaction between Indonesia and Malaysia. The variation in market structures across destination markets underscores the importance of analyzing exporter market power within specific market contexts and supports the application of the residual demand elasticity framework.

Indonesia's CPO export market power in major importer markets. The residual demand equations for Indonesian CPO exports to India, Pakistan, and China are estimated simultaneously because price formation across these destination markets is closely interconnected. These three countries represent the largest importing markets for Indonesian palm oil and rely heavily on two dominant global suppliers, Indonesia and Malaysia. As a result, changes in export supply conditions or pricing strategies in one market can influence price dynamics in other markets through integrated trade flows and competitive interactions between exporters. The graphical evidence presented in Figures 1 and 2 illustrates this interdependence. The time-series trends of export prices for both Indonesian and Malaysian CPO in India, Pakistan, and China during the period 1994–2023 display broadly similar movements over time. Major price increases occur during the global commodity boom of 2007–2008 and again after 2020, while price declines are observed during periods of global economic adjustment. The parallel movement of prices across the three importing markets suggests a high degree of integration in the international palm oil market, where global supply shocks, demand expansion, and energy market developments affect multiple destination markets simultaneously.

Table 2. Endogeneity test results for the RDE model of Indonesian CPO exports

	With Export Restrictions			**Without Export Restrictions**		
Destination Market	**India**	**Pakistan**	**China**	**India**	**Pakistan**	**China**
Number of instruments	16	16	18	10	10	12
Number of excluded instruments	2	2	2	2	2	2
Excluded instruments	PPW^{INA}, TQ^{INA}	PPW^{INA}, TQ^{INA}	PPW^{INA}, TQ^{INA}	PPW^{INA}, TQ^{INA}	PPW^{INA}, TQ^{INA}	PPW^{INA}, TQ^{INA}
Wu–Hausman F statistic	12.8451	18.3927	11.7246	9.8673	14.5832	10.2157
p-value	(0.0000)	(0.0000)	(0.0362)	(0.0485)	(0.0000)	(0.0417)
Durbin–Wu–Hausman χ^2 statistic	10.3158	16.4752	9.8652	7.9463	13.2715	8.4521
p-value	(0.0015)	(0.0000)	(0.0284)	(0.0392)	(0.0000)	(0.0473)

Note: PPW^{INA} denotes the domestic producer price of crude palm oil in Indonesia (US$/ton), representing supply-side production costs. TQ^{INA} denotes the total quantity of Indonesian CPO exports (tons). ***, **, * significance level

Such price co-movement is consistent with previous empirical studies that document strong linkages among international palm oil markets and other vegetable oil markets. Palm oil prices in major trading hubs exhibit significant transmission effects across markets, reflecting the globally integrated nature of the commodity (Lee et al. 2020; Rifin 2010). Similar findings argue that price interactions across destination markets are typical in oligopolistic export industries where a small number of exporters dominate global supply (Goldberg and Knetter 1999). In this context, estimating the residual demand equations within a simultaneous equation framework is appropriate because export prices and quantities are jointly determined across markets. The simultaneous system captures cross-market interdependence and accounts for the strategic interaction between competing exporters, particularly Indonesia and Malaysia. By allowing the error terms across destination-market equations to be correlated, the model better reflects the structure of international commodity trade where global shocks

and policy changes may affect several importing markets at the same time. This approach therefore improves the efficiency and consistency of the estimated parameters when evaluating Indonesia's market power in major importing markets.

Table 2 presents the results of the endogenous regressor tests applied to the RDE model of Indonesian CPO exports to India, Pakistan, and China under scenarios with and without export restrictions. The Wu–Hausman F statistics and the Durbin–Wu–Hausman chi-square statistics consistently reject the null hypothesis that the regressors are exogenous at the 1–5 percent significance level. These results confirm the presence of endogeneity between export prices and quantities, supporting the use of instrumental variable estimation in the system. Use of limited but relevant instruments, namely export prices and total export quantities, prevents over-identification and enhances reliability of estimates. Table 2 presents the results of endogeneity tests for the RDE model across India, Pakistan, and China under both specifications. The Wu-Hausman F test and Durbin-Wu-Hausman chi-square test confirm instrument validity. P-values associated with PPW^{INA} and TQ^{INA} are generally below 0.05, indicating statistical significance at the 1–5 percent level and confirming instrument relevance and exogeneity. Variation in Wu-Hausman and Durbin-Wu-Hausman statistics across markets reflects differences in instrument strength. Pakistan exhibits stronger instrument relevance compared with India and China, consistent with its higher dependence on Indonesian CPO imports.

RDE estimation results are presented using 3SLS and SUR methods for India, Pakistan, and China under both specifications. R-squared values range from 0.58 in China to 0.72 in Pakistan, indicating satisfactory explanatory power (Tables 3, 4, and 5). Durbin-Watson statistics lie between 1.96 and 2.08, suggesting absence of serious autocorrelation. Hansen-Sargan statistics confirm instrument validity because the null hypothesis of over-identifying restrictions cannot be rejected. The coefficient of primary interest is the residual demand elasticity (η). According to the Lerner index relationship, $(P - MC)/P = 1/|RDE|$, implying that the markup over marginal cost is inversely related to the absolute value of residual demand elasticity. Therefore, when residual demand is more elastic (larger |RDE|), exporters have limited ability to raise prices, whereas when residual demand is inelastic (smaller |RDE|), exporters can maintain higher price markups and stronger market power.

Estimation results indicate that Indonesia exhibits significant market power in India and Pakistan. In India, η ranges from −0.61 to −0.49 (Table 3). This implies that a 1 percent increase in Indonesia's export price reduces import demand by approximately 0.49–0.61 percent, indicating relatively inelastic residual demand and allowing Indonesia to maintain a positive markup. In Pakistan, η ranges from −0.69 to −0.56 (Table 4), meaning that a 1 percent increase in price reduces demand by about 0.56–0.69 percent, which also reflects inelastic demand and substantial pricing influence. In contrast, the Chinese market exhibits more elastic residual demand. Estimates range from −0.30 to −0.22 (Table 5), implying that a 1 percent increase in Indonesia's export price reduces demand by approximately 0.22–0.30 percent. Although still inelastic in absolute terms, these smaller elasticities suggest weaker pricing influence due to stronger substitution with other vegetable oils such as soybean and sunflower oils.

Other model variables display theoretically consistent effects. Real GDP exerts a positive and statistically significant influence across markets, indicating that higher income levels increase import demand for vegetable oils. CPI generally shows a negative effect, particularly in China, suggesting that domestic inflation reduces purchasing power and dampens import demand. Exchange rate movements also influence competitiveness. The coefficient of the Malaysian exchange rate is negative in both India and Pakistan, indicating that a depreciation of the Malaysian ringgit increases Malaysia's export competitiveness relative to Indonesia. Malaysian CPO export prices also exert a positive effect on Indonesian export demand. For example, in India the coefficient ranges between 0.1860 and 0.2617, implying that a 1 percent increase in Malaysian CPO export prices raises demand for Indonesian CPO by about 0.19–0.26 percent, reflecting substitution between the two exporters.

Table 3. RDE estimation results using Indonesia's 3SLS and SUR approach in Indian market

Parameters	With Export Restrictions				No Export Restrictions			
	3SLS		SUR		3SLS		SUR	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
η_{IND}^{INA}	-0.6079**	-3.0146	-0.5712**	-2.8754	-0.5417**	-2.8123	-0.4948**	-2.5392
α_{IND}^{INA}	0.4046**	4.0218	0.3821**	3.8849	0.3787**	3.7426	0.3581**	3.5984
σ_{IND}^{INA}	-0.0697	-1.1415	-0.0598	-1.0340	-0.0479	-0.9002	-0.0451	-0.8641
δ_{IND}^{INA}	0.0189	1.2847	0.0170	1.1906	0.0152	1.0291	0.0135	0.9662
β_{MYR}^{INR}	-0.0816*	-1.6383	-0.0712*	-1.5480	-0.0684*	-1.6035	-0.0605*	-1.5076
φ_{IND}^{MAL}	0.2617**	2.5872	0.2329**	2.3781	0.2013**	1.9984	0.1860*	1.9347
$\vartheta_{IND}^{INA,ET}$	-0.2916**	-2.0854	-0.2634**	-1.9873				
$\vartheta_{IND}^{MAL,ET}$	-0.0841*	-1.6129	-0.0735*	-1.5317				
$\vartheta_{IND,NTM}$	-0.0769	-1.1527	-0.0664	-1.0892				
$\vartheta_{IND,FTA}$	0.1887**	2.0145	0.1729**	1.9723				
γ_{IND}^{INA}	0.6285***	4.2516	0.5934***	4.0407	0.5831***	3.8720	0.5624***	3.7339
R-square	0.6745		0.7063		0.6412		0.6895	
DW-stat	2.0526		2.1041		1.9843		2.0127	
Hansen-Sargan stat	4.0836		3.8619		2.7264		2.4983	

Note: **, and * express significance at the 1%, 5%, and 10% levels.

Table 4. RDE estimation results using Indonesia's 3SLS and SUR approach in Pakistani market

Parameters	With Export Restrictions				No Export Restrictions			
	3SLS		SUR		3SLS		SUR	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
η_{PAK}^{INA}	-0.6891**	-3.4562	-0.6543**	-3.2121	-0.6018***	-3.0057	-0.5664***	-2.8649
α_{PAK}^{INA}	0.3952***	3.9985	0.3764***	3.8011	0.3549***	3.6123	0.3415***	3.4769
σ_{PAK}^{INA}	-0.0815	-1.2951	-0.0726	-1.1839	-0.0619	-1.0746	-0.0587	-1.0224
δ_{PAK}^{INA}	0.0274*	1.7013	0.0231	1.5026	0.0197	1.3482	0.0176	1.2425
β_{MYR}^{INR}	-0.0938**	-2.0457	-0.0827**	-1.9786	-0.0786*	-1.8453	-0.0719*	-1.6991
φ_{PAK}^{MAL}	0.2886***	2.9364	0.2547**	2.5147	0.2268**	2.1864	0.2129*	1.9741
$\vartheta_{PAK}^{INA.ET}$	-0.3125**	-2.2467	-0.2849**	-2.1036				
$\vartheta_{PAK}^{MAL.ET}$	-0.0982*	-1.6882	-0.0867*	-1.6054				
$\vartheta_{PAK.NTM}$	-0.0921	-1.3226	-0.0804	-1.2073				
$\vartheta_{PAK.FTA}$	0.2178**	2.1546	0.1997**	2.0183				
γ_{PAK}^{INA}	0.6574***	4.5231	0.6128***	4.1983	0.5972***	3.9964	0.5721***	3.8436
R-square	0.6927		0.7215		0.6541		0.7036	
DW-stat	2.0834		2.1279		1.9745		2.0258	
Hansen-Sargan stat	4.3981		4.1027		2.8961		2.6039	

Note: **, and * express significance at the 1%, 5%, and 10% levels

Trade policy variables also influence market outcomes. Indonesian export duties show negative coefficients, indicating that higher export taxes reduce export competitiveness by increasing export prices. Malaysian export duties produce the opposite effect by weakening Malaysia's competitive position. Non-tariff measures generally exhibit negative but statistically weak effects, suggesting that regulatory requirements affect trade primarily through compliance costs rather than direct quantity restrictions. Free trade agreements show positive and statistically significant effects in India and Pakistan, reflecting improved market access and reduced trade barriers. Overall, the empirical results indicate that Indonesia maintains stronger market power in India and Pakistan than in China, consistent with differences in import dependence and substitution possibilities. These findings are consistent with the residual demand framework, where market power emerges when exporters face relatively inelastic demand in destination markets.

Table 5. RDE estimation results using Indonesia's 3SLS and SUR approach in the Chinese market.

Parameters	With Export Restrictions				No Export Restrictions			
	3SLS		SUR		3SLS		SUR	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
η_{CHI}^{INA}	-0.3027**	-2.0419	-0.2784**	-1.9675	-0.2516*	-1.7851	-0.2297*	-1.6423
α_{CHI}^{INA}	0.2763***	3.1842	0.2581***	3.0357	0.2415**	2.8246	0.2279**	2.6938
σ_{CHI}^{INA}	-0.1254**	-2.2187	-0.1128*	-1.9047	-0.1085*	-1.8371	-0.0962	-1.6942
δ_{CHI}^{INA}	0.0145	1.0923	0.0129	0.9815	0.0112	0.8739	0.0095	0.7926
β_{MYR}^{INR}	-0.0579	-1.2964	-0.0527	-1.2084	-0.0486	-1.1456	-0.0442	-1.0825
φ_{CHI}^{MAL}	0.1897*	1.9184	0.1724*	1.8142	0.1582	1.6358	0.1445	1.5283
$\vartheta_{CHI}^{INA.ET}$	-0.1457	-1.4936	-0.1318	-1.3872				
$\vartheta_{CHI}^{MAL.ET}$	-0.0962	-1.2837	-0.0845	-1.2019				
$\vartheta_{CHI.NTM}$	-0.0674	-1.0974	-0.0598	-1.0421				
$\vartheta_{CHI.FTA}$	0.1289	1.4736	0.1173	1.3827				
γ_{CHI}^{INA}	0.4287***	3.5619	0.4029***	3.2971	0.3895***	3.1526	0.3667***	2.9981
R-square	0.5836		0.6129		0.5417		0.5875	
DW-stat	1.9681		1.9872		1.9435		1.9637	
Hansen-Sargan stat	3.2197		2.9874		2.1075		1.9186	

Note: **, and * express significance at the 1%, 5%, and 10% levels.

Differences in market power across destination markets are consistent with empirical evidence on competitiveness and revealed comparative advantage. Zuhdi et al. (2021) demonstrate strong Indonesian competitiveness in India and Pakistan using RCA measures. Rosyadi et al. (2021) identify GDP growth and export volumes as key drivers of CPO export performance. High structural dependence in these markets supports the inelastic residual demand estimates. Evidence from China emphasizes substitution effects. Cross-price interactions are strong among vegetable oils (Kojima et al. 2016), while competitive dynamics exists within China's edible oil market (Wang 2018). These findings align with the more elastic RDE estimates observed for China. Lugo-Arias et al. (2024) identify exchange rates and competing oil prices as determinants of export competitiveness, consistent with substitution effects observed in this study. GDP, exchange rates, non-tariff measures, and trade agreements are important (Pratiwi 2021). The negative competitiveness effects of palm oil taxation in Malaysia have been documented (Hamzah et al. 2015). The present results are consistent with these findings, as export duties reduce Indonesia's pricing flexibility while free trade agreements enhance market access. Taken together, these empirical comparisons reinforce the conclusion that Indonesia's

market power varies systematically across destination markets due to differences in import dependence, substitution possibilities, macroeconomic conditions, and trade policy instruments.

Market power Malaysia's CPO exports in major importer markets. The endogeneity test results presented in Table 6 indicate that Malaysia's CPO export quantities to India, Pakistan, and China are endogenous. Estimation therefore requires a simultaneous equation system approach. This finding is consistent with the interdependent structure of the global CPO market, which is strongly influenced by two dominant suppliers, Indonesia and Malaysia. Such interdependence justifies the application of Seemingly Unrelated Regressions (SUR) and Three-Stage Least Squares (3SLS) to obtain efficient estimates and correct for potential simultaneity bias. The instruments employed are Malaysian producer prices ($\boldsymbol{PPW^{MAL}}$) and total Malaysian CPO export quantities ($\boldsymbol{TQ^{MAL}}$). Wu-Hausman F statistics confirm strong instrument relevance, particularly in India (F = 13.90) and Pakistan (F = 19.47), reflecting Malaysia's strategic role in these markets. In China, the F-statistics are lower (11.18 with export restrictions and 9.86 without restrictions), indicating that the instruments remain valid but relatively weaker. This outcome corresponds to the more diversified structure of the Chinese vegetable oil market, where substitution among palm oil, soybean oil, and sunflower oil is more pronounced.

Table 6. Endogeneity test results for the RDE model of Malaysian CPO exports.

	With Export Restrictions			**Without Export Restrictions**		
Destination Market	**India**	**Pakistan**	**China**	**India**	**Pakistan**	**China**
Number of instruments	16	16	18	10	10	12
Number of excluded instruments	2	2	2	2	2	2
Excluded instruments	PPW^{MAL}, TQ^{MAL}	PPW^{MAL}, TQ^{MAL}	PPW^{MAL}, TQ^{MAL}	PPW^{MAL}, TQ^{MAL}	PPW^{MAL}, TQ^{MAL}	PPW^{MAL}, TQ^{MAL}
Wu–Hausman F statistic	13.9024	19.4762	11.1839	10.2385	15.3279	9.8641
p-value	(0.0000)	(0.0000)	(0.0387)	(0.0412)	(0.0000)	(0.0529)
Durbin–Wu–Hausman χ^2 statistic	11.2845	17.0381	9.2746	8.1563	12.9842	7.3185
p-value	(0.0008)	(0.0000)	(0.0261)	(0.0376)	(0.0003)	(0.0628)

Note: PPW^{MAL} denotes the domestic producer price of crude palm oil in Malaysia (US$/ton), representing supply-side production costs. TQ^{MAL} denotes the total quantity of Malaysian CPO exports (tons). ***, **, * significance level.

Durbin-Wu-Hausman chi-square results further confirm endogeneity of Malaysian export quantities in India and Pakistan at the 1 percent significance level. In China, statistical significance is weaker but remains acceptable at conventional levels. These findings indicate that Malaysia's export decisions materially influence price formation in India and Pakistan, whereas its pricing influence in China is shared with Indonesia and non-palm oil competitors. Instrument validity within the 3SLS framework therefore, ensures that RDE estimates are not biased by simultaneity.

RDE estimation results for Malaysia. RDE estimates for Malaysia are presented using 3SLS and SUR methods across India, Pakistan, and China (Tables 7, 8, and 9). Residual demand elasticity coefficients ($\boldsymbol{\eta^{MAL}}$) are consistently negative and statistically significant at the 5 percent level. A lower, more inelastic residual demand implies a greater potential mark-up over marginal cost, indicating stronger market power. The negative and significant coefficients demonstrate that Malaysia does not

behave as a pure price taker; instead, it retains the ability to influence export prices through adjustments in export quantities. In the Indian market, residual demand elasticity ranges from -0.28 to -0.25 and is statistically significant (Table 7). These values suggest measurable pricing influence despite strong competition from Indonesia. India's status as the world's largest CPO importer enhances the strategic importance of Malaysia's market position. The Indian vegetable oil processing industry remains highly dependent on CPO imports from both Indonesia and Malaysia, supporting the persistence of Malaysian market power.

In Pakistan, residual demand elasticity ranges from −0.30 to −0.26, which is slightly larger in absolute magnitude than the corresponding estimates for India (−0.29 to −0.25) reported in Tables 7 and 8. This implies that the residual demand faced by Malaysian exporters in Pakistan is marginally less elastic than in India, allowing for a somewhat stronger price markup. Statistical significance at the 5 percent level confirms Malaysia's relatively strong bargaining position in this market. Pakistan's reliance on CPO imports as a primary input for domestic cooking oil production further reinforces Malaysia's capacity to influence export prices. Long-term bilateral supply arrangements also contribute to stabilizing Malaysian export performance in this market.

Table 7. RDE estimation results using Malaysia's 3SLS and SUR approach in the Indian market.

Parameters	With Export Restrictions				No Export Restrictions			
	3SLS		SUR		3SLS		SUR	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
η_{IND}^{MAL}	-0.2874**	-2.6385	-0.2796**	-2.4813	-0.2652**	-2.2281	-0.2517**	-2.0479
α_{IND}^{MAL}	0.3025**	3.6023	0.2879**	3.4037	0.2941**	3.4821	0.2795**	3.2847
σ_{IND}^{MAL}	-0.0458	-1.0834	-0.0432	-1.0112	-0.0387	-0.9425	-0.0361	-0.8573
δ_{IND}^{MAL}	0.0128	1.0842	0.0121	1.0234	0.0114	0.9582	0.0109	0.9104
β_{INR}^{MYR}	-0.0589*	-1.7547	-0.0537*	-1.6825	-0.0478	-1.4108	-0.0461	-1.3726
φ_{IND}^{MAL}	0.2050**	2.1542	0.1915**	2.0186	0.1820*	1.9044	0.1705*	1.8175
$\vartheta_{IND}^{MAL.ET}$	-0.1350*	-1.8032	-0.1240*	-1.7195				
$\vartheta_{IND}^{INA.ET}$	0.1120**	2.0521	0.1015**	1.9764				
$\vartheta_{IND.NTM}$	-0.0780	-1.1820	-0.0705	-1.1156				
$\vartheta_{IND.FTA}$	0.1480**	2.0542	0.1357**	1.9754				
γ_{IND}^{MAL}	0.5150**	3.7025	0.5008**	3.5619	0.4869**	3.4328	0.4681**	3.3081
R-square	0.6120		0.6280		0.5430		0.4970	
DW-stat	2.0140		2.0820		1.9540		1.9760	
Hansen-Sargan stat	3.9281		3.7452		2.8693		2.5914	

Captions: **, and * express significance at the 1%, 5%, and 10% levels

Other explanatory variables reinforce the interpretation of Malaysia's market power. Importer GDP exerts a positive and statistically significant effect across markets, with coefficients ranging from approximately 0.24 to 0.33 in India, Pakistan, and China (Tables 7–9). Higher income levels in importing countries increase demand for vegetable oils and strengthen Malaysia's export price performance. The consumer price index generally displays a negative coefficient, suggesting that domestic food inflation encourages substitution toward alternative vegetable oils. Producer prices in competing countries exhibit positive and statistically significant coefficients in most markets, confirming substitution effects between Malaysia and Indonesia. Exchange rate movements also matter; depreciation of competitor currencies reduces Malaysia's relative competitiveness and exerts

downward pressure on its export prices. Trade policy variables further shape market outcomes. Malaysian export duties generate significant effects, reflecting supply-side adjustments that influence price formation. Non-tariff measures generally display negative but statistically insignificant coefficients, suggesting that quality standards and administrative compliance affect trade less directly than explicit export restrictions. Free trade agreement variables tend to have positive coefficients, particularly in Pakistan and China, indicating that trade cooperation enhances Malaysia's market access and supports pricing outcomes.

Table 8. RDE estimation results using Malaysia's 3SLS and SUR approach in the Pakistani market.

Parameters	With Export Restrictions				No Export Restrictions			
	3SLS		SUR		3SLS		SUR	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
η_{PAK}^{MAL}	-0.2986**	-2.8714	-0.2912**	-2.6958	-0.2764**	-2.4139	-0.2648**	-2.2362
α_{PAK}^{MAL}	0.2768***	3.3520	0.2630***	3.1886	0.2514***	3.0621	0.2397***	2.9012
σ_{PAK}^{MAL}	-0.0587	-1.2941	-0.0553	-1.2024	-0.0496	-1.1286	-0.0468	-1.0637
δ_{PAK}^{MAL}	0.0206	1.2801	0.0191	1.1724	0.0178	1.0923	0.0169	1.0312
β_{INR}^{MYR}	-0.0681*	-1.8214	-0.0634*	-1.7423	-0.0572	-1.4841	-0.0540	-1.3752
φ_{PAK}^{MAL}	0.2206**	2.2832	0.2091**	2.1203	0.1974*	1.9624	0.1868*	1.8541
$\vartheta_{PAK}^{MAL.ET}$	-0.1200	-1.5804	-0.1106	-1.5251				
$\vartheta_{PAK}^{INA.ET}$	0.1260**	2.1035	0.1148**	2.0184				
$\vartheta_{IND.NTM}$	-0.0743	-1.1520	-0.0689	-1.1195				
$\vartheta_{IND.FTA}$	0.1620**	2.0231	0.1497**	1.9875				
γ_{PAK}^{MAL}	0.4850**	3.6012	0.4725**	3.4908	0.4518**	3.3821	0.4342**	3.2742
R-square	0.6680		0.6820		0.5970		0.5520	
DW-stat	2.0834		2.1279		1.9745		2.0258	
Hansen-Sargan stat	4.3981		4.1027		2.8961		2.6039	

Note: **, and * express significance at the 1%, 5%, and 10% levels

The observed variation in Malaysia's market power across destination markets is consistent with previous empirical findings. Malaysia maintains a competitive position in India, Pakistan, and China, although Indonesia exhibits stronger export dynamics (Ramadhani 2019). This aligns with the moderate but statistically significant residual demand elasticities identified in this study. Malaysia's palm oil exports to India benefit from long-term trade relations and sustained demand from refining and food industries (Ali 2019). These findings correspond with the significant RDE estimates for India. Importer income, world palm oil prices, substitute oil prices, and exchange rates are important in determining Malaysia's export performance (Jazuli and Kamu 2019). These determinants are consistent with the significant GDP, competitor price, and exchange rate coefficients obtained in the present model. The relatively lower market power observed in China is supported by Zaidi et al. (2022), who demonstrate strong cross-price linkages between palm oil and substitute oils using a structural VAR approach. Substitution reduces Malaysia's ability to influence export prices in the Chinese market. Gan (2014) emphasizes that Malaysia's long-term competitiveness depends on downstream upgrading and coordinated policy support. This conclusion is consistent with the current findings, which highlight the importance of export duties, trade agreements, and strategic positioning in shaping Malaysia's realized market power. Malaysia exhibits measurable and statistically significant market power in India and

Pakistan, with relatively weaker but still significant influence in China. Market power is shaped by structural import dependence, substitution possibilities, macroeconomic conditions, and trade policy instruments. Malaysia does not act purely as a price taker in international CPO markets; instead, it retains strategic pricing influence that varies systematically across destination countries.

Table 9. RDE estimation results using Malaysia's 3SLS and SUR approach in the Chinese market

Parameters	With Export Restrictions				No Export Restrictions			
	3SLS		SUR		3SLS		SUR	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
η_{CHI}^{MAL}	-0.2583**	-2.4125	-0.2469**	-2.2571	-0.2337**	-2.0664	-0.2215*	-1.9018
α_{CHI}^{MAL}	0.3268***	3.2412	0.3110***	3.0618	0.2987***	2.9721	0.2842***	2.8237
σ_{CHI}^{MAL}	-0.0852**	-1.9813	-0.0801*	-1.8710	-0.0743*	-1.7623	-0.0691*	-1.6721
δ_{CHI}^{MAL}	0.0182	1.2204	0.0175	1.1816	0.0168	1.1017	0.0159	1.0612
β_{INR}^{MYR}	-0.0517	-1.5132	-0.0478	-1.4315	-0.0442	-1.3324	-0.0420	-1.2213
φ_{CHI}^{MAL}	0.1964*	1.9245	0.1853*	1.8421	0.1789	1.7324	0.1695	1.6210
$\vartheta_{CHI}^{MAL.ET}$	-0.1100	-1.4532	-0.1010	-1.3914				
$\vartheta_{CHI}^{INA.ET}$	0.0850*	1.7031	0.0785*	1.6619				
$\vartheta_{CHI.NTM}$	-0.0702	-1.1824	-0.0648	-1.1542				
$\vartheta_{CHI.FTA}$	0.1351	1.6243	0.1243	1.5428				
γ_{CHI}^{MAL}	0.4320**	3.4521	0.4187**	3.3314	0.4049**	3.2135	0.3898**	3.1618
R-square	0.5820		0.5960		0.5210		0.4780	
DW-stat	1.9680		1.9820		1.9430		1.9630	
Hansen-Sargan stat	3.2174		2.9874		2.1075		1.9186	

Note: **, and * express significance at the 1%, 5%, and 10% levels

Export restrictions on the market power of Indonesia and Malaysia. Export restrictions play an important role in shaping the market power of Indonesia and Malaysia in the international crude palm oil (CPO) market. Estimation results from the residual demand elasticity (RDE) model using the 3SLS and SUR approaches (Tables 3–5 for Indonesia and Tables 7–9 for Malaysia) show that export restriction policies significantly influence exporter pricing behavior in India, Pakistan, and China. Across all model specifications, residual demand elasticity is negative and statistically significant, indicating that neither Indonesia nor Malaysia behaves as a pure price taker. Both exporters influence destination-market prices through adjustments in export quantities.

Clear differences emerge across destination markets. In India, Indonesia's RDE values under export restrictions range from approximately −0.61 to −0.57, substantially more inelastic than Malaysia's values of −0.2874 to −0.2796 under the same specification (Table 7). When export restrictions are excluded from the model, Indonesia's elasticity becomes less inelastic, shifting to a range of −0.54 to −0.49. Malaysia's elasticity remains relatively stable between −0.2652 and −0.2517**,** indicating limited sensitivity to policy changes. This pattern suggests that Indonesia's export restriction policies exert a stronger influence on its pricing power than Malaysia's. India's position as the world's largest CPO importer and its strong dependence on Indonesian supply amplify the price effects of Indonesian export restrictions. A contraction in Indonesian export supply therefore generates upward pressure on international prices and strengthens Indonesia's bargaining position.

A similar pattern appears in the Pakistani market. Indonesia's residual demand elasticity under export restrictions ranges between −0.69 and −0.65, while Malaysia's elasticity remains around −0.2986 to −0.2912 (Table 8). When restrictions are excluded, Indonesia's elasticity becomes less inelastic, shifting to approximately −0.60 to −0.56, whereas Malaysia's elasticity again changes only slightly, remaining between −0.2764 and −0.2648**.** Pakistan's high structural dependence on Indonesian CPO imports explains the magnitude of this response. Supply tightening through Indonesian export controls increases export prices and reinforces Indonesia's market power. These results are consistent with residual demand theory, which predicts that exporter market power increases as residual demand becomes more inelastic (Pinelopi Koujianou Goldberg and Michael Knetter 1999; Colin Carter and Donald MacLaren 1997).

The effect of export restrictions is comparatively weaker in China. Indonesia's RDE under export restrictions is approximately −0.30 and becomes about −0.25 when restrictions are excluded. Malaysia's elasticity in China ranges from −0.2583 to −0.2469 with export restrictions and **−0**.2337 to −0.2215 without restrictions (Table 9). These values reflect the more diversified structure of China's vegetable oil market, where palm oil competes with soybean, rapeseed, and sunflower oils. Greater substitution possibilities increase residual demand elasticity and reduce the effectiveness of export restrictions in influencing prices compared with India and Pakistan.

Estimated coefficients of export duty variables further reinforce these findings. Indonesian export duties exert positive and statistically significant effects on export prices across the three markets, with coefficients of 0.1120 in India, 0.1260 in Pakistan, and 0.0850 in China **(**Tables 7–9). These results indicate that Indonesian export policies transmit supply restrictions into higher prices in destination markets. In contrast, Malaysia's export duty coefficients are negative and statistically weaker, with values of −0.1350 in India, −0.1200 in Pakistan, and −0.1100 in China, suggesting a more limited influence on price formation. The stronger response associated with Indonesia reflects its larger market share and dominant position in major importing countries.

These results are consistent with previous empirical studies showing that Indonesian export policies generate substantial pass-through effects on global palm oil prices. Export tax policies influence international palm oil prices through supply adjustments (Jamilah et al. 2022), while export restrictions can transmit domestic policy shocks to international markets (Nur'Aeni et al. 2024). Similarly, Indonesian export duties and export controls can raise world CPO prices, particularly when importing countries rely heavily on Indonesian supply (Pratama and Widodo 2020).

Overall, the empirical patterns align closely with the theoretical predictions of residual demand analysis. The price effects generated by export restrictions increase with the degree of destination-market dependence on the exporting country. India and Pakistan exhibit the strongest responses due to their structural reliance on Indonesian CPO, whereas China demonstrates more moderate effects owing to diversified consumption and greater substitution possibilities. Statistical significance across alternative model specifications confirms the robustness of these results.

Overall, Indonesian export restrictions exert a substantial influence on international CPO prices, particularly in India and Pakistan. The effect remains present but weaker in China due to greater substitution among vegetable oils. Malaysian export restrictions also affect market power, although their impact is smaller and more stable across markets. Differences in market share, competitive interaction, and policy design explain this divergence. Export restriction policies therefore emerge as an important determinant of exporter market power in the global palm oil market, operating through supply adjustments that alter residual demand elasticity and price formation across heterogeneous destination markets.

CONCLUSION AND RECOMMENDATIONS

Residual demand elasticity estimates indicate that both Indonesia and Malaysia possess measurable market power in major crude palm oil (CPO) importing markets and therefore do not behave as pure price takers. Indonesia exhibits stronger market power, particularly in India and Pakistan, while Malaysia's influence is more moderate. In China, market power is weaker for both exporters due to greater substitution among vegetable oils. Export restriction policies influence pricing behaviour, especially for Indonesia, where changes in export supply have a stronger impact on international prices. In contrast, Malaysia's pricing influence appears more stable and less dependent on export restrictions. Overall, differences in market power across destination markets are shaped by levels of import dependence and substitution possibilities. From a policy perspective, Indonesia should apply export restrictions selectively while strengthening downstream development to enhance value-added production. Malaysia should focus on improving supply reliability, logistics, and trade facilitation to sustain competitiveness. For both countries, export strategies should be adaptive to evolving global market conditions and aligned with sustainability standards.

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REFERENCES CITED

Ali, R. 2019. Malaysia's palm oil export to India: An empirical analysis. Journal of International Business, Economics and Entrepreneurship. 4(2): 18–27.

BPS-Statistics Indonesia. 2024. Indonesia export and import development 2024. BPS-Statistics Indonesia, Jakarta.

Carter, C.A. and D. MacLaren. 1997. Price or quantity competition? Oligopolistic structures in international commodity markets. Review of International Economics. 5: 373–385.

Gafarova, G., O. Perekhozhuk, and T. Glauben. 2023. The oligopolistic behavior of Kazakh and Russian wheat exporters in the South Caucasus: Evidence from a residual demand elasticity analysis. Journal of Industry, Competition and Trade. 23(1–2): 1–32.

Go, Y.-H. and W.-Y. Lau. 2017. The relationship of crude palm oil spot-futures under inflationary expectation in gold market. Capital Markets Review. 25: 43–62.

Goldberg, P.K. and M.M. Knetter. 1999. Measuring the intensity of competition in export markets. Journal of International Economics. 47(1): 27–60.

Hamzah, M.A., V. Karri, and W.M. Faizal. 2015. Cost competitiveness of the Malaysian palm oil industry. Oil Palm Industry Economic Journal. 15(2): 18–26.

Immanuel, Suharno, and A. Rifin. 2019. The progressive export tax and Indonesia's palm oil product export competitiveness. Bulletin of Trade Research. 13(2): 211–232.

Jamilah, J., A.A. Yusuf, and M. Firdaus. 2022. The impact of Indonesia's palm oil export ban and export duty policy on global CPO prices. Heliyon. 8(11): e11379.

Jazuli, N.A. and A. Kamu. 2019. Factors affecting the export demand of Malaysian palm oil. Transactions on Science and Technology. 6(2–2): 203–209.

Kojima, Y., J.L. Parcell, and K.D. Cain. 2016. A global demand analysis of vegetable oils for food and industrial use: A system dynamics approach. In: Proceedings of the AAEA Annual Meeting, Boston, USA.

Lee, G.H., K. Joo, and K. Ahn. 2020. Market efficiency of the crude palm oil: Evidence from quantum harmonic oscillator. Journal of Physics: Conference Series. 1593: 012037.

Lugo-Arias, E., F. Alvarez-Pena, and J. Calderon. 2024. Global drivers of palm oil export competitiveness. Current Research in Environmental Sustainability. 6: 100381.

Ministry of Agriculture, Republic of Indonesia. 2024. Analysis of trade performance of palm oil commodities. Ministry of Agriculture, Jakarta.

Nugrahapsari, R.A., H. Harianto, R. Nurmalina, and A. Fariyanti. 2024. The changing role and its determinants of the leading vegetable oil exporting countries. Journal of the International Society for Southeast Asian Agricultural Sciences (ISSAAS). 30(1): 125–141.

Nur'Aeni, N., P.U. Hadi, and E. Rustiadi. 2024. Price transmission of Indonesia's CPO export restrictions: Evidence from major importers. Agriculture and Agricultural Science Procedia. 36: 128–136.

Pall, L., J. Uhl, and R. Brümmer. 2013. Market power in international food commodity markets: Evidence from residual demand estimation. European Review of Agricultural Economics. 40: 1–25.

Pratama, A.R. and T. Widodo. 2020. Welfare effects of Indonesia's crude palm oil export tax: A general equilibrium perspective. Journal of Economic Structures. 9(1): 1–18.

Pratiwi, A. 2021. Competitiveness of Indonesian crude palm oil exports and the impact of free trade agreements. Journal of Management and Agribusiness. 18(1): 15–26.

Ramadhani, F. 2019. Competitiveness of Indonesian and Malaysian palm oil in international markets. Agro Ekonomi. 30(2): 230–245.

Rifai, N., Y. Syaukat, H. Siregar, and E. Gumbira-Sa'id. 2015. Factors affecting increased export of Indonesian palm oil and its derivative products to the United States of America market. Journal of the International Society for Southeast Asian Agricultural Sciences (ISSAAS). 21(1): 137–146.

Rifin, A. 2010. The effect of export tax on Indonesia's crude palm oil (CPO) export competitiveness. ASEAN Economic Bulletin. 27(2): 173–180.

Rosyadi, S.R., A. Firmansyah, and D. Yuliasari. 2021. Export intensity and competitiveness of Indonesia's crude palm oil. Journal of Agricultural Economics and Agribusiness. 5(2): 359–374.

Singh, S. and Q. Zhu. 2008. Analysis of China's vegetable oil consumption and import structure. Food Policy. 33(1): 59–68.

Suroso, A.I. 2022a. Determinants of Indonesia's palm oil exports to Asian markets. Journal of Agro Economics. 40(2): 125–140.

Suroso, A.I. 2022b. The effect of logistics performance index indicators on palm oil and palm-based products export: The case of Indonesia and Malaysia. Economies. 10(10): 1–18.

Suryana, A. 2016. International demand for palm oil estimated within a fats and oils demand system. Journal of Agro Economics. 6(1–2): 67–82.

Uhl, J. 2021. Residual demand elasticity and exporter market power in global agricultural trade. World Economy. 44: 1012–1036.

UN Comtrade. 2024. Commodity trade statistics database. United Nations Statistics Division.

Wang, X. 2018. Competitiveness of Indonesian crude palm oil in the Chinese market. Journal of Agricultural Economics and Management. 5(3): 112–128.

Wibowo, H., H. Adam, and M. Fauziah. 2023. Changes in global, domestic, and stock price as a response to Indonesian CPO export ban. International Journal of Science and Society. 5(5): 66–84.

Winardi, S., Y. Yulianasari, and D.A. Santosa. 2017. Global competitiveness and price dynamics of palm oil: An empirical assessment. Journal of Oil Palm Research. 29(3): 345–355.

World Bank. 2024. Commodity markets outlook. World Bank Group, Washington, D.C.

Yanita, M. and S. Suandi. 2023. Determinant export volume of crude palm oil (CPO) in Indonesia and Malaysia in the European Union. Agricultural Socio-Economics Journal. 23(1): 19–24.

Zellner, A. 1962. An efficient method of estimating seemingly unrelated regressions and tests. Journal of the American Statistical Association. 57(298): 348–368.

Zuhdi, U., A. Daryanto, and Sahara. 2021. Competitiveness of Indonesia's crude palm oil (CPO): An application of RCA and EPD analysis. Journal of Management and Agribusiness. 18(2): 140–152.

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