

COMPETITIVENESS AND TRADE FLOWS OF INDONESIAN PROCESSED TUNA IN THE INTERNATIONAL MARKET

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ABSTRACT

Indonesia is a major tuna producer, contributing substantially to the global supply. Nevertheless, the competitiveness of Indonesian tuna products in the global market continues to confront many challenges. Conversely, Indonesian processed tuna exports have declined, despite the global demand for tuna showing an upward trajectory. This study aims to analyze the competitiveness of Indonesian processed tuna exports in the international market and the factors that affect this competitiveness. The research methodology employed encompasses the utilization of the Revealed Comparative Advantage (RCA) and Gravity Model frameworks. The findings indicate that Indonesian processed tuna, except for Spain, demonstrates notable competitiveness within the global market. The volume of processed tuna exports is significantly influenced by GDP per capita and RCA value, which have a positive impact, and exchange rates, which have a negative impact. Concurrently, the impact of import tariffs on the volume of processed tuna exports is negligible.

Keywords: *exports, gravity model, RCA*

BACKGROUND

Tuna is a prominent fishery commodity among the most sought-after fish in the global market (FAO, 2018). According to data from the International Trade Centre (2024), there has been an observed increase in global demand for processed tuna, as evidenced by 0.56% annual increase in import volume (Figure 1). This persistent upward trend in consumption signifies a substantial opportunity to augment Indonesia's tuna exports (Arthatiani et al. 2020). Indonesia is also the world's largest tuna producer, accounting for 19.1% of the global supply. National tuna production continues to grow, reaching 1.5 million tons in 2023 (KKP, 2024). Conversely, from 2018 to 2023, the volume of Indonesia's processed tuna exports exhibited a marked downward trend. The observed average annual decline of 2.27% is indicative of the diminishing competitiveness of Indonesia's processed tuna in the global market (International Trade Centre, 2024).

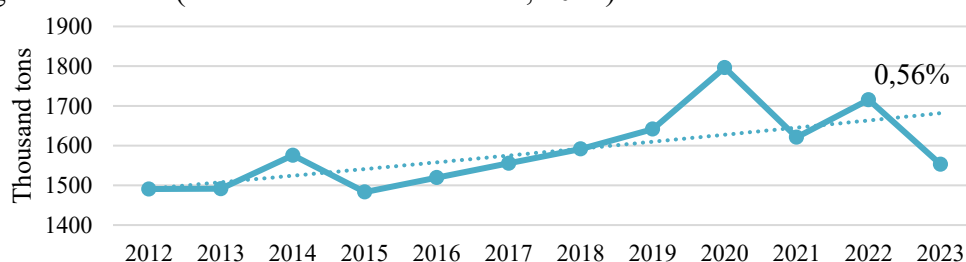


Figure 1. Global Import Volume of Processed Tuna (2012–2023)

Source: ITC Trade Map, 2024

The observed decline in the volume of Indonesian processed tuna exports may be attributed to concerns regarding product quality and safety, which have not yet met international standards. The substantial number of export rejections from destination countries exemplifies this phenomenon. Irawati et al. (2019) observed that tuna was the commodity with the highest number of rejections in the European Union between 2011 and 2017, with 27 cases, surpassing those of shrimp and crab. Rejections have also been documented in Japan and the United States (Arizona, 2018), including inadequate labelling, elevated histamine levels, substandard quality, and Salmonella and carbon monoxide (Resnia et al. 2015). These rejections indicate that Indonesian products do not comply with Sanitary and Phytosanitary Measures (SPS) and Technical Barriers to Trade (TBT) regulations. While these policies are intended to promote public health, they have the potential to act as non-tariff barriers, thereby restricting market access and impeding exports (Tristi et al. 2021).

Several studies have previously investigated the competitiveness of various Indonesian tuna products in international markets. Yusuf et al. (2018) Between 2009 and 2015, Indonesian tuna exhibited high levels of competitiveness in the Japanese and United States markets. This finding was subsequently corroborated by Hartanto et al. (2021), who determined that Indonesian tuna, skipjack, and yellowfin tuna possess a comparative advantage in the US market, exhibiting an average RCA value of 13.68 and an upward trend. According to Khaliqi et al. (2019), three of the six types of Indonesian tuna, as classified by HS codes, have been shown to possess a comparative advantage, particularly within the Japanese market. Conversely, Rahmansyah et al. (2021) demonstrated that Indonesia's processed tuna exports to the European Union exhibited robust competitiveness, with an average RCA value of 2.57 from 2003 to 2018. Furthermore, Nursya'ban et al. (2024) observed the competitive advantage of Indonesia's fresh yellowfin tuna (HS 030232) exports within the global market. However, Putri et al. (2018) observed that from 2012 to 2016, Indonesia's competitiveness remained inferior to that of Thailand and the Philippines.

In addition to assessing competitiveness, several studies have examined the factors influencing Indonesian tuna exports. Rifaldi et al. (2020) discovered that export prices, exchange rates, and domestic production are the primary determinants of export volume. As posited by Ramli et al. (2020), the real GDP of the importing country (i.e., Indonesia), real GDP, real exchange rate, and RTA index have a significant positive effect on exports. Conversely, distance hurts exports. This assertion is further substantiated by Wiranthi et al. (2019), who demonstrated that the population of the importing country, production volume, and real exchange rate significantly influence canned tuna exports to the European Union. Tristi et al. (2021) also mention that GDP per capita, population, exchange rate, export prices, and SPS barriers positively impact exports, while economic distance, TBT, and tariffs negatively impact exports. In the policy context, Da Silva et al. (2023) demonstrate that tariffs, non-tariff barriers (SPS and TBT), and exchange rate fluctuations also affect competitiveness and export volume. This study's novelty lies in using Indonesia's Revealed Comparative Advantage (RCA) values in each export destination country as an independent variable, aiming to more specifically measure the effect of product competitiveness on export performance in the international market. Consequently, despite the inherent comparative advantage of Indonesian tuna, enhancing its competitiveness remains an elusive objective that necessitates strategic attention. This study analyses the competitiveness of Indonesian processed tuna in international markets and

export destination countries. Furthermore, the objective of this study is to examine the factors that influence the export of Indonesian processed tuna to export destination countries.

Based on international trade theories, this study formulates six hypotheses to examine the factors influencing Indonesia's processed tuna exports. First, the real GDP per capita of the importing country is hypothesized to have a positive effect, as higher income levels are expected to increase demand for higher-quality imported goods (Salvatore, 2013). Second, the geographical distance between Indonesia and the importing country is expected to have an adverse effect, since a greater distance raises logistics costs and reduces price competitiveness in the destination market (Salvatore, 2013). Third, an appreciation of the Indonesian rupiah against the partner country's currency is expected to negatively affect exports because it makes Indonesian products more expensive in the international market (Mankiw, 2009). Fourth, non-tariff measures (NTMs) such as Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) are hypothesized to hurt exports, as technical and health-related requirements can increase compliance costs and create trade obstacles (Appleton, 2003; Stone & Casalini, 2021). Fifth, import tariffs are assumed to have an adverse effect, as higher tariffs increase product prices in the destination country and reduce demand (Salvatore, 2013).

RESEARCH METHODS

The present study utilizes secondary data from 2012 to 2023, particularly on processed tuna classified under HS 160414. This commodity was analyzed using the RCA (Revealed Comparative Advantage) and the Gravity Model. The export destinations for processed tuna include several Asian countries, such as Saudi Arabia, Japan, and the United States, as well as several European countries, including Thailand, Italy, and the United Kingdom. Indonesia's primary competitors in the processed tuna are Thailand, Ecuador, Spain, and China. The dependent variable in this study is export volume. In contrast, the independent variables include the real GDP per capita of the destination country, geographical distance, exchange rate, and Indonesia's RCA index. The data sources for this study were ITC TradeMap, World Bank, KKP, and BPS.

Comparative advantage is measured using the Revealed Comparative Advantage (RCA) index, which compares the share of a specific commodity's exports in a country's total exports to the share of that commodity in global exports (Balassa, 1965). This method was developed by Balassa (1965). An RCA value greater than 1 indicates a comparative advantage, whereas a value less than 1 suggests its absence. The RCA formula is presented as a modification of the equation written by Amanda & Rosiana (2023), with the following equation:

$$RCA_{ij} = \frac{(X_{ij} / \sum X_{ij})}{(X_{wj} / \sum X_{wj})}$$

Information:

RCA_{ij} : Revealed comparative advantage of country i in processed tuna exports.

X_{ij} : Export value of processed tuna from country i (USD).

X_{wj} : Total export value of processed tuna from all countries (USD).

$\sum X_{ij}$: Total export value of all commodities from country i (USD).

$\sum X_{wj}$: Total export value of all commodities from all countries (USD).

The Gravity Model is widely used to analyze economic and non-economic factors influencing trade flows between countries. The model is based on an analogy to Newton's Law of Gravitation. It was first applied to international trade by Tinbergen (1962) to examine trade flows among European countries. Subsequently, the model was further developed by Bergstrand (1985). The basic formulation of the Gravity Model is presented as follows (van Bergeijk & Brakman, 2010)

$$F_{ij} = G \frac{M_i M_j}{D_{ij}}$$

Information:

F_{ij} : Trade flows from country i to country j .

G : Constant of proportionality.

M_i : Economic size of the exporting country, typically measured by GDP.

M_j : The economic size of the importing country is typically measured by GDP.

D_{ij} : Trade resistance between the two countries, which may include geographical distance, trade policy factors, and other barriers.

The methodology employed to estimate the determinants of Indonesia's processed tuna exports is grounded in the gravity model framework outlined by Shepherd (2016). The selection of variables in this study draws upon previous empirical works, Ramli et al. (2020), Tristi et al. (2021) and Da Silva et al. (2023). The dependent variable is the export quantity of processed tuna. In contrast, the independent variables include the GDP per capita of the importing country, the bilateral exchange rate, a dummy variable for non-tariff measures (NTMs), a dummy variable for import tariffs, and Indonesia's Revealed Comparative Advantage (RCA) index. All continuous variables were transformed into their natural logarithmic forms to address potential heteroscedasticity and scale disparities among the variables. This transformation helps reduce the impact of significant numerical differences, converting, for example, a tenfold difference between two values into a more manageable twofold difference (Gujarati, 2011). The gravity model specification used to estimate Indonesia's processed tuna exports to international markets is expressed as follows:

$$\text{Log } X_{it} = \beta_0 + \beta_1 \text{Log } \text{GDPPC}_{jt} + \beta_2 \text{Log } \text{DIS}_j + \beta_3 \text{Log } \text{EXC}_{jt} + \beta_4 \text{DNTM}_{jt} + \beta_7 \text{DTIM}_{jt} + \beta_9 \text{Log } \text{RCA}_{ijt} + \varepsilon_{ij}$$

Information:

β_0 : Intercept term

β_n : Coefficients of the independent variables

X_{it} : Export volume of Indonesia's processed tuna (in tons)

GDPPC_{jt} : Real GDP per capita of country j (in USD)

DIS_j : Distance from Indonesia to country j

EXC_{jt} : Real exchange rate between Indonesia and country j (Rupiah per local currency unit)

DNTM_{jt} : Dummy variable indicating the presence of non-tariff measures (NTMs) on processed tuna in country j

DTIM_{jt} : Dummy variable indicating the presence of import tariffs on processed tuna in country j

RCA_{ijt} : Indonesia's Revealed Comparative Advantage (RCA) index for processed tuna in country j

ε_{ij} : Error term

RESULT AND DISCUSSION

Competitiveness of Indonesia’s Processed Tuna in International Markets

The competitiveness analysis of processed tuna uses HS code 160414 and the Revealed Comparative Advantage (RCA) method to evaluate comparative advantage in global trade. The assessment covers five major processed tuna-exporting countries, including Indonesia, from 2012 to 2024. Exporting countries such as Ecuador, Thailand, Indonesia, and Spain exhibit substantial comparative advantages in processed tuna exports, with RCA values exceeding 4 (Table 1).

Table 1. RCA Values of Processed Tuna Exporters in International Markets

Year	Country				
	Indonesia	Thailand	Ecuador	Spain	China
2012	4,84	30,48	91,52	5,15	0,40
2013	4,99	28,18	100,66	4,42	0,46
2014	4,69	27,70	103,58	4,60	0,43
2015	5,46	25,96	107,20	4,50	0,41
2016	5,30	25,41	121,09	4,64	0,47
2017	5,30	21,69	137,91	4,68	0,46
2018	5,31	22,36	128,75	4,61	0,48
2019	6,10	22,10	118,79	4,27	0,50
2020	4,31	21,32	105,77	4,40	0,46
2021	3,49	20,67	126,57	4,72	0,61
2022	3,28	23,00	108,82	4,37	0,63
2023	3,61	20,62	106,50	5,22	0,68
Average	4,72	24,12	113,10	4,63	0,50

Source: ITC Trade Map (Processed), 2024

The four countries vigorously compete for processed tuna exports, with RCA values above 4. These countries are Ecuador, Thailand, Indonesia, and Spain. On the other hand, China is not competitive because its RCA value is below 1 (Table 1). Ecuador has the highest RCA value, with an average of 113.1. This is much higher than its competitors' values. This shows that Ecuador is very specialized in processed tuna exports. Ecuador is competitive globally because it exports a lot of processed tuna. Ecuador's processed tuna exports accounted for 4.3% of the country's total exports. This is much higher than the global average of 0.038%. Ecuador's RCA value grew by an average of 1.95% each year, which matched the annual export growth of 4.87%. The highest value was recorded in 2017, with an RCA of 137.91 and a 42.3% increase in exports compared to the previous year (Figure 2). However, Ecuador's market share is still lower than Thailand's, at 13.70% compared to 30.3%.

Although Thailand is the world's largest exporter of processed tuna, accounting for 30.32% of the global market share, it ranks second in competitiveness based on an average RCA value of 24.12, behind Ecuador. The share of Thailand's processed tuna exports in its total national exports reaches 0.93%, higher than that of Indonesia, Spain, and China, and significantly above the global average of 0.038%. However, Thailand recorded the most significant decline in RCA among the

major exporting countries, with a drop of 3.28% (Figure 2), in line with an average export contraction of 1.63% over the 2012–2023. A significant decline occurred in 2013–2015, 2019, 2021, and 2023, primarily attributed to the European Union's yellow card sanctions in response to illegal, unreported, and unregulated (IUU) fishing practices and labour rights violations in the fisheries sector (Thammachote & Trochim, 2023). As a result, Thailand's tuna exports to the EU plummeted by 40% in 2014 and continued to decline until 2020. The sanctions were finally lifted in 2023, following comprehensive reforms in fisheries governance through amendments to the Royal Ordinance on Fisheries B.E. 2558, which emphasized stricter IUU fishing control and marine resource conservation (Thammachote & Trochim, 2023).

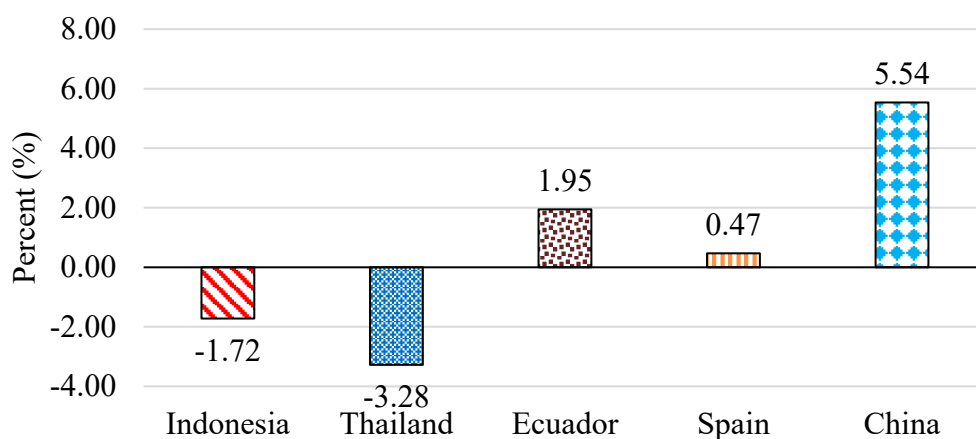


Figure 2. Average RCA Growth of Processed Tuna in the Top 5 Exporting Countries
Source: ITC Trade Map (Processed), 2024

Indonesia also competes strongly in processed tuna exports, with an average RCA value of 4.72. Its market share is 4.58%, below the top four exporting countries. However, Indonesia's RCA value declined by an average of 1.72% (Figure 2), in line with export contractions observed in 2014, 2015, 2016, 2020, and 2021, with the most significant decline occurring in 2012 at 18.68%. This trend is consistent with the findings of Putri et al. (2018), who noted that implementing IUU fishing policies by Minister of Marine Affairs and Fisheries Susi Pudjiastuti contributed to the suppression of export performance. During the enforcement of this policy, Indonesia's processed tuna exports fell from USD 351.5 million in 2012 to USD 278.9 million in 2016.

Spain maintains strong competitiveness in processed tuna exports, with an average RCA value of 4.63 (Table 1) and a market share of 8.03%. Although not the highest, Spain demonstrates consistent export performance, with an average annual growth rate of 3.69% and an RCA increase of 0.47% (Figure 2). The highest RCA value was recorded in 2023, reaching 5.22, alongside a remarkable annual export growth of 22.18%. According to StatLedger (2023), this growth was driven by rising demand from European markets, particularly Germany, France, and Italy. As the region's leading exporter of canned tuna, Spain also imports raw frozen tuna—primarily from Ecuador, the Philippines, and Indonesia—to support its domestic processing industry.

Unlike other major exporting countries, China is not competitive in processed tuna exports, with an average RCA value of only 0.50 (Table 1). This low level of competitiveness is attributed to the small share of processed tuna exports in China's total exports, which stands at just 0.019%, below

the global average of 0.038%. This indicates a lack of comparative advantage, as processed tuna plays a minimal role compared to China's leading export commodities such as electronics, machinery, and textiles. Nevertheless, China's RCA has grown at an average rate of 5.54% (Figure 2), and its global market share for processed tuna has reached 6.76% a relatively large proportion for a product with a low contribution to national exports. This phenomenon can be explained by the immense scale of China's total exports, valued at approximately USD 2.6 trillion. As a result, although the country's average annual export value for processed tuna is only USD 509 million, China remains a significant player in the global market due to its strong trade capacity and logistics infrastructure.

Competitiveness of Indonesia’s Processed Tuna in Destination Markets

Indonesian processed tuna products exhibit strong competitiveness in international markets, particularly in the country’s top ten export destinations. This is evidenced by the RCA values, which reflect a product’s comparative advantage in export markets. As shown in Table 2, nine of the ten destination countries display RCA values for Indonesia exceeding 4, indicating high market competitiveness. However, one exception is Spain, where Indonesia's RCA value falls below the threshold of 2. This suggests that, while Indonesia maintains market access to Spain, its processed tuna products are relatively less competitive.

Table 2. RCA Values of Indonesian Processed Tuna in Destination Countries

Year	Destination Countries									
	KSA	JPN	USA	THA	ITA	AUS	ENG	GER	JOR	ESP
2012	25,81	4,83	6,26	8,60	0,59	1,87	21,30	22,35	25,49	4,14
2013	42,75	4,02	5,06	11,11	4,65	3,60	24,96	27,12	30,16	0,55
2014	36,63	5,29	5,46	5,32	6,38	3,96	25,69	20,87	13,68	1,61
2015	37,25	5,33	6,83	4,89	10,31	6,68	18,88	6,74	10,07	1,83
2016	36,51	5,33	7,22	6,02	9,61	5,29	17,49	1,70	14,04	2,41
2017	36,78	6,42	7,21	9,55	12,82	8,68	16,21	1,98	20,09	4,97
2018	30,82	6,15	6,10	15,66	15,29	7,28	21,89	1,22	26,04	1,95
2019	27,64	8,82	7,95	12,84	17,21	11,22	15,83	0,46	49,22	2,50
2020	28,27	6,89	6,00	10,68	4,30	12,05	9,71	0,80	30,79	0,40
2021	28,87	5,38	5,20	10,42	0,31	13,65	12,34	1,69	14,07	0,19
2022	47,26	4,76	4,22	9,19	0,30	10,21	14,60	0,17	8,46	0,17
2023	54,05	4,61	4,15	9,91	0,37	12,47	10,06	2,71	10,39	0,07
AVG	36,05	5,65	5,97	9,52	6,85	8,08	17,41	7,32	21,04	1,73

Notes :

KSA : Saudi Arabia

JPN : Japan

USA : United States

THA : Thailand

ITA : Italy

AUS : Australia

ENG : United

GER : Germany

JOR : Jordan

ESP : Spain

AVG : Average

Source: ITC Trade Map (Processed), 2024

Indonesia competes strongly in processed tuna exports to several countries, including Saudi Arabia, Jordan, and the United Kingdom. The high average RCA values reflect Indonesia's comparative advantage in these markets. Saudi Arabia is the primary destination for Indonesia’s processed tuna exports, with the highest average RCA value of 36.05, indicating a strong competitive position. This finding is consistent with Fadhila (2019), who also reported a strong competitiveness

of Indonesian processed tuna in the Saudi market, with an average RCA of 18.92. Although the RCA values remain high, the trend in Saudi Arabia has shown fluctuations, with a general upward trajectory of 9.79%. This increase aligns with Indonesia's export growth to Saudi Arabia, which rose by 7.73%. In 2023, the RCA value peaked at 54.05, and Indonesia captured 53% of the processed tuna market share in Saudi Arabia that year (Figure 3).

Indonesian processed tuna also exhibits strong competitiveness in the Jordanian and UK markets. In Jordan, an average RCA value of 21.04 indicates a solid comparative advantage, consistent with Fadhila (2019), who reported an even higher average RCA of 35.5. The competitiveness trend in Jordan shows an upward trajectory, with RCA growing by 2.69% annually, which is in line with increasing demand, reflected in a 16% annual rise in processed tuna imports from Indonesia (Figure 3). Indonesia's RCA in Jordan peaked at 49.2 in 2019, when export value reached USD 108 million. In contrast, while Indonesia also holds a strong position in the UK market with an average RCA of 17.41, the trend has declined, with RCA falling by 3.46% annually and imports dropping by 5.03% per year (Figure 3). This decline is associated with the UK's increasingly strict requirements for sustainability standards, traceability, certification, inspections, and eco-friendly branding (KKP, 2024).

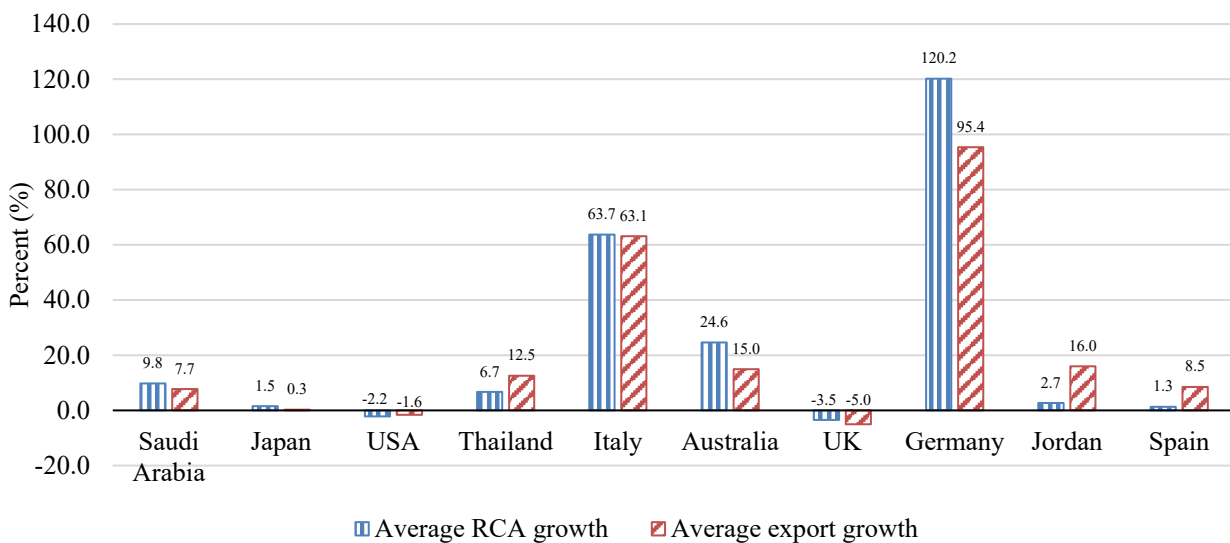


Figure 3. Average Export Growth and RCA Growth of Indonesia's Processed Tuna in Destination Countries

Source: ITC Trade Map (Processed), 2024

Beyond Jordan and the United Kingdom, Indonesia's processed tuna also demonstrates competitiveness in the Australian and Japanese markets, which present differing trends and characteristics yet remain promising for Indonesian exports. The average RCA value of 8.08 in Australia reflects a strong comparative advantage. The competitiveness trend in this market has shown notable improvement, with RCA growing by 0.25% annually, supported by a significant increase in Australia's imports of Indonesian processed tuna, which rose by 14.95% per year (Figure 3). Indonesia's competitiveness in this market peaked in 2021, when the RCA reached 13.65 and export value totalled USD 34 million. Meanwhile, an average RCA value of 5.65 in Japan also

indicates strong competitiveness. This aligns with findings by Hana (2023), who reported an RCA of 6.22 for Indonesian processed tuna in the Japanese market. Although the competitiveness trend in Japan is improving, the growth is relatively modest, with RCA increasing by only 0.02% per year, mirroring the slow pace of import growth from Indonesia, which stood at just 0.28% annually.

Thailand serves as a strategic trading partner for Indonesia in processed tuna exports. With a market share of 24.93%, Indonesia is one of the primary suppliers to Thailand's fisheries industry. An average RCA value of 9.52 indicates that Indonesia is competitive in this commodity trade. Thailand's demand for Indonesian processed tuna has grown at an average rate of 12.54% per year (Figure 3), reflecting steady and consistent demand. However, the high import volume from Indonesia does not necessarily correspond to Thailand's domestic consumption. As a central hub for fish processing and distribution in Southeast Asia, Thailand actively engages in re-export activities, importing raw or semi-processed materials from other countries for further processing and re-exporting to global markets. Indonesia supplies semi-processed tuna products under HS codes 16041490, 16041491, and 16041499, which are then further processed and packaged into finished goods, such as canned tuna, classified under HS codes 16041411 and 16041419. This indicates that Thailand's high demand for Indonesian processed tuna is closely linked to its processing industry's need to support export activities, positioning Thailand as a global market leader in processed tuna trade, particularly in canned products.

The average RCA value of 5.97 for Indonesian processed tuna in the United States market indicates the product's strong competitiveness in this destination. This finding is consistent with the results of Hartanto et al. (2021) who reported that Indonesian tuna products possess a significant comparative advantage in the US market, with an average RCA of 13.68 during the 2000–2019 period, as well as with Hana (2023), who found an RCA value of 6.84. Nevertheless, the long-term trend suggests a gradual decline in competitiveness, as reflected by a negative average annual RCA growth of -0.02% and a decrease in exports of -1.61% per year (Figure 3). This decline is linked to reduced canned tuna consumption in the United States, driven by heightened price sensitivity and growing concerns about health and environmental issues, such as mercury content and resource sustainability. As a result, US canned tuna imports dropped by more than 23% in the first half of 2015 compared to the same period the previous year (FAO, 2018). These dynamics underscore the need for Indonesia to strengthen its sustainable competitiveness to maintain and improve its position in the US market.

Italy and Germany are among the primary export destinations for Indonesian processed tuna within the European Union, with average RCA values of 6.85 in the Italian market and 7.32 in the German market. Figure 3 reflects Indonesia's strong competitiveness in both markets. This is consistent with findings by Hana (2023), who reported that Indonesian processed tuna maintains a high competitiveness level in Italy and Germany. Export performance to Italy has shown a consistent upward trend, with an average annual growth rate of 63.11% between 2012 and 2023 (Figure 3). Similarly, the German market presents strong potential, with an impressive average annual export growth rate of 95.37%. These results align with Rahmansyah et al. (2021), who observed a continuous increase in the competitiveness of Indonesian processed tuna exports to the European Union from 2011 to 2016. This growth has been driven by the expansion of Indonesia's domestic tuna processing industry and rising export prices of tuna products in the European market, which have contributed directly to the increasing value and competitiveness of Indonesian exports.

On the other hand, the competitiveness of Indonesian processed tuna products in the Spanish market is relatively weaker than in other major destination countries. This is reflected in Indonesia's average RCA value of only 1.73 over the 2012–2023. While an RCA value above one still indicates some degree of competitiveness, Figure 3 remains low compared to other markets where Indonesia's RCA values are significantly higher. Like Thailand, Spain engages in re-export activities for processed tuna products. Most of the tuna imported into Spain—particularly in frozen or loin form from non-EU countries—is processed domestically into canned tuna and pouch-packaged products, which are then re-exported to international markets. The primary export destinations for Spanish processed tuna are EU member states, with Italy, France, and Portugal as the largest markets. Approximately 88% of Spain's canned tuna exports are shipped to EU countries, especially Italy and France. At the same time, the remainder is distributed to other markets such as the United States, the United Kingdom, and Morocco (European Market Observatory for Fisheries and Aquaculture Products, 2017).

Trade Flows of Indonesian Processed Tuna in International Markets

Model selection in this study was conducted using a 5% significance level. The Chow test yielded a probability value of 0.0000 for the processed tuna model (Table 3), indicating that the Fixed Effect Model (FEM) is more appropriate than the Common Effect Model (CEM). However, the Hausman test returned to a probability value of 0.2365, supporting the Random Effect Model (REM) as the preferred specification for processed tuna (Table 3). Accordingly, REM was employed to estimate trade flows using the gravity model approach. Classical assumption tests were conducted to ensure the validity of the estimation. Normality was assumed to be satisfied based on the Central Limit Theorem (Gujarati, 2011), given the sample size of 120 observations. No serious multicollinearity issues were detected, as all Variance Inflation Factor (VIF) values were below 10. Heteroskedasticity and autocorrelation were not explicitly tested, as REM applies the Generalized Least Squares (GLS) method specifically designed to address both issues (Basuki & Yuliandi, 2014; Juanda, 2009).

Table 3. Evaluation of the Best-Fit Model for Gravity Model Estimation

Model Specification Test	Prob.
Chow test	0.0000
Hausman test	0.2365

The model's goodness-of-fit test results indicate that the probability value for the F-statistic is 0.000, as shown in Table 4. This value is significantly lower than the 5% significance threshold, confirming the model is statistically valid. In other words, the overall regression is meaningful, and at least one of the independent variables included in the model has a statistically significant influence on the dependent variable. Furthermore, the coefficient of determination (R^2) for processed tuna is calculated at 0.779, which implies that approximately 77.9% of the variation in the dependent variable can be explained by the independent variables in the model. The remaining 22.1% is attributed to other factors not captured within the current model specification.

Table 4. Results of Processed Tuna Trade Flows Using the Gravity Model

Variable	Coef.	Prob.
GDP per Capita of Destination (GDPPC _{ijt})	0,637***	0,001
Distance from Indonesia to Destination (DIS _{ij})	-0,508	0,329
Exchange Rate (EXC _{ijt})	-0,433*	0,051
NTM Dummy (DNTM _{ijt})	-0,034	0,251
Dummy Import Tariff (DTIM _{ijt})	-0,026	0,543
RCA Index (RCA _{ijt})	0,904***	0,000
R-squared		0,779
Prob F-statistic		0,000

Note:

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Source: Processed Data, 2024

Real GDP per Capita of the Destination Country

Gross Domestic Product (GDP) per capita reflects a country's prosperity and purchasing power (Mankiw, 2009). Theoretically, the GDP per capita of importing countries is positively associated with export performance. As the purchasing power of consumers in Indonesia's trading partners increases, the volume of Indonesian exports—including processed tuna—is also likely to rise. The estimation results show that importing countries' real GDP per capita has a positive and statistically significant effect on Indonesia's processed tuna exports at the 1% significance level. This finding supports the hypothesis that an increase in real GDP per capita in destination countries stimulates demand for imported goods due to higher consumer purchasing capacity, thereby boosting Indonesian exports (Salvatore, 2013).

The coefficient of GDP per capita for processed tuna is 0.637, indicating that a 1% increase in the destination country's GDP per capita would increase Indonesia's processed tuna export volume by approximately 0.637%, assuming other variables remain constant (*ceteris paribus*). This result highlights the important role of the importing country's purchasing power in driving Indonesia's fishery exports. Moreover, the finding is consistent with international trade theory and supported by previous studies conducted by Tristi et al. (2021), Dou et al. (2015), Mashari et al. (2019), and Khaliqi (2017), which found that higher GDP per capita in importing countries tends to increase import volumes.

Exchange Rate

The estimation results indicate that the exchange rate of the Indonesian rupiah against the currencies of export destination countries hurts processed tuna exports. The coefficient of the exchange rate variable is -0.433 , meaning that a 1% appreciation of the rupiah (a strengthening of the rupiah relative to the partner country's currency) would reduce the volume of processed tuna exports by approximately 0.433%, assuming other variables remain constant (*ceteris paribus*). This finding is consistent with Mankiw's (2009) theoretical framework and supports the initial hypothesis that domestic currency appreciation tends to reduce the competitiveness of export products. Foreign

demand and export volumes tend to decline as the products become more expensive in international markets.

Mankiw (2009) explains that the real exchange rate directly relates to net exports. When the real exchange rate rises, domestic goods become relatively more expensive than foreign goods, decreasing exports and increasing imports, ultimately negatively impacting the trade balance. Statistically, the exchange rate coefficient in the processed tuna model is significant at the 10% level, with a p-value of 0.051. This indicates that exchange rate fluctuations are a relevant factor influencing the performance of Indonesia's processed tuna exports. The result aligns with previous studies by Wiranthi et al. (2019) and Kusuma & Firdaus (2015), which found that exchange rate movements significantly affect Indonesia's fishery export competitiveness.

RCA Index

The Revealed Comparative Advantage (RCA) index estimation results support the hypothesis that Indonesia's comparative advantage has a positive and statistically significant effect on processed tuna exports. This finding is consistent with the RCA analysis conducted over the past twelve years, which shows that the RCA values for Indonesia's processed tuna exports to all destination countries remain above one. This indicates a comparative advantage, as the share of processed tuna in Indonesia's total exports is greater than the global export share for the same commodity. The result aligns with Balassa's (1965) theory, which suggests that a higher RCA value reflects a country's greater capacity to specialize in exporting a specific commodity, enhancing production efficiency and boosting export volumes.

In the estimation model, the coefficient for the RCA variable is 0.904 with a probability value of 0.001, indicating statistical significance at the 1% level. This means that a 1% increase in the RCA value would lead to an increase of approximately 0.904% in the export volume of processed tuna, assuming other variables remain constant (*ceteris paribus*). This outcome reinforces the role of comparative advantage as a key determinant of export performance. It aligns with the findings of Bilas & Bošnjak (2015) and Ramli et al. (2020), who concluded that comparative advantage is critical in driving a country's export growth.

CONCLUSION AND SUGGESTION

Processed tuna from Indonesia demonstrates strong competitiveness in international markets, particularly in Saudi Arabia, Japan, the United States, Thailand, Italy, Australia, the United Kingdom, Germany, and Jordan. However, it remains less competitive in the Spanish market. The export volume of Indonesian processed tuna is significantly and positively influenced by the GDP per capita of the destination countries and the RCA index. At the same time, the exchange rate has a significant adverse effect. In contrast, variables such as geographical distance, non-tariff measures (NTMs), and import tariffs do not show significant influence. Therefore, it is important to maintain exports to countries where Indonesia's processed tuna is already competitive while enhancing its competitiveness by complying with sustainability standards, traceability, certification, inspection, and environmentally friendly product branding to strengthen market trust. Expanding and reinforcing export markets to countries with high real GDP per capita—such as the United States, Australia, Germany, the United Kingdom, France, Italy, and Spain—and those with high tuna consumption levels, is also a crucial strategy. Additionally, improving logistical efficiency and ensuring exchange rate stability through

well-directed macroeconomic policies are necessary to support Indonesia's processed tuna exports' smooth flow and global competitiveness.

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