Print ISSN: 2765-6934 / Online ISSN: 2765-7027
AJBE website: http://www.ajbe.or.kr/
Doi: 10.13106/ajbe.2023.vol13.no1.31

Analysis of Indonesian Tuna Fish Export to Twelve Main Destination Countries: A Panel Gravity Model

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Received: March 10, 2022. Revised: May 31, 2022. Accepted: January 05, 2023.

Abstract

Purpose: This study purposes to analyze the determinants of the volume of Indonesian tuna exports. **Research design, data and methodology:** The framework was developed from the gravity model for trade, which was expanded with additional variables of competitiveness, exchange rate, and industrial share of the destination country. The data sources used in this study are UN Comtrade and the World Bank. The data used is yearly data from 12 countries in 2001-2019. The scope of the study is limited to exports to the twelve main export destinations. Panel data regression analysis is used to determine the factors that affect the volume of Indonesian tuna exports. **Results:** The results show that according to the theory, Indonesia's GDP has a positive effect and economic distance has a negative effect on the volume of the exports. Meanwhile, the GDPs of the destination countries are not proven to have a positive effect. However, the higher the industrial share in the country, the higher the export volume tends to be. **Conclusions:** The conclusion obtained from this study is that Indonesia's GDP, economic distance, real exchange rate, industrial GDP share of the destination country, and the RCA index affect the volume of Indonesian tuna exports.

Keywords : Tuna Export Volume, Gravity Model, Panel Data, Competitiveness

JEL Classification Code: F10, F12, F14

1. Introduction

Based on data from Comtrade (2021), Indonesia's largest export commodity from 2001 to 2019 was coal with a contribution of 11.31% to the total value of Indonesia's exports in 2019. From one perspective, this is a positive thing, considering that coal can be a driving force for Indonesia's exports. But on the other hand, Indonesia cannot continue to rely on coal as its main export commodity. With the state of Indonesia's exports which are still dominated by coal, this will certainly have a significant impact on the economy. Therefore, it is necessary to have potential export commodities with promising prospects to be used as an alternative to coal.

As a maritime country, Indonesia has abundant marine resources. Rahmadi (2019) said that the estimated biodiversity of Indonesian marine biota is 1,772 trillion rupiahs. The economic worth can be much higher because this value only includes the ecological value. As a result, Indonesia has tremendous potential and opportunity, particularly in the fishing industry. This is also supported by the fact that, behind China, Indonesia is the world's second-largest producer of capture fisheries, with 7.22 million tons produced in 2018.

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Tuna is a promising Indonesian marine commodity. According to Food and Agriculture Organization (FAO) (2020), Indonesia contributes 16 percent of total world production of tuna with an average production reaching more than 1.2 million tons/year. Data from *Badan Pusat Statistik* (BPS) (2020) also shows a positive trend in Indonesian tuna production with an increase in production from 2008 to 2019, reaching 182 percent. The high demand in the global market and the economic value of tuna is an opportunity that must be utilized optimally. For this reason, it is necessary to manage tuna from upstream to downstream and maintain tuna habitat so that this commodity can be an alternative for Indonesian exports to replace mineral fuel exports.

However, the reality on the ground seems contrary to expectations. The high global market demand and Indonesia's potential for tuna coupled with fishery production that increases every year are not followed by an increase in tuna export performance. Indonesia's tuna export volume has a negative trend from 2001 to 2019, especially after 2013 when Indonesia's tuna exports experienced a sharp decline. There has even been a decrease in the volume of tuna exports by 48 percent from 2013 to 2015. If this is not taken seriously, it can result in the non-optimal use of tuna fish resources owned by Indonesia.

The purpose of this study is to analyze the competitiveness and determinants of the volume of Indonesian tuna exports to 12 main destination countries during 2001-2019. The results of this study are expected to contribute to assisting the government in efforts to improve the performance of Indonesian tuna exports.

2. Literature Review

2.1. International Trade and Gravity Model

According to Seyoum (2009), international trade is the exchange of goods and services across national borders. Krugman et al. (2018) state that international trade is based on the interactions and preferences of consumers for various products traded between countries, which in turn supports specialization in producing certain products.

Countries conduct international trade for two reasons. The first is the difference between the countries. Countries will benefit from these differences if cooperation is carried out so that each country focuses on the things it specializes in. Second, countries conduct international trade to achieve economies of scale in production. These countries will be more efficient if they produce certain goods on a larger scale than if they have to produce all goods on a small scale (Krugman et al., 2018).

Countries will tend to conduct international trade with big countries, or in other words, have a high GDP, as compared to little countries. International trade is also more likely to occur between countries that are geographically close as compared to those that are far away. This is associated with higher transportation costs when conducting international trade with geographically distant countries. In addition, economic policies and cultural backgrounds between countries also influence international trade (Salvatore, 2013).

This is the basis of the Gravity Model. Jan Tinbergen proposed the gravity model in 1962, which states that the size of bilateral trade between two countries can be approximated by using Newton's gravity equation. In general, the gravity model can be written as a model in equation (1) (Krugman et al., 2018):

$$T_{ij} = A\frac{Y_i \times Y_j}{D_{ij}} \ , \qquad (1)$$

where A is a constant, T_{ij} is the measure of trade between country i and country j, Y_i is the GDP of country i, Y_j is the GDP of country j, and D_{ij} is the distance between two countries.

Based on the gravity model, several variables affect the volume of a country's commodity exports, namely the country's GDP, the destination country's GDP, and distance. In addition to the variables included in the gravity model, other variables also affect the volume of a country's export commodities, such as the real exchange rate, the share of industrial GDP of the destination country, and the RCA index.

1. GDP

Saptanto and Soetjitpto (2010) show that the variables of Indonesia's GDP and the destination country's GDP have a significant and positive effect on the export of Indonesian fishery commodities. Research conducted by Natale et al. (2015) also shows that there is a positive and significant relationship between the GDP of the exporting country and the GDP of the importing country with respect to the volume of the seafood trade.

2. Distance

Research conducted by Saptanto and Soetjitpto (2010) shows that the relative distance has a significant effect and a negative relationship on the export of Indonesian fishery commodities. Research conducted by Le (2017) shows that economic distance using a proxy for differences in GDP per capita has a negative and significant relationship to exports. Research by Choi et al. (2019) also shows that the relative distance has a negative and significant effect on trading volume.

3. Real Exchange Rate

The real exchange rate is the purchasing power of one currency relative to another currency at a nominal exchange rate and a certain price (Mankiw, 2019). The real exchange rate is closely related to the nominal exchange rate and can be written as the following equation (2):

$$Real\ exchange\ rate = Nominal\ exchange\ rate \times \frac{Domestic\ price}{Foreign\ price} \quad (2)$$

when the real exchange rate appreciates, the price of domestic goods and services becomes relatively more expensive than the price of foreign goods and services. Therefore, exports will decrease, and imports will increase. On the other hand, if the real exchange rate depreciates, then the price of domestic goods and services becomes relatively cheaper than the price of foreign goods and services. As a result, exports will increase, and imports will decrease.

According to research conducted by Wiranthi et al. (2019), the real exchange rate has a significant effect on Indonesia's canned tuna exports and has a negative relationship. Safitri and Kartiasih (2019) also found that as the rupiah exchange rate against the destination country declined, the price of Indonesian pineapples decreased, resulting in increasing demand for Indonesian pineapple exports.

4. Share of Industrial GDP of the Destination Country

The next variable that also influences international trade is the share of the industrial GDP of the destination country. The economy of a country is in line with the industry in that country. According to Arora and Vamvakidis (2004), developing countries will benefit if they conduct international trade with industrialized countries. This is because industrialized countries have relatively higher incomes. At the same time, industrialized countries also benefit from international trade with developing countries because of their rapid growth.

According to research conducted by Uysal and Mohamoud (2018), there is a positive relationship between a country's industrial GDP share and trade volume. The high share of industrial GDP in a country certainly requires various commodities and resources in the process. However, not all of these commodities can be produced domestically, so imports must be carried out from other countries that have a comparative advantage in these commodities. Based on the theory of comparative advantage, this will benefit both countries because each country specializes in the commodity for which it has a comparative advantage.

5. RCA Index

Each country certainly has different capabilities, resources, and preferences. As a result, countries will trade superior commodities for commodities that meet their needs but not their advantages in international trade. The countries involved will gain from such trade. This can happen when each country specializes in products that are its comparative advantage. A country has a comparative advantage in producing certain goods if the opportunity cost of producing that good against other goods is lower than in other countries (Krugman et al., 2018).

One measure that is often used to measure comparative advantage is the RCA (Revealed Comparative Advantage) index obtained from the calculations in equation (3),

$$RCA = \frac{X_{ijk} / X_{wjk}}{X_{ik} / X_{wk}} \quad (3)$$

where X_{ijk} is the export value of commodity i from country j to country k, X_{wjk} is the total value of exports from country j to country k, X_{ik} is the export value of commodity i from the world to country k, and X_{wk} is the total value of exports from the world to country k.

An RCA index greater than one indicates that a country has a comparative advantage over the world average in a particular commodity. On the other hand, an RCA index that is smaller than one indicates that a country does not have a comparative advantage over the world average in a particular commodity.

According to research conducted by Ramli et al. (2020), there is a positive and significant relationship between the competitiveness index and Indonesian tuna exports. Research by Safitri and Kartiasih (2019) also shows that the RCA index has a positive and significant effect on the export volume of Indonesian pineapples.

Based on related theories and studies that have been used as references, this study hypothesizes as follows:

1. Indonesia's GDP has a positive effect on the volume of Indonesian tuna exports
2. GDP of the destination country has a positive effect on the volume of Indonesian tuna exports
3. Economic distance has a negative effect on the volume of Indonesian tuna exports
4. Real exchange rate has a negative effect on the volume of Indonesian tuna exports
5. Share of industrial GDP of the destination country has a positive effect on the volume of Indonesian tuna exports
6. RCA Index has a positive effect on the volume of Indonesian tuna exports

3. Research Methods and Materials

3.1. Variables and Data Sources

The data used in this study is secondary data from 2001 to 2019 that covers Japan, Thailand, the United States, China, Singapore, Spain, Vietnam, South Korea, the Philippines, Hong Kong, the Netherlands, and Malaysia, which are the 12 primary export destinations for Indonesian tuna. The dependent variable used is the volume of Indonesian tuna exports. Indonesian GDP, destination country GDP, economic distance, real exchange rate, destination country's industrial GDP share, and RCA index are the independent variables.

Table 1: Variables and data sources

Variable	Description	Unit	Source
VOLUME	Tuna export volume from Indonesia to 12 export destination countries from 2001-2019	kg	UN Comtrade
GDP1	Indonesia's GDP at constant prices	US$	World Bank
GDP2	GDP of 12 destination countries for Indonesian tuna exports at constant prices	US$	World Bank
DISTANCE	Economic distance. Calculated by multiplying geographic distance by the ratio of GDP per capita between two countries	km	GeoDataSource and World Bank (processed)
XRATE	Real exchange rate. Calculated by multiplying the nominal exchange rate by the comparison of the domestic tuna price and the foreign tuna price	-	UN Comtrade and World Bank (processed)
INDUSTRY	The contribution of the industry's GDP to the total GDP of Indonesia's tuna export destinations	percent	World Bank
RCA	RCA Index	-	UN Comtrade (processed)

3.2. Analysis Method

3.2.1. Export Product Dynamic

According to Hasibuan et al. (2012), Export Product Dynamic (EPD) is one measure that can be used to measure the market position of a particular product of a country for a particular market purpose. The EPD matrix uses export market share and product market share to measure a product's competitiveness. From the combined export market share and product market share, the product position is divided into four quadrants, namely, Rising Star, Falling Star, Lost Opportunity, and Retreat (Estherhuizen, 2006).

The formula used in the EPD calculation is found in equations (4) and (5) (Luhur et al., 2019).

X-axis (Export market share growth),

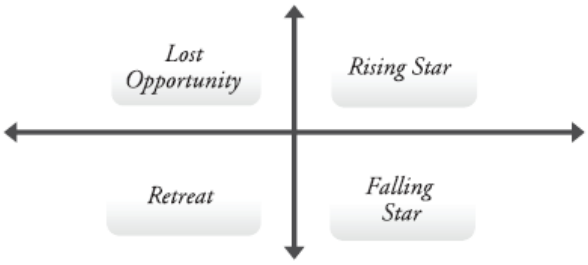
$$\frac{\sum_{t=1}^{T}\left[\left(\frac{X_{ij}}{W_{ij}}\right)_t \times 100\% - \left(\frac{X_{ij}}{W_{ij}}\right)_{t-1} \times 100\%\right]}{T} \quad (4)$$

Y-axis (Growth of product market share):

$$\frac{\sum_{t=1}^{T}\left[\left(\frac{X_t}{W_t}\right)_t \times 100\% - \left(\frac{X_t}{W_t}\right)_{t-1} \times 100\%\right]}{T} \quad (5)$$

where X_{ij} is the value of Indonesian tuna exports to country j, X_t is the total value of Indonesia's exports to country j, W_{ij} is the value of world tuna exports to country j, W_t is the total value of world exports to country j, t is year t, and T is the number of years of observation.

The calculation results are then plotted into Cartesian coordinates to form four quadrants as shown in Figure 1.



Source: Estherhuizen (2006)

Figure 1: Market position with Export Product Dynamic method

3.2.2. X-Model

The X-Model method, according to Nurhayati et al. (2018), is a mix of the RCA index and EPD analysis, resulting in more full analysis findings because they are examined from two sides at once. The purpose of this method is to cluster products based on competitiveness (RCA index) and market position (EPD).

Table 2: X-Model Clustering

RCA	EPD	X-Model
>1	*Rising Star* (Market share increase)	Optimistic Market
	Lost Opportunity (Loss of export market share)	Potential Market
	Falling Star (Product market share decline)	Potential Market
	Retreat (Market share decline)	Less Potential
<1	*Rising Star* (Market share increase)	Potential Market
	Lost Opportunity (Loss of export market share)	Less Potential
	Falling Star (Product market share decline)	Less Potential
	Retreat (Market share decline)	No Potential

Source: Ministry of Trade (2013)

3.2.3. Panel Data Regression Analysis

The method used to analyze the variables that affect the volume of Indonesian tuna exports is panel data regression analysis. According to Gujarati and Porter (2008), the first step of panel data regression analysis is to select the best model from three possible models, namely, the common effects model (CEM), fixed effects model (FEM), and random effects model (REM). To choose between CEM and FEM, Chow test is used. If FEM is chosen, use the Hausman test to decide between REM and FEM. If the Chow test result is CEM, then use the LM test to choose between CEM and REM as the best model.

After getting the best model, the next step is to examine the structure of the variance of the residual covariance if the chosen one is FEM or CEM, but if the chosen one is REM, then immediately proceed with classical assumption testing. Examination of the residual covariance variance structure begins with the LM test to see whether the covariance variance matrix is homoscedastic or heteroscedastic. If the result is that there is heteroscedasticity in the variance-covariance matrix, then it is continued with the λ_{LM} test to see whether there is a cross-sectional correlation. The results of the examination of the covariance variance structure will be used to determine the appropriate estimation method.

The next step is to test the classical assumptions according to the estimation method used. The OLS estimation method requires testing the assumptions of normality, non-multicollinearity, homoscedasticity, and non-autocorrelation. As for the GLS or FGLS estimation methods, the assumptions that must be tested are the assumptions of normality and non-multicollinearity. If all assumptions have been met, then the next step is to test the significance of the model with the coefficient of determination, simultaneous test, and partial test. Finally, the interpretation of the model obtained is carried out.

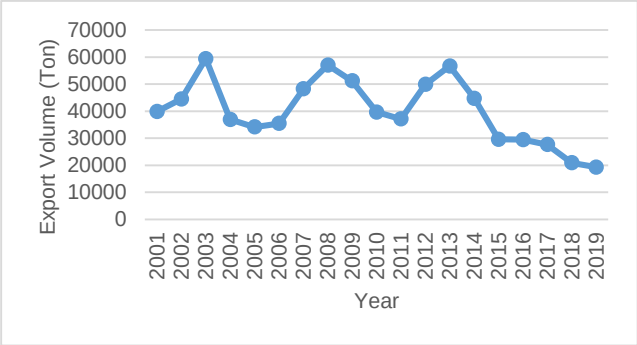
The model used in this study uses a natural logarithm transformation to convert the gravity model into a linear model. The model used can be seen in equation (6).

$$\begin{aligned}\ln(VOLUME)_{it} = \alpha &+ \beta_1 \ln(GDP1)_t \\ &+ \beta_2 \ln(GDP2)_{it} \\ &+ \beta_3 \ln(DISTANCE)_{it} \\ &+ \beta_4 \ln(XRATE)_{it} \\ &+ \beta_5 \ln(INDUSTRY)_{it} \\ &+ \beta_6 \ln(RCA)_{it} + u_{it}\end{aligned} \quad (6)$$

4. Results and Discussion

4.1. Overview of Indonesian Tuna Export Volume

Based on data obtained from Comtrade (2021), Indonesia is one of the largest tuna exporting countries in the world. However, this does not necessarily make Indonesia's export performance increase every year.



Source: Comtrade (2021)

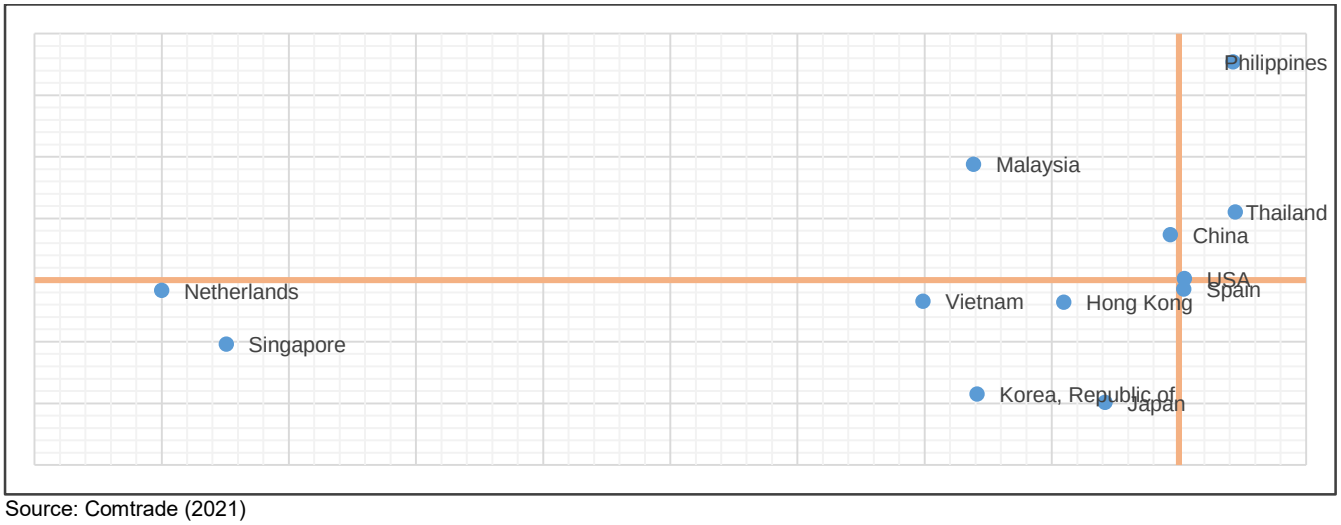
Figure 2: The development of Indonesia's tuna export volume in 2001-2019

Based on Figure 2, from 2001 to 2019, the volume of Indonesian tuna exports was quite volatile, but overall it had a declining trend, especially after 2013. Pasopati (2015) stated that one of the reasons for the decline in Indonesia's tuna export volume was after 2013. 2013 was a decline in Indonesian fishery exports to Japan, one of the largest export destination countries for Indonesian tuna. Apart from the decline in the purchasing power of the Japanese people, other factors that also influenced the decline in export figures were the decline in the yen exchange rate against the dollar, import duty rates, and the Japanese government's policy to absorb tuna produced by Japanese investment in Spain.

In addition, the cause of the declining volume of Indonesian tuna exports is that Indonesian tuna products are vulnerable to rejection from export destination countries because they contain high levels of salmonella bacteria. A Member of the Indonesian Tuna Commission, Satria in Noviani (2013) said that tuna fish commodities must be handled properly starting from catching to shipping. If not handled properly, Indonesian tuna products are difficult to enter the international market that applies high-quality standards. In addition to unhygienic handling, the high content of salmonella bacteria is also caused by the poor quality of port sanitation. According to Irawati et al. (2019), the rejection also occurred because Indonesian fishery products had mercury and histamine contamination that exceeded the European Union standard threshold. Industrial waste is one of the causes of mercury contamination, while histamine contamination is a result of the lack of good fish handling at the primary producer level.

4.2. Indonesian Tuna Competitiveness

Based on the EPD analysis contained in Figure 3, the Philippines, Thailand, and the United States are in the first quadrant, namely the rising star. This indicates an increase in market share in the three countries. The United States is indeed one of the largest Indonesian tuna export destinations. In addition, the exemption of tariffs on Indonesian tuna exports to the United States since 2015 has also opened up more opportunities for Indonesia to dominate the tuna market in the United States. Thailand is also Indonesia's largest tuna export destination. Even in 2019, 50.31% of Indonesian tuna was exported to Thailand. When viewed from the graph of the development of tuna exports, Thailand is also one of the countries that has a positive trend while most other countries have a negative trend. Therefore, these countries are countries that can be focused on becoming the main market for Indonesian tuna.



Source: Comtrade (2021)

Figure 3: Position of 12 Indonesia tuna export destination countries in the EPD quadrant

For market clustering based on the X-Model, 12 Indonesian tuna export destinations can be categorized into several clusters as shown in Table 3.

Table 3: X-Model clustering results

Country	Competitiveness (RCA)	Market position (EPD)	X-Model Clustering
Japan	1.2405	Retreat	Less potential
Thailand	1.6448	Rising star	Optimistic Market
USA	10.3121	Rising star	Optimistic Market
China	9.0297	Lost opportunity	Potential Market
Singapore	6.9777	Retreat	Less potential
Spain	3.2285	Falling star	Potential Market
Vietnam	5.6293	Retreat	Less potential
Korea, Republic of	4.4585	Retreat	Less potential
Philippines	2.0011	Rising star	Optimistic Market
Hong Kong	37.4648	Retreat	Less potential
Netherlands	34.1591	Retreat	Less potential
Malaysia	4.3136	Lost opportunity	Potential Market

Source: Researcher processed data

Based on Table 3, it can be seen that the best markets for Indonesian tuna exports are the United States, Thailand, and

the Philippines. This is because Indonesian tuna has more than one RCA index and the market position is in quadrant I, namely rising star. Therefore, these three countries are optimistic markets for Indonesian tuna exports. In contrast, Japan, Singapore, Vietnam, South Korea, Hong Kong, and the Netherlands are less potential markets for Indonesian tuna.

4.3. Panel Data Regression Analysis

The first step in panel data regression analysis is to choose the best model using the Chow test, Hausman test, and BP-LM test. Based on the test results, it can be concluded that the best model to be used is FEM. Therefore, the next step is to test the variance-covariance structure to determine the appropriate estimation method for FEM. The LM test and λ_{LM} test show that H_0 is rejected, so the appropriate estimation method is FGLS-SUR (See Appendix 1). The summary of the model output obtained can be seen in Table 4.

Table 4: Regression coefficient estimation results

Independent Variable	Coefficient	Std. Error	t-Stat	Critical Value
C	49.109	6.646	7.389	1.652
ln(GDP1)	3.738	0.504	7.422	1.652
ln(GDP2)	-3.584	0.609	-5.882	1.652
ln(DISTANCE)	-6.023	0.695	-8.662	-1.652
ln(XRATE)	-0.754	0.028	-26.753	-1.652
ln(INDUSTRY)	0.686	0.255	2.689	1.652
ln(RCA)	1.019	0.010	102.970	1.652
Summary of Statistics				
R^2	0.9889	F		1105.4260
Adjusted R^2	0.9881	Prob. F		0.0000

Notes: Dependent variable: ln(VOLUME); critical value based on one-tailed t-test
Source: Researcher processed data

After getting the model, the next step is to test the assumptions. Because the estimation method used is FGLS-SUR, the assumption test used is the normality and non-multicollinearity test. For the normality test, the test used is the Jarque-Bera test and the results obtained are 0.9900 with a p-value of 0.6096, which means that the residuals have followed a normal distribution. Based on the multicollinearity detection carried out, there is no VIF value that exceeds 10 so it can be concluded that there is no multicollinearity between independent variables (See Appendix 2).

Because all classical assumptions have been met, the next step is to test the model's significance. Based on Table 4, it can be seen that the p-value of the F test carried out is 0.0000. Therefore, it can be concluded that there is at least one independent variable that affects the dependent variable in the model.

Based on the results of the t-test, it is known that Indonesia's GDP, the industrial GDP share of destination countries, and the RCA index have a positive and significant impact on the volume of Indonesian tuna exports because they have a statistical value greater than the critical value. Meanwhile, the economic distance variable and the real exchange rate have a negative and significant effect on the volume of Indonesian tuna exports because they have a smaller statistical value than the critical value. The GDP variable of the destination country has not been proven to have a positive effect on the volume of Indonesian tuna exports because the statistical value is smaller than the critical value.

The adjusted R^2 value of 0.9881 indicates that as much as 98.81 percent of the total diversity in the dependent variable can be explained by the independent variable in the model. While the remaining 1.19 percent is explained by other variables outside the model.

Based on the steps that have been done previously, the panel data regression model is obtained as in equation (7).

$$\ln(\widehat{VOLUME})_{it} = (49.109 + \mu_i) + 3.738\ln(GDP1)_{it} - 3.584\ln(GDP2)_{it} - 6.023\ln(DISTANCE)_{it} - 0.754\ln(XRATE)_{it} + 0.686\ln(INDUSTRY)_{it} + 1.019\ln(RCA)_{it} \quad (7)$$

Table 5: Individual effect

Country	Individual Effect	Country	Individual Effect
Japan	5.7517	Vietnam	5.4651
Thailand	2.1648	Korea, Republic of	-0.6075
USA	11.8223	Philippines	3.9449
China	15.1673	Hong Kong	-13.3151
Singapore	-21.0116	Netherlands	-3.6800
Spain	4.8290	Malaysia	-10.5310

Source: Researcher processed data

For individual effects, based on Table 5, there are seven countries with positive individual effects, namely Japan, Thailand, the United States, China, Spain, Vietnam, and the Philippines. This means that the volume of Indonesian tuna exports to these countries is higher than the average volume of Indonesian tuna exports assuming all independent variables are the same. In contrast, the other five countries, namely Singapore, South Korea, Hong Kong, the Netherlands, and Malaysia, had negative individual effects. This means that the volume of Indonesian tuna exports to these countries is lower than the average volume of Indonesian tuna exports assuming all independent variables are the same.

Based on this individual effect, the volume of Indonesian tuna exports to China is the highest if the values of all independent variables are the same between countries. In contrast, the volume of Indonesian tuna exports to Singapore is the lowest if the values of all independent variables are the same between countries.

4.4. Variables Affecting Indonesian Tuna Export Volume

1. Indonesia's GDP

Based on the model that has been obtained, the relationship between Indonesia's GDP variable and the volume of Indonesian tuna exports is positive and significant, which indicates that if Indonesia's GDP increases, the volume of Indonesian tuna exports will also increase. The coefficient of 3.738 means that if Indonesia's GDP increases by one percent, the volume of Indonesian tuna exports will increase by 3.738 percent. This result is in line with the theory contained in the gravity model, namely the larger the economy of a country (as measured by its GDP), the volume of trade will also increase. These results are also in line with research conducted by Saptanto and Soetjitpto (2010), Natale et al. (2015), and Ramli et al. (2020) which showed that there was a positive relationship between GDP and export volume.

2. GDP of the Destination Country

Furthermore, based on the existing data, there is not enough evidence to show that the GDP variable of the destination country has a positive and significant effect on the volume of Indonesian tuna exports. The sign of the relationship between the GDP of the destination country and the volume of Indonesian tuna exports is negative. This indicates that the larger the GDP of the export destination country, the lower the volume of Indonesian tuna exports. The variable coefficient of the destination country's GDP is -3.584, which means that every one percent increase in the destination country's GDP will cause a decrease in the volume of Indonesian tuna exports by 3.584 percent. This result is contrary to the theory which states that the larger the economy of a country, the greater the flow of international trade that occurs. This is due to the GDP component of export destination countries which is dominated by the service sector.

Table 6: Composition of GDP of Indonesia's tuna export destination countries (percent of GDP)

Country	Agriculture	Industry	Services
Japan	1.00	21.00	69.30
Thailand	8.00	25.00	58.60
USA	1.00	11.00	76.90
China	7.00	27.00	53.90
Singapore	0.00	20.00	70.40
Spain	3.00	11.00	67.60
Vietnam	14.00	16.00	41.60
Korea, Republic of	2.00	25.00	57.10
Philippines	9.00	18.00	61.00
Hong Kong	0.00	1.00	88.70

Netherlands	2.00	11.00	69.80
Malaysia	7.00	21.00	54.20

Source: World Development Indicators (2021)

Based on Table 6, it can be seen that of the 12 destination countries for Indonesian tuna exports, the GDP component is dominated by the service sector. The industrial sector only accounts for between 11 percent and 27 percent (except Hong Kong) of total GDP.

3. Economic Distance

The next variable is economic distance. Economic distance has a negative and significant impact on Indonesia's export volume. The coefficient of -6.023 means that every one percent increase in economic distance will reduce the volume of Indonesian tuna exports by 6.023 percent. This result is in line with the theory of the gravity model which states that the farther the distance between two countries, the less international trade occurs. This happens because the distance is a proxy for transportation costs. When two countries are far apart, the costs required will likely be greater so that the flow of trade will be small. In addition, these results are also supported by research by Choi et al. (2019), Saptanto and Soetjitpto (2010), and Le (2017) which show that distance has a negative and significant impact on trading volume.

4. Real Exchange Rate

For the real exchange rate variable, there is a negative and significant effect on the volume of Indonesian tuna exports with a coefficient of -0.754. This shows that for every one percent increase in the real exchange rate, the volume of Indonesian tuna exports will decrease by 0.754 percent. This result is supported by the research of Wiranthi et al. (2019) and Safitri and Kartiasih (2019) which found a negative relationship between the real exchange rate and export volume. When there is an appreciation of the value of the rupiah against the dollar, the real exchange rate also increases. This appreciation results in the price of domestic goods and services being relatively more expensive than the prices of goods and services abroad so that imports will increase and exports will decline.

5. Industrial GDP Share of the Destination Country

Furthermore, the industrial GDP share of the destination country has a positive and significant impact on the volume of Indonesian tuna exports. The coefficient obtained is 0.686, which means that every one percent increase in the industrial GDP share of the destination country will cause an increase in the volume of Indonesian tuna exports by 0.686 percent. This result is in line with the findings in the research of Uysal and Mohamoud (2018) which shows that there is a positive relationship between the share of industrial GDP and export performance.

6. Revealed Comparative Advantage

Finally, there is a positive and significant effect of the RCA index on the volume of Indonesian tuna exports. The coefficient obtained is 1.019 which shows that for every one percent increase in the RCA index, the volume of Indonesian tuna exports will increase by 1.019 percent. So it can be concluded that when Indonesia's tuna commodity has a comparative advantage, its export volume also increases. This result is also supported by Ramli et al. (2020) and Safitri and Kartiasih (2019) which show that competitiveness has a positive and significant impact on tuna exports.

5. Conclusions

Based on the results and discussion in this study, it can be concluded that the development of Indonesia's tuna export volume to the 12 main destination countries in 2001-2019 tends to fluctuate, but overall has a negative trend. One of the reasons is the decline in Indonesian fishery exports to Japan. Then Indonesian tuna products are vulnerable to rejection because they do not meet the high-quality standards set in export destination countries. In addition, the high tariffs set by export destination countries are also one of the causes of the decline in Indonesian tuna exports.

The United States, Thailand, and the Philippines are optimistic markets for Indonesian tuna. Meanwhile, Japan, Vietnam, South Korea, Hong Kong, and the Netherlands are less potential markets for Indonesian tuna.

The results show that according to the theory, Indonesia's GDP has a positive effect and economic distance has a negative effect on the volume of the exports. Meanwhile, the GDP of the destination country is not proven to have a positive effect. However, the higher the industrial share in the country, the higher the export volume tends to be.

Based on the conclusions obtained, there are several suggestions that the author can convey. The government can make efforts to negotiate with tuna export destination countries to reduce import duty rates, especially by finalizing negotiations on the Comprehensive Economic Partnership Agreement between Indonesia and the European Union so that the volume of Indonesian tuna exports can be increased. In addition, the management of fishing companies should make regulations related to the handling of tuna so that the quality and cleanliness are maintained so that it is hoped that cases of rejection by export destination countries can be suppressed. Furthermore, the government should strive to increase the ability of tuna production from both upstream and downstream industries such as marketing

and processing. In addition to increasing Indonesia's GDP, this is also because Indonesian tuna has competitiveness and comparative advantage. Then the tuna export target itself can be focused on optimistic tuna export markets or those that have close geographic distances to Indonesia, namely the United States, Thailand, and the Philippines.

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Appendixes

Appendix 1: Diagnostics of Panel Regression and Normality Test

Test	Test Statistics	p-value	Decision	Conclusion
Chow	88.4385	0.0000	Reject H_0	FEM is better than CEM
Hausman	28.6291	0.0001	Reject H_0	FEM is better than REM
LM	111.3941	0.0000	Reject H_0	Residual is heteroscedastic

λ_{LM}	231.8772	0.0000	Reject H_0	There is a cross-sectional correlation in residual
Jarque-Bera	0.9900	0.6096	Do not reject H_0	Residuals are normally distributed

Appendix 2: Multicollinearity detection

Independent Variable	R^2	VIF
GDP1	0.1592	1.1893
GDP2	0.0233	1.0238
DISTANCE	0.1834	1.2247
XRATE	0.1144	1.1291
INDUSTRY	0.2933	1.4150
RCA	0.2713	1.3722